6. Existing environment – Threatened species and aquatic habitats

6.1 Threatened flora

6.1.1 Potential habitat for threatened flora

In general, the study has identified limited potential habitat for threatened flora species. The overall likelihood of occurrence for the 27 threatened flora species that are known or predicted to occur within the locality have been assessed as low (Appendix B).

Given remnant native vegetation patches of PCT 1071 and PCT 1234 are mostly disturbed and provide limited habitat for threatened flora species, the likelihood of future threatened flora recruitment is also considered low.

6.1.2 Threatened flora candidate species

Overall, four threatened flora species were considered as candidate species as part of this BDAR. These species were identified based on the BAM candidate species report for the project (Appendix F). A brief overview of survey and likelihood assessment results for each threatened flora candidate species is presented in Table 6.1.

Table 6.1 Threatened flora candidate species assessment results

Scientific Name	Common Name	Survey month	Presence	Justification
Ancistrachne maidenii	*Ancistrachne maidenii*	Not specified in BAM, summer flowering	No – (surveyed)	There are no known records of this species in the locality. The study area does not contain specific geological habitat and no individuals were observed within native vegetation patches (PCT 1234) during targeted surveys. Based on the lack of recent records and absence of suitable habitat, the potential occurrence of this species within the study area is considered low. Given this, *Ancistrachne maidenii* is not considered affected by the project and as such no further consideration or assessment of this species is deemed warranted.
Cryptostylis hunteriana	Leafless Tongue Orchid	Dec-Jan	No – (surveyed outside flowering period)	This species has not been recorded within the project locality. Within the study area, documented potential habitat identified by the BAM calculator occurs in the form of PCT 1234. This vegetation type has been recorded in poor and low condition with both classes exhibiting an understorey that has been highly disturbed, has low native species richness/cover and is mostly dominated by transformer exotic weed cover. Whilst flora surveys were conducted outside the known flowering period for this species, the lack of any records in the locality and the generally unfavourable understorey habitat conditions lead to the likely occurrence of this species within the study area is considered to be low. Given this, *Cryptostylis hunteriana* is not considered affected by the project and as such no further consideration or assessment of this species is deemed warranted.

Scientific Name	Common Name	Survey month	Presence	Justification
Wilsonia backhousei	Narrow-leafed Wilsonia	All year	No – (surveyed)	This species has not been recorded within the project locality. The occurrence of this species within the broader Sydney region is mostly restricted to discrete populations in the localities of the Parramatta River at Ermington, Clovelly, Voyager Point and the Royal National Park (OEH 2018). Habitat associated with this species is generally restricted to the margins of salt marshes and lakes with potential habitat listed to include PCT 1234. Within the study area, the vegetation type PCT 1234 has been recorded in poor and low condition with both classes exhibiting an understorey that has been highly disturbed, have low native species richness/cover and are mostly dominated by transformer exotic weed cover. There are no seasonality issues associated with surveying for *Wilsonia backhousei* as the species is readily identifiable all year (OEH 2018). Targeted surveys failed to identify any Individuals of this species and given the lack of any records in the locality and the generally unfavourable understorey habitat conditions, the likely occurrence of this species within the study area is considered low. Given this, *Wilsonia backhousei* is not considered affected by the project and as such no further consideration or assessment of this species is deemed warranted.
Zannichellia palustris	Zannichellia palustris	Mar-Nov	No – (surveyed)	*Zannichellia palustris* is a submerged aquatic plant that is only known from the lower Hunter and Sydney Olympic Park in NSW. The plant grows in fresh or slightly saline stationary or slowly flowing water. *Zannichellia palustris* flowers during the warmer months and completely dies back every summer. This species has not been recorded within the locality. Targeted surveys were conducted in PCT 1071 and standing water associated with the Mill Stream. No individuals of this species were observed despite surveys being conducted during favourable seasonal conditions. Given this, *Zannichellia palustris* is not considered affected by the project and as such no further consideration or assessment of this species is deemed warranted.

6.1.3 Affected threatened flora

As detailed in Table 6.1, no threatened flora were identified during surveys, and no threatened flora are likely to occur given the absence of suitable habitat in the project site. The project is therefore considered unlikely to impact on threatened flora species or their habitats and as such no species are considered affected in terms of project impacts and BAM calculations.

6.2 Threatened fauna

6.2.1 Fauna species

A moderate diversity of species was recorded during field surveys, with better quality habitats at Botany Wetland contributing to the range of species present. Most species are those typical of urban environments and wetlands in urban areas. A total of 67 species was recorded in the study area. This comprised 46 bird species, nine mammal species, five reptile species, four frog species, and three fish species. Two threatened species, the Grey-headed Flying-fox (*Pteropus poliocephalus*), and the Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) were recorded. Ten introduced species were also recorded (see list in Appendix B).

6.2.2 Fauna habitats

Much of the land within the study area has been previously cleared of native vegetation for the railway, roads, residential and industrial areas, and for areas of recreation. The majority of the rail corridor is cleared and vegetated with introduced grasses and herbs interspersed with bare ground, ballast and other artificial substrates. Planted trees also occur in some areas, as do thickets of weeds such as Lantana.

Fauna habitats with higher biodiversity value are located in areas adjacent to the rail corridor, and include in particular the Botany Wetlands associated with Mill Stream, which is crossed by the rail corridor. This area contains freshwater wetlands and swamp oak forest. Proposed compound sites also contain a combination of native vegetation, planted introduced trees and weed infestations.

A summary of the various habitat types is provided in Table 6.2 to Table 6.5 below.

Table 6.2 Fauna habitats – Highly disturbed areas (exotic grassland)

Exotic grassland	
Description	Exotic grassland is present within areas of the rail corridor where access has been cleared for maintenance to the rail network. Exotic grassland is interspersed with ballast, bare ground and other artificial substrate. Some planted trees and shrubs are present. These areas would have historically supported native woodland vegetation but have been extensively modified by previous clearing. Exotic grassland contains few habitat resources of relevance to most native species due to its low structural and floristic diversity. Exotic grasses and herbs would provide foraging resources for relatively mobile and opportunistic native fauna species.
Typical fauna species recorded or likely to occur	Bird species commonly recorded in this habitat type included the Crested Pigeon (*Ocyphaps lophotes*), Welcome Swallow (*Hirundo neoxena*), Magpie-lark (*Grallina cyanoleuca*), Superb Fairy-wren (*Malurus cyaneus*), Willie Wagtail (*Rhipidura leucophrys*) and Grey Fantail (*Rhipidura albiscapa*). These species are insectivorous and were observed foraging within mown portions of the grassland. Small, common lizards such as the Dark-flecked Garden Sunskink *(Lampropholis delicata*) are likely to occur in this habitat type, particularly in areas where shelter such as ballast or woody debris is present. The Common Eastern Froglet (*Crinia signifera*) was heard calling from a table drain in grassland areas. Other common native frog species, including the brown Striped Frog (*Limnodynastes peronii*) would also likely occur in drains in these areas.
Threatened fauna species	Microchiropteran bats such as the Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) may forage over this habitat type on occasion.
Migratory species	No migratory species were observed and none are likely to occur in this habitat type.
Introduced species	Rock Dove (*Columba livia*) Feral/domestic Cat (*Felis catus*)

Exotic grassland

Photo 6.1 Exotic grassland adjacent to Banksia Street

Table 6.3 Fauna habitats – Urban exotic and planted native species

Urban exotic and planted native species	
Description	Exotic forest and scrub and planted native species is present on the fringes of the rail corridor. Exotic forest and scrub is dominated by dense midstorey vegetation of variable structural complexity and includes Camphor Laurel (*Cinnamomum camphora*) and Lantana (*Lantana camara*). These areas were once cleared, but have not been regularly maintained and have since overgrown. Planted stands of Spotted Gum (*Corymbia maculata*), Swamp Oak (*Casuarina glauca*), *Ficus* spp. and Brush Box (*Lophostemon confertus*) are present throughout. These species are interspersed with an exotic midstorey within the Rail corridor. Patches of weeds and planted native or exotic trees and shrubs within the rail corridor provide potential foraging habitat for a range of common bird species and mammal species typical of urban parks and gardens.
Typical fauna species recorded or likely to occur	Large flocks of honeyeaters, including the Yellow-faced Honeyeater (*Caligavis chrysops*) and New Holland Honeyeater (*Phylidonyris novaehollandiae*) were observed foraging within this habitat type. Red-whiskered Bulbuls (*Pycnonotus jocosus*) were recorded in exotic forest and scrub adjacent to wetland areas. Smaller flocks of Silvereyes (*Zosterops lateralis*) were recorded foraging on the edge of the rail corridor and in Eastlakes Golf Club. Native mammals, including the Common Ring-tailed Possum (*Pseudocheirus peregrinus*) and small introduced mammals, such as Black Rats (*Rattus rattus*) may den and forage in the dense midstorey of exotic scrub, although none were recorded.
Threatened fauna species	The Grey-headed Flying-fox was recorded flying over the site, and may forage in planted eucalypts and figs when specimens are flowering or fruiting. No breeding camps are present. Microchiropteran bats such as the Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) and Eastern Freetail Bat (*Mormopterus norfolkensis*) may forage in these habitats on occasion. No hollow-bearing trees were observed that would be suitable for bats to roost in.
Migratory species	No migratory fauna species were recorded during surveys. Migratory terrestrial woodland species such as the Rufous Fantail (*Rhipidura rufifrons*) could occur on occasion, but would unlikely depend on the habitats present.
Introduced species	Common Myna (*Sturnus tristis*) Eurasian Blackbird (*Turdus merula*) Red-whiskered Bulbul (*Pycnonotus jocosus*) Feral cat (*Felis catus*) Black rat (irattus rattus)

Photo 6.2 Urban exotic forest and scrub adjacent to Botany Road

Photo 6.3 Planted native trees adjacent to King Street

Table 6.4 Fauna habitats – Swamp Oak Swamp Forest

Swamp Oak Swamp Forest	
Description	Riparian forest occurs in a small patch adjacent to Mill Stream within the ARTC rail corridor. This forest was dominated by Swamp Oak, with various introduced canopy species also present, including Coral trees and Mulberry trees. This vegetation contains a moderate to severe weed infestation and is exposed to erosion where the batter slopes are steep. Understorey vegetation closer to the Mill Stream waterline contains moisture loving species such rushes and sedges. No hollow-bearing trees are present in this habitat type. Canopy species provide foraging and shelter resources for a range of bird species. Foraging resources include seasonal nectar resources, seeds and insects. Winter-flowering acacias would help provide year-round foraging resources for a range of nectarivorous native birds, bats and possums. High quantities of woody debris and leaf litter are present, where exotic canopy species such as Camphor Laurel are present. Fallen timber and leaf litter provides shelter and foraging habitat for small reptiles and snakes. Dense weed infestations are present along the creek banks which may also reduce habitat quality for some species.
Typical fauna species recorded	A moderate number of nectarivorous bird species were observed foraging within the dense midstorey of riparian forest, including the Scarlet Honeyeater (*Myzomela sanguinolenta*), Silvereye (*Zosterops lateralis*), Lewin's Honeyeater (*Meliphaga lewinii*) and Yellow-faced Honeyeater (*Caligavis chrysops*). Seed eaters, including Red-browed Finches (*Neochmia temporalis*) were also observed. Other bird species recorded included the Rufous Whistler (*Pachycephala rufiventris*), Spotted Pardalote (*Pardalotus punctatus*) and Grey Fantail (*Rhipidura albiscapa*). Some of these species also occur in forest patches away from riparian corridors. A number of snake eggs were recorded within mounds of sand in this habitat type, likely from the Eastern Brown Snake (*Pseudonaja textilis*).
Threatened fauna species	The Grey-headed Flying-fox (*Pteropus poliocephalus*) was recorded flying over the study area and foraging within fruiting Mulberry trees. Limited foraging habitat is present within the study area for this species. There is no roosting habitat or camp sites.
Migratory species	No migratory fauna species were recorded during surveys. Migratory woodland species such as the Rufous Fantail (*Rhipidura rufifrons*) could occur on occasion, but would not depend on the habitats present.
Introduced species	Red-whiskered Bulbul (*Pycnonotus jocosus*) Common Starling (*Sturnus vulgaris*) Black Rat (*Rattus rattus*)

Photo 6.4 Swamp Oak Swamp Forest alongside Botany Wetland

Table 6.5 Fauna habitats – Coastal freshwater wetland

Coastal Freshwater Wetland	
Description	The study area crosses Botany Wetland, which contains a number of ponds associated with Mill Stream. Large expanses of open water were observed in wetlands south of Southern Cross Drive. Smaller waterbodies with extensive reed beds also occur in the study area; particularly adjacent to East Lakes Golf Club. Wetlands in the study have connectivity with wetlands to the north in The Lakes Golf Club and also East Lakes Golf Club. These range in habitat value for native fauna depending on their size and presence of emergent or aquatic vegetation. Wetlands contained a low diversity of aquatic vegetation including *Typha orientalis*. Open water in some areas was heavily choked with aquatic weed.
Typical fauna species recorded	A moderate diversity and abundance of native waterfowl, waders and other wetland birds were observed in these water bodies. An unidentified Falcon sp. (*Falco* spp.) was observed flying over the study area. A range of ducks and grebes was observed, including various common species. Many Eurasian Coot (*Fulica atra*) and some Australasian Grebe (*Tachybaptus novaehollandiae*) were recorded foraging in open water. The Purple Swamphen (*Porphyrio porphyrio*), Royal Spoonbill (*Platalea regia*), eastern Great Egret (*Ardea modesta*) and Dusky Moorhen (*Gallinula tenebrosa*) were observed foraging in the shallows of wetlands. Little Pied Cormorants (*Microcarbo melanoleucos*) and Little Egrets (*Egretta garzetta*) were recorded perching on submerged woody debris and on the edges of riparian vegetation overlooking the wetland in the study area. Eastern Snake-necked Turtles (*Chelodina longicollis*) were recorded basking at the old jetty, and Eastern Water Skinks (*Eulamptus quoyi*) were observed basking on the footpath at Botany Road. Eastern Water Dragons (*Intellagama lesueurii*) were observed near the rail bridge. The wetlands provide potential habitat for the Green and Golden Bell Frog (*Litoria aurea*) however none were recorded during targeted surveys. This species was last recorded in 1993 at this location and is considered to no longer be present at Botany Wetland (White and Pyke 2008a). Common frog species recorded included the Dwarf Eastern Tree Frog (*Litoria fallax*), Peron's Tree Frog (*Litoria peroni*) and Common Eastern Froglet (*Crinia signifera*). The Dwarf Eastern Tree Frog and Common Eastern Froglet were recorded at one backwater in Pond 1a about 200 m upstream of the rail bridge, and the Dwarf Eastern Tree Frog was also heard calling at various locations around Mill Pond downstream of the rail bridge. Peron's Tree Frog was heard calling near Botany Road. No frogs were heard or observed in the large Typha patch immediately upstream of the rail bridge. Long-finned Eels (*Anguilla rhinehardtii*), Common Carp (*Cyprinus carpio*) and Mosquitofish (*Gambusia holbrooki*) were also observed in a number of wetlands.
Threatened fauna species	The Eastern Bentwing Bat was possibly recorded at the rail bridge based on Anabat analysis. No calls of the Southern Myotis (*Myotis macropus*) (or any similar calls of *Nyctophilus* species) were recorded. No bats were observed at the rail bridge at dusk, or foraging above the Botany Wetlands during frog surveys.
Migratory species	No migratory species were recorded during surveys. DPIE (OEH 2018a) records show that a number of species have been observed in the Botany Wetlands on rare occasions, including the Sharp-tailed Sandpiper (*Calidris acuminata*), Wood Sandpiper (*Tringa glariola*) and Latham's Snipe (*Gallinago hardwickii*).
Introduced species	Common Carp (*Cyprinus carpio*) Mosquitofish (*Gambusia holbrooki*)

Coastal Freshwater Wetland

Photo 6.5 Wetland south of Southern Cross Drive bordered by reed habitat

Photo 6.6 Wetland south of Southern Cross Drive adjacent to Eastlake golf course with a dense reedbed

6.2.3 Identification of threatened species under the BAM

Predicted threatened species

Based on the vegetation types and habitat resources present within the site, the BAM calculator generates a list of threatened fauna species that are predicted to utilise the study area. Habitat assessments during field surveys and review of existing information was used to refine the list of predicted species (see Appendix A2). The suite of threatened species associated with ecosystem credits required for the study area are listed in Table 6.6. For each predicted threatened species, a sensitivity class rating and vegetation zones they are predicted to be associated with are also provided. The BAM does not require targeted surveys for these species.

Table 6.6 Predicted threatened fauna that may occur in the site

Common Name	Scientific Name	PCT Association
Australasian Bittern	*Botaurus poiciloptilus*	1234 – Swamp Oak 1071 – Coastal Freshwater wetland
Australian Painted Snipe	*Rostratula australis*	1234 – Swamp Oak 1071 – Coastal Freshwater wetland
Black Bittern	*Ixobrychus flavicollis*	1234 – Swamp Oak 1071 – Coastal Freshwater wetland
Black-tailed Godwit	*Limosa*	1071 – Coastal Freshwater wetland
Broad-billed Sandpiper	*Limicola falcinellus*	1071 – Coastal Freshwater wetland
Curlew Sandpiper	*Calidris ferruginea*	1071 – Coastal Freshwater wetland
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	1234 – Swamp Oak 1071 – Coastal Freshwater wetland
Eastern Freetail-bat	*Mormopterus norfolkensis*	1234 – Swamp Oak 1071 – Coastal Freshwater wetland
Eastern Osprey	*Pandion cristatus*	1071 – Coastal Freshwater wetland
Flame Robin	*Petroica phoenicea*	1234 – Swamp Oak

Common Name	Scientific Name	PCT Association
Gang-gang Cockatoo	*Callocephalon fimbriatum*	1234 – Swamp Oak
Great Knot	*Calidris tenuirostris*	1071 – Coastal Freshwater wetland
Grey-headed Flying-fox	*Pteropus poliocephalus*	1071 – Coastal Freshwater wetland
Little Bentwing-bat	*Miniopterus australis*	1234 – Swamp Oak 1071 – Coastal Freshwater wetland
Little Eagle	*Hieraaetus morphnoides*	1234 – Swamp Oak 1071 – Coastal Freshwater wetland
Little Lorikeet	*Glossopsitta pusilla*	1234 – Swamp Oak
Masked Owl	*Tyto novaehollandiae*	1234 – Swamp Oak
Powerful Owl	*Ninox strenua*	1234 – Swamp Oak
Regent Honeyeater	*Anthochaera phrygia*	1234 – Swamp Oak
Spotted Harrier	*Circus assimilis*	1234 – Swamp Oak 1071 – Coastal Freshwater wetland
Square-tailed Kite	*Lophoictinia isura*	1234 – Swamp Oak 1071 – Coastal Freshwater wetland
Superb Fruit-Dove	*Ptilinopus superbus*	1234 – Swamp Oak
Varied Sittella	*Daphoenositta chrysoptera*	1234 – Swamp Oak
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	1071 – Coastal Freshwater wetland
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	1234 – Swamp Oak

Candidate species credit species

Threatened species that cannot reliably be predicted to occur on a development site based on PCT, distribution and habitat criteria are identified by the Threatened Biodiversity Data Collection as ‘species credit species’. In some circumstances, the particular habitat components of species assessed for ecosystem credit species, such as the breeding habitat of a cave roosting bat or forest owls, are also assessed for species credits. The credit calculator references geographic, vegetation and habitat data for the project site to generate a list of the species credit-type threatened species predicted to occur and requiring targeted survey. Searches of threatened species databases were also completed to determine any additional species to those generated by the credit calculator that are known or predicted to occur in the locality (refer to likelihood of occurrence table in Appendix A2). These results were reviewed giving consideration to the relevant habitats available on site, to determine the candidate species credit species that may potentially occur onsite.

Following the desktop assessment and habitat assessments conducted in the field, two threatened fauna species were considered to be candidate species for assessment: The Green and Golden Bell Frog and the Southern Myotis. These are detailed in Table 6.7 and discussed below.

Table 6.7 Candidate species credit species for which surveys were conducted

Scientific Name	Common Name	Survey month	Presence	Justification
Litoria aurea	Green and Golden Bell Frog	Nov-Mar	Not present - surveyed	As detailed in section 3.5.2, detailed surveys for the Green and Golden Bell Frog have been conducted in suitable weather conditions over a number of months. Most surveys were conducted in months identified as suitable in the survey guidelines for the species (DEWHA 2010a). Green and Golden Bell Frogs were active at other reference sites during the survey period. No evidence of the species has been recorded at Botany Wetlands since 1993, and it is accepted by DOEE in the Green and Golden Bell Frog species profile (DOEE 2018c) to no longer be present in this area. Given this, the Green and Golden Bell Frog is not considered affected by the project and as such no further consideration or assessment of this species is deemed warranted.
Myotis macropus	Southern Myotis	Nov-Mar	Not present - surveyed	No evidence of roosting bats was observed at the bridge over Mill Stream at the Botany Wetlands. No hollow-bearing trees were observed in the vicinity of the wetland that could be used for roosting by this species. No calls attributable to this species were recorded on anabats at Botany Wetland, within the rail corridor, or at the Alexandra Canal or Tempe Wetland. There are no records of the species in the last 30 years associated with Botany Wetlands (OEH 2018a). Given this, the Southern Myotis is not considered affected by the project and as such no further consideration or assessment of this species is deemed warranted.

Green and Golden Bell Frog

A population of the Green and Golden Bell Frog (*Litoria aurea*) previously occurred at the Botany Wetlands, which are crossed by the project at Mill Stream. Green and Golden Bell Frogs were known to inhabit the extensive Botany Wetlands in large numbers in the 1960s. By the mid-1970s, the species had declined in abundance at Eastlakes, and also disappeared from the upper Lachlan Swamps at Centennial Park (DECC 2008). White and Pyke (2008a) considered the species to no longer be present from Botany Wetlands, with the last record being 1993. Ponds and other frog habitats were created at Sir Joseph Banks Park at Botany (about 1 kilometre to the south of the project) and individuals were translocated into these habitats in 1996, 1997, 1999 and 2000. Translocations were unsuccessful due to the presence of Mosquitofish (*Gambusia holbrooki*), lack of shelter sites and competition from other frogs (White and Pyke 2008b). Despite this, there are records of the Green and Golden Bell Frog from Sir Joseph Banks Park from 2007 (OEH 2018b), suggesting that the population had persisted longer than thought.

The mapped distribution of the Green and Golden Bell Frog Lower Cooks River key population includes the Botany Wetlands, as well as the Marsh Street wetlands 2 kilometres west of the project site. The species still occurs in the Arncliffe area (Marsh Street, Eve Street and Barton Park wetlands). The Marsh Street wetland population is being monitored as part of the WestConnex New M5 project, although there have only been low numbers of individuals (<10) recorded in recent years (Ecological 2017). Connectivity between the Marsh Street wetlands and Botany Wetlands is limited. The Cooks River, roads, rail line, and large areas of industrial land are barriers to movement of the species between these locations, and no migration from the remnant population at Marsh St to Botany Wetland could occur.

A collection of ponds and wetlands are associated with Mill Stream, with different ponds numbered and named by Sydney Water. Mill Pond is crossed by Botany Road, and is characterised by large expanses of open water, with areas of submerged aquatic plants and fringing reeds, as well as large areas of exotic plants. Upstream of the rail bridge Mill Stream is a narrow creek running between the golf club and reedbeds of New Pond and widens out into a larger pool in Pond 1A. Downstream of the rail bridge Mill Stream again open out into a large pond, dominated, by the submerged aquatic plant *Myriophyllum*. Extensive reed beds dominated by *Typha orientalis* (Cambungi), *Isachne globosa* (Swamp Millet) and *Persicaria strigosa* (Spotted Knotweed) occur in New Pond, located immediately upstream of the rail line adjacent to East Lakes Golf Club, and further upstream in Pond 1A and Pond 1, also located adjacent to Eastlakes Golf Club. The reed beds were predominantly dry during surveys in early September 2018. In surveys conducted in later September that followed heavy rains, small pools were observed within these reedbeds, however these were dry in late October.

Targeted Green and Golden Bell Frog surveys conducted at Botany Wetland for the project over September and October 2018. Surveys were conducted at Mill Pond (between the rail corridor and Botany Road), the large reed bed in New Pond immediately to the north of the rail corridor, and a smaller reedbed in Pond 1A, as well as along the edges of Mill Stream. Surveys occurred following heavy falls of rain and/or on warm and windless nights. No evidence of the Green and Golden Bell Frog was recorded, however common frog species were active at the site. A small backwater of Pond 1A about 200 metres upstream of the rail bridge contained a small population of the Common Eastern Froglet (*Crinia signifera*). These were heard calling on all nights of survey. On warmer nights, Eastern Dwarf Tree Frogs were also heard calling and observed on reeds along the edges of Mill Stream and in the reed bed of Pond 1A, and along the edges of Mill Pond downstream of the rail bed. No frogs of any species were heard calling in the reed bed of New Pond immediately upstream of the rail bridge. On all nights surveys were also conducted at Tempe Wetland, which is located between the extant population and the Botany Wetlands. At this location high levels of chorusing of the Common Eastern Froglet, Eastern Dwarf Tree Frog, Peron's Tree Frog (*Litoria peronii*) and Striped Marsh Frog (*Limnodynastes peronii*) was recorded on all nights. In addition, Striped Marsh Frog and Peron's Tree Frog were recorded foraging during surveys on the 11, 18 and 30 October. High levels of activity at this location showed that survey conditions were suitable during the survey period.

The Green and Golden Bell Frog has not been recorded at Botany Wetland since 1993 (OEH 2018a, White and Pyke 2008a), which is around the same time that Chytrid fungus was discovered in Australia. The Green and Golden Bell Frog has undergone significant declines as a result of this fungus. SMEC (2018) concluded that the Green and Golden Bell Frog was unlikely to be present at Botany Wetland, due to the presence of Mosquitofish (*Gambusia hobrooki*) and high levels of disturbance and pollution. Recent research has suggested that saline conditions may inhibit the fungus (Stockwell et al 2014), and that the Common Eastern Froglet may be a carrier of Chytrid fungus (Brannelly et al 2018). The likely presence of Chytrid fungus, presence of a carrier species and predatory Mosquitofish and high levels of pollution together with freshwater conditions likely all contribute to the ongoing absence of the Green and Golden Bell Frog at Botany Wetlands.

Based on the consideration that this species is considered to no longer be present in the Botany area (White and Pyke. 2008a), and lack of any evidence of the species during targeted surveys over 2017 and 2018, limited connectivity with extant populations known in the Arncliffe area and low number of individuals recorded at the extant populations, the Green and Golden Bell Frog is highly unlikely to be present in the project site.

Southern Myotis

No evidence of roosting bats was observed at the bridge over Mill Stream at the Botany Wetlands. No hollow-bearing trees were observed in the vicinity of the wetland that could be used for roosting by this species. The Southern Myotis breeds from October to January, and is active in most months. While surveys were not conducted between Nov-Mar, suitable survey effort was conducted in a period when the species was likely to be active in the area.

No calls attributable to this species were recorded on anabats at Botany Wetland, within the rail corridor, or at the Alexandra Canal or Tempe Wetland. There are no records of the species in the last 30 years associated with Botany Wetlands (OEH 2018a), although the species is known to occur around Sydney Harbour (Gonsalves and Law 2017) and has been recorded elsewhere in the locality.

Potential candidate species not considered to occur on site

Given the highly disturbed and modified nature of the study area, no suitable habitat for most candidate species credit species occurs within the project site. A list of the remaining potential candidate species considered, and justification for their omission from further consideration under this assessment (where relevant) is provided in Table 6.8. Note that some of these species are ecosystem/species credit species. Only breeding habitat is relevant for these species (such as the Grey-headed Flying-fox and Eastern Bentwing Bat).

Table 6.8 Potential candidate species credit species not on site

Scientific Name	Common Name	Presence	Justification
Burhinus grallarius	Bush Stone-curlew	No	No suitable woodland habitat present.
Cercartetus nanus	Eastern Pygmy-possum	No	No suitable forest habitat present. No connected areas of habitat. No local records.
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	No	No suitable forest habitat present. No connected areas of habitat. No local records.
Chalinolobus dwyeri	Large-eared Pied Bat	No	No cave habitat present for breeding.
Lathamus discolor	Swift Parrot	No	No important area of foraging habitat present.
Limicola falcinellus	Broad-billed Sandpiper	No	No important area of foraging habitat present.
Lophoictinia isura	Square-tailed Kite	No	No raptor nests present.
Haliaeetus leucogaster	White-bellied Sea-Eagle	No	No raptor nests present.
Miniopterus australis	Little Bentwing-bat	No	No cave habitat present for breeding.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	No	No cave habitat present for breeding.
Ninox strenua	Powerful Owl	No	No large hollow-bearing trees present.
Pandion cristatus	Eastern Osprey	No	No raptor nests present.
Petaurus norfolcensis	Squirrel Glider	No	No suitable forest habitat present. No connected areas of habitat. No local records.
Phascolarctos cinereus	Koala	No	No suitable forest habitat present. No connected areas of habitat. No local records.
Pteropus poliocephalus	Grey-headed Flying-fox	No	No breeding camp present.
Tyto novaehollandiae	Masked Owl	No	No large hollow-bearing trees present.
Anthochaera phrygia	Regent Honeyeater	No	No important area of foraging habitat present.
Callocephalon fimbriatum	Gang-gang Cockatoo	No	No large hollow-bearing trees present.
Hieraaetus morphnoides	Little Eagle	No	No raptor nests present.

Scientific Name	Common Name	Presence	Justification
Calidris ferruginea	Curlew Sandpiper	No	No important area of foraging habitat present.
Calidris tenuirostris	Great Knot	No	No important area of foraging habitat present.
Limosa limosa	Black-tailed Godwit	No	No important area of foraging habitat present.
Crinia tinnula	Wallum Froglet	No	No wallum habitat present.
Hoplocephalus bitorquatus	Pale-headed Snake	No	Outside known distribution. No suitable habitat present.
Litoria brevipalmata	Green-thighed Frog	No	Outside known distribution. No suitable habitat present.
Neophema chrysogaster	Orange-bellied Parrot	No	No saltmarsh present.
Nettapus coromandelianus	Cotton Pygmy-Goose	No	Rare visitor to NSW. No suitable habitat.
Turnix maculosus	Red-backed Button-quail	No	Rare visitor to NSW. No suitable habitat.
Callocephalon fimbriatum	Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas	No	Outside distribution of the population.

6.3 Aquatic habitat

The project is located within the catchments of Alexandra Canal (which is a sub-catchment of the Cooks River catchment) and the Mill Stream catchment (which is a sub-catchment of the Georges River catchment). Mill Stream is part of the Botany Wetlands, which are the largest freshwater wetlands in the Sydney Metropolitan Region. Botany Wetlands and associated water bodies are shown on Figure 6.2.

The project crosses Mill Stream adjacent to Mill Pond. Upstream of the existing rail bridge Mill Stream is a small water channel adjacent to a raised sediment island dominated by *Typha.* Some deeper pools occur further upstream. Large beds of Myriophyllum (*Myriophyllum aquaticum*) and Ribbon Weed (*Valiseria americana*) are present in the channel and larger polls. A large gross pollutant trap upstream of sediment island (between New Pond and Pond 1a) has trapped large amounts of rubbish. This net is also likely to be a barrier to fish movement.

Mill Pond downstream of the existing rail bridge (and adjacent to Botany Road) is a large open pond area dominated by *Myriophyllum.* Lilies are present in the downstream end of the pond along with a high concentration of surface scum and algae. Some *Typha* stands are present in the upstream end of the pond. Another gross pollutant trap is present near the Botany Road bridge, and similarly contains large amounts of rubbish. This would also be a barrier to fish passage.

Mill Stream passes through four large culverts at Foreshore Drive. The mouth of the stream at Botany Bay has been substantially modified by the construction of Sydney Airport's third runway and Foreshore Drive. Further downstream the recent construction of the expanded Sydney Ports container terminal has further modified the natural environment of Botany Bay. A small section of Foreshore Beach remains alongside Mill Stream. Seagrasses are present off shore.

Mill Stream is mapped as key fish habitat (DPI 2007) and considered moderate key fish habitat according to DPI (2013) given the presence of clearly defined bed and banks with permanent waters in pools or in connected wetland areas, the presence of freshwater aquatic vegetation, and presence of native fish (eels).

6.3.1 Threatened aquatic species identified in the study area

Botany Wetlands and Mill Stream are not habitat for any threatened fish species. Freshwater habitats crossed by the project are outside the natural range of the Australian Grayling (*Prototroctes maraena*). The Black Rock Cod (*Epinephelus daemelii*) occurs around rocky shores and reefs, and no habitat is present in the study area (see Appendix B).

6.3.2 Coastal Management SEPP 2018 – Coastal Wetland

The small wetland located north of Mill Pond Drive and west of Botany Road is mapped as a Coastal Wetland according to the *Coastal Management SEPP 2018*. This wetland is located immediately adjacent to the project boundary and the project crosses its proximity area north-west of Southern Cross Drive (see Figure 6.2).

Parts of the Botany Wetlands are also mapped as Coastal Wetlands (see Figure 6.2). These comprise small areas upstream of the bridge over Mill Stream located adjacent to Eastlake Golf Club and larger areas located in Bonnie Doon Golf Club further upstream. No areas of Coastal Wetlands or their proximity areas along Mill Stream are within the project site.

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Figure 6.1
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Figure 6.1
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Figure 6.1
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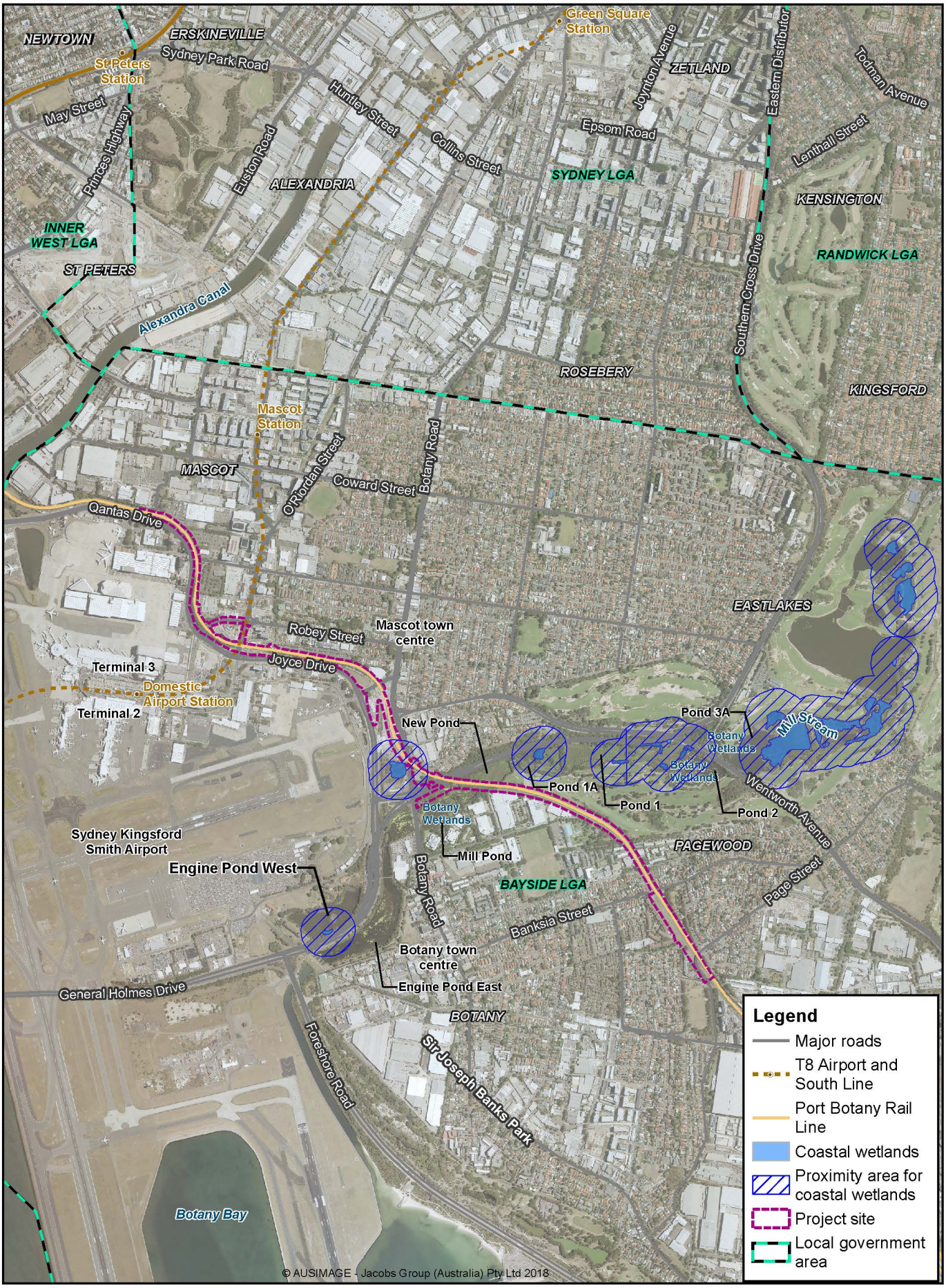

0 335 670 m

Figure 6.2

Aquatic habitat

Author: David Naiken
Date: 30/05/2019
Map no: PS113386_GIS_049_A1

7. Existing environment – Matters of National Environmental Significance

7.1 Threatened ecological communities

The protected matters search conducted for this project identified eleven predicted threatened ecological community as potentially occurring within the locality. These communities are:

- Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion.
- Coastal Swamp Oak *(Casuarina glauca)* Forest of New South Wales and South East Queensland ecological community.
- Coastal Upland Swamps in the Sydney Basin Bioregion.
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion.
- Eastern Suburbs Banksia Scrub of the Sydney Region.
- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia.
- Posidonia australis seagrass meadows of the Manning-Hawkesbury ecoregion.
- Shale Sandstone Transition Forest of the Sydney Basin Bioregion.
- Subtropical and Temperate Coastal Saltmarsh.
- Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion.
- Western Sydney Dry Rainforest and Moist Woodland on Shale.

Of these, one threatened ecological community listed under the EPBC Act, being Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community, was considered as a candidate to occur within the study area. An overview and analysis of this ecological community against recorded field data and the conservation listing advice is provided in Section 7.1.1 below.

7.1.1 Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community

Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community is listed as endangered under the EPBC Act.

Within the study area, the following PCT was considered a candidate to form part of this EPBC Act threatened ecological community listing:

- PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion.

To be considered a Matter of National Environmental Significance (MNES), areas or patches of PCT 1234 must meet both:

- the key diagnostic characteristics AND
- at least the minimum condition thresholds for Category C.

An overview of key diagnostics of the EPBC Act-listed community against candidate PCT 1234 is presented in Table 7.1.

Table 7.1 Comparison of Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community key diagnostics against candidate PCT 1234

Key diagnostic	PCT 1234 – Poor	PCT 1234 – Low
Occurs from south-east Queensland to southern NSW within the South-Eastern Queensland, NSW North Coast, Sydney Basin, or South East Corner bioregions	Yes, study area occurs within the Sydney Basin Bioregion.	
Occurs in coastal catchments at elevations up to 50 m ASL, typically less than 20 m ASL, on coastal flats, floodplains, drainage lines, lake margins, wetlands and estuarine fringes where soils are at least occasionally saturated, water-logged or inundated. There are also minor occurrences on coastal dune swales or flats, particularly deflated dunes and dune soaks.	Yes, located on or associated with (through groundwater) drainage lines in Port Botany catchment at elevations typically between 1 and 5 m ASL.	
Occurs on soils derived from unconsolidated sediments (including alluvium), typically hydrosols (grey-black clay-loam and/or sandy loam soils) and sometimes organosols (peaty soils). It may occur in transitional soils (or catenas) where shallow unconsolidated sediments border lithic substrates.	Yes, occurs on alluvial soils with a high sand component although a number of areas are associated with fill material of unknown origin as a result of previous road and rail construction.	
Has an open woodland, woodland, forest, or closed forest structure, with a tree canopy that has a total crown cover of at least 10 per cent.	Yes – does contain a total crown cover of >10%.	No – does not contain a total crown cover of >10%.
Has a canopy of trees dominated by Casuarina glauca (swamp-oak, swamp she-oak).	Yes – *Casuarina glauca* forms a dominant canopy.	No – *Casuarina glauca* does not form a dominant canopy.
Does this condition type meet the EPBC Act listed of Coastal Swamp Oak (Casuarina glauca) Forest key characteristics?	**Yes, meets EPBC Act characteristics and so has been assessed against condition criteria below.**	**No, does not meet EPBC Act key characteristics and therefore has not been considered further.**

Based on a comparison of candidate PCT 1234 and corresponding vegetation zones against key diagnostic data in Table 7.1 the following vegetation zone is considered further against minimum condition thresholds:

- PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion – Poor condition.

A comparison of PCT 1234 - Poor condition within the study area was undertaken against the EPBC Act listing minimum condition thresholds (Table 3.3).

Each ‘patch’ of Poor condition PCT 1234 was assessed in accordance with the criteria detailed in Table 3.3. A patch refers to a discrete and mostly continuous area of the ecological community, as defined by the key diagnostics, but can include small-scale variations, gaps and disturbances. When it comes to defining a patch of the ecological community allowances are made for “breaks” up to 30 metres between areas that meet the key diagnostics. Within the study area these breaks included the rail corridor, Botany Road and Southern Cross Drive.

The discrete patches assessed within the study area included:

- Patch 1 – located on the northern side of Southern Cross Drive and to the west of the rail corridor, less than 0.5 hectare in area.
- Patch 2 – located on the northern side of Southern Cross Drive and to the west of the rail corridor, less than 0.5 hectare in area.
- Patch 3 – located on the southern side of Southern Cross Drive and to the west of the rail corridor, less than 0.5 hectare in area.
- Patch 4 – located on southern side of Southern Cross Drive, to the east of the rail corridor. Is a small less than 0.5-hectare patch however the understorey is not predominately native instead dominated by perennial exotic grasses and transformer weeds such as *Ipomoea cairica*.
- Patch 5 – located adjacent to the eastern side of the rail corridor to the south of Banksia Street.

The minimum condition thresholds for Coastal Swamp Oak (Casuarina glauca) Forest of NSW and South East Queensland ecological community is shown in Figure 7.1 and Figure 7.2 shows the location of each patch.

Of the candidate patches assessed, only Patches 2 and 4 meet the condition threshold minimum patch size requirement although both patches do not meet recorded native perennial understorey cover thresholds. As such, none of the areas mapped as PCT 1234 within the study area meet the EPBC Act listing of Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community.

Condition thresholds Patch size classes→ ↓ Vegetation quality classes	**Large patch** The patch is at least 5 ha	**Medium patch** The patch is at least 2 ha and less than 5 ha	**Small contiguous** patch** The patch is at least 0.5 ha and less than 2 ha, and is connected to a larger area of native vegetation of at least 5 ha	**Small patch** The patch is at least 0.5 ha and less than 2 ha
HIGH QUALITY **Predominantly native understorey** Non-native species comprise **less than 20%** of total understorey vegetation cover*	CATEGORY A A large patch that meets **key diagnostics** and has a predominantly native understorey	CATEGORY B A medium patch that meets **key diagnostics** and has a predominantly native understorey OR A small patch that meets **key diagnostics** and has a predominantly native understorey and is contiguous** with another large area of native vegetation		CATEGORY C A small patch that meets **key diagnostics** and has a predominantly native understorey
GOOD QUALITY **Mostly native understorey** Non-native species comprise **less than 50%** of total understorey vegetation cover* AND transformer species*** comprise **less than 30%** of total understorey vegetation cover*	CATEGORY B A large patch that meets **key diagnostics** and has a mostly native understorey	CATEGORY C A medium patch that meets **key diagnostics** and has a mostly native understorey OR A small patch that meets **key diagnostics** and has a mostly native understorey and is contiguous** with another large area of native vegetation		
MODERATE QUALITY **Some native understorey** Non-native species comprise **less than 80%** of total understorey vegetation cover* AND transformer species*** comprise **less than 50%** of total understorey vegetation cover*	CATEGORY C A large or medium patch that meets **key diagnostics** and has some native understorey			

*Refers to total perennial understorey vegetation cover for the patch of the ecological community. Includes vascular plant species of all layers below the canopy with a life-cycle of more than two growing seasons. It includes herbs (graminoids and forbs), grasses, shrubs and juvenile plants of canopy species, but does not include annual plants, cryptogams, plant litter or exposed soil. Areas of little to no understorey vegetation cover (e.g. plant litter) are included if key diagnostics are met and non-native species are below thresholds.
**Contiguous means the patch is connected or in close proximity (within 30 m) to another area of native vegetation.
***Transformer species (e.g. *Chrysanthemoides monilifera, Asparagus* spp, *Pennisetum* spp, *Ipomoea* spp. etc.) are non-native plant species with the potential to permanently change the character, condition, form or nature of patches of the ecological community. See p. 43 for further information on weeds, including transformer species. Annual weeds, such as *Symphyotrichum subulatum* (saltmarsh aster), may be seasonally very abundant and temporarily restrict the development of native species, but would not be counted as transformer weeds in determining condition.

Figure 7.1 Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community minimum condition thresholds

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DRG CHECK		J WYLLIE	13/05/2019

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Figure 7.2
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7.2 Threatened species

7.2.1 Threatened flora species

The protected matters search conducted for this project identified 16 predicted threatened flora species as potentially occurring within the locality. The results of the field surveys and likelihood of occurrence assessments have determined these species to have a low likelihood of occurrence and are not considered to be affected by the project (Appendix B).

7.2.2 Threatened fauna species

One threatened fauna species listed under the EPBC Act, the Grey-headed Flying-fox, was recorded in the project site. Occasional fig trees, eucalypts and mulberry trees occur along the edges of the rail corridor and in planted vegetation in proposed compound and access sites. Grey-headed Flying-foxes would forage in these trees on occasion when fruiting or flowering. There is no breeding camp in the project site. Nearby breeding camps include those at Wolli Creek (3 kilometres to the west) and Centennial Park (5.5 kilometres to the north-east). Foraging habitat in the project site would be a negligible proportion of available foraging habitat used by individuals from these camps and thus would not be habitat critical to the survival of the species.

As discussed in section 6.1.3, the Green and Golden Bell Frog is considered to no longer be present at Botany Wetland and would not be impacted by works.

Migratory species are discussed in section 7.3.

No other threatened fauna species listed under the EPBC Act are likely to occur on a regular basis or be reliant on habitats present based on the results of the field surveys and likelihood of occurrence assessments provided in Appendix B.

7.3 Migratory species

Botany Bay and surrounds, and in particular Towra Point Nature Reserve on the southern side of Botany Bay 6.5 kilometres from the site, are known to provide habitat for a range of migratory species listed under the EPBC Act.

The project site crosses the Botany Wetlands and Mill Stream. These contain freshwater habitats and may occasionally provide foraging habitat for some migratory birds. Latham's Snipe (*Gallinago hardwickii*), the Sharp-tailed Sandpiper (*Calidris acuminata*) and Wood Sandpiper (T*ringa glareola*) have previously been recorded at the Botany Wetlands or Mill Stream (OEH 2013a, 2018a). Latham's Snipe occurs in freshwater wetlands, generally with dense cover. The Sharp-tailed Sandpiper and the Wood Sandpiper prefer foraging along the muddy edges of shallow freshwater or brackish wetlands (DECCW 2010). These species would occur at the Botany Wetlands on occasion, however this habitat within the project site is a negligible proportion of the available foraging habitat in this wetland. Given their relatively small size compared to the nearby Towra Point Nature Reserve, the Botany Wetlands are unlikely to support 18 Latham's Snipe, and would not support 15 different migratory shorebird species, over 2000 migratory shorebirds, or 0.1 per cent of the flyway population of any species. No important habitat is likely to be present for these species at Botany Wetlands.

A critical consideration in assessing the significance of potential impacts on listed migratory shorebird species, according to the significant impact guidelines for migratory shorebird species (DEE 2017), is whether or not a proposed action is likely to affect 'important habitat'. Important habitat is defined separately for 36 of the migratory shorebird species and Latham's Snipe (*Gallinago hardwickii*). An area of 'important habitat' for the 36 migratory shorebird species is either:

- a site that is identified as internationally important, or
- a site that supports either:
  - at least 0.1 per cent of the flyway population of a single species, or
  - at least 2000 migratory shorebirds, or
  - at least 15 shorebird species.

Important habitat for Latham's Snipe is described as:

- areas that have previously been identified as internationally important for the species, or
- sites that support at least 18 individuals of the species.

Towra Point Nature Reserve Ramsar Site is located on the southern side of Botany Bay, about 6.5 kilometres from the project site, and is important habitat for migratory waders. Towra Point Nature Reserve and adjacent areas regularly support approximately 34 of the 80 species of migratory birds listed under the various migratory agreements, including JAMBA, CAMBA and ROKAMBA. These birds use the mudflats, saltmarsh, mangrove and sand spit areas for feeding and roosting, and these areas provide favourable habitat due to the high productivity of the reserve and the protection from predators and disturbance (Department of Environment, Climate Change and Water 2010). DPIE (formally OEH) has mapped important habitat for the Eastern Curlew (*Numenius madagascariensis*) and Bar-tailed Godwit (*Limosa lapponica*) in particular in Botany Bay, and this area of habitat most likely encompasses Towra Point Nature Reserve. The Eastern Curlew and Bar-tailed Godwit use the intertidal flats for foraging or roosting during high tide on the sandy flats particularly Towra Spit Island (OEH 2013). The Botany Wetlands are unlikely to provide suitable habitat for the Eastern Curlew and Bar-tailed Godwit. Similarly, most other migratory waders known to occur at Towra Point Nature Reserve are unlikely to utilise habitats at Botany Wetlands given the lack of mudflats. Botany Wetlands are therefore unlikely to be important habitat for these species.

7.4 Wetlands of International Importance (RAMSAR wetlands)

Towra Point Nature Reserve Ramsar Site is located on the southern side of Botany Bay, about 6.5 kilometres from the project site. The reserve contains a gradation of environments from subtidal areas to extensive intertidal mudflats and mangrove forest to occasionally tidal-flooded saltmarsh to freshwater wetlands to shallow and deep sand dunes supporting littoral forest. As discussed above, this Ramsar Site provides important habitat for a number of migratory waders. It also hosts one of the most important nesting sites in NSW for the Little Tern (*Sterna albifrons*) and a significant proportion of the state-wide nesting population of the Pied Oystercatcher (*Haematopus longirostris*) which are listed as endangered under the NSW BC Act (OEH 2013).

7.5 Commonwealth Land

Much of the project is located adjacent to Commonwealth Land associated with Sydney Airport, although some proposed compound sites and other areas outside the rail corridor are located within Commonwealth land. Most of the land comprises cleared hardstand areas, although 0.1 hectares of planted trees and shrubs are present.

Due to the long history of industrial use of the area there is significant contamination of soil and groundwater in Commonwealth land at the Sydney Airport. This includes bonded asbestos containing material and asbestos fines/fibrous asbestos within fill materials; contaminants in the soil and/or groundwater, including hydrocarbons, polycyclic aromatic hydrocarbons, per- and poly-fluoroalkyl substances and heavy metals; and high levels of noise and vibration from aircraft and traffic.

The main areas of natural biodiversity value remaining at Sydney Airport are the Sydney Airport wetlands. Sydney Airport manages the downstream sections of the Botany Wetlands, including Mill Pond, Engine Pond East and West and Mill Stream. These downstream ponds of the Botany Wetlands are referred to as the Sydney Airport Wetlands. The project crosses the Botany Wetlands upstream of Mill Pond, and thus does not directly affect the Airport Wetlands, although there is the potential for indirect impacts (see section 8).

The Botany Wetlands are listed in the Directory of Important Wetlands in Australia and are known to provide occasional habitat for threatened and migratory waders (Sydney Airport Corporation 2013). The wetlands are considered an environmentally significant area under the Airport Master Plan 2039. The marine environment of Botany Bay is also identified as an area of environmental sensitivity under the Master Plan. The Sydney Airport Wetlands and the wider aquatic environment of Botany Bay area zoned EC1 Environmental Conservation areas under the Airport Master Plan.

8. Impact assessment

8.1 Measures to avoid and minimise impacts

The majority of the project site is located within the existing rail corridor within an industrial area of Sydney, which has been cleared and substantially modified through previous earthworks and construction. The project's impacts are substantially less than would be associated with an undisturbed 'green field' site. The project has been purposefully designed to avoid or further reduce impacts on biodiversity values as far as is practicable, through the use of cleared and disturbed compound sites where possible.

There are small patches of vegetation consistent with the EECs Swamp Oak Floodplain Forest and Sydney Coastal Freshwater Wetlands adjacent to the rail corridor. The project site has been purposefully designed to avoid vegetation removal in these areas as far as is practicable.

A Construction Environmental Management Plan (CEMP) would be required for the construction phase of the project. The CEMP would include, as a minimum, industry-standard measures for the management of soil, surface water, weeds and pollutants, as well as site-specific measures, as per the mitigation measures specified in the EIS.

Mitigation measures are detailed in section 9.

8.2 Impacts during construction

8.2.1 Direct impacts on vegetation and habitat

The project site is characterised in general by cleared land in a rail corridor with minimal value for native biodiversity. The majority of the vegetation to be removed for the project is not native vegetation and comprises exotic plants or planted, often non-indigenous (native but not naturally occurring in this area) native species on fill material. Construction within these areas would remove a small number of individuals of non-threatened native plants, including planted trees, and priority and high threat weeds within highly modified habitat that does not support a native vegetation community.

The study area contains small areas of remnant and regrowth native vegetation, including small patches of two EECs (Swamp Oak Floodplain Forest and Sydney Coastal Freshwater Wetlands) and marginal habitat for a small number of highly mobile threatened fauna species. Native vegetation and habitat within the study area is in medium to poor condition and features impacts from existing rail corridor maintenance, edge effects, weed infestation, and exotic fauna species (i.e. foxes and cats).

In total, the project would remove about 0.72 hectares of native vegetation as summarised in Table 8.1, from a total impact area of 8.12 hectares. Impacts on Commonwealth land comprise the removal of 0.1 hectare of urban exotic/native landscape plantings.

For the purposes of this assessment, it is assumed that all native vegetation within the project site would be removed. The majority of this native vegetation removal (0.72 hectares) would occur in the vicinity of Mill Stream and the Botany Wetlands. This riparian vegetation would be impacted during construction of the bridge over Mill Stream and use of the associated compound site adjacent to Mill Pond. Following construction, disturbed areas alongside Mill Stream, Mill Pond and New Pond would be stabilised and revegetated with locally endemic species (see section 9.2).

Table 8.1 Direct impact of native vegetation

Zone	Plant community type (PCT)	Threatened ecological community	Area impacted (ha)
VZ1	PCT 1071 *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (moderate condition)	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	0.10
VZ2	PCT 1234 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (poor condition)	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	0.46
VZ3	PCT 1234 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (low condition)		0.16
VZ4	Miscellaneous ecosystem – highly disturbed areas with no or limited native vegetation	Not native	5.53
VZ5	Miscellaneous ecosystem – urban exotic / native landscape plantings	Not native	1.89
VZ6	Miscellaneous ecosystem – water bodies (not wetlands)	Not native	0.05
	Total native vegetation		**0.72**
	Total area		**8.12**

Impacts on fauna and habitat

Potential direct impacts on fauna habitats are detailed in Table 8.2.

Table 8.2 Direct impacts on fauna and fauna habitat resources

Impact	Description
Removal of habitat resources	Construction of the project would remove a very small area of fauna habitat, as most of the project site is already cleared land. The vegetation that would be removed or modified provides limited habitat resources for native fauna species due to its existing highly modified nature and the surrounding urban environment. Fauna habitat resources that would be removed include foraging and shelter resources for mainly common native fauna typical of urban environments. The project would remove a small number of forage trees of the Grey-headed Flying-fox and forage habitat for microbats.
Impact on wetland habitat	There would be limited direct impacts on wetland habitat at the Botany Wetlands. Clearing would be limited in area, and would comprise mainly the removal of weed-infested planted vegetation. Impacts on native vegetation would be restricted to the removal of 0.62 ha of Swamp Oak Forest and 0.1 ha of Coastal Freshwater Wetland from immediately adjacent to the rail bridge at Mill Stream. Some minor material within Mill Stream would be excavated and scour protection would also be constructed along the eastern and western banks of Mill Stream, where required. Impacts on the water body would be minor.
Removal of hollow-bearing trees	No hollow-bearing trees were recorded in the project site.
Injury and mortality	Construction is likely to result in the injury or mortality of some individuals of less mobile fauna species and other small terrestrial fauna that may be sheltering in vegetation within the project site during clearing activities and unable to move out of the area. This could include nestlings, small lizards and frogs. More mobile native fauna such as native birds, bats, terrestrial and arboreal mammals that may be sheltering in vegetation in the project site are likely to evade injury during construction activities.
Fragmentation and isolation of habitat.	The project would require the removal of vegetation and habitat and would create or increase small gaps in habitat. The vegetation within the study area is currently fragmented by the existing rail corridor, roads and urban development. It is unlikely that the project would create an additional barrier to the movement of pollinator and seed dispersal vectors, such as insects and birds.
Impacts on key fish habitat	There would be no loss of key fish habitat. There would be no impacts on aquatic connectivity or fish passage along Mill Stream. The gap in riparian vegetation at this location would be increased, but would be unlikely to prevent the movement of any fauna along this corridor.

8.2.2 Indirect impacts on native vegetation and habitat

Indirect impacts on biodiversity values that may result from construction of the project are detailed in Table 8.3.

Table 8.3 Indirect impacts on biodiversity values

Impact	Description
Weed invasion and edge effects	'Edge effects' refer to increased noise and light or erosion and sedimentation at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to vegetation type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna. Altered environmental conditions along new edges can allow invasion by pest animals specialising in edge habitats and/or change the behaviour of resident animals. Edge effects would result from construction activities and then continue to affect vegetation and habitats adjoining the project site. The project site and adjoining land has been extensively cleared for the existing rail corridor and surrounding urban development. Small, linear patches of vegetation occur at scattered locations. Due to the small size and linear arrangement of native vegetation patches in the study area, they are already severely affected by edge effects and associated negative impacts such as weed infestation. The project would create few novel edge effects and is unlikely to result in a significant increase in the impact of existing edge effects.
Pests and pathogens	Construction activities, in general, have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangelii*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) into native vegetation. There is little available information about the distribution of these pathogens within the locality, and no evidence of these pathogens was observed during surveys, however Chytrid fungus is likely to have contributed to the loss of the Green and Golden Bell Frog from the area (DECC 2008b). The potential for impacts associated with these pathogens is low, given the existing disturbed nature and high visitation rates to the study area, and lack of intact native vegetation in the vicinity of the project site.
Noise, light and vibration	Construction of the project would require the use of additional vehicles and plant in the site. Fauna that occupy habitats within the project site and adjacent areas are likely to be accustomed to existing high noise and vibration levels originating from trains, road traffic and the urban environment. Similarly, fauna and fauna habitats are already exposed to existing light from trains, cars, street lights and residential and industrial areas. Noise and vibration disturbance at the bridge at Mill Stream could disturb temporary roost habitat for threatened microchiropteran bats. While there would be localised increases in noise, vibration and light that would temporarily create substantial disturbance, increases above existing background levels during construction are unlikely to result in a significant impact on fauna that occur in the study area.
Sedimentation and erosion	Construction of the project has the potential to result in sedimentation and erosion within the construction corridor and adjoining native vegetation and aquatic habitats, through soil disturbance and construction activities. This is of particular risk during construction of the second bridge at Mill Stream. Sediment laden runoff to waterways can alter water quality and adversely affect aquatic life.
Aquatic disturbance and pollution	Construction of the project has the potential to result in the mobilisation of contaminated sediments into waterways, or chemical spills from vehicles or plant. The introduction of pollutants from the project into the surrounding environment, if uncontrolled, could potentially impact on water quality further downstream. The existing environment is already highly contaminated due to the long history of industrial activities in the area. Bonded asbestos containing material and asbestos fines/fibrous asbestos are present within fill materials, and contaminants in the soil and/or groundwater include hydrocarbons, polycyclic aromatic hydrocarbons, per- and poly-fluoroalkyl substances and heavy metals.

The potential for indirect impacts will be managed through the CEMP (see section 9).

8.2.3 Impacts on threatened species

Threatened flora species

No threatened flora species or their habitat, listed under BC Act, have been determined to be affected by the project.

Threatened fauna species

The project would have minimal impacts on threatened fauna species listed under the BC Act. Only two species, the Grey-headed Flying-fox and the Eastern Bentwing Bat, were recorded during surveys. Some other highly mobile species may occur on occasion within the project site. The Green and Golden Bell Frog was not recorded at Botany Wetlands and is unlikely to be present (see Section 6.2.3). It is highly unlikely that any threatened species or any fauna populations would rely on the habitat resources within the project site for their survival.

Impacts on threatened fauna would comprise:

- the removal of up to 2.51 hectares of canopied foraging habitat for the threatened Eastern Bentwing Bat, Grey-headed Flying-fox and other threatened fauna species with potential habitat in the study area (consisting of 1.89 hectares of planted native species and 0.62 hectares of native vegetation)
- the removal of 0.10 hectares of Freshwater Wetland habitat, which is marginal potential foraging habitat for a variety of migratory waders
- noise and vibration disturbance at the bridge at Mill Stream, which could provide temporary roost habitat for threatened microchiropteran bats, although no roosting bats or evidence of roosting bats was observed during surveys.

There would be no impacts on habitat for species credit species. Targeted surveys did not find any evidence of the Green and Golden Bell Frog or Southern Myotis. No suitable habitat for any other candidate species credit species is present in the project site.

8.2.4 Impacts on aquatic fauna and habitats

The project includes a new bridge across Mill Stream, which is mapped as key fish habitat. Construction at this location would include piling for the bridge, some minor works along the banks and potentially instream to stabilise the abutments in this area. The aquatic habitats within and downstream of the project site have the potential to be impacted during construction if not mitigated. Potential aquatic issues during construction include:

- potential sedimentation of Mill Stream, as a result of soil disturbance, erosion and sediment-laden runoff
- exposure of actual or potential acid sulfate soils, which may generate acidic runoff and affect water quality
- potential effects on surface and groundwater quality as a result of disturbance of contaminated soils
- potential spills or leaks of fuels and/or oils from construction equipment and/or from vehicle/truck incidents.

Construction involving excavation would interact with contaminated soils and groundwater during piling for the new bridge over Mill Stream. Works would intercept the Botany Sand Beds Aquifer, which is known to be shallow and contaminated. Construction water runoff and sedimentation in Mill Stream could affect habitat for fish, wading birds and other species that utilise this waterway. This waterway is already subject to substantial disturbance and pollution. Design of construction and mitigation measures would be in place to minimise these impacts where possible. No extraction or dewatering is anticipated for the project.

The project would not directly impact any habitat for threatened biota listed under the FM Act. Potential habitat for the Black Rock Cod is located over 5 kilometres downstream of the project (rock headlands of Botany Bay), and indirect effects on habitat are highly unlikely. Impacts to the geomorphology of the waterways are minor and short term and considered manageable with appropriate mitigation measures. There would be no blockage of fish passage and no removal of snags as a result of the project.

Standard construction management and mitigation strategies (as recommended in the Blue Book and widely adopted across the construction industry) to minimise sediment disturbance, mobilisation and runoff are recommended to be adopted during construction (Section 9). Following construction, disturbed areas alongside

Mill Stream, Mill Pond and New Pond would be stabilised and revegetated using locally endemic species typical of riparian areas where available (Section 9).

8.2.5 Impacts on groundwater dependent ecosystems

The project would remove 0.62 hectares of PCT 1234 Swamp Oak swamp forest fringing estuaries, which are likely to be somewhat dependent on groundwater (see Section 5.6). This vegetation is in a highly modified state. Construction of the bridge over Mill Stream has the potential to further mobilise contaminated groundwater at Mill Stream. There is a potential for a minimal increase in groundwater recharge during construction due to re-profiling works exposing more permeable materials. No groundwater extraction or dewatering is anticipated for the project. Given the existing contamination of the Botany Wetlands, limited clearing of native vegetation, and negligible drawdown of groundwater, impacts on GDEs outside the project site is likely to be minimal.

8.3 Impacts during operation

Effects on biodiversity values would be largely restricted to the construction phase of the project. Effects on biodiversity values that may result from operation of the project are detailed in Table 8.4.

Table 8.4 Potential operational effects on biodiversity values

Impact	Description
Noise, light and vibration	Operation of the project would introduce additional noise, light and vibration from the movement of vehicles. The project is located in a highly industrial urban environment already subject to substantial noise, light and vibration levels and with limited habitat value for biodiversity. Fauna species present would be accustomed to existing noise, light and vibration. The project is likely to involve only a minor increase in noise, light and vibration given the levels of existing disturbance and is not likely to result in a significant impact on fauna and flora that occur adjacent to the project site.
Vehicle strike	Few terrestrial fauna species occur in the project site that are at high risk of vehicle strike, and those that occur are already subject to the risk of vehicle strike given the location of the project. The project is unlikely to significantly increase the risk of vehicle collisions with fauna above current levels.
Erosion and sedimentation and discharge of pollutants	Operation of the project has the potential to introduce pollutants to the environment as a result of incidental spills from trains and result in erosion and sedimentation from runoff from hardstand areas. The project is located in a highly industrial area subject to substantial existing contamination and risk of chemical spills, and operation of the project would not substantially increase this risk. Appropriate mitigation measures will be implemented to effectively manage any potential adverse water quality impacts associated with the operation phase of the project.

The project site is located within or immediately adjoining existing urban infrastructure and highly modified environments. Each of the potential operational impacts identified below would already be occurring in the project site and affecting the surrounding study area. Fauna that occupy habitats within the project site and adjacent areas are likely to be accustomed to existing noise originating from road traffic, trains, planes and the urban environment. The project when operational is unlikely to significantly increase the risk of fauna collisions above current levels, given the highly modified habitats present. In this context, the project is likely to comprise only a minor increase in any of these potential negative effects. The project is unlikely to increase the extent, duration or magnitude of any of these impacts to the extent that would result in a significant negative effect on biodiversity values.

The potential for these operational impacts will be further minimised through the implementation of appropriate mitigation measures as outlined in section 9 below.

8.4 Cumulative impacts

The study area is located within central Sydney, and an extensive and complex road and rail network, and residential and industrial/commercial areas dominate the area.

The project would involve the removal of small patches of already highly fragmented, predominantly planted, vegetation. Other local rail projects such as the Chatswood to Sydenham metro project and Sydenham to Bankstown metro project would similarly affect small patches of fragmented habitat in highly modified urban areas (GHD 2017, Arcadis 2016), however these are not in close proximity to the project. Road projects such as the proposed Sydney Gateway road project, as well as the WestConnex New M5 and future M4–M5 Link would also result in the removal of mainly planted vegetation and associated fauna habitats. Losses in biodiversity from these projects and developments are also likely to be restricted in area, given their location in a highly modified environment. Together these projects and other developments would result in the further loss of habitat from an already modified environment with only limited natural biodiversity values.

8.5 Key threatening processes

A key threatening process (KTP) is as an action, activity or project that:

- adversely affects two or more threatened species, populations or ecological communities
- could cause species, populations or ecological communities that are not currently threatened to become threatened.

KTPs listed under the BC Act, FM Act and EPBC Act relevant to this project are listed in Table 8.5 below. Construction of the project would involve KTPs, including clearing of native vegetation, removal of dead wood and dead trees, and human-induced climate change. The latter KTP would continue to occur under operation of the project. The project is not a KTP in its entirety. Mitigation measures to limit the impacts of these KTPs (where possible) are discussed in section 9.

Table 8.5 Key threatening processes

KTP	Status	Comment
Clearing of native vegetation	BC Act EPBC Act	The project includes the clearing of less than one hectare of native vegetation. This minor reduction in extent is highly unlikely to affect the viability of remnant vegetation in the project site or locality or reduce the extent of habitat below a minimum size required for any fauna species.
Removal of hollows	BC Act	No mature trees with obvious large hollows would be removed.
Removal of dead wood and dead trees	BC Act	The project site contains very little fallen timber and dead trees. The project may result in the removal or disturbance to those small amounts that do occur within the project site, during construction of the project.
The degradation of native riparian vegetation along NSW water courses	FM Act	The project would remove small areas of native vegetation and planted and exotic vegetation from adjacent to Mill Stream and has the potential to introduce sediments and pollutants during construction and operation. Mill Stream is already a highly modified water course in a predominantly urban environment.
Human-caused climate change	BC Act EPBC Act	Combustion of fuels associated with construction of the project would contribute to anthropogenic emissions of greenhouse gases. The project does not pass through any areas mapped as coastal corridors for climate change that provide for the latitudinal movement of species. The increase in greenhouse gases as a result of the project may impact climatic habitat elsewhere in NSW over the long-term.

8.6 Serious and irreversible impacts

No threatened ecological communities recorded within the study area have been determined to be Serious and Irreversible Impact entities (SAII) entities under the BC Act. Given this, the project is considered unlikely to lead to a serious and irreversible impact on any threatened ecological community.

No threatened species recorded within the study area have been determined to be SAII entities under the BC Act. There is no habitat present for any SAII entities. Given this, the project is considered unlikely to lead to a serious and irreversible impacts on any threatened species.

8.7 Prescribed biodiversity impacts

8.7.1 Areas of geological significance

No areas of geological significance are present. No caves for breeding by bats are present.

8.7.2 Human made structures and non-native vegetation

Human-made structures present in the project site and relevant to this study include rail bridges. A number of rail bridges are present along the alignment, including over Mill Stream at the Botany Wetlands. Rail bridges provide potential roosting habitat for threatened microchiropteran bats, such as the Eastern Bentwing Bat (recorded during surveys). The bridge over Mill Stream was observed at dusk for emerging microbats over four evenings. No bats were observed to leave the bridge and no other evidence of roosting bats (e.g. guano) was observed. On one of the evenings rain had been falling, and most crevices showed signs of water flow, reducing the potential for this bridge to be used as a roost site. It may be used as a temporary roost by bats in dry weather.

This bridge would not be removed for the project. A second bridge would be constructed immediately to the south of the existing bridge. Construction noise and vibration has the potential to impact microchiropteran bats if any happen to be roosting at the bridge during construction. Given the mobility of these species, individuals if present would likely relocate to alternate roosting habitat for this period.

Non-native vegetation provides minimal habitat for threatened species. Grey-headed Flying-foxes were observed foraging in planted Mulberry trees and Fig trees within the study area near Mill Stream. These resources would be a very small proportion of foraging habitat for the local roost camps. Grey-headed Flying-foxes would likely forage in these trees on occasion when fruiting or flowering. There is no breeding camp in the project site. Nearby breeding camps include those at Wolli Creek (3 kilometres to the west) and Centennial Park (5.5 kilometres to the north-east). Foraging habitat in the project site would be a negligible proportion of available foraging habitat used by individuals from these camps and thus would not be habitat critical to the survival of the species.

Microchiropteran bats such as the Eastern Bentwing Bat may forage above non-native vegetation on occasion. The area to be removed as a result of the project would be a negligible proportion of the foraging habitat for this species in the locality.

8.7.3 Connectivity and movement

Habitat fragmentation through the clearing of vegetation can increase the isolation of remnant vegetation and create barriers to the movements of small and sedentary fauna such as ground dwelling mammals, reptiles and amphibians. Furthermore, habitat fragmentation can create barriers to the movement of pollinator vectors, such as insects, or seed vectors, such as birds, and consequently affect the life cycle of both common and threatened flora.

There will be minimal impact on connectivity and movement corridors as a result of the project. Species that require larger tracts of connected vegetation would not occur as habitat exists only as highly fragment patches with thin connections along rail corridor and roads. The main habitat corridor is associated with Botany Wetland and Mill Stream. A second bridge will be constructed over Mill Stream, resulting in the loss of a small area of generally modified and disturbed riparian vegetation. There would be no impact on aquatic connectivity or fish passage.

The project would require the removal of vegetation and habitat and would create or increase small gaps in habitat that are the width of the project site. The vegetation within the study area is currently fragmented by the existing rail corridor, roads and urban development. It is unlikely that the project would create an additional barrier to the movement of pollinator and seed dispersal vectors, such as insects and birds.

Vegetation in the project site comprises scattered linear fragments that together with trees in adjacent urban areas provide ‘stepping stones’ of habitat between larger areas of vegetation for mobile species such as bats and birds. Removal of these linear patches from within the rail corridor would reduce the availability of these stepping stones to a small degree.

8.7.4 Hydrology

During construction, there is the potential to impact Mill Stream and the associated Botany Wetlands during construction of the Mill Stream Bridge. Physical impacts include increasing sedimentation to waterways, increasing turbidity and changing bed and bank conditions through construction and scour. Riparian vegetation would be removed for construction of the bridge and compound site.

Ongoing detailed design would aim to minimise changes to flow regimes and potential operational scour and erosion at Mill Stream. Impacts to the geomorphology of the waterways are minor and short term and considered manageable with appropriate mitigation measures. There would be no blockage of fish passage and no removal of snags as a result of the project. No groundwater extraction or dewatering is anticipated for the project.

Standard construction management and mitigation strategies (as recommended in the Blue Book and widely adopted across the construction industry) to minimise sediment disturbance, mobilisation and runoff are recommended to be adopted during construction. Revegetation would be conducted to rehabilitate disturbed riparian areas along Mill Stream (see Section 9).

8.7.5 Vehicle strike

The project is located in a busy industrial area within Sydney, subject to high levels of vehicular traffic. Regular movements of freight trains currently occur along the Botany Line. The project will increase the number of train movements per day. This would increase the risk of fauna mortality or injury as a result of train-strike. Use of vehicles and plant during construction also increase the risk of fauna mortality in areas adjacent to the rail corridor. Few terrestrial fauna species occur in the project site that are at risk of train or vehicle strike. The increased risk of train strike is unlikely to have a substantial impact on any local populations of fauna species.

8.8 Impacts on Matters of National Environmental Significance (including Commonwealth land)

A summary of impacts on MNES is provided in Table 8.6. Given the general lack of habitat present and small area of vegetation to be removed, the project is unlikely to result in a significant impact on any MNES. An assessment of significance has been prepared for the Green and Golden Bell Frog given the historic records of the species in the area.

Table 8.6 Impacts on MNES

MNES	Impact
Threatened ecological communities	No threatened ecological communities listed under the EPBC Act have been determined to be affected by the project.
Threatened flora species	No threatened flora species listed under the EPBC Act have been determined to be affected by the project.
Threatened fauna species	The project would result in the loss of 2.38 hectares of foraging habitat for the Grey-headed Flying-fox. The project is unlikely to impact any habitat for an extant population of the Green and Golden Bell Frog. No other threatened fauna species listed under the EPBC Act are likely to rely on habitats present in the project site.
Migratory fauna species	The project would remove 0.1 ha of Coastal Freshwater Wetland habitat that is marginal potential habitat for migratory waders and 0.62 ha of forested vegetation that may provide habitat for migratory woodland bird species. This habitat is not considered important habitat for any species. An ecologically significant proportion of a migratory species would not occur at the site. The project is highly unlikely to impact Towra Point Nature Reserve, which provides important habitat for migratory waders, given its location over 6.5 kilometres from the project site.
Wetlands of National Significance	The project is highly unlikely to impact Towra Point Ramsar site, given its location over 6.5 kilometres from the project site.
Commonwealth land	Limited areas of Commonwealth Land intersect with the project site. These are predominantly cleared hardstand, although occasional planted shrubs or trees and weeds are present (totalling 0.1 hectares). The majority of the vegetation to be removed in Commonwealth land for the project is not native vegetation. The removal of a small area of planted and exotic vegetation would remove limited habitat for some common flora and fauna species typical of urban and industrial areas. There would be no direct impacts on the Sydney Airport Wetlands. Construction at Mill Stream has the potential to result in downstream impacts on Mill Pond and other downstream areas. An assessment of the likely significance of effects on plants and animals (as a component of the environment of Commonwealth land) pursuant to the Significant impact guidelines 1.2 for actions on Commonwealth land (DSEWPC 2013) has been prepared and is attached at Appendix F. The conclusion of this assessment is that the project would not have a significant impact on plants and animals within Commonwealth land given the highly modified nature of the existing environment and the small magnitude and extent of effects on plants and animals. Significant Impact Guideline 1.2 also requires an assessment of effects on other matters (e.g. heritage, water, soil, people etc.) that are not covered in this report.

9. Management of impacts

9.1 Approach

In order to address the potential impacts of the project on biodiversity values as discussed in Section 8, the recommended mitigation measures outlined in Section 9.2. In accordance with 3.2(f) of the SEARs, these detail how likely impacts that have not been avoided through design will be minimised, and the predicted effectiveness of these measures.

Mitigation measures would be managed through the following:

- ARTC's Site environmental management plans (EMP(s) for enabling works
- project specific CEMP for main construction works
- community and stakeholder engagement plan
- ARTC's environmental management system for operation of the project.

9.2 List of mitigation measures

The following mitigation measures are recommended to address potential biodiversity impacts are listed in Table 9.1 and will be incorporated into the relevant management plans.

Medium- predicted effectiveness of risk is based on administrative mitigation measures which minimise but may not entirely eliminate the risk. High- predicted effectiveness of risk is based on physical mitigation measures which would largely eliminate the risk.

Table 9.1 Mitigation measures

Stage	Impact	Measure	Predicted effectiveness
Construction	General	The project environmental induction will include information on the ecological values of the study area, protection measures to be implemented to protect biodiversity and penalties for breaches.	Medium – communication of environmental values and responsibilities to construction staff is likely to ensure that mitigation measures are implemented. Measures will meet best practice for management of construction projects. Medium – the flora and fauna management plan will be prepared by a qualified and experienced professional.

Stage	Impact	Measure	Predicted effectiveness
	Impact to flora and fauna during vegetation clearance	A trained ecologist will undertake pre-clearing surveys and be present during the clearing of native vegetation or removal of potential fauna habitat during construction where necessary, to avoid impacts on resident fauna as far as is practicable. Pre-clearing surveys will include: ■ inspections of native vegetation for resident fauna and/or nests or other signs of fauna occupancy ■ inspections of bridges for roosting bats ■ pre-clearing surveys for the Green and Golden Bell Frog at Mill Stream as a precaution ■ capture and relocation or captive rearing of less mobile fauna (such as nestling birds) by a trained fauna handler and with assistance from Wildlife Information Rescue and Education Service (WIRES) as required.	High – measures will meet best practice management of fauna on construction projects.
	Vegetation clearing	Disturbance of vegetation will be limited to the minimum necessary to construct works. The contractor will design the layout of the work areas to locate infrastructure, where practicable, to previously cleared areas or areas of exotic vegetation to minimise or avoid impacts on native vegetation (and particularly EECs). Where the project site adjoins native vegetation, the limits of clearing will be marked and temporary fencing installed around the vegetated area prior to the commencement of construction activities to avoid unnecessary vegetation and habitat removal. Restrict equipment storage and stockpiling of resources to designated areas in cleared land.	High – exclusion areas will be established and maintained around vegetation adjoining the project site. The need to avoid impacts will be communicated to all construction staff. Measures will meet best practice management of flora and fauna on construction projects.
	Additional clearing	If additional vegetation is identified to be impacted, an ecologist will undertake further assessment for impact and the need for offsetting in accordance with the legislation, prior to clearing.	Medium – measures will meet best practice management of biodiversity on construction projects.
	Spread of chytrid fungus	Protocols to prevent introduction or spread of chytrid fungus will be detailed in the relevant management plan and implemented following the DPIE Hygiene protocol for the control of disease in frogs (DECC, 2008b).	Medium – measures will meet best practice management of fauna on construction projects.
	Reduction in water quality and impact to aquatic habitats	Standard construction management and mitigation measures will be detailed in the relevant management plan (as recommended in the Blue Book and widely adopted across the construction industry) and implemented to minimise sediment disturbance, mobilisation and runoff.	Medium to high – measures will meet best practice management of water quality on construction projects.

Stage	Impact	Measure	Predicted effectiveness
	Increase in weeds	Management and disposal of the weeds, including the priority weeds listed in section 5.4, will be conducted in accordance with the *Biosecurity Act 2015* and the *New South Wales Weed Control Handbook* (DPI 2018). Vehicles and other equipment to be used within the rail corridor will be cleaned to minimise seeds and plant material entering the study area to prevent the introduction of further exotic plant species or disease.	Medium to high – measures will meet best practice management of weeds on construction projects.
	Reinstatement of vegetation	Revegetation of riparian areas along Mill Stream, Mill Pond and New Pond following construction will be undertaken by a bush regeneration contractor. Disturbed areas will be stabilised as soon as possible following construction and locally endemic species typical of Swamp Oak swamp forest and Coastal freshwater wetlands would be used to revegetate these disturbed riparian areas.	Medium to high – measures will meet best practice management of vegetation on construction projects.
Operation	Increase in weeds	ARTC's Assessment Management System (under the Safety Management System) includes provision for regular weed management and ARTC's Environmental Management System provides procedures for weed management and pesticide use. Ongoing weed management throughout the rail corridor would be undertaken in accordance with ARTC's procedures, as well as relevant legislation such as the Biosecurity Act 2015.	Medium to high – measures will meet best practice management of weeds.

10. Offset requirements

10.1 BC Act – Offset for affected threatened biota

Biodiversity offsetting for residual impacts on BC Act biodiversity values is mandatory for SSI developments being assessed under Part 7 of the Act and subject to a BDAR. Biodiversity offset obligations have been determined using the BAM calculator. The required ecosystem and species credit obligations based on the current design are outlined below.

10.1.1 Ecosystem credits

The required ecosystem credits, as determined using the BAM calculator, for the project are provided in Table 10.1.

Table 10.1 Ecosystem credits required to offset project impacts

Plant community type (PCT)	Threatened ecological community	Area impacted (ha)	Ecosystem credit obligation
PCT 1071 *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.10	3
PCT 1234 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.62	8
Total		**0.72**	**11**

10.1.2 Species credits

No species credit obligations were deemed warranted for this project.

10.1.3 Offsetting strategy

The biodiversity offset strategy for this project, that will enable the credit obligations to be met, comprises two options. These options are, the purchase and retirement of existing biodiversity credits currently available on the biodiversity credit register or through making a payment into the Biodiversity Conservation Fund.

Existing biodiversity credits

The purchase and retirement of existing biodiversity credits is required to be undertaken based on like for like trading rules as outlined under the *Biodiversity Conservation Regulation 2017* and as identified by the BAM calculator output for the project. The like for like ecosystem credit class options for each ecosystem credit obligation is summarised in Table 10.2.

Table 10.2 Like for like trading credit classes

Credit class PCT	Any PCT with the below TEC	Containing HBT[1]	In the below IBRA subregions
PCT 1071 *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (including PCT's 780, 781, 782, 828, 1071, 1735, 1736, 1737, 1738, 1739, 1740, 1741, 1742, 1911).	No	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA sub region that is within 100 kilometres of the outer edge of the impacted site.
PCT 1234 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (including PCT's 915, 916, 917, 918, 919, 1125, 1230, 1232, 1234, 1235, 1236, 1726, 1727, 1728, 1729, 1731, 1800, 1808).	No	Pittwater, Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA sub region that is within 100 kilometres of the outer edge of the impacted site.

Source: Like for like trading credit classes as per the BAM credit report (Appendix F)
(1) HBT: hollow bearing tree

Payment into the Biodiversity Conservation Fund

Payments for the project offset obligations could be paid into the Biodiversity Conservation Fund as outlined in Table 10.3.

It should be noted that payment for offsets are subject to change and that credit payment prices are reviewed quarterly. The payment amounts presented within this report were calculated and valid as of 31 May 2019.

Table 10.3 Estimated biodiversity offset credit payment price

Credit class	Price per credit	Number of credits required	Final credit price
PCT 1071 Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	$2,499.32	3	$7,497.95
PCT 1234 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	$1,494.19	8	$11,953.55
		Subtotal (excl. GST)	$19,451.50
		GST	$1,945.15
		Total	**$21,396.65**

10.2 EPBC Act – Offset for affected threatened biota

Under the EPBC Act Environmental Offsets Policy (DSEWPaC, 2012) biodiversity offsets are required to compensate for significant residual effects on MNES. This BDAR includes the identification and assessment of potentially affected MNES, including an assessment of the likely significance of effects on the Grey-headed Flying-fox pursuant to the EPBC Act significant impact guidelines 1.1 (DotE, 2013). The outcome of these assessments of significance is that the project would not be likely to result in a significant impact on the Grey-headed Flying-fox or on any other MNES. The project is unlikely to impact Towra Point Ramsar site as it is located about 6.5 kilometres away on the southern side of Botany Bay. No biodiversity offsets for effects on MNES are therefore required in accordance with the EPBC Act Environmental Offsets Policy.

11. Conclusion

This BDAR has been prepared to address the project SEARs. The BDAR has been prepared by accredited BAM assessors in accordance with the BAM to describe the biodiversity values present at the project site, outline the approach to avoiding or minimising impacts, assess residual impacts of the project and determine the need or otherwise for biodiversity offsets.

The project site has been cleared historically and is highly modified. It predominantly comprises industrial areas dominated by roads and hardstand. Native vegetation occurs in areas associated with the Botany Wetlands at Mill Stream. Two native vegetation PCTs occur in the project site:

- PCT 1071 *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion. This PCT is commensurate with Freshwater Wetland on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions listed as an EEC under the BC Act.
- PCT 1234 Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion. This PCT is commensurate with Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions listed as an EEC under the BC Act. No patches meet the condition criteria for the threatened Swamp Oak ecological community listed under the EPBC Act.

No threatened flora species occur in the project site or would be impacted by the project. No candidate species credit fauna species were recorded during surveys, and none are considered likely to be affected by the project. Two threatened fauna species were recorded, the Eastern Bentwing-bat and Grey-headed Flying-fox. Both species are ecosystem credit species for this project as no breeding habitat is present. Potential effects on foraging habitat for these species in the project site would be offset through the provision of ecosystem credits. No SAII entities would be affected by the project.

The project crosses the Botany Wetlands and construction has the potential to impact Mill Stream and the wetlands through removal of riparian vegetation and introduction of sediments and pollutants. There would be no blockage of fish passage as a result of the project, and no threatened aquatic species would be impacted. The project will not have any direct impact on mapped Coastal Wetlands, but the proximity area for the wetland north of Mill Pond Drive is crossed by the project. The project has been designed to avoid disturbance of contaminated sediment in the project site where possible and mitigation measures to prevent adverse effects on water quality within and downstream of the project site during construction and operation will be implemented.

No Groundwater Dependent Ecosystems are present in the project site or would be affected by the project.

The project has adopted the ‘avoid, minimise and offset’ approach to mitigate impacts to biodiversity values in accordance with the BAM, the BC Act and associated policy. The project has been purposefully designed to avoid or minimise effects on biodiversity values as far as is practicable, including through the location of compound sites in already disturbed areas where possible. Mitigation measures will be implemented to further minimise effects on biodiversity values of the project site.

Despite measures taken to avoid and mitigate impacts, the project would result in some unavoidable residual adverse impacts imposed upon some elements of the natural environment. In total, the project would remove about 0.72 hectares of native vegetation, comprising 0.62 hectares of PCT 1234 Swamp Oak floodplain swamp forest and 0.10 hectares of PCT 1071 *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands.

The project would remove a very small proportion of available habitat resources for local populations of native fauna. Impacts would include the removal of up to 5.34 hectares of patchily distributed potential foraging habitat for mobile threatened fauna species, including the Grey-headed Flying-fox and microbats. The site is unlikely to contain any important breeding, roosting or nesting habitat for native fauna.

Biodiversity offsetting for residual effects on BC Act biodiversity values is mandatory for SSI developments being assessed under Part 7 of the Act and subject to a BDAR. Biodiversity offset obligations have been determined using the BAM calculator as follows:

- Three ecosystem credits are required for PCT 1071 *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands.
- Eight ecosystem credits are required for PCT 1234 Swamp Oak floodplain swamp forest.
- No species credits are required.

The project offset obligations could be met by paying into the Biodiversity Conservation Fund or through purchase and retirement of existing biodiversity credits on a like for like basis.

The desktop assessment, field surveys and habitat assessments undertaken for this biodiversity assessment report have been used to identify MNES listed under the EPBC Act that may be affected by the project, through either direct or indirect impacts. The project will not affect any important habitat for migratory birds and hence will not have a significant impact on these species. Similarly, there will not be any adverse effects on Towra Point Ramsar site which is located over 6 kilometres from the project site. The project would result in the removal of a small area of foraging habitat (1.89 hectares of patchily distributed planted trees) for the Grey-headed Flying-fox. The population of the Green and Golden Bell Frog that previously occurred at Botany Wetland is considered to no longer be present. The project would not result in any significant effects on any threatened biota listed under the EPBC Act and so there is no requirement for biodiversity offsets under the EPBC Act and associated policy (DSEWPaC, 2012).

An assessment of the likely significance of effects on plants and animals (as a component of the environment of Commonwealth land) pursuant to the Significant impact guidelines 1.2 for actions on Commonwealth land (DSEWPC 2013) has concluded that the project would not have a significant impact on plants and animals within Commonwealth land given the highly modified nature of the existing environment and the small magnitude and extent of effects on plants and animals.

While no significant impacts on MNES are likely, the project will be referred to the Commonwealth Minister for the Environment to provide certainty.

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Appendix A

Likelihood of occurrence of threatened and migratory biota

A1. Likelihood of occurrence of threatened flora

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Acacia bynoeana	Bynoe's Wattle	E	V	This species occurs in heath or dry sclerophyll forest on sandy soils and is generally associated with overstorey species such as Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksias and Narrow-leaved Apple.	EPBC Act Protected matters search	Low This species has not been recorded within the locality. The study area does not contain associated habitat attributes such as vegetation formation, floristic assemblage or geological substrate. The occurrence of *Acacia bynoeana* within the study area is considered unlikely.
Acacia pubescens	Downy Wattle	V	V	Restricted to the Sydney Region from Bilpin to the Georges River and also at Woodford where it usually grows in open sclerophyll forest and woodland on clay soils. Typically, it occurs at the intergrade between shales and sandstones in gravely soils often with ironstones.	EPBC Act Protected matters search	Low This species has not been recorded within the locality. The study area does not contain associated habitat attributes such as vegetation formation, floristic assemblage or geological substrate. The occurrence of *Acacia pubescens* within the study area is considered unlikely.
Acacia terminalis subsp. *terminalis*	Sunshine Wattle	E	E	This species is associated with coastal scrub and dry sclerophyll woodland on sandy soils.	BioNet, PlantNET, Atlas of living Australia	Low There are 46 known records of this species within the locality (OEH 2018). The recorded vegetation types within the study area (PCT1071 & PCT 1234) are not known to be associated with this species. The occurrence of *Acacia terminalis* subsp. *terminalis* within the study area is considered unlikely.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Allocasuarina glareicola	Allocasuarina glareicola	E	E	Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. Grows on lateritic soil in open forest.	EPBC Act Protected matters search	Low This species has not been recorded within the locality. The study area does not contain associated habitat attributes such as vegetation formation, floristic assemblage or geological substrate. The occurrence of *Allocasuarina glareicola* within the study area is considered unlikely.
Ancistrachne maidenii	Ancistrachne maidenii	V	–	Grows on sandstone derived soils. Thought to have specific habitat requirements, with populations occurring in distinct bands in areas associated with a transitional geology between Hawkesbury and Watagan soil landscapes.	BAM Calculator	Low There are no known records of this species in the locality. The study area does not contain specific geological habitat and no individuals were observed within native vegetation patches (PCT 1234) during targeted surveys. Based on the lack of recent records and absence of suitable habitat, the occurrence of *Ancistrachne maidenii* within the study area is considered highly unlikely.
Caladenia tessellata	Thick Lip Spider Orchid	E	V	Occurs south of Swansea where it grows on clay loam or sandy soils. Prefers low open forest with a heathy or sometimes grassy understorey. Within NSW, currently known from two distinct areas; one population near Braidwood on the Southern Tablelands and three populations in the Wyong area on the Central Coast. Previously known also from Sydney and South Coast areas.	BioNet	Low Two historic records of this species occur within the locality. These records exceed 100 years in date and are located within highly urbanised areas of Marrickville South and Tempe. The local occurrence of this species is considered to no longer be present. In addition, the recorded vegetation types within the study area (PCT1071 & PCT 1234) are not known to be associated with this species. Based on the lack of recent records and absence of suitable habitat, the occurrence of *Caladenia tessellata* within the study area is considered highly unlikely.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Callistemon linearifolius	Netted Bottle Brush	V	–	This species is associated with dry sclerophyll forest on the coast and adjacent ranges.	BioNet, PlantNET, Atlas of living Australia	Low There are 3 known records of this species within the locality (OEH 2018). These records occur to the east of the study area at Phillip Bay and La Perouse. The recorded vegetation types within the study area (PCT1071 & PCT 1234) are not known to be associated with this species. The occurrence of *Callistemon linearifolius* within the study area is considered unlikely.
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	Occurs south from the Gibraltar Range, chiefly in coastal districts but also extends on to tablelands. Grows in swamp-heath and drier forest on sandy soils on granite & sandstone. Occurs in small, localised colonies most often on the flat plains close to the coast but also known from some mountainous areas growing in moist depressions and swampy habitats.	EPBC Act Protected matters search, BAM candidate species report	Low This species has not been recorded within the locality. Within the study area, marginal potential habitat occurs in the form of PCT 1234. This vegetation type has been recorded in poor and low condition with both classes exhibiting an understorey that has been highly disturbed, has low native species richness / cover and is dominated by transformer exotic weed cover. Based on the lack of any records in the locality and the generally unfavourable understorey habitat conditions, the occurrence of *Cryptostylis hunteriana* within the study area is considered unlikely.
Dichanthium setosum	Bluegrass	V	V	This species is associated with heavy basaltic black soils and red-brown loams with clay in the New England Tablelands, North West Slopes and the Central West Slopes of NSW.	PlantNET, Atlas of living Australia	Low Three historic records (1913) of this species occur in the central Sydney area, in the vicinity of Darlinghurst. The accuracy of these records is unclear however the study area is well outside the known distribution for this species and lacks the associated soils for this species. The occurrence of *Dichanthium setosum* within the study area is considered highly unlikely.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Dillwynia tenuifolia	Dillwynia tenuifolia	V		Occurs on the Cumberland Plain from the Blue Mountains to Howes Valley area where it grows in dry sclerophyll woodland on sandstone, shale or laterite. Specifically, occurs within Castlereagh woodlands, particularly in shale gravel transition forest. Associated species include *Eucalyptus fibrosa*, *E. sclerophylla*, Melaleuca decora, *Daviesia ulicifolia*, *Dillwynia juniperina* and *Allocasuarina littoralis*.	PlantNET	Low This species has not been recorded within the locality. The study area does not contain associated habitat attributes such as vegetation formation, floristic assemblage or geological substrate. The occurrence of *Dillwynia tenuifolia* within the study area is considered unlikely.
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	Occurs from Niangala to Glenn Innes where it grows in grassy sclerophyll woodland on shallow relatively infertile soils on shales and slates, mainly on granite. Endemic on the NSW Northern Tablelands, of limited occurrence, particularly in the area from Walcha to Glen Innes; often on porphyry or granite (OEH 2018).	BioNet	Low This species is non-endemic within the Sydney Basin Bioregion. The species is widely cultivated in the horticultural industry and has been commonly planted for landscape purpose. The natural occurrence of *Eucalyptus nicholii* within the study area is considered highly unlikely.
Eucalyptus scoparia	Wallangarra White Gum	E	V	Occurs in Queensland and reaches its southern limit in NSW. In NSW, it is known from three locations all near Tenterfield in the far northern New England Tableland Bioregion where it grows on well drained granitic hilltops, slopes and outcrops, often as scattered trees in open forest and woodland (OEH 2018).	BioNet	Low This species is non-endemic within the Sydney Basin Bioregion. The species is widely cultivated in the horticultural industry and has been commonly planted for landscape purpose. The natural occurrence of *Eucalyptus scoparia* within the study area is considered highly unlikely.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Genoplesium baueri	Yellow Gnat-orchid		E	Grows in dry sclerophyll forest and moss gardens over sandstone. The species has been recorded from locations between Ulladulla and Port Stephens (OEH 2018).	EPBC Act Protected matters search	Low This species has not been recorded within the locality. The study area does not contain associated habitat attributes such as vegetation formation, floristic assemblage or geological substrate. The occurrence of *Genoplesium baueri* within the study area is considered unlikely.
Hibbertia puberula	Hibbertia puberula	E	–	Recent work on this species and its relatives have shown it to be widespread, but never common. It extends from Wollemi National Park south to Morton National Park and the south coast near Nowra. Early records of this species are from the Hawkesbury River area and Frenchs Forest in northern Sydney, South Coogee in eastern Sydney, the Hacking River area in southern Sydney, and the Blue Mountains. It favours low heath on sandy soils or rarely in clay, with or without rocks.	BioNet	Low The study area does not contain associated habitat attributes such as vegetation formation, floristic assemblage or geological substrate. Further, the recorded vegetation types within the study area (PCT1071 & PCT 1234) are not known to be associated with this species. No wiry sub-shrub Hibbertia specimens were recorded during targeted surveys. The occurrence of *Hibbertia puberula* within the study area is considered unlikely.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Maundia triglochinoides	Maundia triglochinoides	V	–	*Maundia triglochiniodes* is currently known to occur north from the Wyong region on the Central Coast with most populations occurring within the North Coast Bioregion. Historic records occur from the Sydney region although the species is generally considered to no longer be present within this area. The Sydney records were all from the early 1900's with the localities recorded as Kogarah Swamp, Rockdale and Sans Souci (Atlas of Living Australia 2018). *Maundia triglochiniodes* is known to grow in swamps, lagoons, dams, channels, creeks or shallow freshwater <60 cm deep on heavy clays with low nutrients.	Atlas of Living Australia	Low Based on the lack of any records of this species in the last 100 years within the locality and given the highly disturbed nature of the study area, it is considered the likelihood of occurrence of this species is low.
Melaleuca biconvexa	Biconvex Paperbark	V	V	Occurs as disjunct populations in coastal New South Wales from Jervis Bay to Port Macquarie, with the main concentration of records is in the Gosford/Wyong area. Grows in damp places, often near streams, or low-lying areas on alluvial soils of low slopes or sheltered aspects.	EPBC Act Protected matters search	Low This species has not been recorded within the locality. The study area provides marginal habitat in the form of PCT 1234. *Melaleuca biconvexa* is readily identifiable based of leaf morphology. No individuals of this species were recorded during targeted surveys. The occurrence *Melaleuca biconvexa* within the study area is considered unlikely.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Melaleuca deanei	Deane's Paperbark	V	V	Occurs in two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas respectively. There are also more isolated occurrences at Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas. The species occurs mostly in ridgetop woodland, with only 5% of sites in heath on sandstone.	BioNet, PlantNET	Low There are only historic records of this species within the locality. The study area does not contain associated habitat attributes such as vegetation formation, floristic assemblage or geological substrate. Further, the recorded vegetation types within the study area (PCT1071 & PCT 1234) are not known to be associated with this species. The occurrence of *Melaleuca deanei* within the study area is considered unlikely.
Pelargonium sp. Striatellum	Omeo Stork's-bill	E	E	Known from only 4 locations in NSW, with three on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. The only other known population is at Lake Omeo, Victoria. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities. It occurs on sandy soils or gravelly soils or amongst rocks.	EPBC Act Protected matters search	Low This species has not been recorded within the locality. The study area does not contain associated habitat attributes such as vegetation formation, floristic assemblage or geological substrate. Further, the recorded vegetation types within the study area (PCT1071 & PCT 1234) are not known to be associated with this species. The occurrence of *Pelargonium* sp. Striatellum within the study area is considered unlikely.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Persoonia hirsuta	Hairy Geebung	E	E	The species is distributed from Singleton in the north, along the east coast to Bargo in the south and the Blue Mountains to the west. It has a large area of occurrence, but occurs in small populations. Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone or very rarely on shale. Often occurs in areas with clay influence, in the ecotone between shale and sandstone.	BioNet, EPBC Act Protected matters search	Low There are only historic records of this species within the locality. The study area does not contain associated habitat attributes such as vegetation formation, floristic assemblage or geological substrate. Further, the recorded vegetation types within the study area (PCT1071 & PCT 1234) are not known to be associated with this species. The occurrence of *Persoonia hirsuta* within the study area is considered unlikely.
Pimelea curviflora var. *curviflora*	-	V	V	Confined to coastal areas around Sydney where it grows on sandstone and laterite soils. It is found between South Maroota, Cowan, Narrabeen, Allambie Heights, Northmead and Kellyville, but its former range extended south to the Parramatta River and Port Jackson region including Five Dock, Bellevue Hill and Manly. Usually occurs in woodland in the transition between shale and sandstone, often on Lucas Heights soil landscape.	EPBC Act Protected matters search	Low This species has not been recorded within the locality. The study area does not contain associated habitat attributes such as vegetation formation, floristic assemblage or geological substrate. Further, the recorded vegetation types within the study area (PCT1071 & PCT 1234) are not known to be associated with this species. The occurrence of *Pimelea curviflora* var. *curviflora* within the study area is considered unlikely.
Pimelea spicata	Spiked Rice-flower	E	E	This species occurs in two disjunct areas: in coastal districts from Lansdowne to Shellharbour, and in Cumberland Plain Woodland inland to Penrith. In western Sydney it grows on Wianamatta Shales in Greybox - Ironbark Woodland with Bursaria spinosa and Themeda australis. In the Illawarra, it occurs on well structured clay soils in grassland or open woodland.	EPBC Act Protected matters search	Low This species has not been recorded within the locality. The study area does not contain associated habitat attributes such as vegetation formation, floristic assemblage or geological substrate. Further, the recorded vegetation types within the study area (PCT1071 & PCT 1234) are not known to be associated with this species. The occurrence of *Pimelea spicata* within the study area is considered unlikely.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Pterostylis saxicola	Sydney Plains Greenhood	E	E	Known now only from Freemans Reach to Picton district. Grows in Sydney Sandstone Gully Forest in shallow or skeletal soils over sandstone shelves, often near streams.	EPBC Act Protected matters search	Low This species has not been recorded within the locality. The study area does not contain associated habitat attributes such as vegetation formation, floristic assemblage or geological substrate. Further, the recorded vegetation types within the study area (PCT1071 & PCT 1234) are not known to be associated with this species. The occurrence of *Pterostylis saxicola* within the study area is considered unlikely.
Pterostylis sp. Botany Bay	Botany Bay Bearded Greenhood	E	E	This species favours moist level sites on skeletal sandy soils derived from sandstone. It is associated with coastal heath vegetation dominated by *Melaleuca nodosa* and *Baeckea imbricata* (OEH 2018).	EPBC Act Protected matters search	Low This species has not been recorded within the locality. The study area does not contain associated habitat attributes such as vegetation formation, floristic assemblage or geological substrate. Further, the recorded vegetation types within the study area (PCT1071 & PCT 1234) are not known to be associated with this species. The occurrence of *Pterostylis* sp. Botany Bay within the study area is considered unlikely.
Senecio spathulatus	Coast Groundsel	E	–	Grows on frontal dunes and recorded from Nadgee Nature Reserve (Cape Howe) and between Kurnell in Sydney and Myall Lakes National Park (with a possible occurrence at Cudmirrah). In Victoria there are scattered populations from Wilsons Promontory to the NSW border.	BioNet	Low The study area does not contain associated habitat attributes such as vegetation formation, floristic assemblage or geological substrate. Further, the recorded vegetation types within the study area (PCT1071 & PCT 1234) are not known to be associated with this species. The occurrence of *Senecio spathulatus* within the study area is considered unlikely.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Syzygium paniculatum	Magenta Lilly Pilly	E	E	Occurs between Bulahdelah and St Georges Basin where it grows in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast, Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	BioNet, EPBC Act Protected matters search	Low The study area does not contain associated habitat attributes such as vegetation formation, floristic assemblage or geological substrate. Further, the recorded vegetation types within the study area (PCT1071 & PCT 1234) are not known to be associated with this species. The occurrence of *Syzygium paniculatum* within the study area is considered unlikely.
Tetratheca juncea	Black-eyed Susan	V	V	Historically recorded in the Sydney area although now confined to the local government areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock.	BioNet	Low Based on the lack of any records of this species in the last 100 years within the locality and given the highly disturbed nature of the study area, it is considered the likelihood of occurrence of this species is low.
Thesium australe	Austral Toadflax	V	V	Grows in grassland or woodland often in damp sites. It is a semi-parasitic herb and hosts are likely to be *Themeda triandra* (Syn. *Themeda australis* and *Poa* spp.	EPBC Act Protected matters search	Low This species has not been recorded within the locality. The study area does not contain associated habitat attributes such as vegetation formation, floristic assemblage or geological substrate. Further, the recorded vegetation types within the study area (PCT1071 & PCT 1234) are not known to be associated with this species. The occurrence of *Thesium australe* within the study area is considered unlikely.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Wilsonia backhousei	Narrow-leafed Wilsonia			The occurrence of this species within the broader Sydney region is mostly restricted discrete populations in the localities of Parramatta River at Ermington, Clovelly, Voyager Point and the Royal National Park Habitat associated with this species is generally restricted to the margins of salt marshes and lakes	BAM candidate species report	This species has not been recorded within the project locality. Potential habitat occurs in the form of PCT 1234. Within the study area, this vegetation type has been recorded in poor and low condition with both classes exhibiting an understorey that has been highly disturbed, have low native species richness / cover and are mostly dominated by transformer exotic weed cover. There are no seasonality issues associated with surveying for *Wilsonia backhousei* as the species is readily identifiable all year. Targeted surveys failed to identify any Individuals of this species and given the lack of any records in the locality and the generally unfavourable understorey habitat conditions, the occurrence of this species within the study area is considered unlikely.
Zannichellia palustris	Zannichellia palustris	E	–	Zannichellia palustris is a submerged aquatic plant that is only known from the lower Hunter and Sydney Olympic Park in NSW. The plant grows in fresh or slightly saline stationary or slowly flowing water. Zannichellia palustris flowers during the warmer months and completely dies back every summer.	BAM candidate species report	Low Based on the lack of any records of this species within the locality and given the highly disturbed nature of the study area, it is considered the likelihood of occurrence of this species is low.

A2. Likelihood of occurrence of threatened fauna

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Botaurus poiciloptilus	Australasian Bittern	E	E	Widespread but uncommon over most NSW except the northwest. Favours permanent freshwater wetlands with tall dense reedbeds particularly *Typha* spp. and *Eleocharis* spp., with adjacent shallow, open water for foraging. Roosts during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails.	BioNet, EPBC Act Protected matters search	High. Could occur at Botany Wetland. Negligible area of poor-quality habitat within the project site itself.
Sternula nereis	Australian Fairy Tern		V	Occurs along NSW coast. Inhabit offshore, estuarine or lake islands, wetlands, beaches and spits. Nests on coral shingle on continental islands or coral cays, on sandy islands and beaches inside estuaries and on open sandy beaches.	BioNet	Nil. No suitable sandy beach habitat present.
Rostratula australis	Australian Painted Snipe	E	E	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	BioNet, EPBC Act Protected matters search	High. Could occur at Botany Wetland. Negligible area of poor-quality habitat within the project site itself.
Ninox connivens	Barking Owl	V		Occurs from coast to inland slopes and plains, though is rare in dense, wet forests east of the Great Dividing Range and sparse in higher parts of the tablelands and in the arid zone. Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. Roosts along creek lines in dense, tall understorey foliage (e.g. in Acacia and Casuarina), or dense eucalypt canopy. Nests in hollows of large, old eucalypts. Birds and mammals important prey during breeding. Territories range from 30 to 200 hectares.	BioNet	Low. Few local records. Could forage on site on occasion. No breeding habitat present.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Esacus magnirostris	Beach Stone-curlew	CE		In NSW occurs regularly from the Manning River north, with occasional vagrants to South-east NSW and VIC. Inhabit a range of beaches, islands, reefs and in estuaries. Often seen near mangroves. Forage in the intertidal zone of beaches and estuaries, on islands, flats, banks and spits of sand, mud, gravel or rock, and among mangroves. Nests in shallow scrapes above the littoral zone, among low vegetation of grass, scattered shrubs or low trees; also among open mangroves or on sandbanks.	BioNet	Unlikely. No resident population known from the Sydney area.
Ixobrychus flavicollis	Black Bittern	V		Occurs from southern NSW to Cape York and the Kimberley, and southwest WA. Inhabits terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. May occur in flooded grassland, forest, woodland, rainforest and mangroves as long as there is permanent water. Roosts by day in trees or within reeds on the ground. Nests in branches overhanging water and breeds from December to March.	BioNet	High. Could occur at Botany Wetland. Negligible area of poor-quality habitat within the project site itself.
Ephippiorhynchus asiaticus	Black-necked Stork	E		In NSW, becomes increasingly uncommon south of the Northern Rivers region, and rarely occurs south of Sydney. Breeding recorded as far south as Buladelah, though most breeding in NSW occurs in the north-east. Primarily inhabits permanent freshwater wetlands and surrounding vegetation including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters. Will also forage in inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water. Breeds during summer, nesting in or near a freshwater swamp.	BioNet	Unlikely. No resident population known from the Sydney area.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Limosa	Black-tailed Godwit	V		The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the north and south coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed. It is usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. It has also been found around muddy lakes and swamps, wet fields and sewerage treatment works.	BioNet, EPBC Act Protected matters search	Low. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Known to occur at Towra Point Wetland.
Limicola falcinellus	Broad-billed Sandpiper	V		Breeds in the northern hemisphere. In the non-breeding season most common in north and north west of Australia, but is a regular visitor in small numbers to the NSW coast from Ballina to Shoalhaven Heads. Occurs on sheltered parts of the coast, favouring estuarine mudflats but also occasionally in saltmarshes, freshwater lagoons, saltworks and sewerage farms. Forage on exposed mudflats or wet sand.	BioNet, EPBC Act Protected matters search	Low. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Known to occur at Towra Point Wetland.
Climacteris picumnus victoriae	Brown Treecreeper	V		Occurs from Corowa, Wagga Wagga, Temora, Forbes, Dubbo and Inverell to the east coast, in areas such as the Snowy River Valley, Cumberland Plain, Hunter Valley and parts of the Richmond and Clarence Valleys. Most common on the inland slopes and plains. Inhabits eucalypt woodlands and dry open forest, usually dominated by stringybarks or rough-barked species with open grassy understorey. Fallen timber is important foraging habitat. Nests in hollows in standing trees or stumps.	BAM calculator	Nil. No suitable habitat present. No local records.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Burhinus grallarius	Bush Stone-curlew	E		Scattered distribution across NSW. Inhabits lowland grassy woodland and open forest and, in coastal areas, Casuarina and Melaleuca woodlands, saltmarsh and mangroves. Requires a low, sparse groundcover, some fallen timber and leaf litter, and a general lack of a shrubby understory. Bush Stone-curlews were formerly found in the fertile, shale-soiled areas of Sydney - the Cumberland Plain - but are now absent. There are occasional sightings in the inner Sydney area, including Timbrel Park at Five Dock (2008) and a banded individual in Ultimo (2011) that was transferred to Taronga Zoo. No resident populations are known from the study area or surrounds.	BioNet	Unlikely. No suitable potential habitat present. Only small areas of Swamp Oak Woodland present, with high incidence of weeds. No connected areas of woodland with sparse groundcover present. Project located in a highly industrial area. High incidence of feral predators present. No resident populations known. No evidence during spotlighting at Botany Wetland or call playback at Tempe.
Nettapus coromandelianus	Cotton Pygmy-goose		E	Although once found from north Queensland to the Hunter River in NSW, the Cotton Pygmy-Goose is now only a rare visitor to NSW and is uncommon in Queensland. Small surface-feeding duck with a goose-like bill. Prefers freshwater lakes, lagoons, swamps and dams, particularly those vegetated with waterlilies and other floating and submerged aquatic vegetation. Uses standing dead trees with hollows close to water for roosting and breeding.	BAM calculator	Unlikely. Rare visitor to NSW. Highly unlikely to rely on habitats within Botany Wetlands.
Calidris ferruginea	Curlew Sandpiper	E	CE	Breeds in northern hemisphere. In Australia generally occupies littoral and estuarine habitats. In NSW mainly found in intertidal mudflats on sheltered coasts. Roosts on beaches, spits or islands on the coast/in wetlands, or in saltmarsh on rocky shores. No mapped important areas in the study area or surrounds (i.e. not a candidate species for assessment).	BioNet, EPBC Act Protected matters search	Low. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Known to occur at Towra Point Wetland.
Stagonopleura guttata	Diamond Firetail	V		Typically found west of the Great Dividing Range, but populations also occur in drier coastal areas including W Sydney, Hunter, Clarence and Snowy River valleys. Occurs in grassy eucalypt woodlands including Box Gum and Snow Gum communities, as well as open forest, mallee and natural and derived grasslands. Often found in riparian areas and occasionally in lightly wooded farmland. Nests in shrubby understorey or higher up under nests of other species.	BioNet	Unlikely. Outside usual range. Few local records. Preferred woodland habitat not present.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Artamus cyanopterus	Dusky Woodswallow	V		The Dusky Woodswallow is widespread from the coast to inland, it is often recorded in woodlands and dry open sclerophyll forests, and has also been recorded in shrublands, heathlands regenerating forests and very occasionally in moist forests or rainforests. The understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, often with coarse woody debris. Individuals spend most of their time in about a 2 ha range and defend an area about 50 m around the nest. Dusky Woodswallows prefer larger remnants over smaller remnants. Competitive exclusion by Noisy Miners (*Manorina melanocephala*) is a significant threat to this species.	BioNet	Unlikely. Preferred woodland habitat not present.
Dasyornis brachypterus	Eastern Bristlebird	E	E	Occurs in three disjunct areas of south-eastern Australia: southern Queensland/northern NSW, the Illawarra Region and in the vicinity of the NSW/Victorian border. Habitat characterised by dense, low vegetation including heath and open woodland with a heathy understorey. The fire history of habitat is important, and the Illawarra and southern populations reach maximum densities in habitat that have not been burnt for over 15 years.	EPBC Act Protected matters search only	Nil. No suitable habitat present.
Numenius madagascariensis	Eastern Curlew		CE	Within Australia, the species has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. Breeds in Russia and north-eastern China. Most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes use the mangroves. The birds are also found in saltworks and sewage farms.	BioNet, EPBC Act Protected matters search	Low. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Known to occur at Towra Point Wetland.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Tyto longimembris	Eastern Grass Owl	V		Most common in N and NE Australia, but recorded in all mainland states. In NSW, most likely to be resident in the NE. Inhabit areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. Nests on the ground in trodden grass, and are often accessed by tunnels through vegetation.	BioNet	Nil. No suitable habitat. Local records are from Kurnell Peninsula.
Pezoporus wallicus	Eastern Ground Parrot	V		Occurs in high rainfall coastal and near coastal low heathlands and sedgelands, generally below one metre in height and very dense (up to 90% projected foliage cover). Ground Parrots can re-colonise burnt habitat after 1-2 years and reach maximum densities after 15-20 years without fire. Home ranges of adult birds is typically 10 ha and overlapping with other birds, while juveniles have a significantly larger home range. Ground Parrots feed mostly on seeds from a large range of plant species, which varies seasonally. eggs are laid in a shallow bowl of fine sticks and grass, well hidden under overhanging tall, coarse grass, sedge or low, heathy shrubs.	BioNet	Nil. No suitable heath habitat present. Outside usual range.
Pandion cristatus	Eastern Osprey	V		Favours coastal areas, especially the mouths of large rivers, lagoons and lakes. They feed on fish over clear, open water. Breeding takes place from July to September in NSW, with nests being built high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea, though there are a handful of records from inland areas.	BioNet	Possible. Would forage within Botany bay. Less likely to forage within freshwater habitats of Botany Wetlands. No raptor nests observed.
Pachyptila turtur subantarctica	Fairy Prion		V	The fairy prion (southern) breeds on Macquarie Island and a number of other subantarctic islands outside of Australia. The subspecies digs burrows among rocks or low vegetation in which to nest. Burrows may be dug below mat forming herbs. Fairy Prion feed by plucking food from the ocean surface. Some individuals may migrate towards New Zealand and southern Australia in winter.	EPBC Act Protected matters search only	Nil. No suitable habitat present.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Petroica phoenicea	Flame Robin	V		Breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. Migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains. Forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. Fallen logs and coarse woody debris are important habitat components. Open cup nest of plant fibres and cobweb is often built near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank.	BioNet	Unlikely. Preferred woodland habitat not present.
Stictonetta naevosa	Freckled Duck	V		Breeds in large, ephemeral swamps in the Murray-Darling, particularly along the Paroo and Lachlan Rivers and other Riverina rivers. In drier times moves to more permanent waters. Disperses during extensive inland droughts and may be found in coastal areas during such times. Prefers freshwater swamps/creeks with dense Cumbungi, Lignum or tea-tree. Nests in dense vegetation at or near water level.	BioNet	Low. Could occur on occasion at Botany Wetland. Outside usual range. Few local records.
Callocephalon fimbriatum	Gang-gang Cockatoo	V		Restricted to the south-eastern coast and highlands, from the lower Hunter and northern Blue Mountains to the Southwestern Slopes, south to and contiguous with the Victorian population. Inhabits eucalypt open forests and woodlands with an acacia understorey. In summer it lives in moist highland forest types, and in winter it moves to more open types at lower elevations. The Gang-Gang Cockatoo nests in hollows in the trunks, limbs or dead spouts of tall living trees, especially eucalypts, often near water. The Gang-gang Cockatoo feeds on seeds obtained in trees and shrubs, mostly from eucalypts and wattles.	BAM calculator	Low. No records in the locality. No breeding populations known from the inner Sydney area.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Callocephalon fimbriatum	Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas	V		Largely confined to area bounded by Thornleigh and Wahroonga in the north, Epping and North Epping in the south, Beecroft and Cheltenham in the west and Turramurra/ South Turramurra to the east.	BAM calculator	Nil. Not within distribution of the population
Calyptorhynchus lathami	Glossy Black-Cockatoo	V		Widespread but uncommon from coast to southern tablelands and central western plains. Feeds almost exclusively on the seeds of Allocasuarina species. Prefers woodland and open forests, rarely away from Allocasuarina. Roost in leafy canopy trees, preferably eucalypts, usually <1 km from feeding site. Nests in large (approx. 20 cm) hollows in trees, stumps or limbs, usually in Eucalypts (Higgins 1999).	BioNet	Low. Minimal suitable habitat present. No breeding habitat present.
Calidris tenuirostris	Great Knot	V	CE	Breeds in northern hemisphere. In Australia, prefers sheltered coastal habitats with large intertidal mud or sandflats, including inlets, bays, harbours, estuaries and lagoons. Occasionally found on exposed reefs or rock platforms, mangroves, saltwork ponds, near-coastal swamps, saltlakes and non-tidal lagoons. Rarely occurs on inland lakes and swamps. Roosts in large groups in open areas, often at the water's edge or in shallow water close to feeding areas.	BioNet, EPBC Act Protected matters search	Low. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Known to occur at Towra Point Wetland.
Charadrius leschenaultii	Greater Sand-plover	V	V	Does not breed in Australia. In NSW, recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Occurs mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; forage on wet ground at low tide.	BioNet, EPBC Act Protected matters search	Low. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Known to occur at Towra Point Wetland.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Thinornis rubricollis	Hooded Plover	CE	V	The Hooded Plover is endemic to southern Australia and is nowadays found mainly along the coast from south of Jervis Bay. In the late 1920s and early 1930s the species was recorded from Port Stephens but are now considered locally to no longer be present. It has not been seen in the Sydney area since the 1940s. Occasionally, individual birds are sighted slightly further north to the Shoalhaven River and Comerong Beach and one bird was sighted at Lake Illawarra in March 2001. Hooded Plovers prefer sandy ocean beaches backed by sparsely vegetated sand-dunes for shelter and nesting. Hooded Plovers display high nest site fidelity and nest solitarily. Occasionally Hooded Plovers are found on tidal bays and estuaries, rock platforms and rocky or sand-covered reefs near sandy beaches, and small beaches in lines of cliffs. They regularly use near-coastal saline and freshwater lakes and lagoons, often with saltmarsh.	BioNet	Low. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Known to occur at Towra Point Wetland.
Charadrius mongolus	Lesser Sand-plover	V	E	Does not breed in Australia. Found along the entire coast of Australia, most common in northern NSW, QLD and the Gulf of Carpentaria. Rarely recorded south of the Shoalhaven. In NSW almost entirely coastal, on beaches of sheltered bays, harbours and estuaries with large intertidal sand or mudflats, occasionally on sandy beaches, coral reefs and rock platforms.	BioNet, EPBC Act Protected matters search	Low. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Known to occur at Towra Point Wetland.
Hieraaetus morphnoides	Little Eagle	V		Occurs throughout NSW except most densely forested parts of the Dividing Range escarpment. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring.	BioNet	Unlikely. No breeding sites observed during appropriate survey months. May forage on occasion over the project site.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Glossopsitta pusilla	Little Lorikeet	V		Occurs from coast to western slopes of the Great Dividing Range. Inhabits dry, open eucalypt forests and woodlands. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Feed primarily on profusely-flowering eucalypts and a variety of other species including melaleucas and mistletoes. Mostly nests in small hollows in living, smooth-barked eucalypts. Most breeding records are from the western slopes.	BioNet	Unlikely. Suitable foraging or breeding habitat not present. May occur on occasion as transient individuals.
Sternula albifrons	Little Tern	E		In NSW occurs mainly north of Sydney, with smaller numbers south to VIC. Almost exclusively coastal, preferring sheltered environments; may occur several kilometres from the sea in harbours, inlets and rivers. Nests in low dunes or sandy beaches just above high tide mark near estuary mouths/ adjacent to coastal lakes and islands. Forage in shallow waters of estuaries, coastal lagoons and lakes, also along open coasts, less often at sea, and usually within 50 m of shore.	BioNet	Low. Could occur at Botany Wetland on rare occasions. Minimal habitat within the project site itself. Known to occur at Towra Point Wetland.
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V		Occupies habitat in arid semi-desert scrublands, savannahs and sparse woodlands, where there is fresh surface water and large hollow trees for nesting. These birds have been recorded in forest, woodland and shrub land, including mulga, mallee, Acacia, Eucalyptus and Callitris associations. It has also been recorded in cropping areas throughout its range. Large areas of suitable habitat are required for a viable population to exist.	BioNet	Unlikely. Outside usual distribution.
Tyto novaehollandiae	Masked Owl	V		Occurs across NSW except NW corner. Most common on the coast. Inhabits dry eucalypt woodlands from sea level to 1100 m. Roosts and breeds in large (>40 cm) hollows and sometime caves in moist eucalypt forested gullies. Hunts along the edges of forests and roadsides. Home range between 500 ha and 1000 ha. Prey mostly terrestrial mammals but arboreal species may also be taken.	BioNet	Possible. May forage in the project site on occasion. No breeding habitat present.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Limosa lapponica menzbieri	Northern Siberian Godwit		CE	Has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria, including the offshore islands. Breeds in the north of Scandinavia, Russia and north-west Alaska. Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	EPBC Act Protected matters search only	Low. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself.
Neophema chrysogaster	Orange-bellied Parrot	CE	CE	Breeds in Tasmania and migrates in winter to SE South Australia and southern Victoria. There are occasional reports from NSW, including Shellharbour, Maroubra and the Shoalhaven. In winter, usually found within 3 km of the coast in saltmarsh and strandline/ foredune vegetation. May also occur on golf-courses and other grassy areas, including improved pasture.	BioNet	Low. Could occur on rare occasions at Eastlakes Golf Course. No saltmarsh in the project site.
Grantiella picta	Painted Honeyeater	V	V	Nomadic, occurring in low densities across most of NSW. Highest concentrations and almost all breeding occur on inland slopes of the Great Dividing Range. Inhabits Boree, Brigalow and Box Gum woodlands and Box-Ironbark forests. Specialist forager on the fruits of mistletoes, preferably of the Amyema genus. Nests in outer tree canopy.	EPBC Act Protected matters search only	Nil. No suitable habitat present.
Haematopus longirostris	Pied Oystercatcher	E		Scattered along NSW coast. Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide. Nests mostly on coastal or estuarine beaches; occasionally saltmarsh or grassy areas.	BioNet	Low. Would occur around beaches and rock platforms of Botany Bay. Large breeding colony known to occur at Towra Point Wetland.
Ninox strenua	Powerful Owl	V		Occurs from the coast to the western slopes. Solitary and sedentary species. Inhabits a range of habitats from woodland and open sclerophyll forest to tall open wet forest and rainforest. Prefers large tracts of vegetation. Nests in large tree hollows (> 0.5 m deep), in large eucalypts (dbh 80–240 cm) that are at least 150 years old. Pairs have high fidelity to a small number of hollow-bearing nest trees and defend a large home range of 400–1,450 ha. Forages within open and closed woodlands as well as open areas.	BioNet	Possible. May forage in the project site on occasion. No breeding habitat present.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Calidris canutus	Red Knot		E	Breeds in northern hemisphere. Occurs in coastal areas around Australia, with important sites in VIC, SA, WA, NT and Qld. Mainly inhabits intertidal mudflats, sandflats and sandy beaches. Occasionally seen in terrestrial saline wetlands but rarely in freshwater wetlands. Forage in soft substrates in intertidal areas.	BioNet, EPBC Act Protected matters search	Low. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Known to occur at Towra Point Wetland.
Turnix maculosus	Red-backed Button-quail			Recorded infrequently in coastal and subcoastal regions of central and northern NSW. The population around Sydney was last recorded in 1912. Inhabit grasslands, open and savannah woodlands with grassy ground layer, pastures and crops of warm temperate areas.	BAM calculator	Nil. Highly unlikely to occur given lack of records in Sydney, and few recent records in NSW. No suitable habitat present.
Anthochaera phrygia	Regent Honeyeater	CE	CE	In NSW confined to two known breeding areas: the Capertee Valley and Bundarra-Barraba region. Non-breeding flocks occasionally seen in coastal areas foraging in flowering Spotted Gum and Swamp Mahogany forests, presumably in response to drought. Inhabits dry open forest and woodlands, particularly Box-Ironbark woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes.	BioNet, EPBC Act Protected matters search	Unlikely. No suitable foraging habitat present. Would not breed in the area.
Ptilinopus regina	Rose-crowned Fruit-Dove	V		Occurs from Newcastle north to Cape York, with vagrants occasionally as far south as Victoria. Occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. Thought to be locally nomadic in response to fruit availability.	BioNet	Nil. No suitable rainforest or moist eucalypt forest present.
Calidris alba	Sanderling	V		Sanderlings occur along the NSW coast, with occasional inland sightings. Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands. Roosts on bare sand, behind clumps of beach-cast kelp or in coastal dunes.	BioNet, EPBC Act Protected matters search	Low. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Known to occur at Towra Point Wetland.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Petroica boodang	Scarlet Robin	V		In NSW occurs from coast to inland slopes. Breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within open understorey of shrubs and grasses and sometimes in open areas. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. Abundant logs and coarse woody debris are important habitat components.	BioNet	Unlikely. Preferred woodland habitat not present.
Tyto tenebricosa	Sooty Owl	V		Occurs in the coastal, escarpment and tablelands regions of NSW. More common in the north and absent from the western tablelands and further west. Inhabits tall, moist eucalypt forests and rainforests, and are strongly associated with sheltered gullies, particularly those with tall rainforest understorey. Roosts in tree hollows, amongst dense foliage in gullies or in caves, recesses or ledges of cliffs or banks. Nest in large (>40 cm wide, 100 cm deep) tree hollows in unlogged/unburnt gullies within 100 m of streams or in caves.	BioNet	Unlikely. Suitable forested habitat not present.
Haematopus fuliginosus	Sooty Oystercatcher	V		Evenly distributed along NSW coast, including offshore islands. Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide. Breeds almost exclusively on offshore islands, and occasionally on isolated promontories.	BioNet	Nil. No suitable rocky shore or beach habitat present.
Onychoprion fuscata	Sooty Tern	V		Occurs over tropical and subtropical seas and islands around northern NSW. Occasionally seen along coastal NSW, especially after cyclones. Breeds in sand or coral scrapes on offshore islands and cays including Lord Howe and Norfolk Islands.	BioNet	Nil. No suitable beach habitat present.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Circus assimilis	Spotted Harrier	V		Occurs throughout Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Inhabits grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods). Most commonly in native grassland, but also in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn).	BioNet	Unlikely. No breeding sites observed during appropriate survey months. May forage on occasion over the project site.
Lophoictinia isura	Square-tailed Kite	V		Occurs across NSW, resident in North, northeast and along west-flowing rivers. Summer breeding migrant to southeast of state. Inhabits a variety of habitats including woodlands and open forests, with preference for timbered watercourses. Favours productive forests on the coastal plain, box-ironbark-gum woodlands on the inland slopes, and Coolibah/River Red Gum on the inland plains. In Sydney area nests in mature living trees within 100m of ephemeral/permanent watercourse. Large home range > 100 km^2.	BioNet	Unlikely. No breeding sites observed during appropriate survey months. May forage on occasion over the project site.
Ptilinopus superbus	Superb Fruit-Dove	V		Occurs mainly north from NE NSW, much less common further south and largely confined to pockets of habitat south to Moruya. Vagrants occur south to VIC and TAS. Inhabits rainforest and closed forests, may also forage in eucalypt or acacia woodland with fruit-bearing trees. Nests 5-30 m above ground in rainforest/rainforest edge tree and shrub species. Part of the population migratory/nomadic.	BioNet	Unlikely. No suitable closed forest present. May occur on a transient basis on rare occasions.
Lathamus discolor	Swift Parrot	E	CE	Migratory, travelling to the mainland from March to October. Breeds in Tasmania from September to January. On the mainland, it mostly occurs in the southeast foraging on winter flowering eucalypts and lerps, with records of the species between Adelaide and Brisbane. Principal over-winter habitat is box-ironbark communities on the inland slopes and plains. *Eucalyptus robusta, Corymbia maculata* and *C. gummifera* dominated coastal forests are also important habitat.	BioNet, EPBC Act Protected matters search	Nil. No suitable habitat present.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Xenus cinereus	Terek Sandpiper	V		The two main sites for this species in NSW are the Richmond River and Hunter River estuaries. Inhabits coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks near mangroves, also observed on rocky pools and reefs and up to 10 km inland around brackish pools. Roost communally in mangroves or dead trees. Forages in open intertidal mudflats.	BioNet	Low. Could occur at Botany Wetland on rare occasions. Minimal habitat within the project site itself. Known to occur at Towra Point Wetland.
Neophema pulchella	Turquoise Parrot	V		Occurs from coast to inland slopes. In coastal area, most common between Hunter and Northern Rivers, and further south in S Coast. Inhabits open eucalypt woodlands and forests, typically with a grassy understorey. Favours edges of woodlands adjoining grasslands or timbered creek lines and ridges. Feeds on the seeds of native and introduced grasses and other herbs. Grasslands and open areas provide important foraging habitat for this species while woodlands provide important roosting and breeding habitat. Nests in tree hollows, logs or posts from August to December.	BioNet	Unlikely. No suitable woodland habitat present.
Daphoenositta chrysoptera	Varied Sittella	V		Sedentary, occurs across NSW from the coast to the far west. Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Sensitive to habitat isolation and loss of structural complexity, and adversely affected by dominance of Noisy Miners. Cleared agricultural land is potentially a barrier to movement. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	BAM calculator	Unlikely. No suitable woodland habitat present. No local records.
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	C	Primarily coastal but may extend inland over major river systems. Breeds close to water, mainly in tall open forest/woodland but also in dense forest, rainforest, closed scrub or remnant trees. Usually forages over large expanses of open water, but also over open terrestrial habitats (e.g. grasslands).	323 records within 10 km (OEH 2018a)	Possible. Would forage within Botany Bay. Less likely to forage within freshwater habitats of Botany Wetlands. No raptor nests observed. Known to nest at Towra Point Reserve.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Epthianura albifrons	White-fronted Chat	V		This species occurs from southern Queensland to Western Australia and down to Tasmania, mostly in temperate to arid climates and very rarely in sub-tropical areas. It is found in damp open habitats, particularly wetlands containing saltmarsh areas that are bordered by open grasslands. Along the coast they are found in estuarine and marshy habitats with vegetation <1m tall, and in open grasslands and areas bordering wetlands. Inland, they are often observed in grassy plains, saltlakes and saltpans along waterway margins.	245 records within 10 km (OEH 2018a)	Low. Could occur on rare occasions at Eastlakes Golf Course. No saltmarsh in the project site. Known to occur at Towra Point Wetland.
Epthianura albifrons	White-fronted Chat population in the Sydney Metropolitan Catchment Management Area	EP		There are two isolated sub-populations of White-fronted Chats currently known from the Sydney Metropolitan CMA: at Newington Nature Reserve and at Towra Point NR. This species is unlikely to cross the 25 km separating these areas, or the greater distances separating other colonies outside the CMA.	BioNet	Low. Could occur on rare occasions at Eastlakes Golf Course. No saltmarsh in the project site. Known to occur at Towra Point Wetland.
MAMMALS						
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Occurs from the Shoalhaven north to the Queensland border. Now mostly lost west of the Great Dividing Range, except in the Warrumbungles and Mt Kaputar. Occurs on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Diet consists of vegetation in adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	EPBC Act Protected matters search only	Nil. No suitable habitat present.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V		Generally occurs east of the Great Dividing Range along NSW coast Inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man-made structures. Only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and Texas. Females may travel hundreds of kilometres to the nearest maternal colony.	BioNet	Known. Probable record at Mill Stream and definite record at Alexandra Canal and Tempe Wetland. Would forage throughout the project site. No breeding habitat present.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Occurs on southeast coast and ranges. Prefers tall (>20 m) and wet forest with dense understorey. Absent from small remnants, preferring continuous forest but can move through cleared landscapes and may forage in open areas. Roosts in hollow trunks of Eucalypts, underneath bark or in buildings. Forages in gaps and spaces within forest, with large foraging range (12 km foraging movements recorded).	BioNet	Unlikely. Suitable foraging or breeding habitat not present.
Mormopterus norfolkensis	Eastern Freetail-bat	V		Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Forages in natural and artificial openings in vegetation, typically within a few kilometres of its roost. Roosts primarily in tree hollows but also recorded from man-made structures or under bark.	BioNet	Likely. Would forage throughout the project site. No breeding habitat present.
Cercartetus nanus	Eastern Pygmy-possum	V		Inhabits range of habitats from coastal heath and woodland though open and closed forests, subalpine heath and rainforest. Banksia spp. and myrtaceous shrubs and trees are favoured food sources and nesting subject sites in drier habitats. Diet mostly pollen and nectar from Banksia spp., Eucalyptus spp., Callistemon spp. and insects. Nests in hollows in trees, under the bark of Eucalypts, forks of tea-trees, abandoned bird nests and Xanthorrhoea bases.	BAM calculator	Nil. No suitable habitat present. No local records.
Kerivoula papuensis	Golden-tipped Bat	V		Inhabits moist, closed forest with high summer rainfall. Wide range of possible roosts but 95% in the bottom of Yellow-throated Scrubwren and/or Brown Gerygone nests within rainforest, usually along creek lines. However individuals frequently forage in dry sclerophyll forests on upper slopes, generally within 2 km of the roost. Thought to have limited dispersal ability through cleared landscape (Woodside et al 2008).	BAM Calculator	Nil. No suitable habitat present.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Occurs on the east coast and Great Dividing Range. Inhabits a variety of habitats from woodland to wet and dry sclerophyll forests and rainforest, also remnant paddock trees and timber-lined creeks, typically below 500 m asl. Forages in relatively uncluttered areas, using natural or man-made openings in denser habitats. Usually roosts in tree hollows or fissures but also under exfoliating bark or in the roofs of old buildings. Females congregate in maternal roosts in suitable hollow trees (Hoye and Richards 2008, Churchill 2008).	BioNet	Likely. Would forage throughout the project site. No breeding habitat present.
Petauroides volans	Greater Glider		V	The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. It prefers taller montane, moist eucalypt forest with relatively old trees and abundant hollows.	EPBC Act Protected matters search	Nil. No suitable habitat present. No Local records.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Roosts in camps within 20 km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability (Eby and Law 2008). Will also forage in urban gardens and cultivated fruit crops.	BioNet, EPBC Act Protected matters search	Known. Would forage in fig trees, flowering gums and other trees in the project site. No breeding camp present.
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)	Koala	V	V	Occurs from coast to inland slopes and plains. Restricted to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on habitat quality, from < 2 to several hundred hectares. Only known populations in Sydney are in outer areas such as the Holsworthy/Campbelltown area and Pittwater area. No known populations in inner Sydney.	EPBC Act Protected matters search	Nil. No suitable habitat present. No local records.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Chalinolobus dwyeri	Large-eared Pied Bat,	V	V	Occurs from the coast to the western slopes of the divide. Largest numbers of records from sandstone escarpment country in the Sydney Basin and Hunter Valley (Hoye and Schulz 2008). Roosts in caves and mines and most commonly recorded from dry sclerophyll forests and woodlands. An insectivorous species that flies over the canopy or along creek beds (Churchill 2008). In southern Sydney appears to be largely restricted to the interface between sandstone escarpments and fertile valleys.	EPBC Act Protected matters search	Nil. No suitable habitat present. No local records.
Miniopterus australis	Little Bentwing-bat	V		Occurs from Cape York to Sydney. Inhabits rainforests, wet and dry sclerophyll forests, paperbark swamps and vine thickets. Only one maternity cave known in NSW, shared with Eastern Bentwing-bats at Willi Willi, near Kempsey. Outside breeding season roosts in caves, tunnels and mines and has been recorded in a tree hollow on one occasion. Forages for insects beneath the canopy of well-timbered habitats (Churchill 2008, Hoye and Hall 2008).	BioNet	Likely. Would forage throughout the project site. No breeding habitat present.
Perameles nasuta	Long-nosed Bandicoot population in inner western Sydney	EP		Occurs within Marrickville and Canada Bay LGAs, and may also occur in the Canterbury, Ashfield and Leichhardt LGAs. Shelter mostly under older houses and buildings, and forage in parkland and backyards.	BioNet	Unlikely. Outside known distribution of the population.
Pseudomys novaehollandiae	New Holland Mouse		V	Occurs in disjunct, coastal populations from Tasmania to Queensland. In NSW inhabits a variety of coastal habitats including heathland, woodland, dry sclerophyll forest with a dense shrub layer and vegetated sand dunes. Populations may recolonise/ increase in size in regenerating native vegetation after wildfire, clearing and sandmining. Presence strongly correlated with understorey vegetation density, and high floristic diversity in regenerating heath (Lock and Wilson 1999).	EPBC Act Protected matters search	Nil. No suitable heath habitat present.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Isoodon obesulus obesulus	Southern Brown Bandicoot	E	E	Occurs mainly in 2 areas: Ku-ring-gai Chase and Garigal National Parks north of Sydney, and far SE NSW, but also occurs between these areas. Inhabits scrubby vegetation, including heath, shrubland, and heathy forest and woodland. Often associated with well-drained soils and dry heathland communities, and prefers periodically burnt areas as this increases insect abundance.	EPBC Act Protected matters search	Nil. No suitable habitat present.
Myotis macropus	Southern Myotis	V		Mainly coastal but may occur inland along large river systems. Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water.	BioNet	Unlikely. Could forage along Mill Stream and the Botany Wetlands however there are no records of the species in this location in the last 30 years. No breeding habitat present. No evidence during surveys.
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Inhabits a range of environments including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites are in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 ha and males up to 3,500 ha, usually traversed along densely vegetated creek lines.	EPBC Act Protected matters search	Nil. No suitable habitat present. Highly urban, modified landscape.
Petaurus norfolcensis	Squirrel Glider	V		Occurs along the drier inland slopes as well as coastal habitats. Inhabits woodland and open forest with a Eucalyptus, Corymbia or Angophora overstorey and a shrubby understorey of Acacia or Banksia. Key habitat components include reliable winter and early-spring flowering Eucalypts, Banksia or other nectar sources, and hollow-bearing trees for roost and nest sites, with social groups moving between multiple hollows. Social groups include one or two adult males and females with offspring, and have home ranges of 5-10 ha within NSW.	BioNet	Nil. No suitable habitat present.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		Migrates from tropics to SE Aus in summer. Forages across a range of habitats including those with and without trees, from wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert. Roosts communally in large tree hollows and buildings.	BioNet	Likely. Could forage on occasion in the project site. No breeding habitat present.
REPTILES						
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter, and spring, moving to shelters in hollows of large trees within 200 m of escarpments in summer. Feeds mostly on geckos and small skinks, and occasionally on frogs and small mammals.	EPBC Act Protected matters search	Nil. No suitable habitat present.
Hoplocephalus bitorquatus	Pale-headed Snake	V		Occurs north from Tuggerah along the coast and to the western side of the Great Divide. Inhabits dry eucalypt forests and woodlands, cypress woodland and occasionally in rainforest or moist eucalypt forest. Favours streamside areas, particularly in drier habitats. Shelter during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees.	BAM calculator	Nil. No suitable habitat present. Outside known distribution.
FROGS						
Heleioporus australiacus	Giant Burrowing Frog	V	V	Occurs along the coast and eastern slopes of the Great Dividing Range south from Wollemi National Park. The species is associated with sandy soil on sandstone ridges that support heath vegetation. Breeds in ephemeral to intermittent streams with persistent pools. Only infrequently moves to breeding sites, most commonly found on ridges away from creeks, several hundred metres from water.	EPBC Act Protected matters search	Nil. No suitable sandstone or heath habitat present.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Litoria aurea	Green and Golden Bell Frog	E	V	Formerly occurred from Brunswick Heads to Victoria, but >80% populations now lost. Inhabits marshes, natural and artificial freshwater to brackish wetlands, dams and in stream wetlands. Prefers sites containing cumbungi (Typha spp.) or spike rushes (Eleocharis spp.), which are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby. Gambusia holbrooki is a key threat as they feed on green and Golden Bell Frog eggs and tadpoles.	BioNet, EPBC Act Protected matters search	Unlikely. Known to occur in lower Cooks River area, however thought to no longer be present at Botany Wetland. Extant population known from Marsh Street wetland. No evidence despite targeted surveys in suitable conditions.
Litoria brevipalmata	Green-thighed Frog	V		Occurs north from Gosford to Queensland. Breeding occurs in flooded semi-permanent or ephemeral pools, usually in grassy areas and within 100 m of significant stands of native vegetation. Can tolerate some disturbance but not found in >50% cleared grazing land or entirely urban areas. Usually associated with moist forest (swamp forest, wet sclerophyll or rainforest) but often recorded from dry sclerophyll forests in the northern part of its range.	BAM calculator	Nil. No suitable habitat present. Outside known distribution.
Litoria raniformis	Growling Grass Frog	E	V	Currently, the species is known to exist only in isolated populations in the Coleambally Irrigation Area, the Lowbidgee floodplain and around Lake Victoria. Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys.	EPBC Act Protected matters search	Nil. No suitable habitat present. Outside known distribution.
Pseudophryne australis	Red-crowned Toadlet	V		Restricted to Sydney Basin, from Nowra to Pokolbin and west to Mt Victoria. Inhabits heathland and open woodland on Hawkesbury and Narrabeen Sandstones, within 100 m of ridgelines. Breeds in ephemeral feeder creeks or flooded depressions, requiring unpolluted water between 5.5 and 6.5 pH. Shelters under rocks, amongst masses of dense vegetation or leaf litter. Populations restricted to immediate vicinity of breeding areas.	BioNet	Nil. No suitable habitat present.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Mixophyes balbus	Stuttering Frog	E	V	Occurs along the east coast of Australia. Has undergone a massive range reduction particularly in the south of its range. Inhabits rainforest and wet, tall, open forest. Shelter in deep leaf litter and thick understorey vegetation on the forest floor. Feeds on insects and smaller frogs, breeding in streams during summer after heavy rain. The species does not occur in areas where the riparian vegetation has been disturbed or where there have been significant upstream human impacts.	EPBC Act Protected matters search	Nil. No suitable habitat present.
Crinia tinnula	Wallum Froglet	V		Inhabits acid paperbark swamps and sedge swamps along the northern and central coast regions of NSW. It is generally not associated with disturbed habitats.	BioNet	Nil. No suitable habitat present.
FISH						
Prototroctes maraena	Australian Grayling		V	Occurs in coastal rivers and streams south from the Shoalhaven River. Inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults. Most of their lives are spent in freshwater rivers and streams in cool, clear waters with a gravel substrate and alternating pool and riffle zones, however can also occur in turbid water. The species can penetrate well inland, being recorded over 100 km inland from the sea. (Backhouse et al 2008).	EPBC Act Protected matters search	Nil. No suitable habitat present. Outside known range.
Epinephelus daemelii	Black Rockcod		V	Found in warm temperate/sub-tropical parts of south-western Pacific. Naturally occur along NSW Coastincl. Lord Howe Island. Adults generally found on rocky reefs. Juveniles found in coastal rock pools and around rocky shores in estuaries. (DPI 2013).	EPBC Act Protected matters search	Nil. No suitable habitat present. May occur around rocky headlands of Botany Bay.
Macquaria australasica	Macquarie Perch	V	E	Occurs in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers, and in parts of the Hawkesbury and Shoalhaven catchment areas. Inhabits river and lake habitats, especially the upper reaches of rivers and their tributaries. Requires clear water with deep, rocky holes and abundant cover (including aquatic vegetation, woody debris, large boulders and overhanging banks). Spawning occurs in spring and summer in shallow upland streams or flowing sections of river systems.	EPBC Act Protected matters search	Nil. No suitable habitat present.

Scientific name	Common name	BC Act Status[1]	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
GASTROPODS						
Pommerhelix duralensis	Dural Land Snail	E	E	This species is a shale-influenced habitat specialist, which occurs in low densities along the northwest fringes of the Cumberland Plain on shale-sandstone transitional landscapes. The majority of confirmed records for the species occur within The Hills Shire Local Government Area. The species is also found within the Local Government Areas of Blue Mountains City, Penrith City, Hornsby Shire and Parramatta City.	EPBC Act Protected matters search	Nil. No suitable habitat present.

A3. Likelihood of occurrence of migratory fauna

Scientific name	Common name	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Limosa lapponica	Bar-tailed Godwit	Migratory	Has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria, including the offshore islands. Breeds in the north of Scandinavia, Russia and north-west Alaska. Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Monarcha melanopsis	Black-faced Monarch	Migratory	Found along the coast of eastern Australia, becoming less common further south. Found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. Resident in the north of its range, but is a summer breeding migrant to coastal south-eastern Australia, arriving in September and returning northwards in March. It may also migrate to Papua New Guinea in autumn and winter.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland. Minimal habitat within the project site itself.

Scientific name	Common name	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Limosa	Black-tailed Godwit	Migratory	The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the north and south coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed. It is usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. It has also been found around muddy lakes and swamps, wet fields and sewerage treatment works.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Limicola falcinellus	Broad-billed Sandpiper	Migratory	Breeds in the northern hemisphere. In the non-breeding season most common in north and north west of Australia, but is a regular visitor in small numbers to the NSW coast from Ballina to Shoalhaven Heads. Occurs on sheltered parts of the coast, favouring estuarine mudflats but also occasionally in saltmarshes, freshwater lagoons, saltworks and sewerage farms. Forage on exposed mudflats or wet sand.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Tringa nebularia	Common Greenshank	Migratory	Does not breed in Australia, but occurs in all types of wetlands. In NSW has been recorded in most coastal regions and is widespread west of the Great Dividing Range, particularly in the north-west, Macquarie Marshes and areas between the Lachlan and Murray Rivers and Darling River drainage basin. The Hunter River estuary is an internationally important site for the species. In coastal areas typically occurs in sheltered habitats with large mudflats and saltmarsh, mangroves or seagrass.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.

Scientific name	Common name	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Actitis hypoleucos	Common Sandpiper	Migratory	Does not breed in Australia. When in Australia it is found on all coastlines and in inland areas, but is concentrated in the north and west with important areas in WA, the NT and Qld. Utilises a wide range of coastal and inland wetlands with varying salinity levels.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Calidris ferruginea	Curlew Sandpiper	Migratory	Breeds in northern hemisphere. In Australia generally occupies littoral and estuarine habitats. In NSW mainly found in intertidal mudflats on sheltered coasts. Roosts on beaches, spits or islands on the coast/in wetlands, or in saltmarsh on rocky shores.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Charadrius bicinctus	Double-banded Plover	Migratory	Found in both coastal and inland areas. During the non-breeding season, it is common in eastern and southern Australia. Breeds only in New Zealand. Found on littoral, estuarine and fresh or saline terrestrial wetlands and also saltmarsh, grasslands and pasture. It occurs on muddy, sandy, shingled or sometimes rocky beaches, bays and inlets, harbours and margins of fresh or saline terrestrial wetlands such as lakes, lagoons and swamps, shallow estuaries and rivers.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Numenius madagascariensis	Eastern Curlew	Migratory	Within Australia, the species has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. Breeds in Russia and north-eastern China. Most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes use the mangroves. The birds are also found in saltworks and sewage farms.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.

Scientific name	Common name	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Calidris tenuirostris	Great Knot	Migratory	Breeds in northern hemisphere. In Australia, prefers sheltered coastal habitats with large intertidal mud or sandflats, including inlets, bays, harbours, estuaries and lagoons. Occasionally found on exposed reefs or rock platforms, mangroves, saltwork ponds, near-coastal swamps, saltlakes and non-tidal lagoons. Rarely occurs on inland lakes and swamps. Roosts in large groups in open areas, often at the water's edge or in shallow water close to feeding areas.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Charadrius leschenaultii	Greater Sand Plover	Migratory	Does not breed in Australia. In NSW, recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Occurs mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; forage on wet ground at low tide.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Pluvialis squatarola	Grey Plover	Migratory	Breed in the northern Hemisphere. Widespread on Australian coasts in the non-breeding season. Occur almost entirely in coastal areas, usually in sheltered embayments with mud or sandflats and occasionally on rocky coasts or near-coastal lakes and swamps. Very occasionally recorded further inland. Forage on exposed mudflats and beaches.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Tringa brevipes	Grey-tailed Tattler	Migratory	Non-breeding visitor to Australia. In NSW occurs along the coast from the Queensland border south to Tilba Lake, and has been recorded as far south as Gippsland. In NSW it is recorded more frequently north of Sydney. Found on sheltered coasts with reefs and rock platforms or with intertidal mudflats. Inland records are rare. Forages in shallow water in intertidal areas. Usually roosts in the branches of mangroves or rocks which may be partly submerged. Also rarely recorded in dense shrubs, on driftwood or sand dunes.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.

Scientific name	Common name	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Gallinago hardwickii	Latham's Snipe	Migratory	Occurs along the coast and west of the great dividing range. Non breeding visitor to Australia. Inhabit permanent and ephemeral wetlands up to 2000 m asl. Typically in open, freshwater wetlands with low, dense vegetation (incl. swamps, flooded grasslands and heathlands). Can also occur in saline/brackish habitats and in modified or artificial habitats close to human activity.	EPBC Act Protected matters search	High. Could occur at Botany Wetland. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Charadrius mongolus	Lesser Sand Plover	Migratory	Does not breed in Australia. Found along the entire coast of Australia, most common in northern NSW, QLD and the Gulf of Carpentaria. Rarely recorded south of the Shoalhaven. In NSW almost entirely coastal, on beaches of sheltered bays, harbours and estuaries with large intertidal sand or mudflats, occasionally on sandy beaches, coral reefs and rock platforms.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Numenius minutus	Little Curlew	Migratory	Generally spend the non-breeding season in northern Australia. In NSW, most records are scattered east of the Great Dividing Range, from Casino, south to Greenwell Point with a few scattered records west of the Great Dividing Range. Recorded breeding in Siberia. Most often found feeding in short, dry grassland and sedgeland, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools or areas seasonally inundated. Open woodlands with a grassy or burnt understorey, dry saltmarshes, coastal swamps, mudflats or sandflats of estuaries or beaches on sheltered coasts, mown lawns, gardens, recreational areas, ovals, racecourses and verges of roads and airstrips are also used.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.

Scientific name	Common name	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Calidris subminuta	Long-toed Stint	Migratory	Widely scattered records around coastal NSW. They prefer shallow freshwater or brackish wetlands including lakes, swamps, river floodplains, streams, lagoons and sewage ponds. The species is also fond of areas of muddy shoreline, growths of short grass, weeds, sedges, low or floating aquatic vegetation, reeds, rushes and occasionally stunted samphire. They roost or loaf in sparse vegetation at the edges of wetlands and on damp mud near shallow water and forage on wet mud or in shallow water.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Tringa stagnatilis	Marsh Sandpiper	Migratory	Breeds in N Hemisphere. Occurs in coastal and inland wetlands, including freshwater and estuarine habitats, throughout Australia. All regions of NSW but particularly central and south coasts and western slopes and plains. Sites of national importance in NSW include Parkes wetlands, Macquarie Marshes and Tullakool Evaporation Ponds.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Cuculus optatus	Oriental Cuckoo	Migratory	This species migrates to northern and eastern Australia in the warmer months. Occurs south to the Shoalhaven area. Occurs in a range of habitats, including monsoon forest, rainforest edges, leafy trees in paddocks, river flats, roadsides and mangroves.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland. Minimal habitat within the project site itself.
Charadrius veredus	Oriental Plover	Migratory	The Oriental Plover is a non-breeding visitor to Australia, where the species occurs in both coastal and inland areas, mostly in northern Australia. Most records are along the north-western coast, between Exmouth Gulf and Derby in Western Australia. Oriental Plovers spend a few weeks in coastal habitats such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches or nearby reefs, or in near-coastal grasslands, before dispersing further inland. Oriental Plovers usually forage among short grass or on hard stony bare ground (McCrie 1984), but also on mudflats or among beachcast seaweed on beaches.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.

Scientific name	Common name	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Pandion haliaetus	Osprey	Migratory	The Osprey is found around the Australian coast line, except for Victoria and Tasmania. They favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Ospreys feed on fish over clear, open water and breed from July to September in NSW. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.	EPBC Act Protected matters search	High. Could forage and breed in the Botany Wetlands. No nests observed near the rail corridor.
Pluvialis fulva	Pacific Golden Plover	Migratory	Breeds in the northern hemisphere. In Australia occurs mainly in coastal areas but also recorded inland. Important sites in NSW include the Hunter and Shoalhaven River estuaries. Usually occur on beaches, mudflats and sandflats in sheltered areas.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Calidris melanotos	Pectoral Sandpiper	Migratory	Widespread but scattered records across NSW, east of the divide and in the Riverina and Lower Western regions. Breeds in the northern hemisphere. In Australasia, prefers shallow fresh to saline wetlands and is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. Usually in coastal or near-coastal habitats, and prefers wetlands with open mudflats and low emergent or fringing vegetation such as grass or samphire.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.

Scientific name	Common name	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Gallinago stenura	Pin-tailed Snipe	Migratory	The species distribution within Australia is not well understood. There are confirmed records from NSW, south-west Western Australia, Pilbara and the Top End. In NSW a single banded bird was reported near West Wyalong. During non-breeding period the Pin-tailed Snipe occurs most often in or at the edges of shallow freshwater swamps, ponds and lakes with emergent, sparse to dense cover of grass/sedge or other vegetation. The species is also found in drier, more open wetlands such as claypans in more arid parts of species' range. It is also commonly seen at sewage ponds; not normally in saline or inter-tidal wetlands (Higgins & Davies 1996).	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Calidris canutus	Red Knot	Migratory	Breeds in northern hemisphere. Occurs in coastal areas around Australia, with important sites in VIC, SA, WA, NT and Qld. Mainly inhabits intertidal mudflats, sandflats and sandy beaches. Occasionally seen in terrestrial saline wetlands but rarely in freshwater wetlands. Forage in soft substrates in intertidal areas.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Calidris ruficollis	Red-necked Stint	Migratory	Distributed along most of the Australian coastline with large densities on the Victorian and Tasmanian coasts. Breeds in Siberia and sporadically in north and west Alaska. In Australasia, mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores. Occasionally they have been recorded on exposed or ocean beaches, and sometimes on stony or rocky shores, reefs or shoals.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Arenaria interpres	Ruddy Turnstone	Migratory	Breeds in northern Hemisphere. In non-breeding season, widespread in most coastal regions of Australia with occasional inland records. Strongly prefers rocky shores or beaches with large seaweed deposits.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.

Scientific name	Common name	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Philomachus pugnax	Ruff	Migratory	In NSW the species has been recorded at Kurnell, Tomki, Casino, Ballina, Kooragang Island, Broadwater Lagoon and Little Cattai Creek. The species has also found around the Riverina, including Windouran Swamp, Wanganella, Fivebough Swamo and the Tullakool Saltworks. Most NSW records come from the Sydney region. In Australia the Ruff is found on generally fresh, brackish of saline wetlands with exposed mudflats at the edges. It is found in terrestrial wetlands including lakes, swamps, pools, lagoons, tidal rivers, swampy fields and floodlands. They are occasionally seen on sheltered coasts, in harbours, estuaries, seashores and are known to visit sewage farms and saltworks. They are sometimes found on wetlands surrounded by dense vegetation including grass, sedges, saltmarsh and reeds.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Rhipidura rufifrons	Rufous Fantail	Migratory	Found along NSW coast and ranges. Inhabits rainforest, dense wet forests, swamp woodlands and mangroves. During migration, it may be found in more open habitats or urban areas (Birds Australia 2008).	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland. Minimal habitat within the project site itself.
Calidris alba	Sanderling	Migratory	Sanderlings occur along the NSW coast, with occasional inland sightings. Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands. Roosts on bare sand, behind clumps of beach-cast kelp or in coastal dunes.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.

Scientific name	Common name	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Myiagra cyanoleuca	Satin Flycatcher	Migratory	In NSW widespread on and east of the Great Divide, sparsely scattered on the western slopes, very occasional records on the western plains. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, often near wetlands and watercourses. On migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Generally not in rainforests.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland. Minimal habitat within the project site itself.
Calidris acuminata	Sharp-tailed Sandpiper	Migratory	Spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. In Australasia, prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. Breeds in northern Siberia.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Monarcha trivirgatus	Spectacled Monarch	Migratory	The Spectacled Monarch is found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. It is much less common in the south. Prefers thick understorey in rainforest, wet gullies and waterside vegetation as well as mangroves.	EPBC Act Protected matters search	Low. Could occur on rare occasions at the Botany Wetlands.
Gallinago megala	Swinhoe's Snipe	Migratory	Swinhoe's Snipe is recorded in north Australia, particularly the Kimberley region, from October–April. It is a non-breeding migrant to Australia and occurs at the edges of wetlands, such as wet paddy fields, swamps and freshwater streams. The species is also known to occur in grasslands, drier cultivated areas (including crops of rapeseed and wheat) and market gardens (Higgins & Davies 1996).	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.

Scientific name	Common name	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Xenus cinereus	Terek Sandpiper	Migratory	The two main sites for this species in NSW are the Richmond River and Hunter River estuaries. Inhabits coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks near mangroves, also observed on rocky pools and reefs and up to 10 km inland around brackish pools. Roost communally in mangroves or dead trees. Forages in open intertidal mudflats.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Tringa incana	Wandering Tattler	Migratory	Breeds in N Hemisphere. Generally found on rocky coasts, occasionally on coral reefs or beaches, and tends to avoid mudflats. Forages among rocks or shingle or in shallow pools, mainly along the tideline. Roost and perch on top of boulders surrounded by or close to water.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Numenius phaeopus	Whimbrel	Migratory	A regular migrant to Australia and New Zealand, with a primarily coastal distribution. There are also scattered inland records in all regions. It is found in all states but is more common in the north. It is found along almost the entire coast of Queensland and NSW. Breeds in north and west Alaska, Eurasia and Iceland. Often found on the intertidal mudflats of sheltered coasts. It is also found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats. It is occasionally found on sandy or rocky beaches, on coral or rocky islets, or on intertidal reefs and platforms.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Hirundapus caudacutus	White-throated Needletail	Migratory	Recorded along NSW coast to the western slopes and occasionally from the inland plains. Breeds in northern hemisphere. Almost exclusively aerial while in Australia. Occur above most habitat types, but are more frequently recorded above more densely vegetated habitats (rainforest, open forest and heathland) than over woodland or treeless areas.	EPBC Act Protected matters search	Low. May forage high above the study area on occasion.

Scientific name	Common name	EPBC Act Status[2]	Habitat association	Nature of record	Likelihood of occurrence
Tringa glareola	Wood Sandpiper	Migratory	Breeds in N Hemisphere. Occurs in largest numbers in NW Australia, with all sites of national importance within WA. In NSW there are records east of the Divide north from Nowra, and inland from the upper and lower Western regions. Uses well-vegetated, shallow, freshwater wetlands and are typically associated with wetlands supporting emergent aquatic plants or grass and taller fringing vegetation such as dense reeds/rushes, shrubs or trees. Also frequent flooded grasslands and irrigated crops. Rarely in brackish wetlands or saltmarsh. Known from artificial wetlands.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.
Motacilla flava	Yellow Wagtail	Migratory	This species breeds in temperate Europe and Asia. They occur within Australia in open country habitat with disturbed ground and some water. Recorded in short grass and bare ground, swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land and town lawns.	EPBC Act Protected matters search	Low. Could occur on occasion at Botany Wetland. Minimal habitat within the project site itself. No sandflats or mudflats present. Does not breed in Australia.
Limosa lapponica	Bar-tailed Godwit	Migratory	Has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria, including the offshore islands. Breeds in the north of Scandinavia, Russia and north-west Alaska. Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	EPBC Act Protected matters search	Moderate. Could occur at Botany Wetland on rare occasions. Negligible area of poor-quality habitat within the project site itself. Does not breed in Australia.

Appendix B
Survey results

B1. Flora survey

Family	Species	Common name	RM	Q1	Q2	Q3	Q4	Q5
Acanthaceae	*Thunbergia alata**	Black-eyed Susan	x					
Aceraceae	*Acer negundo**	Box Elder	x					
	*Acer palmatum**	Japanese Maple	x					
Agavaceae	*Agave americana**	Century Plant	x					
	*Yucca aloifolia**	–	x					
Alstroemeriaceae	*Alstroemeria psittacina**	Parrot lily	x					
Amaranthaceae	*Alternanthera philoxeroides**	Alligator Weed				x	x	
	*Amaranthus viridis**	Green Amaranth	x					
Anacardiaceae	*Schinus molle**	Pepper Corn	x					
Apiaceae	*Daucus carota**	Wild Carrot	x					
	*Foeniculum vulgare**	Fennel		x				
	*Hydrocotyle bonariensis**	A Pennywort		x			x	
Apocynaceae	*Araujia sericifera**	Moth Vine	x					x
	*Gomphocarpus fruticosus**	Narrow-leaved Cotton Bush	x					
	*Nerium oleander**	Oleander	x					
	Plumeria sp.*	Frangipani	x					
Arecaceae	*Livistona australis*	Cabbage Palm	x					
	*Phoenix canariensis**	Canary Island Date Palm	x					x
	*Syagrus romanzoffiana**	Cocos palm	x					x

Family	Species	Common name	RM	Q1	Q2	Q3	Q4	Q5
Asparagaceae	*Asparagus aethiopicus**	Asparagus Fern		x	x			x
	*Asparagus officinalis**	Asparagus	x					
	*Asparagus plumosus**	Climbing Asparagus Fern			x			
Asteraceae	*Ageratina adenophora**	Crofton Weed		x		x	x	
	*Ambrosia artemisiifolia**	Annual Ragweed	x					
	*Bidens pilosa**	Cobbler's Pegs		x				x
	Chrysanthemoides monilifera subsp. *rotundata**	Bitou Bush		x				
	*Conyza bonariensis**	Flaxleaf Fleabane		x				
	*Conyza sumatrensis**	Tall fleabane		x	x		x	
	*Erigeron karvinskianus**	Bony-tip Fleabane	x					
	*Gamochaeta americana**	Cudweed	x					
	*Hypochaeris glabra**	Catsear	x					
	*Hypochaeris radicata**	Smooth Catsear		x				
	Onopordum acanthium subsp. *acanthium**	Scotch Thistle	x					
	*Pseudognaphalium luteo-album**	Jersey Cudweed	x					
	*Senecio madagascarensis**	Fireweed	x	x	x			
	*Silybum marianum**	Variegated Thistle	x					
	*Soliva sessilis**	Bindii	x					
	*Sonchus asper**	Prickly Sowthistle					x	
	*Sonchus oleraceus**	Common Sowthistle			x			
Asteraceae	*Tagetes minuta**	Stinking Roger	x					
	*Taraxacum officinale**	Dandelion	x					

Family	Species	Common name	RM	Q1	Q2	Q3	Q4	Q5
Basellaceae	*Anredera cordifolia**	Madeira Vine	x					
Berberidaceae	*Nandina domestica**	Sacred Bamboo	x					
Bignoniaceae	*Jacaranda mimosifolia**	Jacaranda	x					
Brassicaceae	*Brassica rapa**	Field Mustard	x					
	*Capsella bursa-pastoris**	Shepherd's Purse	x					
	*Rapistrum rugosum**	Turnip Weed		x				
	*Sisymbrium officinale**	Hedge Mustard	x					
Cactaceae	*Opuntia* sp.*	–	x					
	Opuntia stricta var. *stricta**	Common Prickly Pear	x					
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell	x					
Caprifoliaceae	*Lonicera japonica**	Japanese Honeysuckle	x					
Caryophyllaceae	*Stellaria media**	Common Chickweed	x					
Casuarinaceae	*Casuarina glauca*	Swamp Oak		x	x			x
Chenopodiaceae	*Chenopodium album**	Fat Hen	x					
Commelinaceae	*Commelina cyanea*	Native Wandering Jew		x				
	*Tradescantia fluminensis**	Wandering Jew				x		
Convolvulaceae	*Ipomoea cairica**	Coast Morning Glory	x				x	
	*Ipomoea indica**	Blue Morning Glory	x					
Cupressaceae	*Cupressus torulosa**	Bhutan Cypress	x					

Family	Species	Common name	RM	Q1	Q2	Q3	Q4	Q5
Cyperaceae	*Carex appressa*	Tall Sedge				x	x	
	*Cyperus eragrostis**	Umbrella Sedge	x					
	Cyperus polystachyos	A Sedge	x					
	Eleocharis sphacelata	Tall Spike Rush					x	
	*Isolepis prolifera**	Budding Club-rush				x		
	Schoenoplectus validus	–	x					
Dennstaedtiaceae	*Hypolepis muelleri*	Harsh Ground Fern				x		
Euphorbiaceae	*Euphorbia peplus**	Petty Spurge	x					
	Glochidion ferdinandi var. *ferdinandi*	Cheese Tree		x				
	*Ricinus communis**	Castor Oil Plant		x	x			
Fabaceae (Faboideae)	*Erythrina crista-galli**	Cockspur Coral Tree	x					
	*Erythrina x sykesii**	Coral Tree	x					
	*Trifolium repens**	White Clover	x					
	Vicia sativa subsp. *sativa**	Common Vetch	x					
Fabaceae (Mimosoideae)	*Acacia binervia*	Coast Myall	x					
	Acacia longifolia subsp. *longifolia*	Sydney Golden Wattle		x				
	Acacia longifolia subsp. *sophorae*	Coastal Wattle	x					
	Acacia parramattensis	Parramatta Wattle	x					
	*Acacia saligna**	Golden Wreath Wattle	x	x				
Fumariaceae	*Fumaria muralis**	–	x					
Gentianaceae	*Centaurium erythraea**	Common Centaury	x					
Geraniaceae	*Pelargonium x domesticum**	Pelargonium		x	x			

Family	Species	Common name	RM	Q1	Q2	Q3	Q4	Q5
Haloragaceae	*Myriophyllum aquaticum**	Brazilian Water-milfoil	x					
Iridaceae	*Romulea minutiflora**	Small-flowered Onion Grass	x					
Juncaceae	*Juncus acutus**	Sharp Rush	x					
	Juncus usitatus	Common Rush				x	x	
Juncaginaceae	*Cycnogeton procerum*	Water Ribbons	x					
Lamiaceae	*Stachys arvensis**	Stagger Weed	x					
Lauraceae	*Cinnamomum camphora**	Camphor Laurel		x				x
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	x					
Loranthaceae	*Amyema cambagei*	Sheoak Mistletoe	x					
Malvaceae	*Abutilon grandifolium**	–	x					
	*Modiola caroliniana**	Red-flowered Mallow	x					
	*Sida rhombifolia**	Paddy's Lucerne		x				
Moraceae	*Ficus Hillii**	–	x					
	Ficus macrophylla	Moreton Bay Fig	x					x
	*Ficus pumila**	Climbing Fig	x					
	Ficus rubiginosa	Port Jackson Fig	x					
	*Morus alba**	Mulberry	x			x		
Myrsinaceae	*Anagallis arvensis**	Scarlet/Blue Pimpernel	x					
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush	x					

Family	Species	Common name	RM	Q1	Q2	Q3	Q4	Q5
Myrtaceae	*Callistemon* sp. *(Cultivar)**	–	x					
	*Corymbia citriodora**	Lemon-scented Gum	x					
	Corymbia maculata	Spotted Gum	x					
	Eucalyptus botryoides	Bangalay	x					
	Eucalyptus microcorys	Tallowwood	x					
	Eucalyptus saligna	Blue Gum	x					
	Kunzea ambigua	Tick Bush	x					
	Leptospermum laevigatum	Coast Teatree	x					
	Leptospermum polygalifolium	Lemon-scented Tea Tree	x					
	Lophostemon confertus	Brush Box	x					
	Melaleuca quinquenervia	Broad-leaved Paperbark	x		x			
	Tristaniopsis laurina	Water Gum	x					
Ochnaceae	*Ochna serrulata**	Mickey Mouse Plant		x				
Oleaceae	*Ligustrum lucidum**	Large-leaved Privet	x					
	*Ligustrum sinense**	Small-leaved Privet	x	x				
	Olea europaea subsp. *cuspidata**	African Olive	x					
Oxalidaceae	*Oxalis corniculata**	Creeping Oxalis		x				
	*Oxalis pes-caprae**	Soursob	x					
Passifloraceae	*Passiflora edulis**	Common Passionfruit	x					
	*Passiflora subpeltata**	White Passionflower	x					
Phormiaceae	*Dianella caerulea* var. *producta*	Blue Flax lily		x	x			
Phytolaccaceae	*Phytolacca octandra**	Inkweed	x					

Family	Species	Common name	RM	Q1	Q2	Q3	Q4	Q5
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum		x	x			x
Plantaginaceae	*Plantago lanceolata**	Lamb's Tongues	x	x				
Poaceae	*Arundo donax**	Giant Reed	x					
	*Avena fatua**	Wild Oats	x					
	*Axonopus fissifolius**	Narrow-leaved Carpet Grass	x					
	*Briza maxima**	Quaking Grass	x					
	*Briza minor**	Shivery Grass	x					
	*Bromus catharticus**	Prairie Grass	x					
	*Cenchrus clandestinus**	Kikuyu Grass	x					
	*Cenchrus echinatus**	Mossman River Grass	x					
	*Chloris gayana**	Rhodes Grass	x					
	*Chloris virgata**	Feathertop Rhodes Grass	x					
	*Cortaderia selloana**	Pampas Grass	x					
	Cynodon dactylon	Common Couch		x				
	*Digitaria ciliaris**	Summer Grass	x					
	*Digitaria sanguinalis**	Summer Grass, Crab Grass	x					
	*Ehrharta erecta**	Panic Veldtgrass		x	x			x
	*Ehrharta longiflora**	Annual Veldtgrass	x					
	*Eragrostis curvula**	African Lovegrass		x	x			

Family	Species	Common name	RM	Q1	Q2	Q3	Q4	Q5
Poaceae	*Imperata cylindrica* var. *major*	Blady Grass	x					
	Isachne globosa	Swamp Millet				x	x	
	*Melinis repens**	Red Natal Grass			x			
	Microlaena stipoides var. *stipoides*	–		x				
	Panicum maximum var. *maximum**	Guinea Grass		x				
	*Paspalum dilatatum**	Paspalum	x					
	*Paspalum urvillei**	Vasey Grass	x				x	
	*Poa annua**	Winter Grass	x					
	*Setaria parviflora**	Slender Pigeon Grass				x		
	*Sporobolus africanus**	Parramatta Grass	x					
	*Stenotaphrum secundatum**	Buffalo Grass	x					
	*Urochloa panicoides**	Urochloa Grass	x					
Polygonaceae	*Acetosa sagittata**	Turkey Rhubarb		x				x
	Persicaria strigosa	Spotted Knotweed				x	x	
	*Rumex crispus**	Curled Dock		x				
Proteaceae	*Banksia integrifolia* subsp. *integrifolia*	Coastal Banksia			x			
	Grevillea robusta	Silky Oak	x					
	Hakea salicifolia	Willow-leaved Hakea	x					
Ranunculaceae	*Ranunculus sceleratus**	Celery Buttercup				x		
Rosaceae	*Cotoneaster sp.**	Cotoneaster	x					
Rosaceae	*Rubus fruticosus* agg.*	Blackberry				x	x	

Family	Species	Common name	RM	Q1	Q2	Q3	Q4	Q5
Rubiaceae	*Coprosma repens**	Looking-glass Bush	x					
	*Richardia brasiliensis**	Mexican Clover	x					
	*Richardia stellaris**		x					
Rutaceae	*Murraya paniculata**	Orange Jessamine	x					
Sapindaceae	*Cardiospermum grandiflorum**	Balloon Vine	x					
	Cupaniopsis anacardioides	Tuckeroo						x
Solanaceae	*Cestrum parqui**	Green Cestrum	x	x	x			
	*Solanum americanum**	Glossy Nightshade		x	x			
	*Solanum nigrum**	Black-berry Nightshade	x					
	*Solanum pseudocapsicum**	Madeira Winter Cherry	x					
	*Solanum sisymbriifolium**	Viscid Nightshade	x					
Strelitziaceae	*Strelitzia nicolai**	Bird of Paradise	x					
Typhaceae	*Typha orientalis*	Broad-leaved Cumbungi				x	x	
Ulmaceae	*Celtis sinensis**	Chinese Nettle Tree			x			x
Urticaceae	*Parietaria judaica**	Asthma Weed	x	x				x
Verbenaceae	*Lantana camara**	Lantana		x	x			x
	*Verbena bonariensis**	Purpletop		x				
	*Verbena officinalis**	Common Verbena	x					
	*Verbena rigida**	Veined Verbena		x				

B2. Fauna survey

Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	Rail corridor	Botany Wetland	Tempe Wetland
Limnodynastes peronii	Brown-striped Frog						OW
Crinia signifera	Common Eastern Froglet				W	W	W
Litoria fallax	Eastern Dwarf Tree Frog					W	OW
Litoria peronii	Peron's Tree Frog						OW
Tachybaptus novaehollandiae	Australasian Grebe					O	
Cracticus tibicen	Australian Magpie				O		
Pelecanus conspicillatus	Australian Pelican					O	
Corvus coronoides	Australian Raven				O		
Acrocephalus australis	Australian Reed-Warbler					W	
Threskiornis molucca	Australian White Ibis				O	O	
Cygnus atratus	Black Swan					O	
Sturnus tristis	Common Myna	*			O		
Sturnus vulgaris	Common Starling	*			O		
Ocyphaps lophotes	Crested Pigeon				O	O	
Gallinula tenebrosa	Dusky Moorhen					O	
Ardea modesta	Great Egret					O	
Acanthorhynchus tenuirostris	Eastern Spinebill				O		

Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	Rail corridor	Botany Wetland	Tempe Wetland
Turdus merula	Eurasian Blackbird	*			O		
Fulica atra	Eurasian Coot					O	
Cracticus torquatus	Grey Butcherbird				O	O	
Rhipidura albiscapa	Grey Fantail				O	O	
Meliphaga lewinii	Lewin's Honeyeater					O	
Phalacrocorax sulcirostris	Little Black Cormorant					O	
Egretta garzetta	Little Egret					O	
Microcarbo melanoleucos	Little Pied Cormorant					O	
Grallina cyanoleuca	Magpie-lark				O		
Vanellus miles	Masked Lapwing				O		
Phylidonyris novaehollandiae	New Holland Honeyeater				O	O	
Manorina melanocephala	Noisy Miner				O		
Anas superciliosa	Pacific Black Duck					O	
Strepera graculina	Pied Currawong				O	O	
Porphyrio	Purple Swamphen					O	
Trichoglossus haematodus	Rainbow Lorikeet				O	O	
Anthochaera carunculata	Red Wattlebird				O	O	
Neochmia temporalis	Red-browed Finch				O	O	
Pycnonotus jocosus	Red-whiskered Bulbul	*			O	O	
Platalea regia	Royal Spoonbill					O	

Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	Rail corridor	Botany Wetland	Tempe Wetland
Pachycephala rufiventris	Rufous Whistler					O	
Myzomela sanguinolenta	Scarlet Honeyeater					O	
Zosterops lateralis	Silvereye				O	O	
Dicrurus bracteatus	Spangled Drongo				O		
Pardalotus punctatus	Spotted Pardalote					O	
Streptopelia chinensis	Spotted Turtle-dove	*			O		
Malurus cyaneus	Superb Fairy-wren				O	O	
Falco sp.	Unidentified Falcon					O	
Hirundo neoxena	Welcome Swallow				O	O	
Rhipidura leucophrys	Willie Wagtail				O		
Caligavis chrysops	Yellow-faced Honeyeater				O	O	
Calyptorhynchus funereus	Yellow-tailed Black-cockatoo				O	O	
Rattus rattus	Black Rat	*				O	O
Rattus norvegicus	Brown Rat	*			K		
Felis catus	Cat	*			O	O	
Miniopterus schreibersii oceanensis	Eastern Bentwing-Bat		V			?	D
Mormopterus ridei	Eastern Free-tailed Bat						PR
Chalinolobus gouldii	Gould's Wattled Bat						D
Pteropus poliocephalus	Grey-headed Flying-fox		V	V	O		
Vespadelus sp.	Unidentified Eptesicus					?	

Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	Rail corridor	Botany Wetland	Tempe Wetland
Austronomus australis	White-striped Freetail-Bat						D
Pseudonaja textilis	Eastern Brown Snake					O	
Chelodina longicollis	Eastern Snake-necked Turtle					O	
Intellagama lesueurii	Eastern Water Dragon					O	
Eulamprus quoyi	Eastern Water Skink					O	
Lampropholis guichenoti	Pale-flecked Garden Sunskink					O	
Cyprinus carpio	Carp	*					
Anguilla reinhardtii	Longfin Eel					O	
Gambusia holbrooki	Mosquitofish	*				O	

Key: D – definite, PR – probable, ✓ - species group

Appendix C
Field data sheets

BAM Plot – Field Survey Form

Site Sheet no:

Survey Name	Plot Identifier	Recorders
Gateway	Q1	IW MS

Date	Zone	Datum	IBRA region	Photo #	Zone ID
26 6 18	56		Syd	phone	

Easting	Northing	Plot Dimensions (e.g. 20 x 20 in 20 x 50)	Orientation of midline from the 0 m point.
333340	6243282	20x20 20x50	263

		Confidence: H M L
Likely Vegetation Class	PCT 1234 - Low (<17 veg intreg)	
Plant Community Type	EEC:	Confidence: H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
Sum of Cover of native vascular plants by growth form group	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
High Threat Weed cover %		

This table may be completed after entering data into spreadsheets. It is not required solely in the field

BAM Attribute (20 x 50 m plot)	Stem Classes and Hollows		
dbh	Euc*	Non Euc	Hollows†
80 + cm			6
50 – 79 cm			
30 – 49 cm			Hollows 20cm+
20 – 29 cm			0
10 – 19 cm	✓		
5 – 9 cm	✓		
< 5 cm	✓		This size class records tree regeneration
Length of logs (m) (≥10 cm diameter, >50 cm in length)	HHT III		total

Record living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately

Data needed is presence only (tick) unless a 'large tree' for that veg class.

* includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*

† For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

Each size class is noted as present by the living tree stems only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a multi-stemmed tree, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class.

Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species.

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	20 40 10 15 10			
Average of the 5 subplots	95			

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (identify native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Free Text Section for brief site description

Banksia integrifolia nearby

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date: 26 6 18	Gateway	Q1	WJMS

GF Code	Full species name mandatory, or a unique means of identifying separate taxa within a survey. Data from here will be used to assign growth form counts and covers.	N, E or HTE	Cover	Abund	stratum	voucher
	Acacia stigma	N	2	3		
	Cinnamodendron corticosum	E	2	1		
	Equisetum ramosissimum	N	3	5		
	Globulidion gerrardii	N	5	3		
	Thunbergia grandiflora	E	0.5	20		
	Cynodon dactylon	N	2	50		
	Pteridium aquilinum	N	2	50		
	Conyza sumatrensis	E	1	25		
	Eragrostis curvula	E	60	200		
	Commelina cyanea	N	1	50		
	Cestrum parqui	E	5	25		
	Acalypha sagittata	E	2	40		
	Tagetes minuta	E	2	15		
	Lantana camara	E	5	15		
	Ricinus communis	E	1	10		
	Salvia scutellata	E	0.1	1		
	Asthma buchanani	E	10	40		
	Cryptocarya sinensis	N	1	1		
	Verbena bonariensis	E	1	10		
	Tulipa Brus	E	0.5	5		
	Solanum americanum	E	0.2	4		
	Asparagus undulatum	N	3	3		
	Fennel	E	1	15		
	Acacia longifolia	N	1	6		
	Verbena rigida	E	0.4	5		
	Sida rhombifolia	E	0.7	20		
	Panicum maximum	E	2	50		
	Rumex cuspis	E	0.2	2		
	Senecio madagascariensis	E	0.4	25		
	Oxalis corniculata	E	0.2	10		
	Hypochaeris glabra	E	0.8	15		
	Plantago arborescens	E	1	25		
	Conyza bonariensis	E	0.9	20		
	Hydrocotyle bonariensis	E	0.6	30		
	Dianella revoluta var revoluta	N	0.7	3		
	Bitou bush	E	0.8	4		
	Asparagus asparagoides	E	0.2	1		
	Microlaena stipoides	N	0.1	5		
	Watsonia x borbonica	E	0.1	2		

GF Code: see Growth Form definitions in BAM Appendix 1. Identify top 3 dominants in the veg zone. **N:** native, **E:** exotic, **HTE:** high threat exotic.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); *Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Print more copies of this sheet to allow for higher species counts at a plot. All species at a plot need to be recorded.

BAM Plot – Field Survey Form

Site Sheet no:

Survey Name	Plot Identifier	Recorders
Gateway	Q2	JW / MS

Date	Zone	Datum	IBRA region	Photo #	Zone ID
26/6/18	56				

Easting	Northing	Plot Dimensions (e.g. 20 x 20 in 20 x 50)	Orientation of midline from the 0 m point.
333311	6243280	20x20 20x50	250

		Confidence: H M L
Likely Vegetation Class	PCT 1234 - Poor	
Plant Community Type	EEC:	Confidence: H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
Sum of Cover of native vascular plants by growth form group	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
High Threat Weed cover %		

This table may be completed after entering data into a suitable tool. It is not required while in the field.

BAM Attribute (20 x 50 m plot)	Stem Classes and Hollows		
dbh	Euc*	Non Euc	Hollows†
80 + cm			–
50 – 79 cm			
30 – 49 cm			Hollows 20cm+
20 – 29 cm		✓	–
10 – 19 cm		✓	
5 – 9 cm		✓	
< 5 cm		✓	This size class records tree regeneration
Length of logs (m) (≥10 cm diameter, >50 cm in length)	HHT III		total

Record living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately

Data needed is presence only (tick) unless a 'large tree' for that veg class.

* includes all species of *Eucalyplus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*

† For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

Each size class is noted as present by the living tree stems only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a multi-stemmed tree, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class.

Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species.

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	100 95 80 80 90	30 15 25 20 15		
Average of the 5 subplots		21.		

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (identify native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Free Text Section for brief site description

8-10, 60 1. Eucalyptus glauca
5-6, 15 1 Melaleuca quin, Banksia ericifolia
1-3, 5 1. Lantana
0 1 15 1 1. Eragrostis curvula, Ehrharta

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date: 26 06 18	Mapping	Q2	MS, HW

GF Code	*Full species name mandatory, or a unique means of identifying separate taxa within a survey. Data from here will be used to assign growth form counts and covers.*	N, E or HTE	Cover	Abund	stratum	voucher
	Casuarina glauca	N	60	30		
	Melaleuca quinquenervia	N	15	5		
	Lantana camara	E	5	25		
	Axonopus fissifolius	E	0.1	2		
	Senecio madagascariensis	E	0.3	10		
	Ricinus communis	E	0.2	1		
	Pittosporum undulatum	N	1	2		
	Ehrharta erecta	E	2	30		
	Dianella caerulea var. producta	N	0.9	10		
	Asparagus aethiopicus	E	0.2	2		
	Eragrostis curvula	E	2	30		
	Cestrum parqui	E	0.3	5		
	Banksia integrifolia	N	3	2		
	Celtis sinense	E	0.1	1		
	Melinis repens	E	0.2	5		
	Rubus fruticosus	E	0.5	10		
	Solanum americana	E	2.2	4		
	Paspalum sp	E	0.3	10		
	Sonchus oleraceus					

GF Code: see Growth Form definitions in BAM Appendix 1. Identify top 3 dominants in the veg zone. N: native, E: exotic, **HTE:** high threat exotic.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Print more copies of this sheet to allow for higher species counts at a plot. All species at a plot need to be recorded.

Form version designed 15 September 2017 Printed 26 June 2018

BAM Plot – Field Survey Form

Site Sheet no: 1 of 2

Survey Name	Plot Identifier	Recorders
Gateway Rail	03	Mark Stables

Date	Zone	Datum	IBRA region	Photo #	Zone ID
19/09/18	56	WGS84	Sydney Basin		VZ1

Easting	Northing	Plot Dimensions (e.g. 20 x 20 in 20 x 50)	Orientation of midline from the 0 m point.
333516	6243313	20x20x50.	295

		Confidence: H M L
Likely Vegetation Class	PCT 1071 – Typha. Freshwater Wetland.	
Plant Community Type	Freshwater Wetland on coastal floodplains – EEC	EEC: Confidence: (H) M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	0
	Shrubs	0
	Grasses etc.	4
	Forbs	1
	Ferns	1
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	0
	Shrubs	0
	Grasses etc.	11.3
	Forbs	5
	Ferns	0.1
	Other	0
High Threat Weed cover %		5.4

This table may be modified where appropriate to suit vegetation structure

BAM Attribute (20 x 50 m plot)	Stem Classes and Hollows		
dbh	Euc*	Non Euc	Hollows†
80 + cm			
50 – 79 cm			
30 – 49 cm			Hollows 20cm+
20 – 29 cm			
10 – 19 cm			
5 – 9 cm			
< 5 cm			This size class records tree regeneration
Length of logs (m) (≥10 cm diameter, >50 cm in length)	N/A		total —

Record living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately

Data needed is presence only (tick) unless a 'large tree' for that veg class.

* includes all species of *Eucalyptus, Corymbia, Angophora, Lophostemon* and *Syncarpia*

† For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

Each size class is noted as present by the living tree stems only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a multi-stemmed tree, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class.

Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species.

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)				
Average of the 5 subplots				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (identify native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Free Text Section for brief site description

Freshwater wetland - grassland ~2m
Dominated by Typha orientalis, Eleocharis sphacelata
emergent.
Relatively mono specific stand although swamp millet common
Alligator weed present.

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet 2 of 2	Survey Name	Plot Identifier	Recorders
Date: 19/09/18	Gateway Rail	Q3	Mark Stasiuk.

GF Code	Full species name mandatory, or a unique means of identifying separate taxa within a survey. Data from here will be used to assign growth form counts and covers.	N, E or HTE	Cover	Abund	stratum	voucher
	Typha orientalis.		65	1000		
	Agrostina capillaris		0.8	30		
	Persicaria strigosa		5	100		
	Isachne globosa		30	500		
	Tradescantia fluminensis		2	40		
	Rubus fruticosa agg.		0.6	10		
	Setaria parviflora		0.4	5		
	Juncus usitatus		0.2	10		
	Morus alba		1	1		
	Alternanthera philoxeroides.		5	100		
	Hypolepis muelleri		0.1	3		
	Carex appressa		0.1	2		
	Isolepis prolifera		0.4	30		
	Ranunculus sceleratus		0.2	10		
	Evidence of vehicle usage - tracks					
	RM Fringed gall mites					
	Paspalum urvillei					
	Melaleuca quinquenervia					
	Leptospermum laevigatum					
	Kunzea ambigua					

GF Code: see Growth Form definitions in BAM Appendix 1. Identify top 3 dominants in the veg zone. **N:** native, **E:** exotic, **HTE:** high threat exotic.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Print more copies of this sheet to allow for higher species counts at a plot. All species at a plot need to be recorded.

BAM Plot – Field Survey Form

Site Sheet no: 1 2

Survey Name	Plot Identifier	Recorders
Gateway Rd 1	Q1	Mark Stables

Date	Zone	Datum	IBRA region	Photo #	Zone ID
19/09/18	56	UTM	Sydney Basin		Q1

Easting	Northing	Plot Dimensions (e.g. 20 x 20 in 20 x 50)	Orientation of midline from the 0 m point.
333487	6243325		10°

Likely Vegetation Class	Confidence: H M L
Freshwater Wetland	

Plant Community Type	EEC:	Confidence: H M L
PCT 1071 _ Typha		H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	0
	Shrubs	0
	Grasses etc.	5
	Forbs	1
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	0
	Shrubs	0
	Grasses etc.	100
	Forbs	3
	Ferns	0
	Other	0
High Threat Weed cover %		5

This table may be completed after entering data into available tools. It is not required while in the field.

BAM Attribute (20 x 50 m plot)	Stem Classes and Hollows		
dbh	Euc*	Non Euc	Hollows†
80 + cm			
50 – 79 cm			
30 – 49 cm			Hollows 20cm+
20 – 29 cm			
10 – 19 cm			
5 – 9 cm			
< 5 cm			This size class records tree regeneration
Length of logs (m) (≥10 cm diameter, >50 cm in length)			total

Record **living** eucalypt* (Euc*) and **living** native non-eucalypt (Non Euc) stems separately

Data needed is presence only (tick) unless a 'large tree' for that veg class.

* includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*

† For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

Each size class is noted as present by the **living tree stems** only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class.

Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species.

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)				
Average of the 5 subplots				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (identify native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Free Text Section for brief site description

Typha [illegible]

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet 2 of 2	Survey Name	Plot Identifier	Recorders
Date 19/09/18	Gateway Rail	Q4	Mark Stables

GF Code	*Full species name mandatory, or a unique means of identifying separate taxa within a survey. Data from here will be used to assign growth form counts and covers.*	N, E or HTE	Cover	Abund	stratum	voucher
	Typha orientalis		80.	1000		
	Isachne globosa		20	500		
	Hydrocotyle bonariensis		0-6	30.		
	Persicaria strigosa		3	50		
	Eleocharis spatulata		0-3	10		
	Agerantina adenophora		0-6.	20.		
	Carex appressa		0-4	10.		
	Alternanthera philoxeroides		5	100		
	Juncus usitatus		0-1	5		
	Rubus [illegible] agg		0-2	10		
	Paspalum urvillei		0-4	20.		
	Sonchus [illegible]		0-4	20		
	[illegible]		0-1	5		
	Ipomoea [illegible]		0-8	50		
	Rumex crispus					
	Ehretia longiflora					
	Hrasm. sp. weed					

GF Code: see Growth Form definitions in BAM Appendix 1. Identify top 3 dominants in the veg zone. **N:** native, **E:** exotic, **HTE:** high threat exotic.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ...; 1000, ...

Print more copies of this sheet to allow for higher species counts at a plot. All species at a plot need to be recorded.

BAM Plot – Field Survey Form

Site Sheet no: 2

Survey Name	Plot Identifier	Recorders
Galoway Rail	05	Mark Stables.

Date	Zone	Datum	IBRA region	Photo #	Zone ID
19/09/18.	56.	Utm.	Sydney Basin.		

Easting	Northing	Plot Dimensions (e.g. 20 x 20 in 20 x 50)	Orientation of midline from the 0 m point.
332452	6243356.		230°

Likely Vegetation Class	Forested Wetland.	Confidence: H M L
Plant Community Type	PCT 1234 _ Swamp Oak. _ poor condition	EEC: Confidence: H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	3
	Shrubs	1
	Grasses etc.	0
	Forbs	0
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	10 %
	Shrubs	0.1
	Grasses etc.	0
	Forbs	0
	Ferns	0
	Other	0
High Threat Weed cover %		72.2

BAM Attribute (20 x 50 m plot)	Stem Classes and Hollows		
dbh	Euc*	Non Euc	Hollows†
80 + cm			
50 – 79 cm	/		/
30 – 49 cm	✓		Hollows 20cm+
20 – 29 cm	✓		
10 – 19 cm	✓		/
5 – 9 cm	✓		
< 5 cm	✓		This size class records tree regeneration
Length of logs (m) (≥0 cm diameter, >50 cm in length)	5, 3-5		total

Record living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately

Data needed is presence only (tick) unless a 'large tree' for that veg class.

* includes all species of *Eucalyptus, Corymbia, Angophora, Lophostemon* and *Syncarpia*

† For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

Each size class is noted as present by the living tree stems only. Depending on the Vegetation Class, DBH values and counts may be needed for a size class. For a multi-stemmed tree, only the largest living stem is included in the count/estimate if it is required by the large tree category for that vegetation class.

Hollows at least 20cm across are recorded for the purposes of habitat of some threatened species.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	45	80	65	85	70			
Average of the 5 subplots								

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (identify native/stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Free Text Section for brief site description

C. _ Corymbia gummifera 14-26m. (24)

S Lantana camara 1-2-3 (2.5)

Mostly canopy only — highly disturbed understorey dominated by transformer weeds.

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² plot: Sheet 2 of 2	Survey Name	Plot Identifier	Recorders
Date: 19/09/18	Gateway Rail	Q5	Mark Spicer

GF Code	*Full species name mandatory, or a unique means of identifying separate taxa within a survey. Data from here will be used to assign growth form counts and covers.*	N, E or HTE	Cover	Abund	stratum	voucher
	Casuina glauca		15.	20.		
	Parietaria judaica		30	400		
	Lantana camara		55.	500		
	Anemone canadensis		1	2.		
	Rhantherium		15	200		
	Acacia sagittata		1	20.		
	Pittosporum undulatum		0-4	1		
	Ficus macrophylla		1	1		
	Cupaniopsis anacardioides		0-4	4		
	Bidens pilosa		0-6.	30.		
	Cocos palm.		0.1	1		
	Celtis sinensis		0.5	3		
	Phoenix canariensis		1	1		
	Archontophoenix cunninghamiana		0.1	3		
	Asparagus aethiopicus		0.1	1		

(2)

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 26 6 18		2/4	IW/MS

GF Code	Full species name mandatory, or a unique means of identifying separate taxa within a survey. Data from here will be used to assign growth form counts and covers.	N, E or HTE	Cover	Abund	stratum	voucher
	Juniperus spartan (SEMI LYING)					
	Acacia saligna /					
	Anthemis / Ixiolaena viscosa					
	Asparagus officinalis					
	Avena sativa					
	Kickxia					
	Lamprocaulos spinescens					
	Lolium gasparinii					
	Lotus creticus					
	Melilotus indica					
	Oxalis pes-caprae					
	Pittosporum undulatum					
	Acacia implexa					
	Acacia elata					
	Pennisetum setaceus (Rodd. ex Lam.) Chiov.	m	INCI	INCI	US	
	Rumex crispus /					
	Briza minor /					
	Melaleuca armillaris /					
	Ficus microcarpa /					
	Acacia cyclops					
	Eucalyptus polyanthemos / sideroxylon (A)					
	Eucalyptus botryoides /					
	Melia azedarach - Indian lilac					
	Acacia longifolia /					
	Arctotheca calendula /					
	Solanum nigrum					
	Watsonia meriana var. p					
	Ficus rubiginosa					
	Briza x. banariensis /					
	Andropogon virginicus					
	Acacia longifolia var. sophorae					
	Briza diandra					
	Hedypnois rhagadioloides /					
	Lagurus ovatus /					
	Paspalum dilatatum					
	Euphorbia peplus					
	Cenchrus clandestinus /					
	Ehrharta erecta					
	Ursinia sp.					
TB	Paspalum dilatatum					
	Euphorbia sp. chamaesyce prostrata					
	Verbascum virgatum					

GF Code: see Growth Form definitions in BAM Appendix 1. Identify top 3 dominants in the veg zone. N: native, E: exotic, HTE: high threat exotic.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); *Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Print more copies of this sheet to allow for higher species counts at a plot. All species at a plot need to be recorded.

(1)

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 26 6 18		Random Meander	IW I MS

GF Code	*Full species name mandatory, or a unique means of identifying separate taxa within a survey. Data from here will be used to assign growth form counts and covers.*	N, E or HTE	Cover	Abund	stratum	voucher
	— RP1 —					
	Bromus rubb.					
	Eucalyptus rivularis					
	Plantago lanceolata					
	Ehrharta erecta					
	Cynodon dactylon					
	Sporobolus africanus					
	Trifolium repens					
	Sida rhombifolia					
	Oxalis corniculata					
	Bidens pilosa					
	Panicum maximum					
	Acetosa sagittata					
	fennel					
	Pepper tree					
	Sonchus oleraceus					
	Olea europea					
	phoenix canariensis					
	Brassica nigra ram					
	Ricinus communis					
	Chloris virgata					
	Anagallis arvensis					
	Setaria pamiflora					
	Gamochaeta sp.					
	Unidentified					
	senecio madagascariensis					
	vetch - vicia sativa?					
	Hypochaeris radicata					
	Taraxacum officinale					
	Hypochaeris glabra					
	Eucalyptus camaldulensis. Camphor					
	Xanthium spinosa					
	Fumaria officinale					
	Urtica urens					
	Morning glory					
	Avena fatua					
	Oval tree					
	Ficus sycamore					
	Urochloa panicoides					
	Banksia integrifolia					

GF Code: see Growth Form definitions in BAM Appendix 1. Identify top 3 dominants in the veg zone. N: native, E: exotic, HTE: high threat exotic.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); *Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Print more copies of this sheet to allow for higher species counts at a plot. All species at a plot need to be recorded.

(3)

,1² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
ate 26.6.18		RM	JW / MS

GF Code	*Full species name mandatory, or a unique means of identifying separate taxa within a survey. Data from here will be used to assign growth form counts and covers.*	N, E or HTE	Cover	Abund	stratum	voucher
	Ehrharta erecta					
	Wahlenbergia gracilis					
	Vaingalea hirsuta					
	Araeia parviflorus					
	Eucalyptus sanguea					
	Pittosporum undulatum					
	Acacia longifolia					
	Lomandra					
	Asparagus aethiopicus					
	Pennisetum alopecuroides					
	Cortaderia selloana					
	Eucalyptus botryoides					
	Leptospermum polygalifolium					
	Ligustrum sinense					
	Ambrosia sp.					
	Eucalyptus pilularis					
	Eucalyptus saligna x botryoides					
	Plantago lanceolata					
	Ligustrum ovalifolium					
	Hedera helix (G)					
	Trachelospermum jasminoides					
	Agapanthus praecox					
	Rhopalostylis sapida					
	Ficus rubiginosa					
	Ligustrum lucidum					
	Pittosporum undulatum					
	Senecio linearifolius					
	Paspalum dilatatum					
	Cyperus eragrostis					
	Bidens pilosa					
	Lantana camara					
	Araujia sericifera					
	Solanum mauritianum					

GF Code: see Growth Form definitions In BAM Appendix 1. Identify top 3 dominants In the veg zone. N: native, E: exotic, HTE: high threat exotic.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); *Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Print more copies of this sheet to allow for higher species counts at a plot. All species at a plot need to be recorded.

400 m² plot: Sheet 1 of 1		Agreement ID	Zone ID	Plot ID	Assessor name
Date	19/09/18.	Gateway Rail		Random Meander	Mark Stubbs / Julia Hyllie.

Mill stream. between rail line and Botany Rail. Genus and species name	Cover	Abund	N / E	stratum	voucher
Planted trees.					
Lophostemon confertus ✓					
Eucalyptus citri-gallii ✓					
Acer negundo > → Acer ✓					
Richardia brasiliensis ✓					
Ricinus communis ✓					
Nasturtium (Oleander) ✓					
Ficus subincana ✓					
Asparagus plumosus ✓					
Acetosa sagittata ✓					
Alstonia sp. ✓					
Camphor laurel ✓					
Tradescantia fluminensis ✓					
Pavetta indica					
Solanum chrysotrichum ✓					
Lantana camara ✓					
Asplenium sp. ✓					
Morus alba ✓					
Senecio madagascariensis ✓					
Arundo donax ✓					
Vinca sp. ✓					
Phoenix canariensis ✓					
Tamarindus longifolia ✓					
Grevillea robusta ✓					
Asparagus declinatus ✓					
Schefflera actinophylla ✓					
Weeds Bidens pilosa ✓					
Impatiens sylvatica ✓					
Tamarindus sp. ✓					
Pittosporum undulatum ✓					
Hypericum perforatum ✓					
Schefflera sp. ✓					
Celtis sinensis ✓					
Ficus microcarpa hillii variegata ✓					
Parthenocissus ✓					

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, 300 ..., 1000, 2000, 3000 ... **N:** native, **E:** exotic

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover = leaves, branchlets and branches)
Note: 0.1% cover ~ 63 x 63 cm, 0.5% cover ~ 1.4 x 1.4 m, 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

ATTACHMENT 2 – Full-floristic data sheet

400 m² plot: Sheet _ of _	Agreement ID	Zone ID	Plot ID	Assessors
Date				

Genus and species name	Cover	Abund	N / E	stratum	voucher

Appendix D
Biodiversity Assessment Method (BAM) requirements

D1. BAM Vegetation integrity plot data

Q1			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
PCT 1234 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion - Low condition			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			39	9	2	2	2	3	0	0	30	13
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			120.4	16	8	4	2.1	1.9	0	0	104.4	80
Acacia longifolia subsp. longifolia	1	6	SG			1						
*Acacia saligna**	2	3	EX								2	
*Acetosa sagittata**	2	40	HT									2
*Ageratina adenophora**	2	15	HT									2
*Asparagus aethiopicus**	0.2	1	HT									0.2
*Bidens pilosa**	2	50	EX								2	
Casuarina glauca	3	5	TG		3							
*Cestrum parqui**	5	25	HT									5
*Chrysanthemoides monilifera subsp. rotundata**	0.8	4	HT									0.8
*Cinnamomum camphora**	2	1	HT									2
Commelina cyanea	1	50	FG					1				
*Conyza bonariensis**	0.9	20	EX								0.9	
*Conyza sumatrensis**	1	25	EX								1	
Cynodon dactylon	2	50	GG				2					
Dianella caerulea var. producta	0.7	3	FG					0.7				
*Ehrharta calycina**	0.5	30	HT									0.5
*Eragrostis curvula**	60	200	HT									60
*Foeniculum vulgare**	1	15	EX								1	
Glochidion ferdinandi var. ferdinandi	5	3	TG		5							
*Hydrocotyle bonariensis**	0.6	30	EX								0.6	
*Hypochaeris radicata**	0.8	50	EX								0.8	
*Lantana camara**	5	15	HT									5
*Ligustrum sinense**	1	1	HT									1
Microlaena stipoides var. stipoides	0.1	5	GG				0.1					
*Ochna serrulata**	0.1	1	HT									0.1
*Oxalis corniculata**	0.2	10	EX								0.2	
*Panicum maximum var. maximum**	2	50	EX								2	
*Parietaria judaica**	10	40	EX								10	
*Pelargonium x domesticum**	0.1	2	EX								0.1	
Pittosporum undulatum	3	3	SG			3						
*Plantago lanceolata**	1	25	EX								1	

Easting	33340
Northing	6243282
Orientation	263
Plot size	20 x 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	0
20-29	0
10-19	Yes
5-9	Yes
<5	Yes
Hollows	0
Length logs (m)	8
BAM Attributes 1x1 plot (%)	
Litter (%)	19

Q1 (cont.)

*Rapistrum rugosum**	0.5	5	EX								0.5				
*Ricinus communis**	1	10	HT									1			
*Rumex crispus**	0.2	2	EX								0.2				
*Senecio madagascarensis**	0.4	25	HT									0.4			
*Sida rhombifolia**	0.7	20	EX								0.7				
*Solanum americanum**	0.2	4	FG					0.2							
*Verbena bonariensis**	1	10	EX								1				
*Verbena rigida**	0.4	5	EX								0.4				

Q2			**Covers**	**Native**	Trees	Shrubs	Grass	Forb	Fern	Other	**Exotic**	HighThreat
PCT 1234 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion - Poor condition			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
			19	**6**	3	1	0	2	0	0	**13**	8
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			91.9	**80.1**	78	1	0	1.1	0	0	**11.8**	10.6
*Asparagus aethiopicus**	0.2	2	HT									0.2
*Asparagus plumosus**	0.1	2	HT									0.1
Banksia integrifolia subsp. integrifolia	3	2	TG		3							
Casuarina glauca	60	50	TG		60							
*Celtis sinensis**	0.1	1	EX								0.1	
*Cestrum parqui**	0.3	5	HT									0.3
*Conyza sumatrensis**	0.5	10	EX								0.5	
Dianella caerulea var. producta	0.9	10	FG					0.9				
*Ehrharta calycina**	2	30	HT									2
*Eragrostis curvula**	2	30	HT									2
*Lantana camara**	5	25	HT									5
Melaleuca quinquenervia	15	5	TG		15							
*Melinis repens**	0.2	5	EX								0.2	
*Pelargonium x domesticum**	0.3	10	EX								0.3	
Pittosporum undulatum	1	2	SG			1						
*Ricinus communis**	0.2	1	HT									0.2
*Senecio madagascarensis**	0.8	10	HT									0.8
*Solanum americanum**	0.2	4	FG					0.2				
*Sonchus oleraceus**	0.1	1	EX								0.1	

Easting	333311
Northing	6243280
Orientation	250
Plot size	20 x 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	0
20-29	0
10-19	Yes
5-9	Yes
<5	Yes
Hollows	0
Length logs (m)	8
BAM Attributes 1x1 plot (%)	
Litter (%)	89

Q3			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
PCT 1071 *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion - Moderate condition			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			14	6	0	0	4	1	1	0	8	4
Species	**Cover**	**Abundance**	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			109.5	100.4	0	0	95.3	5	0.1	0	10.4	8.4
*Ageratina adenophora**	0.8	30	HT									0.8
*Alternanthera philoxeroides**	5	100	HT									5
Carex appressa	0.1	2	GG				0.1					
Hypolepis muelleri	0.1	3	EG						0.1			
Isachne globosa	30	500	GG				30					
*Isolepis prolifera**	0.4	30	EX								0.4	
Juncus usitatus	0.2	10	GG				0.2					
*Morus alba**	1	1	EX								1	
Persicaria strigosa	5	100	FG					5				
*Ranunculus sceleratus**	0.2	10	EX								0.2	
*Rubus fruticosus agg.**	0.6	10	HT									0.6
*Setaria parviflora**	0.1	5	EX								0.4	
*Tradescantia fluminensis**	1	40	HT									2
Typha orientalis	65	1000	GG				65					

Easting	333516
Northing	6243313
Orientation	295
Plot size	20 x 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	0
20-29	0
10-19	0
5-9	0
<5	0
Hollows	0
Length logs (m)	0
BAM Attributes 1x1 plot (%)	
Litter (%)	0

Q4			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
PCT 1071 *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion - Moderate condition			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			14	6	0	0	5	1	0	0	10	5
Species	**Cover**	**Abundance**	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			111.9	103.8	0	0	100.8	3	0	0	10.5	8.6
*Ageratina adenophora**	0.6	20	HT									0.6
*Alternanthera philoxeroides**	5	100	HT									5
Carex appressa	0.4	10	GG				0.4					
*Conyza sumatrensis**	0.1	5	EX								0.1	
Eleocharis sphacelata	0.3	10	GG				0.3					
*Hydrocotyle bonariensis**	0.6	30	EX								0.6	
*Ipomoea cairica**	0.8	50	HT									0.8
Isachne globosa	20	500	GG				20					
Juncus usitatus	0.1	5	GG				0.1					
*Paspalum urvillei**	0.4	20	EX								0.4	
Persicaria strigosa	3	50	FG					3				
*Rubus fruticosus agg.**	0.2	10	HT								0.4	0.2
*Sonchus asper**	0.4	20	EX								0.4	2
Typha orientalis	80	1000	GG				80					

Easting	333487
Northing	6243325
Orientation	10
Plot size	20 x 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	0
20-29	0
10-19	0
5-9	0
<5	0
Hollows	0
Length logs (m)	0
BAM Attributes 1x1 plot (%)	
Litter (%)	0

Q5			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
PCT 1234 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion - Poor condition			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			15	4	3	1	0	0	0	0	11	6
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			151.6	46.8	46.4	0.4	0	0	0	0	104.8	72.2
*Acetosa sagittata**	1	20	HT									1
*Araujia sericifera**	0.1	3	HT									0.1
*Asparagus aethiopicus**	0.1	1	HT									0.1
*Bidens pilosa**	0.6	30	EX								0.6	
Casuarina glauca	45	20	TG		45							
*Celtis sinensis**	0.8	3	EX								0.8	
*Cinnamomum camphora**	1	2	HT									1
Cupaniopsis anacardioides	0.4	4	TG		0.4							
*Ehrharta erecta**	15	200	HT									15
Ficus macrophylla	1	1	TG		1							
*Lantana camara**	55	500	HT									55
*Parietaria judaica**	30	400	EX								30	
*Phoenix canariensis**	1	1	EX								1	
Pittosporum undulatum	0.4	1	SG			0.4						
*Syagrus romanzoffiana**	0.2	1	EX								0.2	

Easting	333452
Northing	6243356
Orientation	230
Plot size	20 x 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	0
Length logs (m)	8.5
BAM Attributes 1x1 plot (%)	
Litter (%)	69

Appendix E
Biodiversity credit report

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00012151/BAAS18097/18/00012152	Gateway Program - Rail EIS	24/02/2018
Assessor Name	Report Created	BAM Data version *
Mark Stables	31/10/2018	3
Assessor Number	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.	
BAAS18097		

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Candidate SAII	Ecosystem credits
Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion								
3	1071_Moderate	65.2	0.1	0.25	High Sensitivity to Potential Gain	2.00	TRUE	3
							Subtotal	**3**

BAM Credit Summary Report

Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion								
1	1234_Low	22.7	0.2	0.25	High Sensitivity to Potential Gain	2.00	TRUE	2
2	1234_Poor	25.7	0.5	0.25	High Sensitivity to Potential Gain	2.00	TRUE	6
							Subtotal	**8**
							Total	**11**

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Candidate SAII	Species credits

BAM Candidate Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00012151/BAAS18097/18/00012152	Gateway Program - Rail EIS	24/02/2018
Assessor Name	**Report Created**	**BAM Data version ***
Mark Stables	31/10/2018	3
Assessor Number	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.	
BAAS18097		

List of Species Requiring Survey

Name	Presence	Survey Months
Litoria aurea Green and Golden Bell Frog	No (surveyed)	Jan Feb Mar Nov Dec
Myotis macropus Southern Myotis	No (surveyed)	Jan Feb Mar Nov Dec
Wilsonia backhousei Narrow-leafed Wilsonia	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Zannichellia palustris Zannichellia palustris	No (surveyed)	Mar Apr May Jun Jul Aug Sep Oct Nov

List of Species Not On Site

Name
Burhinus grallarius Bush Stone-curlew
Cercartetus nanus Eastern Pygmy-possum
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern)
Chalinolobus dwyeri Large-eared Pied Bat
Cryptostylis hunteriana Leafless Tongue Orchid
Lathamus discolor Swift Parrot

Limicola falcinellus Broad-billed Sandpiper
Lophoictinia isura Square-tailed Kite
Haliaeetus leucogaster White-bellied Sea-Eagle
Miniopterus australis Little Bentwing-bat
Miniopterus schreibersii oceanensis Eastern Bentwing-bat
Ninox strenua Powerful Owl
Pandion cristatus Eastern Osprey
Petaurus norfolcensis Squirrel Glider
Phascolarctos cinereus Koala
Pteropus poliocephalus Grey-headed Flying-fox
Tyto novaehollandiae Masked Owl
Anthochaera phrygia Regent Honeyeater
Callocephalon fimbriatum Gang-gang Cockatoo
Hieraaetus morphnoides Little Eagle
Calidris ferruginea Curlew Sandpiper
Ancistrachne maidenii Ancistrachne maidenii
Calidris tenuirostris Great Knot
Limosa limosa Black-tailed Godwit
Crinia tinnula Wallum Froglet
Hoplocephalus bitorquatus Pale-headed Snake
Litoria brevipalmata Green-thighed Frog
Melaleuca biconvexa Biconvex Paperbark
Neophema chrysogaster Orange-bellied Parrot
Nettapus coromandelianus Cotton Pygmy-Goose
Turnix maculosus Red-backed Button-quail
Callocephalon fimbriatum - endangered population Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00012151/BAAS18097/18/00012152	Gateway Program - Rail EIS	24/02/2018
Assessor Name	**Report Created**	**BAM Data version ***
Mark Stables	31/10/2018	3
Assessor Number	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.	
BAAS18097		

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common Name	Scientific Name	Vegetation Types(s)
Australasian Bittern	Botaurus poiciloptilus	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
		1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Australian Painted Snipe	Rostratula australis	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
		1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Black Bittern	Ixobrychus flavicollis	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
		1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Black-tailed Godwit	Limosa limosa	1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Broad-billed Sandpiper	Limicola falcinellus	1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Curlew Sandpiper	Calidris ferruginea	1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Eastern Bentwing-bat	Miniopterus schreibersii oceanensis	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
		1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Eastern Freetail-bat	Mormopterus norfolkensis	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion

Eastern Freetail-bat	Mormopterus norfolkensis	1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Eastern Osprey	Pandion cristatus	1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Flame Robin	Petroica phoenicea	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
Gang-gang Cockatoo	Callocephalon fimbriatum	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
Great Knot	Calidris tenuirostris	1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Grey-headed Flying-fox	Pteropus poliocephalus	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
Little Bentwing-bat	Miniopterus australis	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
		1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Little Eagle	Hieraaetus morphnoides	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
		1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Little Lorikeet	Glossopsitta pusilla	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
Masked Owl	Tyto novaehollandiae	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
Powerful Owl	Ninox strenua	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
Regent Honeyeater	Anthochaera phrygia	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
Spotted Harrier	Circus assimilis	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
		1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Square-tailed Kite	Lophoictinia isura	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
		1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Superb Fruit-Dove	Ptilinopus superbus	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion

Varied Sittella	Daphoenositta chrysoptera	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
White-bellied Sea-Eagle	Haliaeetus leucogaster	1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion

Threatened species not within the area of these PCT's

Common Name	Scientific Name	Vegetation Types(s)
Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
Eastern Osprey	Pandion cristatus	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
Golden-tipped Bat	Kerivoula papuensis	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
Koala	Phascolarctos cinereus	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
Spotted-tailed Quoll	Dasyurus maculatus	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
		1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Swift Parrot	Lathamus discolor	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
Turquoise Parrot	Neophema pulchella	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
White-bellied Sea-Eagle	Haliaeetus leucogaster	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion

BAM Vegetation Zones Report

Proposal Details

Assessment Id
00012151/BAAS18097/18/00012152

Assessment name
Gateway Program - Rail EIS

BAM data last updated *
24/02/2018

Assessor Name
Mark Stables

Report Created
31/10/2018

BAM Data version *
3

Assessor Number
BAAS18097

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Vegetation Zones

#	Name	PCT	Condition	Area	Minimum number of plots	Management zones
1	1234_Low	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	Low	0.16	1	

2	1234_Poor	1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	Poor	0.46	1	
3	1071_Moderate	1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Moderate	0.1	1	

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00012151/BAAS18097/18/00012152

Proposal Name
Gateway Program - Rail EIS

BAM data last updated *
24/02/2018

Assessor Name
Mark Stables

Assessor Number
BAAS18097

BAM Data version *
3

Proponent Names

Report Created
31/10/2018

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Candidate Serious and Irreversible Impacts

Nil

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

Predicted Threatened Species Not On Site

BAM Biodiversity Credit Report (Like for like)

Name
Dasyurus maculatus / Spotted-tailed Quoll
Kerivoula papuensis / Golden-tipped Bat
Lathamus discolor / Swift Parrot
Neophema pulchella / Turquoise Parrot
Phascolarctos cinereus / Koala
Climacteris picumnus victoriae / Brown Treecreeper (eastern subspecies)

Ecosystem Credit Summary

PCT	TEC	Area	Credits
1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.6	8.00
1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.1	3.00

Credit classes for 1071	**Like-for-like options**		
	Any PCT with the below TEC	Containing HBT	In the below IBRA subregions

	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (including PCT's 780, 781, 782, 828, 1071, 1735, 1736, 1737, 1738, 1739, 1740, 1741, 1742, 1911)	No	Pittwater,Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Credit classes for 1234	**Like-for-like options**		
	Any PCT with the below TEC	Containing HBT	In the below IBRA subregions
	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (including PCT's 915, 916, 917, 918, 919, 1125, 1230, 1232, 1234, 1235, 1236, 1726, 1727, 1728, 1729, 1731, 1800, 1808)	No	Pittwater,Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

No Species Credit Data

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id
00012151/BAAS18097/18/00012152

Proposal Name
Gateway Program - Rail EIS

BAM data last updated *
24/02/2018

Assessor Name
Mark Stables

Assessor Number
BAAS18097

BAM Data version *
3

Proponent Name(s)

Report Created
31/10/2018

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Candidate Serious and Irreversible Impacts

Nil

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

Predicted Threatened Species Not On Site

BAM Biodiversity Credit Report (Variations)

Name
Dasyurus maculatus / Spotted-tailed Quoll
Kerivoula papuensis / Golden-tipped Bat
Lathamus discolor / Swift Parrot
Neophema pulchella / Turquoise Parrot
Phascolarctos cinereus / Koala
Climacteris picumnus victoriae / Brown Treecreeper (eastern subspecies)

Ecosystem Credit Summary

PCT	TEC	Area	Credits
1071-Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.1	3.00
1234-Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.6	8.00

Credit classes for 1071	**Like-for-like options**		
	Any PCT with the below TEC	Containing HBT	In the below IBRA subregions

	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (including PCT's 780, 781, 782, 828, 1071, 1735, 1736, 1737, 1738, 1739, 1740, 1741, 1742, 1911)	No	Pittwater,Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.	
	Variation options			
	Any PCT in the below Formation	And in any of below trading groups	Containing HBT	In the below IBRA regions/subregions
	Freshwater Wetlands	Tier 3 or higher	No	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Credit classes for 1234	**Like-for-like options**			
	Any PCT with the below TEC	Containing HBT	In the below IBRA subregions	
	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (including PCT's 915, 916, 917, 918, 919, 1125, 1230, 1232, 1234, 1235, 1236, 1726, 1727, 1728, 1729, 1731, 1800, 1808)	No	Pittwater,Cumberland, Sydney Cataract, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.	
	Variation options			
	Any PCT in the below Formation	And in any of below trading	Containing HBT	In the below IBRA regions/subregions

		groups		
	Forested Wetlands	Tier 2 or higher	No	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

No Species Credit Data

Biodiversity payment summary report

Assessment Id	Payment data version	Revision number	Report created
00012151/BAAS18097/19/00012152	57	0	31/05/2019

PCT list

Include	PCT common name	Credits
Yes	**1234 -** Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	8
Yes	**1071 -** Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	3

Species list

Include	Species	Credits

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

IBRA sub region	PCT common name	Baseline price	Dynamic coefficient	Market coefficient	Risk premium	Administrative cost	Methodology adjustment factor	Price per credit	No. of ecosystem credits	Final credits price
Pittwater	**1234 -** Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion **Warning: This PCT has NO trades recorded in Pittwater**	$2,523.43	0.74219770	1.29971600	19.99%	$20.00	1.0000	$1,494.19	8	$11,953.55

Biodiversity payment summary report

Pittwater	**1071 -** Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion **Warning: This PCT has NO trades recorded in Pittwater**	$5,083.85	0.74219770	1.29971600	19.99%	$20.00	1.0000	$2,499.32	3	$7,497.95

Subtotal (excl. GST)	**$19,451.50**
GST	**$1,945.15**
Total ecosystem credits (incl. GST)	**$21,396.65**

Species credits for threatened species

Species profile ID	Species	Threat status	Price per credit	Risk premium	Administrative cost	No. of species credits	Final credits price

No species available

Grand total	**$21,396.65**

Appendix F
EPBC Act assessments of significance

F1. Green and Golden Bell Frog

Green and Golden Bell Frog, a vulnerable species

According to the DoE (2013) 'significant impact criteria' for vulnerable species, an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of an important population of a species

A population of the Green and Golden Bell Frog (*Litoria aurea*) previously occurred at the Botany Wetlands, which are crossed by the project at Mill Stream. Green and Golden Bell Frogs were known to inhabit the extensive Botany Wetlands in large numbers in the 1960s. By the mid-1970s, the species had declined in abundance at Eastlakes, and also disappeared from the upper Lachlan Swamps at Centennial Park (Department of Environment and Climate Change 2008). White and Pyke (2008a) considered the species to be no longer be present in Botany Wetlands, with the last record being 1993. Ponds and other frog habitats were created at Sir Joseph Banks Park at Botany (about 1 kilometre to the south of the project) and individuals were translocated into these habitats in 1996, 1997, 1999 and 2000. Translocations were unsuccessful due to the presence of Mosquitofish (*Gambusia holbrooki*), lack of shelter sites and competition from other frogs (White and Pyke 2008b). Despite this, there are records of the Green and Golden Bell Frog from Sir Joseph Banks Park from 2007 (Office of Environment and Heritage 2018b), suggesting that the population had persisted longer than thought.

The mapped distribution of the Green and Golden Bell Frog Lower Cooks River key population includes the Botany Wetlands, as well as the Marsh Street wetlands 2 kilometres west of the project site. The species still occurs in the Arncliffe area (Marsh Street, Eve Street and Barton Park wetlands). The Marsh Street wetland population is being monitored as part of the Westconnex New M5 project, although there have only been low numbers of individuals (<10) recorded in recent years (Ecological 2017). Connectivity between the Marsh Street wetlands and Botany Wetlands is limited. The Cooks River, roads, rail line, and large areas of industrial land are barriers to movement of the species.

A collection of ponds and wetlands are associated with Mill Stream, with different ponds numbered and named by Sydney Water. Mill Pond is crossed by Botany Road, and is characterised by large expanses of open water, with areas of submerged aquatic plants and fringing reeds, as well as large areas of exotic plants. Upstream of the rail bridge Mill Stream is a narrow creek running between the golf club and reedbeds of New Pond and widens out into a larger pool in Pond 1A. Downstream of the rail bridge Mill Stream again open out into a large pond, dominated, by the submerged aquatic plant *Myriophyllum*. Extensive reed beds dominated by *Typha orientalis* (Cambungi), *Isachne globosa* (Swamp Millet) and *Persicaria strigosa* (Spotted Knotweed) occur in New Pond, located immediately upstream of the rail line adjacent to East Lakes Golf Club, and further upstream in Pond 1A and Pond 1, also located adjacent to Eastlakes Golf Club. The reed beds were predominantly dry during surveys in early September 2018. In surveys conducted in later September that followed heavy rains, small pools were observed within these reedbeds, however these were dry in late October.

Targeted Green and Golden Bell Frog surveys conducted at Botany Wetland for the project over September and October 2018. Surveys were conducted at Mill Pond (between the rail corridor and Botany Road), the large reed bed in New Pond immediately to the north of the rail corridor, and a smaller reedbed in Pond 1A, as well as along the edges of Mill Stream. Surveys occurred following heavy falls of rain and/or on warm and windless nights. No evidence of the Green and Golden Bell Frog was recorded, however common frog species were active at the site. A small backwater of Pond 1A about 200 metres upstream of the rail bridge contained a small population of the Common Eastern Froglet (*Crinia signifera*). These were heard calling on all nights of survey. On warmer nights Eastern Dwarf Tree Frogs were also heard calling and observed on reeds along the edges of Mill Stream and in the reed bed of Pond 1A, and along the edges of Mill Pond downstream of the rail bed. No frogs of any species were heard calling in the reed bed of New Pond immediately upstream of the rail bridge. On all nights surveys were also conducted at Tempe Wetland, which is located between the extant population and the Botany Wetlands. At this location high levels of chorusing of the Common Eastern Froglet, Eastern Dwarf Tree Frog, Peron's Tree Frog (*Litoria peronii*) and Striped Marsh Frog (*Limnodynastes peronii*) was recorded on all nights. In addition, Striped Marsh Frog and Peron's Tree Frog were recorded foraging during surveys on the 11, 18 and 30 October. High levels of activity at this location showed that survey conditions were suitable during the survey period.

The Green and Golden Bell Frog has not been recorded at Botany Wetland since 1993 (OEH 2018a, White and Pyke 2008a), which is around the same time that Chytrid fungus was discovered in Australia. The Green and Golden Bell Frog has undergone significant declines as a result of this fungus. SMEC (2018) concluded that the Green and Golden Bell Frog was unlikely to be present at Botany Wetland, due to the presence of Mosquitofish (*Gambusia hobrooki*) and high levels of disturbance and pollution. Recent research has suggested that saline conditions may inhibit the fungus (Stockwell et al 2014), and that the Common Eastern Froglet may be a carrier of Chytrid fungus (Brannelly et al 2018). The likely presence of Chytrid fungus, presence of a carrier species and predatory Mosquitofish and high levels of pollution together with freshwater conditions likely all contribute to the ongoing absence of the Green and Golden Bell Frog at Botany Wetlands.

Green and Golden Bell Frog, a vulnerable species
Based on the historic extinction of the species in the Botany area, and lack of any evidence of the species during targeted surveys over 2017 and 2018, limited connectivity with extant populations and low number of individuals recorded at the extant populations, the Green and Golden Bell Frog is highly unlikely to be present in the project site. There would be minimal direct impacts on potential habitat (removal of 0.1 hectare of freshwater wetland habitat and 0.6 ha of Swamp Oak forest, as well as the removal of small areas of exotic vegetation). Better quality potential habitat is located in the area of freshwater wetland with emergent vegetation which extends for about one kilometre upstream from the rail bridge. Construction may disturb contaminated soils that could then reduce water quality in downstream areas. No extant population is known to occur downstream of the rail corridor. There would be limited if any impacts on the areas of potential habitat upstream. Any direct or indirect impacts on vegetation or water quality at this location are therefore unlikely to result in a substantial impact on potential habitat for the species. Given the lack of evidence of the species at Botany Wetland for 25 years, negligible area of direct impact, the project is unlikely to lead to a long-term decrease in the size of an important population of a species.
Reduce the area of occupancy of an important population
The area of mapped habitat includes the botany wetlands but it is not considered to be occupied anymore by the species. The loss of 0.7 hectares of native vegetation at Botany Wetland would not reduce the area of occupancy of the important population. The project would not impact any areas where the species is known to persist.
Fragment an existing important population into two or more populations
Connections between the various parts of the population's habitat areas are exceedingly tenuous. The area around Sydney Airport is a highly industrial area, with large areas of buildings, hardstand, roads and rail lines. Few vegetated corridors are present, and these do not connect any areas of potential habitat to each other. The project would not impact any areas where the species is known to persist. The loss of 0.7 hectares of native vegetation at Botany Wetland would not fragment the existing population into two or more populations.
Adversely affect habitat critical to the survival of a species
The Green and Golden Bell Frog inhabits marshes, dams and stream-sides, particularly those containing bullrushes (Typha spp.). Optimum breeding habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (Gambusia holbrooki), have a grassy area nearby and diurnal sheltering sites available (OEH 2018b). Habitat critical to the survival of the key population would include known breeding sites at Arncliffe and Rosebery. The 0.7 hectares of native vegetation at Botany Wetland that would be removed would not be critical to the survival of the species, given that there has been no evidence of the species at this location for 25 years, and the areas of better quality habitat are located upstream of the project.
Disrupt the breeding cycle of an important population
Given that there would be no impacts on habitat at Arncliffe or Rosebery, impacts on breeding habitat are highly unlikely to occur. There has been no evidence of the Green and Golden Bell Frog at Botany Wetlands for 25 years. The loss of 0.7 ha of habitat at this location would not disrupt the breeding cycle of the important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
There would be minimal direct impacts on potential habitat (removal of 0.1 hectare of freshwater wetland habitat and 0.6 ha of Swamp Oak forest, as well as the removal of small areas of exotic vegetation). The main area of freshwater wetland with emergent vegetation extends for about one kilometre upstream from the rail bridge and is unlikely to be affected by the project. Construction may disturb contaminated soils that could then reduce water quality in downstream areas. No extant population is known to occur downstream of the rail corridor. Any direct or indirect impacts on vegetation or water quality at this location are unlikely to result in a substantial impact on potential habitat for the species. The project would not impact any areas where the species is known to persist. Given the lack of evidence of the species at Botany Wetland for 25 years, negligible area of direct impact, lack of impact on known breeding sites, and lack of impact on any movement corridors the project is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Green and Golden Bell Frog, a vulnerable species

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The project site is located in a highly modified industrial area. Large numbers of exotic species already occur. Introduction of new invasive species that may impact habitat for the Green and Golden Bell Frog is unlikely.

Introduce disease that may cause the species to decline

The project has the potential to spread Chytrid fungus in the project site through contaminated vehicles or equipment. This fungus is generally accepted to have spread throughout coastal NSW and so it is highly unlikely that the project would result in a novel introduction of the fungus. The project would not introduce the disease into any known areas of occupied habitat.

Interfere substantially with the recovery of the species

The objectives of the recovery plan are initially to stabilise and prevent further decline of the species, and secondly to return the species to its former distribution, abundance and role in the ecosystem where-ever possible. The second part is highly dependent on the success of the initial objective (DEC 2015). Specific actions include:

- preventing the further loss of GGBF habitat at key populations across the species range and where possible secure opportunities for increasing protection of habitat areas
- ensure extant GGBF populations are managed to eliminate or attenuate the operation of factors that are known or discovered to be detrimentally affecting the species
- implement habitat management initiatives.

The project will result in the loss of a very small area of wetland habitat from a location where the species is considered to be extinct. The project would not impact any areas where the species is known to persist. The project is therefore unlikely to interfere with the recovery of the species.

Conclusion

The project is unlikely to have a significant impact on the Green and Golden Bell Frog as:

- there would be no impact on any occupied habitat of the key population.
- direct impacts are limited to the removal of small area of vegetation in an area where the species is extinct.

There would be no permanent fragmentation or isolation of occupied habitat, and dispersal of the species would not be disrupted.

F2. Grey-headed Flying-fox

Grey-headed Flying-fox

According to the DotE (2013) 'significant impact criteria' for vulnerable species, an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of an important population of a species

All of the Grey-headed Flying-fox populations in eastern NSW are linked and hence can be considered one important population.

The project site does not contain any diurnal roost sites or breeding camps for the Grey-headed Flying-fox and the project will not have a direct impact on any such features in the wider locality. Life-cycle characteristics of the population that are considered pertinent to the proposed action relate to the potential loss of critical foraging habitat within a 50 kilometre radius of local camps which takes in the project study area. This is the expected maximum foraging distance of the species from roost sites (Eby 1996).

Foraging habitat for the Grey-headed Flying-fox in the project site comprises planted trees such as eucalypts and figs. Individuals from various roost camps are likely to forage in the study area on an opportunistic basis when food trees are flowering or fruiting. The project would remove about 1.89 hectares of planted trees that may be used as a foraging resource by the Grey-headed Flying-fox. More extensive areas of higher quality foraging habitat, including patches of intact native vegetation are present in the wider locality, such as Wolli Creek and Centennial Park. Planted trees throughout the local suburbs also provide foraging habitat for the species.

Whilst Grey-headed Flying-foxes are likely to forage in the project site on occasion, the small patches of planted vegetation to be removed comprise only a small component of that available in the wider locality, and are not likely to comprise habitat critical to the survival of the local population as discussed below. The vegetation within the project site occurs as isolated patches within an already highly fragmented urban landscape and the project will not create a barrier to the movements of the Grey-headed Flying-foxes between roost camps and foraging grounds.

Given the above considerations, the project is highly unlikely to result in a long term decline in an important population of the species.

Reduce the area of occupancy of an important population

The project will not directly impact on any known roost camps in the locality. The impacts of construction of the project on the Grey-headed Flying-fox population would be primarily confined to loss of foraging habitat caused by clearing or damage to planted trees during the construction phase. No impacts are anticipated during operation.

The project would result in the loss of about 1.89 hectares of planted trees that contains food trees for the Grey-headed Flying-fox. This vegetation represents a minor proportion of the foraging habitat available in a 50 kilometre radius of local camps sites for the Grey-headed Flying-fox.

The project will not affect the ability of this highly mobile and wide-ranging species to move between local camps and foraging habitats. Extensive areas of habitat are present in the locality and wider area, including various national parks and reserves throughout Sydney, as well as planted trees in residential areas. Given the widespread nature and abundance of potential foraging habitat within the feeding range of the local population, the project is not expected to substantially reduce the area of occupancy of an important population of the Grey-headed Flying-fox.

Fragment an existing important population into two or more populations

The project will not affect a breeding camp of diurnal roost site of the important population of the Grey-headed Flying-fox, and will not fragment the population in any way. The project will not form a barrier to the movement of the species between any local camps or roosts and foraging habitat in the locality.

The Grey-headed Flying-fox is a highly mobile species that is capable of accessing isolated patches of foraging habitat within urban areas. Any such habitat within the study area exists as small, isolated patches that are already fragmented from any large extensive patches of high-quality or important foraging habitat.

The project would therefore not fragment an existing important population of the Grey-headed Flying-fox into two or more populations.

Grey-headed Flying-fox

Adversely affect habitat critical to the survival of a species

Grey-headed Flying-foxes require a continuous temporal sequence of productive foraging habitats, linked by migration corridors or stopover habitats, and suitable roosting habitat within nightly commuting distance of foraging areas. All foraging habitat has the potential to be productive during general food shortages and therefore provide a critical resource (DEE 2017).

No breeding camps are present in the project site and there would be no direct impact to any Grey-headed Flying-fox camp sites.

The project would result in the removal of patches of planted vegetation along the edges of existing roads from within an urban environment. Grey-headed Flying-foxes would forage in the area on an opportunistic basis when trees are flowering or fruiting. Additional foraging habitat is present in planted vegetation throughout the locality.

The area of habitat loss caused by the project represents a minor proportion of available habitat present within 50 kilometre radius of local camps. As such, the project is unlikely to adversely affect habitat critical to the survival of the species.

Disrupt the breeding cycle of an important population

The project site does not contain any Grey-headed Flying-fox camp sites and none will be affected by the project. The project will not form a barrier to the movement of Grey-headed Flying-foxes between any local camps and foraging habitat throughout the locality.

The project would remove about 1.89 hectares of planted trees. This total is made up of small, isolated patches of planted vegetation, typically distributed in linear patches along the edges of existing roads, which is not considered habitat critical to the survival of a local population. This represents a minor proportion of the potential foraging habitat for the Grey-headed Flying-fox within a 50 km radius of local roost camps. The loss of this foraging habitat is not likely to disrupt the breeding cycle of the local population of this highly mobile species.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The area of habitat loss associated with the project represents a minor proportion of the potential foraging habitat for the Grey-headed Flying-fox within a 50 kilometre radius of local roost camps and will not isolate areas of foraging habitat for this highly mobile species though this already highly urbanised landscape.

The project will not directly impact on any local roost camps. The loss and/or modification of foraging habitat is not likely to disrupt the breeding cycle of the local population of this highly mobile species given the extent of suitable foraging habitat within a 50 kilometre radius of local camps.

Given the above considerations the proposed action is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat for the Grey-headed Flying-fox to the extent that the species is like to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The project is not likely to introduce new feral animals to the area or encourage the spread of feral animals.

The project will not result in or cause the spread of any weed or invasive species in any areas of native vegetation that may provide habitat critical to the Grey-headed Flying-fox in the locality.

Introduce disease that may cause the species to decline

There are no known diseases affecting this species that are of relevance to the project. The project would be unlikely to increase the potential for significant disease vectors to affect this species.

Grey-headed Flying-fox

Interfere substantially with the recovery of the species

The project would not remove habitat critical to the survival of the species. The project would not directly impact on any local roost camps for the local population and no impacts on the breeding success of the local population are anticipated.

The draft recovery plan for the Grey-headed Flying-fox (DEE 2017) identifies the protection of foraging resources as a key recovery objective. The project is located in a highly urbanised environment, and would involve the removal of small, linear patches of planted trees. This habitat loss represents a minor proportion of the potential foraging habitat for the Grey-headed Flying-fox within a 50 kilometre radius of local roost camps. As such, the removal and modification of this foraging habitat is not likely to interfere with the recovery of the species.

Conclusion

The project is unlikely to have a significant impact on the Grey-headed Flying-fox as:

- the project is located in a highly urbanised environment
- no breeding camps would be directly impacted
- removal of foraging habitat is restricted to 1.89 hectares, comprising small patches of planted trees located along existing urban roads
- this habitat loss represents a minor proportion of the potential foraging habitat for the Grey-headed Flying-fox within a 50 kilometre radius of local roost camps
- it would not impact movements between breeding camps and foraging grounds.

F3. Impacts on plants and animals in Commonwealth land

Impacts on plants

Is there a real chance or possibility that the action will:

involve medium or large-scale native vegetation clearance

The project would predominantly impact already cleared hardstand areas with no biodiversity value. In total, the project would remove about 0.72 hectares of native vegetation from a total impact area of 8.12 hectares. Impacts on Commonwealth land comprise the removal of 0.1 hectare of urban exotic / native landscape plantings.

involve any clearance of any vegetation containing a listed threatened species which is likely to result in a long-term decline in a population or which threatens the viability of the species

No threatened flora species listed under the EPBC Act or BC Act were recorded or are considered likely to occur in the project site.

introduce potentially invasive species

The project site and adjoining land has been extensively cleared for the Sydney Airport and industrial and urban development. Of the 137 introduced species recorded within the study area, 13 species are listed under the NSW *Biosecurity Act 2015* as priority weeds for the Greater Sydney region (DPI 2018) and eight are also listed as Weeds of National Significance (Australian Weeds Committee, 2018). No new weeds are likely to be introduced as a result of the project. A weed management plan would be developed to manage weeds during the construction phase of the project. This would include the management and disposal of the weeds that were recorded within the project site, as well as management of novel impacts.

involve the use of chemicals which substantially stunt the growth of native vegetation, or

The project would not include the use of chemicals that would substantially stunt the growth of native vegetation in the wider area.

involve large-scale controlled burning or any controlled burning in sensitive areas, including areas which contain listed threatened species?

Controlled burning is not proposed as part of the project.

Impacts on animals

Is there a real chance or possibility that the action will:

cause a long-term decrease in, or threaten the viability of, a native animal population or populations, through death, injury or other harm to individuals

The project would predominantly impact already cleared hardstand areas with no biodiversity value. Terrestrial fauna habitats comprise small patches of native vegetation, planted trees and patches of thickets of weeds such as Lantana. Aquatic habitats include Mill Stream, which is crossed by the project site, and Alexandra Canal, located downstream of the project site. Fauna habitats occur as small fragments within a highly modified landscape. Most fauna present are common and mobile species. The project is unlikely to cause a long-term decrease in, or threaten the viability of, any native animal populations.

displace or substantially limit the movement or dispersal of native animal populations

Most fauna that occur are mobile and likely move between patches of fragmented and isolated habitat. The project will not affect these movements. The loss of small, disturbed fragments of predominantly non-native vegetation would not result in the displacement of fauna populations or impacts their movement or dispersal.

substantially reduce or fragment available habitat for native species;
The project would remove about 0.72 hectares of native vegetation, and 7.42 hectares of planted trees and exotic species, and this is already fragmented into small patches. Fauna habitats occur as small fragments within a highly modified landscape. The loss of small, fragmented patches of predominantly non-native vegetation would not substantially reduce or fragment available habitat for native species.
reduce or fragment available habitat for listed threatened species which is likely to displace a population, result in a long-term decline in a population, or threaten the viability of the species.
One threatened species listed under the EPBC Act, the Grey-headed Flying-fox, was recorded in the study area. The project would remove a very small area of planted trees that would comprise foraging habitat for this species. No breeding camps would be impacted. The population would not be displaced or have its viability reduced as a result of the project. No other threatened species listed under the EPBC Act are likely to be impacted by the project.
introduce exotic species which will substantially reduce habitat or resources for native species, or
No exotic species would be introduced that would substantially reduce habitat or resources for native species.
undertake large-scale controlled burning or any controlled burning in areas containing listed threatened species?
Controlled burning is not proposed as part of the project.
Conclusion
The project would have limited impacts on habitat for native flora and fauna or their habitat.

ARTC

G2SJV Gateway to Sydney Joint Venture
WSP Australia Pty Limited and GHD Pty Ltd

ABN: 55 836 411 311

Project Office
Level 27 Ernst & Young Centre
680 George Street
Sydney NSW 2000

GPO Box 5394
Sydney NSW 2001

Tel: +61 2 9272 5100
Fax: +61 2 9272 5101