Figure 4-4 Groundwater-dependent ecosystems in the vicinity of the Proposal

4.8 Fauna habitat

4.8.1 Terrestrial habitats

Terrestrial fauna habitats in the development site were generally limited. The development site comprised three broad terrestrial fauna habitat types: urban areas, woodland, disturbed shrubland. Fauna habitat features within each habitat type are described below and mapped in Figure 4-5.

Woodland

Woodland habitats occur in the road reserve of Rees James Road, HWC land, Kings Hill URA and isolated patches in the southern compounds. These areas typically contain scattered eucalypts with a grassy understorey and low shrub density, though vary in vegetative cover, habitat features and weed incursion/disturbance. Habitat features of woodland vegetation are described at each general location below.

Five hollow-bearing trees were identified in the woodland vegetation in the development site and three directly adjacent. Hollow-bearing tree locations are shown in Figure 4-5. Characteristics of hollows dictate their suitability for different fauna groups or species. Hollow-dependent fauna are defined as species that rely on tree hollows for shelter, roosting, or nesting at some stage in their life cycle (Moloney et al., 2002). Several hollow-dependent species occur in the development site, including Laughing Kookaburra *(Dacelo novaeguineae*) and Rainbow Lorikeet (*Trichoglossus moluccanus*). Small hollows (< 5cm diameter), cracks and fissures offer potential roosting habitat to microbats.

Hollow-bearing trees offer potential breeding and/or roosting habitat to locally occurring threatened species including; Dusky Woodswallow, Glossy Black-Cockatoo, Brown Treecreeper, Little Lorikeet, Squirrel Glider, Brush-tailed Phascogale and hollow-roosting microbats.

Central and southern compounds

Small isolated pockets of woodland were found within the central and southernmost compound sites. They contain planted eucalypts and pines with a dense shrubby understorey dominated by exotic species, including fruiting trees that provide foraging resources and shelter to arboreal and ground fauna. No hollow-bearing trees were identified. Woodland patches are surrounded by disturbed shrubland with high weed incursion and are otherwise isolated from any other patches of bushland in the landscape by surrounding roads.

Rees James Road

The road reserve of Rees James Road contains mature and regenerating eucalypts and occasional casuarinas/allocasuarinas and mistletoe providing a foraging resource for arboreal fauna. Koala (*Phascolarctos cinereus*) feed tree species including *E. tereticornis, E. punctata* and *E. moluccana* occur in densities >20% in places. A moderate cover of shrubs and native grasses are present providing foraging habitat and shelter for ground-dwelling fauna and birds such as Willie Wagtail (*Rhipidura leucophrys*) and White-browed Srubwren (*Sericornis frontalis*). Fallen timber is in high abundance and leaf litter is dense in most places. Occasional hollow-bearing trees are present though they are in low abundances and no signs of use were present.

Kings Hill URA/HWC land

The Kings Hill URA and HWC land contains mature and regenerating eucalypts with a disturbed grassy understorey. The secondary Koala feed tree *E. moluccana* occurred in densities around 10-15% of the canopy in Kings Hill URA and the majority of the canopy on HWC land. *E. tereticornis* were present in very low densities in Kings Hill URA. Eucalypts and occasional mistletoe provide a foraging and shelter resource for fauna, including threatened species such as Grey-headed Flying-fox (*Pteropus poliocephalus*) and Koala, though hollow-bearing trees are rare. Two hollow-bearing trees, one of which is a stag, were

recorded in the Kings Hill URA. Shrubs are largely absent and groundcover and vegetative diversity is very low due to heavy disturbance by cattle grazing in Kings Hill URA and slashing/vegetative maintenance in HWC land.

Plate 10: Woodland habitat in the southern compounds

Plate 11: Woodland habitat in Rees James Road with *E. tereticornis* present in the canopy

Plate 12: Woodland habitat in Kings Hill URA

Plate 13: Woodland habitat in HWC land

Disturbed grassland/shrubland

Disturbed grassland/shrubland occurs in the potential compounds and road reserves, HWC land and Kings Hill URA. Open expanses of slashed grasses with minimal fauna habitat value occur with exotic shrub encroachment in patches. Dense grass and shrubs (e.g. blackberry), provide cover and foraging habitat for fauna species adapted to disturbed environments such as rabbits (*Oryctolagus cuniculus*) and superb fairy-wren (*Malurus cyaneus*). Rabbit diggings were observed in the potential compounds. Minor ephemeral drainage lines and soaks are present in the compounds and HWC land which have small patches of emergent vegetation (*Typha* sp.). They provide habitat for frogs including eastern dwarf tree frog (*Litoria fallax*).

Plate 14: Disturbed grassland/shrubland in potential compound

Plate 15: Drainage line in potential compound

Plate 16: Blackberry cover in HWC land

Plate 17: Drainage channel in HWC land

Urban vegetation

Urban vegetation occurs mostly in the southern extent of the development site and contains planted roadside trees and shrubs and parkland vegetation. Urban vegetation is found in Boomerang Park and the kerbside vegetation of Adelaide Street and Rees James Road.

Boomerang Park contains tall planted eucalypts, pines and native shrubs with a mown grassy understorey. Kerbside vegetation in Adelaide Street and Rees James Road includes planted street trees and shrubs. Mature trees and shrubs provide foraging and nesting habitat for urbanised fauna such as Little Corellas (*Cacatua sanguinea*) and Noisy Miners (*Manorina melanocephala*). One hollow-bearing tree was identified in Adelaide Street with a medium sized hollow which had signs of use. It is located on the edge of the development site in a residential property. Several hollow-bearing trees and are located just outside the development site along Rees James Road. These contain small to large hollows providing habitat for arboreal fauna. Further, several nest boxes have been installed on planted trees in a small strip of the road reserve and adjacent residential land at James Rees Road.

Plate 18: Boomerang Park

Plate 19: Planted trees on Rees James Road

Plate 20: Nest boxes on Rees James Road

Plate 21: Hollow-bearing tree on Adelaide Street

Figure 4-5 Fauna habitats identified in the development site

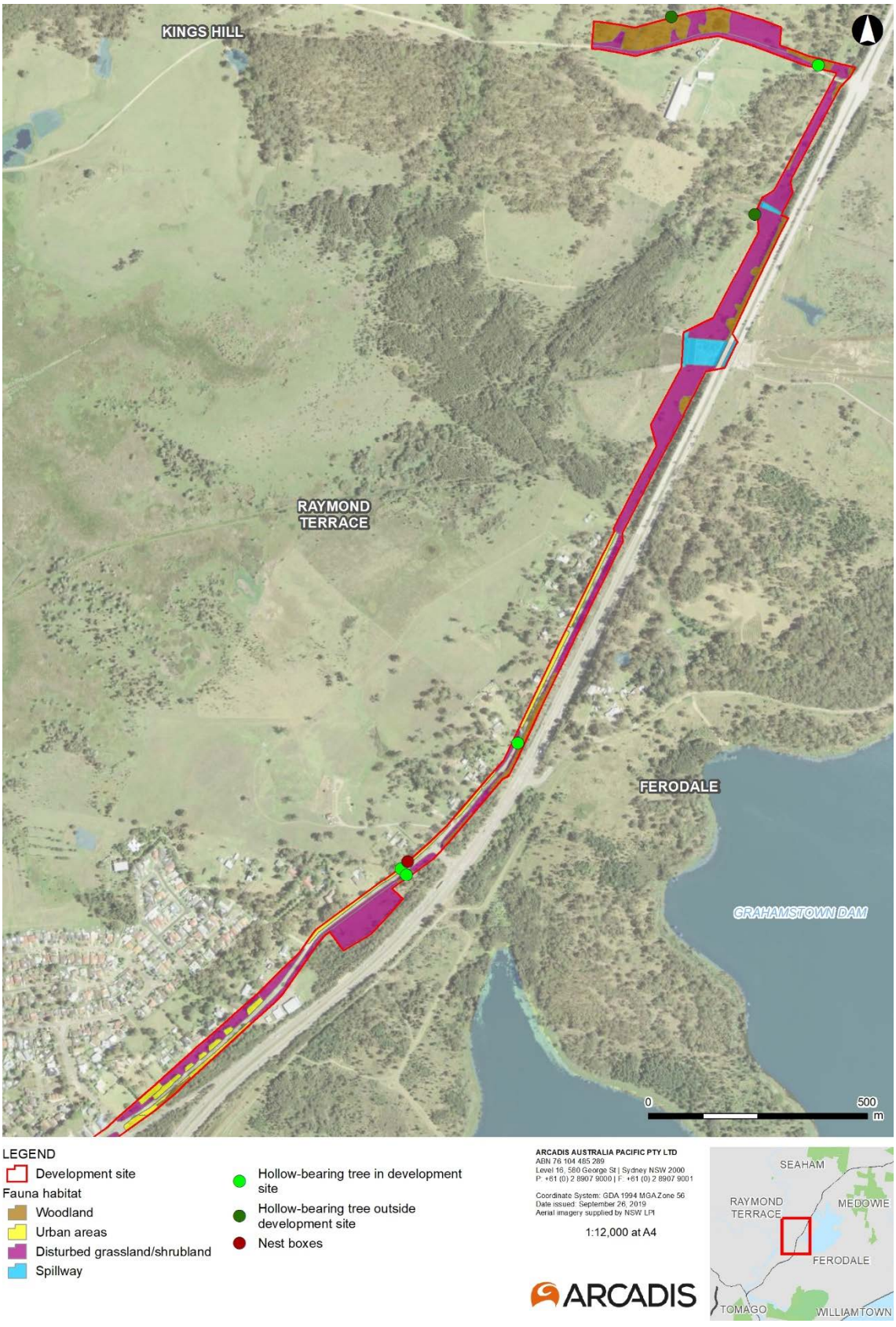

Figure 4-5 Fauna habitats identified in the development site

4.8.2 Aquatic habitats

Aquatic habitats in the development site are limited to mapped second order ephemeral streams (see Section 3.5 and Figure 1-2). Several minor unmapped ephemeral drainage lines and soaks occur, as discussed in Section 4.8.1, which are unlikely to provide habitat for fish. The development site crosses three mapped watercourses, two of which have been created by the operating Grahamstown Spillway and the obsolete Irrawang Spillway and are part of the Pennington Drain (Figure 3-1). Pennington Drain is a large open channel, constructed centrally through Irrawang Swamp in the 1970's as a component of the initial Grahamstown Dam construction works to efficiently convey spillway flows through the swamp to the Williams River (Alluvium, 2019). The third watercourse, the Kings Hill URA watercourse, is from the Kings Hill URA area draining from the north (part of the Kings Hill South sub-catchment area). The Irrawang spillway is a concrete-lined channel conveying flow from a drainage channel on HWC-land from the east of the Pacific Motorway. The spillway is disused and flow from Grahamstown Dam is directed to the Grahamstown Spillway further south, severing fish habitat connectivity between the channel feeding into the Irrawang Spillway and Grahamstown Dam. Key Fish Habitat has been mapped at the Irrawang spillway (Figure 3-1). However, it is considered Type 3 – Minimally sensitive key fish habitat and Class 3 – Minimal key fish habitat in accordance with DPI's Policy and guidelines for fish habitat conservation and management (2013 update) (DPI, 2013). A second order channel feeds into Irrawang Spillway near the development site. At this location, the channel is about 13 metres wide with an open pool at the spillway edge and exotic grasses and shrubs occurring on the channel and banks. The channel is considered Type 2 – moderately sensitive key fish habitat and Class 3 – Minimal key fish habitat in accordance with DPI's Policy and guidelines for fish habitat conservation and management (2013 update) (DPI, 2013).

A second order channel flows from Grahamstown Spillway near the development site. At this location, the channel is about 60 metres wide and contains emergent vegetation and scattered casuarinas with open pools at the spillway edge. The banks are steep and graded and covered in large rock. The channel is considered Type 1 – highly sensitive key fish habitat and Class 2 – Moderate key fish habitat in accordance with DPI's Policy and guidelines for fish habitat conservation and management (2013 update) (DPI, 2013).

Plate 22: Second order stream on Kings Hill URA (outside of the development site) view downstream

Plate 23: Grahamstown Dam spillway

Plate 24: Irrawang spillway

4.9 Irrawang Swamp

Irrawang Swamp is located directly west of the development site where it passes through HWC land just north of Rees James Road. Irrawang Swamp is identified as a Coastal Wetland (I.D. 36586) under the Coastal Management SEPP. As discussed in section 3.6, the overlap of mapping of this Coastal Wetland with the development site is likely due to inaccuracies with the eastern boundary mapping. Wetland vegetation associated with Irrawang Swamp is approximately 30 metres from the development site at its closest point. Irrawang Swamp is characterised by a mosaic of ephemeral freshwater wetland, semi-permanent freshwater wetland, *Casuarina glauca* (Swamp Oak) Forest and wet pasture, from which native vegetation has been largely cleared for livestock grazing. Water bodies within the Irrawang Swamp study area do not hold water continuously, and Irrawang Swamp hydrology is currently dominated by surface runoff inflows from the local catchments (BIOCM, 2017).

Vegetation Types

Three vegetation types, including two TECs, were identified in Irrawang Swamp by BIOCM (2017):

- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions Endangered Ecological Community (EEC)
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC
- Wet pasture.

Alluvium (2019) with reference to Kleinfelder (2018) identified the following vegetation communities:

- Swamp Meadow Complex (Perennial, Seasonal and Transient Swamp Meadows) – equivalent to Freshwater Wetlands EEC (recorded by BIOCM)
- Swamp Oak Woodland – equivalent to Swamp Oak Floodplain Forest EEC (recorded by BIOCM)
- Paperbark Woodland – equivalent to Swamp Sclerophyll Forest EEC (not recorded by BIOCM).

Threatened flora species

No threatened flora species were recorded in the Irrawang Swamp study area during surveys by BIOCM (2017) or Alluvium (2019), however BIOCM recorded suitable habitat for two threatened flora species (Table 4-13 Threatened fauna species for which Irrawang Swamp support potential habitat).

Table 4-12 Threatened flora species for which Irrawang Swamp supports potential habitat

Scientific Name	Common Name	Status under BC Act	Status under EPBC Act
Maundia triglochinoides	-	Vulnerable	-
Persicaria elatior	Tall Knotweed	Vulnerable	Vulnerable

Threatened fauna species

Alluvium (2019) did not identify any threatened fauna species at Irrawang Swamp. BIOCM (2017) determined that Irrawang Swamp supports potential habitat for at least eight locally threatened fauna species listed under the BC Act, and two threatened and migratory fauna species listed under the EPBC Act that have a high to moderate probability of using the

swamp on a temporary or permanent basis. Additionally, several threatened species were identified in Irrawang Swamp during recent surveys by RPS (pers comm. Mark Aitkens (Principal Ecologist, RPS)). All threatened species with the potential to occur are included in Table 4-13 Threatened fauna species for which Irrawang Swamp support potential habitat.

Table 4-13 Threatened fauna species for which Irrawang Swamp support potential habitat

Scientific Name	Common Name	Status under BC Act	Status under EPBC Act
Ephippiorhynchus asiaticus	Black-necked Stork	Endangered	-
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Vulnerable	-
Gallinago hardwickii	Latham's Snipe	-	Migratory
Haliaeetus leucogaster	White-bellied Sea Eagle	Vulnerable	
Lophoictinia isura	Square-tailed Kite	Vulnerable	
Miniopterus australis	Little Bent-winged Bat	Vulnerable	-
Miniopterus orianae oceanensis	Large Bent-winged Bat	Vulnerable	-
Pandion cristatus	Eastern Osprey	Vulnerable	-
Phascolarctos cinereus	Koala	Vulnerable	Vulnerable
Pomatostomus temporalis temporalis	Grey-crowned Babbler	Vulnerable	-
Scoteanax rueppellii	Greater Broad-nosed Bat	Vulnerable	-
Tyto novaehollandiae	Masked Owl	Vulnerable	-

5 THREATENED SPECIES

5.1 Flora

5.1.1 Species credit species

A total of 39 threatened flora species (species credit species) listed under the BC Act and/or EPBC Act have been identified for assessment in the BAMC and database searches. A likelihood of occurrence assessment was undertaken for each species and is provided in Appendix D. One threatened flora species, *Callistemon linearifolius,* is considered to have a moderate likelihood of occurrence on the development site based on the presence of marginal suitable habitat and nearby records of the species. The area of potential suitable habitat for the species within the development site is small, comprising the patches of PCTs 1590 and 1600 in moderate condition in the north of the development site.

All other threatened flora species are considered to have a low likelihood of occurrence in the development site, based on the lack of suitable potential habitat for the species and therefore were not considered as candidate species (Appendix D). No threatened flora species were recorded in the development site.

Table 5-1 Candidate threatened flora species

Common name	BC Act status	EPBC Act status	Sensitivity to gain class	Biodiversity risk weighting	Likelihood of occurrence	Targeted surveys
Callistemon linearifolius	V	-	High	2.00	Moderate.	Four days of intensive vegetation and flora surveys including targeted searches for the species.

Targeted searches during the survey period identified in the BAMC (October-January) for *Callistemon linearifolius* did not identify it as occurring on or near the development site, therefore it was discounted from further assessment.

5.2 Fauna

5.2.1 Species credit species

The BAMC identified 18 candidate threatened fauna species credit species and 14 threatened fauna species to which both species and ecosystem credits may apply. Fifty-three threatened fauna species credit species listed under the BC Act have been identified for assessment from the BAMC and database searches combined. A likelihood of occurrence assessment was undertaken for each species and is provided in Appendix D. Species restricted to marine and estuarine environments have been excluded from assessment. All threatened fauna species considered to have a low likelihood of occurrence in the development site were not considered as candidate species.

Three species credit species were recorded during field surveys including:

- Little Bentwing-Bat (*Miniopterus australis*)
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*)

- Grey-headed Flying-fox (*Pteropus poliocephalus*)

Southern Myotis (*Myotis macropus*), also a species credit species, was potentially recorded in the development site on the Anabat, though may be confused with a *Nyctophilus* sp. whose call profile is very similar.

Of the remaining candidate threatened fauna species, the following eight species were considered highly or moderately likely to occur in the development site:

- Regent Honeyeater (*Anthochaera phrygia*)
- Glossy Black-Cockatoo (*Calyptorhynchus lathami*)
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*)
- Little Eagle (*Hieraaetus morphnoides*)
- Swift Parrot (*Lathamus discolor*)
- Square-tailed Kite (*Lophoictinia isura*)
- Powerful Owl (*Ninox strenua*)
- Masked Owl (*Tyto novaehollandiae*)
- Squirrel Glider (*Petaurus norfolcensis*)
- Brush-tailed Phascogale (*Phascogale tapoatafa*)
- Koala (*Phascolarctos cinereus*)

Of the aforementioned species, twelve species are listed as both species credit and ecosystem credit species; Regent Honeyeater, Glossy Black-Cockatoo, White-bellied Sea-Eagle, Little Eagle, Swift Parrot, Square-tailed Kite, Powerful Owl, Masked Owl, Little Bentwing-bat, Large Bentwing-bat, Koala and Grey-headed Flying-fox.

Potential foraging habitat was identified for the Koala at various locations in the development site. Though the species was not recorded on site, there are known individuals inhabiting connected land in the Kings Hill URA (RPS 2019). Therefore, a species polygon has been prepared for the Koala (Figure 5-1). Further discussion on the Koala is provided below.

Species credits apply to breeding camps of the Grey-headed Flying-fox. Though the Raymond Terrace camp is located adjacent to the development site, it would not be directly impacted by the Proposal and therefore only ecosystem credits apply.

Searches for raptor nests were undertaken across the development site in August 2019, November and December 2018 targeting three candidate species: White-bellied Sea-Eagle, Little Eagle and Square-tailed Kite. No nests were found and these species were therefore discounted from further assessment due to absence of breeding habitat (Table 5-2).

No suitable breeding habitat for the remaining split species, to which species credits would apply, was identified in the development site. Accordingly, these species were not identified as candidate species and are discussed in Section 5.2.2 as ecosystem credit species.

The remaining candidate species with a high or moderate likelihood of occurrence have been listed in Table 5-2 and have been assumed present. Species polygons for suitable habitat have been prepared in Figure 5-1 as follows:

- Southern Myotis – in accordance with '*Species credit' threatened bats and their habitats* (OEH 2018b), all associated PCTs within 200 metres of waterways wider than 3 metres (Irrawang Spillway and Grahamstown Spillway) which includes PCT 1590 (Poor):
- Brush-tailed Phascogale – associated PCTs in Poor and Moderate condition where there are mature eucalypts and connectivity to larger patches of suitable habitat which includes PCTs 1590 (Moderate), 1590 (Poor), 1600 (Moderate) and 1619 (Moderate) (isolated patches of poor condition PCT 1619 and PCT 1590 (road batter) were excluded)

- Squirrel Glider - associated PCTs in Poor and Moderate condition where there are mature eucalypts and connectivity to larger patches of suitable habitat which includes PCTs 1590 (Moderate), 1590 (Poor), 1600 (Moderate) and 1619 (Moderate) (isolated patches of poor condition PCT 1619 and PCT 1590 (road batter) were excluded)
- Koala – PCT vegetation with Koala feed trees occurring in densities greater than 15% (on average) of the canopy cover which includes PCTs 1590 (Moderate), 1590 (Poor), 1590 (Road Batter), 1600 (Moderate) and 1619 (Moderate). See discussion on Koala habitat below.

Table 5-2 Candidate threatened fauna species

Common name	Scientific name	BC Act status	EPBC Act status	Sensitivity to gain class	Biodiversity risk weighting	Indication of presence	Targeted surveys
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	V	-	High	2.00	None. No nests identified (species credits apply to breeding habitat only).	Searches for nests over 6 days in November and December 2018 and August 2019
Little Eagle	*Hieraaetus morphnoides*	V	-	Moderate	1.50	None. No nests identified (species credits apply to breeding habitat only).	Searches for nests over 2 days in August 2019
Square-tailed Kite	*Lophoictinia morphnoides*	V	-	Moderate	1.50	None. No nests identified (species credits apply to breeding habitat only).	Searches for nests over 4 days in November and December 2018
Southern Myotis	*Myotis macropus*	V	-	High	2.00	High. Potentially recorded. Core foraging habitat not present in development site, though occurs nearby.	4 nights of Anabat surveys December 2018, August 2019
Squirrel Glider	*Petaurus norfolcensis*	V	-	High	2.00	Moderate.	10 person hours spotlight surveys

Common name	Scientific name	BC Act status	EPBC Act status	Sensitivity to gain class	Biodiversity risk weighting	Indication of presence	Targeted surveys
						Marginal habitat present. Species not recorded during targeted surveys for this project nor for the adjacent Kings Hill URA.	(November and December 2018, August 2019)
Brush-tailed Phascogale	*Phascogale tapoatafa*	V	-	High	2.00	High The species was not identified during field surveys though is known to occur on the adjacent URA.	10 person hours spotlight surveys (November and December 2018, August 2019)
Koala	*Phascolarctos cinereus*	V	V	High	2.00	High. The species was not identified during field surveys though is known to occur on the adjacent URA. Feed trees identified in some areas.	Scat searches in areas of potential feed trees

*-species recorded

Koala assessment

No Koalas or signs of Koala activity were recorded within the development site during surveys undertaken by Arcadis in 2019. Koala surveys undertaken for the Kings Hill Development SIS (RPS, 2019) recorded a total of 10 individual Koalas (four females and six males) from within the study area for the SIS. Koalas are considered likely to occur within the development site given the species is known to occur in the locality (DPIE 2019a, RPS, 2019), however population density for the development site is assumed to be low given the absence of sightings or signs of activity (i.e. scats or scratches) during surveys.

SEPP 44

Under SEPP 44, potential Koala habitat is defined as an area of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component. Koala feed trees listed under Schedule 2, that occur in the development site are *E. tereticornis* and *E. punctata*. A patch of roadside vegetation in the northern end of James Rees Road was the only area in the development site which contained these species in densities greater than 15% and therefore constitutes potential Koala habitat. Scat searches in this area did not detect the species. As such, this area is not considered to constitute core Koala habitat. In accordance with Clause 8 of SEPP 44, development consent may be granted for impacts to potential Koala habitat that is not considered core Koala habitat.

Port Stephens Comprehensive Koala Plan of Management

A Koala habitat assessment has been undertaken in accordance with Appendix 6: Guidelines for Koala habitat assessment of the *Port Stephens Comprehensive Koala Plan of Management* (CKPoM) (Port Stephens Council 2002).

The following steps were undertaken to determine the value of Koala habitat within the study area, and to determine the likelihood of significant impacts resulting from the Proposal:

1. Preliminary assessment
2. Vegetation mapping
3. Koala habitat identification
4. Assessment of the Proposal

The results of these steps are outlined below.

Preliminary assessment

The CKPoM Koala habitat planning map identifies land across the development site as ‘mainly cleared’ and ‘link over cleared’ with small areas of ’50 metre buffer over cleared’ in sections.

Surveys determined that *E. tereticornis* is the only preferred Koala feed tree (as identified in the CKPoM for the Port Stephens LGA) present within the development site. *E. tereticornis* occurs in varying densities across the development site but is most common in the northern road reserve of James Rees Road.

Vegetation mapping

Flora surveys and vegetation mapping have been undertaken across the development site to inform the biodiversity assessment for the Proposal. Vegetation mapping for the Proposal has been used to provide an accurate assessment of Koala habitat types present within the development site.

Vegetation within the development site is comprised of small patches of the following vegetation types:

- PCT 1590
- PCT 1600

- PCT 1619

Large portions of the development site are Cleared grassland or support planted landscape trees and shrubs. These areas are not considered to provide Koala foraging habitat, although Koalas may traverse these areas.

Koala habitat identification

Surveys have determined that the development site does not provide any ‘preferred’ or ‘supplementary’ habitat as defined in the CKPoM given the absence of Koala sightings or evidence of activity, the small, highly fragmented patches of marginal habitat present and the large areas of Cleared grassland, existing roads or residential areas between patches.

Ground-truthing during surveys confirmed that Koala habitat across the development site is generally consistent with the Koala habitat planning map, although some areas of ‘50 metre buffer over cleared’ may be incorrect given the areas of ‘preferred’ Koala habitat within these mapped buffers are likely to be inaccurate.

E. tereticornis occurs in varying densities across the development site but is common along the northern road reserve of Rees James Road.

Figure 5-1 Species polygons

5.2.2 Ecosystem credit species

The BAMC identified 18 predicted threatened fauna ecosystem credit species associated with the PCTs in the development site. Sixty-five threatened fauna ecosystem credit species listed under the BC Act have been identified for assessment from the BAMC and database searches combined. A likelihood of occurrence assessment was undertaken for each species and is provided in Appendix D. Species with a high or moderate likelihood of occurrence have been listed in Table 5-3. Seven ecosystem credit species, some of which are split ecosystem/species credit species, were recorded during field surveys:

- Little Lorikeet (*Glossopsitta pusilla*)
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)
- Grey-headed Flying-fox
- Eastern Coastal Free-tailed bat (*Micronomus norfolkensis*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Little Bentwing-Bat
- Large Bent-winged Bat

The locations of threatened fauna species recorded during field surveys are shown on Figure 5-2.

Figure 5-2 Threatened species recorded on and adjacent to the development site

LEGEND

Development site

Threatened species

Grey-headed Flying-fox camp

Grey-headed Flying-fox

Grey-crowned Babbler

Little Lorikeet

Large Bent-winged Bat, Greater Broad-nosed Bat, Eastern Freetail-bat, Southern Myotis

Little Bent-winged Bat, Large Bent-winged Bat, Southern Myotis, Greater Broad-nosed Bat, Easter False Pipistrelle

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Coordinate System: GDA 1994 MGA Zone 56
Date issued: October 9, 2019
Aerial imagery supplied by NSW LPI

1:25,000 at A4

ARCADIS

Table 5-3 Predicted threatened fauna species

Common name	Scientific name	BC Act status	EPBC Act status	Sensitivity to gain class	Associated PCTs
Birds					
Magpie Goose	*Anseranas semipalmata*	V	-	Moderate	Nil
Regent Honeyeater	*Anthochaera phrygia*	CE	CE	High	1590 1600
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	V	-	Moderate	Nil
Glossy Black-cockatoo	*Calyptorhynchus lathami*	V	-	High (Breeding), High (Foraging)	1590 1600 1619
Spotted Harrier	*Circus assimilis*	V	-	Moderate	Nil
Brown Treecreeper	*Climacteris picumnus victoriae*	V	-	High	1590 1600 1619
Varied Sittella	*Daphoenositta chrysoptera*	V	-	Moderate	1590 1600 1619
Black Falcon	*Falco subniger*	V	-	Moderate	Nil
Little Lorikeet	*Glossopsitta pusilla*	V	-	High	1590 1600 1619
White-bellied Sea-eagle	*Haliaeetus leucogaster*	V	-	High	1590 1600 1619

Common name	Scientific name	BC Act status	EPBC Act status	Sensitivity to gain class	Associated PCTs
Little Eagle	*Hieraaetus morphnoides*	V	-	Moderate	1590 1600 1619
Swift Parrot	*Lathamus discolor*	E	CE	Moderate	1590 1600 1619
Square-tailed Kite	*Lophoictinia isura*	V	-	Moderate	Nil
Turquoise Parrot	*Neophema pulchella*	V	-	High	1590 1600 1619
Powerful Owl	*Ninox strenua*	V	-	High	1590 1600 1619
Scarlet Robin	*Petroica boodang*	V	-	Moderate	1590 1600 1619
Grey-crowned Babbler*	*Pomatostomus temporalis temporalis*	V	-	Moderate	1600 1619
Eastern Grass Owl	*Tyto longimembris*	V	-	Moderate	1590 1600 1619
Masked Owl	*Tyto novaehollandiae*	V	-	High	1590 1600

Common name	Scientific name	BC Act status	EPBC Act status	Sensitivity to gain class	Associated PCTs
					1619
Mammals					
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V	-	High	1590 1600 1619
Eastern Coastal Free-tailed bat*	*Micronomus norfolkensis*	V	-	High	1590 1600 1619
Little Bentwing-Bat	*Miniopterus australis*	V	-	High	1590 1600 1619
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	V	-	High	1590 1600 1619
Koala	*Phascolarctos cinereus*	V	V	High	1590 1600 1619
Grey-headed Flying-fox*	*Pteropus poliocephalus*	V	V	High	1590 1600 1619
Greater Broad-nosed Bat*	*Scoteanax rueppellii*	V	-	High	1590 1600 1619

*-species recorded

5.3 Aquatic species

A search of DPI's Fisheries Spatial Data Portal found none of the waterways in the development site contain mapped habitat for threatened fish listed under the FM Act, based on predicted occupancy extents (DPI 2019). Further, no threatened fish are predicted to occur in any waterways on or directly downstream of the development site. No critical habitat is known to occur in proximity to the development site. No named creeks or rivers transect the development site. The Kings Hill URA watercourse, bisecting the development site to the north, provides fish habitat and is considered Type 1 – highly sensitive key fish habitat and Class 2 – Moderate key fish habitat.

6 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

A search of the EPBC Protected Matters Search Tool was completed for an area within 10 kilometres of the development site. This search found:

- One wetland of international importance (Ramsar): The Hunter Estuary Wetlands.
- A number of threatened species and communities listed under the EPBC Act that are known or likely to occur
- A number of fauna species listed as 'migratory' under the EPBC Act that are known or likely to occur.

No migratory species listed under the EPBC Act are likely to occur, however four threatened species listed under the EPBC Act have a moderate or high likelihood of occurrence in the development site (Appendix D) and are discussed below.

6.1 Wetlands of international importance

Hunter Estuary Wetlands

The Hunter Estuary Wetlands Ramsar site is comprised of two components, Kooragang and Hunter Wetlands Centre Australia. The Kooragang component of the Hunter Estuary Wetlands Ramsar site is located in the estuary of the Hunter River, approximately 14 kilometres south of the development site. Habitat types within the Kooragang Reserve include mangrove forests dominated by Grey Mangrove, Samphire saltmarsh, Paperbark and Swamp she-oak swamp forests, brackish swamps, mudflats, and sandy beaches (DoEE 2017).

Hunter Wetlands Centre Australia is located 18 kilometres south-west of the development site. Previously degraded, this urban wetland has been restored. Habitat types at the Hunter Wetlands Centre Australia include restored semi-permanent/seasonal freshwater ponds and marshes, natural semi-permanent/seasonal brackish ponds and marshes, freshwater swamp forests and a coastal estuarine creek (DoEE 2017).

The Hunter Estuary Wetlands Ramsar site is extremely important as both a feeding and roosting site for a large seasonal population of shorebirds and as a waylay site for transient migrants. Over 250 species of birds have been recorded within the Ramsar site, including 45 species listed under international migratory conservation agreements. In addition, the Ramsar site provides habitat for the nationally threatened Green and Golden Bell Frog (*Litoria aurea*) and Australasian Bittern (*Botaurus poiciloptilus*) (DoEE 2017).

The development site does not maintain connectivity to any components of the Hunter Estuary Wetlands, nor does any river or watercourse transect the development site that flows to these downstream environments.

6.2 Terrestrial threatened species and communities listed under the EPBC Act

Regent Honeyeater

The Regent Honeyeater has not been recorded from the development site but has been recorded from the locality as recently as 2018. The development site supports three plant species that are known foraging species for the Regent Honeyeater. The Regent Honeyeater may therefore infrequently forage within the development site during non-breeding periods.

The development site does not occur within or near any mapped Key Biodiversity Areas (KBAs) for the Regent Honeyeater. As such the development site is not considered to provide important habitat or key breeding habitat for this species.

Swift Parrot

The Swift Parrot was not recorded during surveys of the development site. The most recent Swift Parrot records from within 10 kilometres of the development site are from Wallaroo National Park in 2012, and the closest recent records to the development site are from Raymond Terrace in 2007 (DPIE 2019a).

The development site supports tree species that are known foraging species for the Swift Parrot. The Swift Parrot may therefore infrequently forage within the development site during non-breeding periods.

The development site does not provide habitat which is used by the Swift Parrot:

- For nesting
- By large proportions of the population
- Repeatedly between seasons
- For prolonged periods of time

Draft important areas for the Swift Parrot have been mapped by DPIE in Boomerang Park and Newbury Park. The mapped important areas overlap with the development site, however in the overlapping areas, there are no eucalypts/potential feed trees. Some eucalypts are nearby though the densities are very low such that they are unlikely to be an important foraging resource for the species.

Koala

The Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) is listed as Vulnerable under the EPBC Act. This species was not recorded within the development site during current surveys. The development site provides suitable foraging habitat for the Koala, and this species has been recorded from adjacent to the development site during surveys undertaken for the Kings Hill Development Species Impact Statement (RPS 2019). The Koala is therefore considered to have a 'high' likelihood of occurrence within the development site.

Potential Koala habitat within the development site is comprised of small, highly fragmented patches of native vegetation with Koala feed trees listed below occurring in varying densities in the canopy of PCT 1590, PCT 1600 and PCT 1619 covering an area 1.88 hectares of the development site as mapped in the species polygon in Figure 5-1.

The following tree species from the development site have been identified as Koala food trees in the North Coast Koala Management Area for the Approved Koala Recovery Plan (DECC 2008b):

Primary Koala feed tree:

- *Eucalyptus tereticornis* (Forest Red Gum)

Secondary Koala feed trees:

- *Eucalyptus moluccana* (Grey Box)
- *Eucalyptus punctata* (*biturbinata*) (Grey Gum)

The Port Stephens CKPoM lists Forest Red Gum as a 'preferred Koala feed tree' in the Port Stephens LGA. Forest Red Gum and Grey Box occur in the far northern portion of the development site and the all three feed tree species occur in the road reserve of

James Rees Road but are uncommon or absent in other portions of the development site.

EPBC Act Koala habitat assessment tool

The Koala habitat assessment tool provided in EPBC Act Referral Guidelines for the vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) (DoE 2014) has been utilised to determine the sensitivity, value and quality of habitat within the development site, and, therefore, whether it contains habitat critical to the survival of the Koala (Table 6-1). A habitat score of 6 has been calculated.

Table 6-1 Koala habitat assessment criteria

Attribute	Score	Criteria for coastal areas	Response
Koala occurrence	+2 (high)	Evidence of one or more Koalas within the last 2 years.	**SCORE: +1** No Koalas or evidence of Koala activity (e.g. scats or scratches) were recorded from the development site during surveys undertaken by Arcadis in 2019. Koalas have been observed in the Kings Hill URA (RPS 2019) and in the locality of development site by Arcadis in 2019. There are several additional records of Koala in the locality the development site (DPIE 2019a).
	+1 (medium)	Evidence of one or more Koalas within 2 km of the edge of the impact area within the last 5 years.	
	0 (low)	None of the above	
Vegetation composition	+2 (high)	Has forest or woodland with 2 or more known Koala food tree species, OR 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata.	**SCORE: +2** Three feed trees were recorded in forest vegetation within the development site: • *Eucalyptus tereticornis* (Forest Red Gum) • *Eucalyptus punctata* (Grey Gum) • *Eucalyptus moluccana* (Grey Box)
	+1 (medium)	Has forest or woodland with only 1 species of known Koala food tree present.	
	0 (low)	None of the above.	
Habitat connectivity	+2 (high)	Area is part of a contiguous landscape ≥ 500 ha.	**SCORE: +2** Potential Koala habitat within the development site occurs as small, highly fragmented patches of vegetation. Although these patches are disconnected they are considered to be part of a contiguous landscape ≥ 500
	+1 (medium)	Area is part of a contiguous landscape < 500 ha, but ≥ 300 ha.	
	0 (low)	None of the above.	

Attribute	Score	Criteria for coastal areas	Response
			ha in accordance with the BAM.
Key existing threats	+2 (high)	Little or no evidence of Koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for Koala occurrence. Areas which score 0 for Koala occurrence and have no dog or vehicle threat present	**SCORE: +1** NSW Bionet Koala Species Sightings data (DPIE 2019a) shows six records of 'Roadkill' and one record of 'dog injured' Koalas from within or adjacent to the development site between 1980 and 2014. Dogs have been observed within/near the development site during previous fauna surveys.
	+1 (medium)	Evidence of infrequent or irregular Koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for Koala occurrence, OR Areas which score 0 for Koala occurrence and are likely to have some degree dog or vehicle threat present.	
	0 (low)	Evidence of frequent or regular Koala mortality from vehicle strike or dog attack in the development site at present, OR Areas which score 0 for Koala occurrence and have a significant dog or vehicle threat present.	
Recovery value	+2 (high)	Habitat is likely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	**SCORE: +0** Protect and conserve large, connected areas of Koala habitat, particularly large, connected areas that support Koalas that are: • of sufficient size to be genetically robust / operate as a viable sub-population. The Kings Hill URA SIS (RPS 2019) identifies several individuals occurring north of the development site which are a known viable sub population. OR • free of disease or have a very low incidence of
	+1 (medium)	Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	
	0 (low)	Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	

Attribute	Score	Criteria for coastal areas	Response
			disease. The Proposal will not introduce disease to Koalas (appropriate mitigation measures would be included in assessment) OR • breeding. The Proposal is unlikely to adversely affect breeding. Maintain corridors and connective habitat that allow movement of Koalas between large areas of habitat. The Proposal would remove small patches of potential habitat that may provide 'stepping stone' linkage for Koalas. Given the absence of Koala sightings or evidence of Koala activity it is considered unlikely that these habitat patches are currently used regularly or by a significant number of Koalas. Though there is a known population of Koalas north of the site, there is no large patch of vegetation likely to be habitat for the species in the south to which the development site provides a link to.

Grey-headed Flying fox

The Grey-headed Flying-Fox is listed as Vulnerable under the EPBC Act and the BC Act. This species was observed during spotlighting surveys, foraging in the canopy of flowering eucalypts within the development site.

The Grey-headed Flying-fox is known to forage on blossoms and fruit from a wide range of native and exotic trees and shrubs. The range of flowering trees, predominantly Eucalyptus sp., Corymbia sp., and Melaleuca sp. recorded within the development site, provide suitable foraging resources for the Grey-headed Flying-fox. Some of the feed trees known to be used by this species (Eby and Law, 2008) that were recorded in the development site are listed in Table 6-2.

Table 6-2: Grey-headed Flying fox feed trees recorded in the development site

Species in the blossom diet of Grey-headed Flying foxes recorded in the development site	Species in the fruit diet of Grey-headed Flying foxes recorded in the development site
Angophora costata (Smooth-barked apple): uncommon *Corymbia maculata* (Spotted Gum): common *Eucalyptus moluccana* (Grey Box): common	*Pittosporum undulatum* (Sweet Pittosporum): uncommon

Species in the blossom diet of Grey-headed Flying foxes recorded in the development site	Species in the fruit diet of Grey-headed Flying foxes recorded in the development site
Eucalyptus paniculata (Grey Ironbark): common	
Eucalyptus punctata (Grey Gum): occasional	
Eucalyptus tereticornis (Forest Red Gum): uncommon	
Melaleuca quinquenervia (Broad-leaved paperbark)	

The Grey-headed Flying-fox is a highly mobile species and may forage each night up to 20 - 50 kilometres from camps. It is likely that suitable forage habitat for the Grey-headed Flying-fox would occur throughout the locality of the development site, including large areas of high-quality foraging habitat protected within State Conservation Areas, Nature Reserves and National Parks. It is therefore unlikely that the comparatively much smaller area of suitable habitat within the development site would provide important foraging resources for the Grey-headed Flying-fox.

No active flying-fox camps were recorded within the development site for the Proposal during surveys, and none are mapped by the *National Flying-fox monitoring viewer* (DoEE 2019a) as occurring within the development site. The development site is located about 50 metres from a nationally important flying-fox camp at Raymond Terrace (Camp ID 265). Up to approximately 10,000 flying foxes have been recorded roosting at Camp ID 265 in recent years (DoEE 2019a, PSC 2018).

The *Raymond Terrace Flying Fox Camp Management Plan* (Port Stephens Council, 2018) states that the camp occupies two council reserves: Ross Walbridge Reserve and Newbury Park. Grey-headed Flying-foxes were recorded roosting in Ross Walbridge Reserve in large numbers during surveys undertaken by Arcadis in 2019. No Grey-headed Flying-foxes were recorded roosting at Newbury Park during the surveys. Only two large *Eucalyptus* sp were recorded at Newbury Park, and these were in poor condition. It is likely that Newbury Park is no longer used by Grey-headed Flying-foxes as a roosting site.

7 AVOID AND MINIMISE IMPACTS

7.1 Measures to avoid and minimise impacts on native vegetation and habitat

Chapter 3.3 of the environmental impact statement describes the options that were considered as part of the project development process and explains the selection of the preferred pipeline alignment and design. Three options were considered:

- Option 1: Do Nothing;
- Option 2: construction of Wastewater Option SE2 identified by SMEC (2014) and Water Option 3 identified by SMEC (2017); and
- Option 3: construction of Water Option 3 identified by SMEC (2017) and alternate wastewater option identified by Northrop (2017).

Under Option 1, development of water and wastewater infrastructure would not occur. Land at Kings Hill has been rezoned specifically to support the development of 3,500 residential dwellings and a town centre, and Kings Hill has been identified as a Future Growth Area of economic importance by Port Stephens Planning Strategy 2011-2036. However, given that there is currently no water and wastewater infrastructure present with the capacity to service Kings Hill URA, the provision of water and wastewater infrastructure is required to facilitate the development of the Kings Hill URA. Without adequate water and wastewater infrastructure, the development of the Kings Hill URA could not feasibly occur. As such, the "do nothing" option was not considered viable and was not considered further.

The alignment of Option 3 differs from the preferred wastewater infrastructure option alignment proposed under Option 2 by the proportion of the alignment that was located at the rear of properties along Holwell Circuit and Dalyell Way being relocated to the verge of Rees James Road. The alternate wastewater infrastructure would connect to the existing gravity network at a maintenance hole near Panorama Close (MH K1950).

This alternate option minimises the extent the rising main that traverses land mapped as a Coastal Wetland the Coastal Management SEPP, which is also land that HWC proposes to establish as a biodiversity stewardship site under the *Biodiversity Conservation Act 2016*. In addition, Option 3 is located on slightly higher elevation than the preferred wastewater infrastructure option proposed under Option 2, and as such, it is expected that the alternate option may encounter smaller areas of Potential Acid Sulphate Soils (PASS) and intercept less groundwater.

Following consideration of environmental constraints, topography, conflicts with existing infrastructure, the location and capacity of existing HWC assets, and the outcomes of extensive consultation with HWC, it was determined that Option 3 is the preferred option for the Proposal.

Option 3 best meets the Proposal objectives while minimising potential environmental impacts, due to the realignment of the wastewater infrastructure. Benefits of the wastewater infrastructure alignment proposed under Option 3 when compared to that proposed under Option 2 include:

- Reduces the overall length of wastewater rising main alignment, from approximately 4.8 kilometres to approximately 4.2 kilometres;
- Avoids land that HWC proposes to establish as a biodiversity stewardship site;
- Reduces the length of wastewater rising main alignment that traverses a Coastal Wetland from approximately 4.6 kilometres to approximately 960 metres;
- Has a lower risk of encountering PASS;
- Has a lower risk of groundwater dewatering required, due to higher topography of the alignment;

- Connects to the existing gravity network, rather than Raymond Terrace WWPS, avoiding the need for an upgrade to support the proposed wastewater infrastructure; and
- Common trenching could be carried out with the water infrastructure alignment for almost the entire alignment of the wastewater infrastructure, thereby reducing the overall disturbance footprint of the Proposal.

The southern portion of the preferred water infrastructure alignment has been further refined as part of the concept design. Originally, the alignment followed Irrawang Street from the existing water pumping station north-east to Kangaroo Street, where the alignment turned north-west along Kangaroo Street to Adelaide Street. From here, the alignment followed Adelaide Street north-east to Reese James Road and the northern portion of the alignment.

The alignment has been refined to follow Irrawang Street from the existing water pumping station north-east to Newbury Park, where the alignment passes through the park to Adelaide Street and continues north-east to Reese James Road and the northern portion of the alignment.

This refinement of the alignment was undertaken to minimise the length of the alignment following along Adelaide Street, as this is a high traffic area (i.e. minimise traffic conflicts during construction) and to limit the works to be completed in close proximity to the main area of the Raymond Terrace Grey-headed Flying-fox camp located in the Ross Wallbridge reserve.

The principles in Section 8.1 of the BAM (OEH, 2017) have been considered to avoid and minimise impacts on native vegetation and habitat, where possible. The Proposal development process is provided in Table 7-1 Proposal consistency with the principles of the BAM to avoid and minimise impacts on native vegetation and habitat .

Table 7-1 Proposal consistency with the principles of the BAM to avoid and minimise impacts on native vegetation and habitat

BAM principles	Proposal consistency
Locating the Proposal	
Locating the proposal in areas where there are no biodiversity values.	The Proposal does not entirely avoid biodiversity values.
Locating the proposal in areas where the native vegetation or threatened species habitat is in the poorest condition (ie areas that have a lower vegetation integrity score).	The Proposal is located primarily on land that is previously disturbed and cleared. Native vegetation to be cleared is generally in a poor or highly modified condition.
Locating the proposal in areas that avoid habitat for species that have a high biodiversity risk weighting or native vegetation that is a TEC.	The Proposal does not impact any TEC. It will not impact any breeding habitat for threatened species with the potential to occur that have the highest biodiversity risk weighting (Table 5-2).
Locating the proposal such that connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained.	Vegetation clearing for the Proposal would occur mostly on the edge of previously cleared vegetation. This would not restrict the movement of species and their genetic material.
Consideration of alternatives	
Reducing the clearing footprint of the proposal.	The option selected minimises the length of the pipeline relative to alternative options thereby reducing the clearing footprint.

BAM principles	Proposal consistency
Locating ancillary facilities in areas where there are no biodiversity values.	Compound sites are generally located on land that is cleared grassland with negligible biodiversity values. The southernmost two potential compound sites are located on PCT 1619 which is in poor condition and has some biodiversity value, though minimal. Sites were selected where clearing would occur as part of the Kings Hill URA development.
Locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (ie areas that have a lower vegetation integrity score).	Compound sites are generally located on land that is cleared grassland. The central and southernmost potential compound sites are located on PCT 1619, however this is in poor condition with a vegetation integrity score of 25.8.
Locating ancillary facilities in areas that avoid habitat for species and vegetation in high threat status categories (eg an EEC or CEEC).	Compound sites are not located on habitat for any species or TEC with a high threat status.
Designing the proposal	
Reducing the clearing footprint of the proposal.	During the concept design process, the Proposal was not refined to reduce the clearing footprint.
Locating ancillary facilities in areas where there are no biodiversity values.	The initial compound sites considered were the southernmost two and the northernmost. During the concept design process, additional potential compounds were included on cleared grassland with negligible biodiversity values.
Locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (ie areas that have a lower vegetation integrity score).	The initial compound sites considered were the southernmost two and the northernmost. During the concept design process, additional potential compounds were included on cleared grassland with negligible biodiversity values. The southernmost two potential compound sites are still an option and they are located on PCT 1619, however this is in poor condition with a vegetation integrity score of 25.8.
Locating ancillary facilities in areas that avoid habitat for species and vegetation in high threat status categories (eg an EEC or CEEC).	Compound sites refined during concept design are not located on habitat for any species or TEC with a high threat status.
Providing structures to allow species and genetic material to move across barriers or hostile gaps.	The Proposal would not create any barriers or hostile gaps requiring structures to allow species movements.
Making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on the development site.	Native vegetation to be retained adjacent to the development site is currently subject to maintenance and this would be ongoing and would not be changed by the Proposal. These areas would be demarcated to be protected during clearing activities in the construction period. Operational activities are unlikely to

BAM principles	Proposal consistency
	have an impact on native vegetation and do not require demarcation.

7.2 Measures to avoid and minimise prescribed biodiversity impacts

Section 8.2 of the BAM (OEH, 2017) identifies principles for avoiding and minimising prescribed biodiversity impacts. Prescribed biodiversity impacts are discussed in Section 8.2.1 of this BDAR. Prescribed biodiversity impacts that are relevant to the project include:

- Impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation
- Impacts of development on the habitat of threatened species or ecological communities associated with human made structures

Table 7-2 Project consistency with the principles of the BAM to avoid and minimise prescribed biodiversity impacts

BAM principles	Project consistency
Locating the project	
Locating the envelope of surface works to avoid direct impacts on the habitat features identified as subject to prescribed biodiversity impacts.	The selected corridor is of width large enough to avoid clearing non-native vegetation and nest boxes where possible.
Locating the envelope of sub-surface works, both in the horizontal and vertical plane, to avoid and minimise operations beneath the habitat features identified as subject to prescribed biodiversity impacts eg locating longwall panels away from geological features of significance or water dependent plant communities and their supporting aquifers.	The majority of the Proposal will be located in cleared land and avoid non-native vegetation.
Locating the project to avoid severing or interfering with corridors connecting different areas of habitat, migratory flight paths to important habitat or local movement pathways.	The development site is located largely in urban areas or on the edge of disturbed and fragmented native vegetation.
Optimising project layout to minimise interactions with threatened species and ecological communities, eg designing turbine layout to allow buffers around features that attract and support aerial species, such as forest edges, riparian corridors and wetlands, ridgetops and gullies.	The development site is located largely in urban areas or on the edge of disturbed and fragmented native vegetation which minimises impacts to threatened species inhabiting these areas. No TECs would be impacted by the Proposal.
Locating the project to avoid direct impacts on water bodies.	The Proposal crosses two spillways, avoiding crossing the associated waterways and thereby avoiding direct impacts to them. There will be one waterway crossing at the Kings Hill URA
An analysis of alternative modes or technologies that would avoid or minimise	An alternative method of pipeline installation is underboring. This would have impacts on ground water and vibration and is onerous and expensive

BAM principles	Project consistency
prescribed biodiversity impacts and justification for selecting the proposed mode or technology.	relative to trenching. The narrow footprint of the trench means impacts to non-native vegetation would be minor.
An analysis of alternative routes that would avoid or minimise prescribed biodiversity impacts and justification for selecting the proposed route.	Alternative routes considered would have impacts on non-native vegetation, however these are commensurate with the selected route.
An analysis of alternative locations that would avoid or minimise prescribed biodiversity impacts and justification for selecting the proposed location.	Alternative locations considered would have impacts on non-native vegetation, however these are commensurate with the selected route.
An analysis of alternative sites within a property on which the project is proposed that would avoid or minimise prescribed biodiversity impacts and justification for selecting the proposed site.	No alternative sites within the property were selected that have a different impact on prescribed impacts.
Justifications for project location decisions should identify any other site constraints that the proponent has considered in determining the location and design of the project, eg bushfire protection requirements including clearing for asset protection zones, flood planning levels, servicing constraints.	Compared to the alternative location considered, the selected location would have a reduced length of pipeline in the Coastal Wetland from approximately 4.6 kilometres to approximately 960 metres, less risk of encountering PASS, a lower risk of groundwater dewatering and smaller footprint.
Designing the project	
Engineering solutions, eg proven techniques to minimise fracturing of bedrock underlying features of geological significance, water dependent communities and their supporting aquifers, proven engineering solutions to restore connectivity and favoured movement pathways.	Not applicable.
Design of project elements to minimise interactions with threatened and protected species and ecological communities, eg designing turbines to dissuade perching and minimise the diameter of the rotor swept area, designing fencing to prevent animal entry to transport corridors.	The Proposal will be largely situated below ground and therefore avoid interactions with threatened species.
Design of the project to maintain environmental processes critical to the formation and persistence of habitat features not associated with native vegetation.	The Proposal will be largely situated below ground and therefore avoid interactions with threatened species.
Design of the project to maintain hydrological processes that sustain threatened species and TECs.	Once the proposed pipelines have been constructed, disturbed areas would be rehabilitated generally to pre-existing condition (with the exception of the areas which included native vegetation). Given this, existing stormwater runoff quality, volumes and peak flows are not expected to be significantly impacted during the operational period thereby

BAM principles	Project consistency
	minimising hydrological impacts to adjacent threatened species habitat and TECs in Irrawang Swamp.
Design of the project to avoid and minimise downstream impacts on rivers, wetlands and estuaries by control of the quality of water released from the site.	The Proposal is not anticipated to have any significant operational impacts on water quality as the ground surface will be returned to its existing condition with little aboveground infrastructure present.

8 IMPACTS

8.1 Direct impacts on native vegetation and habitat

8.1.1 Removal of native vegetation

The Proposal would result in the removal of about 5.22 hectares of native vegetation from within the development site. The areas of each PCT that would be removed as a result of the Proposal are listed in Table 8-1.

Table 8-1 Direct impacts on native vegetation

PCT	PCT name	Vegetation zone	Area of direct impact (ha)	Vegetation integrity score
North Coast bioregion/Karuah Manning subregion				
1590	Spotted Gum/ Broad-leaved Mahogany/ Red Ironbark shrubby open forest	1590 – Moderate	0.14	66.6
		1590 – Road batter	0.36	28.3
		1590 – Poor	0.03	11.8
1600	Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	1600 – Moderate	1.32	33.3
Sydney basin bioregion/Hunter subregion				
1590	Spotted Gum/ Broad-leaved Mahogany/ Red Ironbark shrubby open forest	1590 – Poor	0.07	14.6
1619	Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	1619 – Moderate	0.41	45.4
		1619 – Poor	0.66	25.8
		1619 – Planted trees	2.23	14.0
Total			**5.22**	

8.1.2 Removal of threatened species habitat

The clearing of 5.22 hectares of vegetation that meets the definition of a PCT would result in the loss of habitat for threatened fauna species known or considered likely to occur in the development site. This includes the species listed in Table 5-3 that were identified as predicted ecosystem species from the BAMC with a moderate to high likelihood of occurrence in the development site.

Clearing of vegetation from the development site would result in the removal of specific fauna habitat components, including live trees, tree hollows, foraging resources, groundlayer habitats such as ground timber and well-developed leaf litter. Clearing of vegetation would result in the loss of up to five hollow-bearing trees that were identified in the development site and potentially additional three hollow-bearing trees identified just outside the development site due to encroachment on the tree root zone. The removal of hollow-bearing trees would impact a range of fauna, largely birds and arboreal mammals, including the threatened Brush-tailed Phascogale and Squirrel Glider.

No threatened species, to which species credits would apply, were recorded in the development site during targeted seasonal surveys. However four species credit species

have been assumed to be present and therefore species polygons have been prepared. Species credit impacts in each IBRA subregion are outlined in Table 8-2.

Table 8-2 Impacts to species credit species per IBRA subregion

Species	Habitat to be impacted Sydney bioregion/Hunter subregion (ha)	Habitat to be impacted in North Coast bioregion/Karuah Manning subregion (ha)	Total impact (ha)
Southern Myotis	0.07	0.03	0.10
Squirrel Glider	0.48	1.49	1.97
Brush-tailed Phascogale	0.48	1.49	1.97
Koala	0.34	1.54	1.88

8.1.3 Fauna injury and mortality

Fauna injury or mortality may occur during vegetation clearing activities (particularly during the felling of hollow-bearing trees) or may result from collisions with work vehicles or plant, or accidental entrapment in plant, trenches or other works.

The majority of fauna species recorded within the development site were highly mobile bird and mammal species and these species are likely to be able to move away from vegetation clearing activities quite readily. Mitigation measures to reduce the potential for fauna mortality are provided in Section 9.

8.2 Indirect impacts on native vegetation and habitat

Indirect impacts occur when the project or activities relating to the construction or operation of the project affect native vegetation, TECs and threatened species habitat adjoining or outside the development site. Impacts may also result from changes to land-use patterns, such as an increase in vehicular access and human activity on native vegetation, TECs and threatened species habitat (OEH 2017a).

Section 9.1.4.2 of the BAM (OEH 2017a) identifies the types of indirect impacts on native vegetation and habitat beyond the development site that must be considered as part of biodiversity assessment. The relevance of these types of impacts to the Proposal are assessed in Table 8-3. Matters that have been determined to be relevant are considered further in this section.

Table 8-3 Indirect impacts on native vegetation and habitat specified by the BAM

Indirect impact	Relevance to the project
Inadvertent impacts on adjacent habitat or vegetation	Vegetation adjoining the development site could be inadvertently impacted by the construction of the Proposal. This impact has been considered further in this section.
Reduced viability of adjacent habitat due to edge effects	All vegetation adjoining the development site is already subject to edge effects. Some new edges may be created in adjacent native vegetation, however these areas are generally already substantially disturbed. This impact has been considered further in this section.
Reduced viability of adjacent habitat due to noise, dust or light spill	Noise, vibration, dust and light spill could affect fauna inhabiting vegetation in nearby terrestrial

Indirect impact	Relevance to the project
	habitats. This impact has been considered further in this section.
Transport of weeds and pathogens from the site to adjacent vegetation	An increase in movements of people and machinery may facilitate the introduction or spread of weeds. This impact has been considered further in this section.
Increased risk of starvation, exposure and loss of shade or shelter	Not relevant. Fauna species using the modified habitats that characterise the majority of the development site are highly mobile bird and mammal species that are likely to be able to move away from vegetation clearing and other construction activities quite readily. Fauna habitat to be removed in the northern parts of the development site is adjacent to larger areas of native vegetation that could be used by less mobile species for relocation during clearing activities.
Loss of breeding habitats	Adjacent vegetated habitats could be used for breeding and could be impacted or degraded as a result of edge effects and increased noise, light and dust. However, the Proposal would not result activities/disturbances that could result in a loss of adjacent breeding habitat. The potential impact of this on breeding habitat has been considered further in this section.
Trampling of threatened flora species	Not relevant. No threatened flora species were recorded within or next to the development site. There is some potential habitat for threatened flora in areas adjacent to the Proposal in the Kings Hill URA, however previous assessment of these areas, including targeted seasonal surveys, by RPS (2019) did not detect any threatened flora species in the habitat adjoining the development site.
Inhibition of nitrogen fixation and increased soil salinity	Not relevant. The project would not inhibit nitrogen fixation in adjacent vegetation communities and the risk of increased soil salinity as a result of the project is low to negligible.
Fertiliser drift	Not relevant. The Proposal would not include use of fertiliser.
Rubbish dumping	Not relevant. The Proposal would not result in increased public access to areas of habitat that could be impacted by rubbish dumping and therefore would not increase the existing likelihood of rubbish dumping.
Wood collection	Not relevant. The Proposal would not result in increased public access to areas of native vegetation and therefore would not increase the existing likelihood of wood collection.
Bush rock removal and disturbance	Not relevant. The Proposal would not result in increased public access to areas of native vegetation and therefore would not increase the existing likelihood of bush rock removal and disturbance.
Increase in predatory species populations	Not relevant. Predatory species in the locality of the Proposal are most likely to be domesticated pets

Indirect impact	Relevance to the project
	and foxes, and the project would not result in an increase in these populations.
Increase in pest animal populations	Not relevant. The development site is in an urbanised area, and the Proposal is unlikely to increase the population of any pest animals.
Increased risk of fire	Not relevant. Provided safe work procedures are used during construction, there is no increased risk of fire as a result of the construction or operation of the Proposal.
Disturbance to specialist breeding and foraging habitat, e.g. beach nesting for shorebirds.	Not relevant. No areas of specialist breeding and foraging habitat have been identified within the development site.

8.2.1 Inadvertent impacts on adjacent native vegetation and habitat

Native vegetation occurring along the edges of the development site could be inadvertently impacted during construction of the Proposal from over-clearing. Impacts are considered in detail in Table 8-4 S.

Table 8-4 Summary of indirect impacts from inadvertent impacts on adjacent native vegetation and habitat

Assessment consideration	Assessment
Nature	Inadvertent impacts adjacent native vegetation could include accidental over-clearing.
Extent	Inadvertent impacts are likely to be minor and contained to the edge of development site.
Duration/Timing	Inadvertent impacts are most likely to occur during the construction period. Trenching in areas adjacent to large trees that results in root cutting or removal may have longer-term impacts on these trees.
Threatened species and communities that may be impacted	Threatened birds including: Scarlet Robin, Grey-crowned Babbler, Turquoise Parrot, Brown Treecreeper and Dusky Woodswallow. Threatened microbats Threatened forest owls Grey-headed Flying-fox Koala
Consequence of impacts for bioregional persistence of threatened species and communities	The area of habitat that may be impacted is negligible in comparison to the amount of available habitat for these species in the locality and would not impact their persistence in the bioregion.

8.2.2 Reduced viability of adjacent habitat due to edge effects

The vegetation adjacent to the development site is currently subject to edge effects. The clearing of small areas of vegetation along the edges of existing vegetation patches could lead to the existing edge effects reaching further into patches as well as new edge effects being introduced. These new edges could be subject to degradation by the establishment and spread of weeds and enriched runoff from new areas of hardstand.

Table 8-5 Summary of indirect impacts from reduced viability of adjacent habitat due to edge effects

Assessment consideration	Assessment
Nature	Newly cleared edges could be subject to degradation by the establishment and spread of weeds and enriched runoff from new areas of hardstand.
Extent	The extent of the impacts of the Proposal are likely to be limited, given that areas adjoining the development site are also currently subject to edge effects.
Duration/Timing	Additional edges would be created during vegetation clearing for construction. There is potential for edge effects during maintenance activities through the operational period. Trampling of adjacent native vegetation, rubbish dumping, soil disturbance and weed spread could occur, though this is likely to be minor and localised.
Threatened species and communities that may be impacted	Threatened birds including: Scarlet Robin, Grey-crowned Babbler, Turquoise Parrot, Brown Treecreeper, Dusky Woodswallow and Magpie Goose.
Consequence of impacts for bioregional persistence of threatened species and communities	The area of habitat that may be impacted is negligible in comparison to the amount of available habitat for these species in the locality and would not impact their persistence in the bioregion.

8.2.3 Reduced viability of adjacent habitat due to noise, dust or light spill

The proposal would be lit during the construction phase if/when nightworks are required. No lighting would be required for the operational phase of the proposal. Light pollution has the potential to impact on nocturnal fauna that can be more vulnerable to predation. Lighting and other disturbance during nightworks is likely to result in some short-term disruption to the typical behaviour of nocturnal (active) and diurnal (roosting) fauna in the vicinity of the construction. Based on the existing lighting associated with urban areas it is unlikely that this additional temporary lighting would impact the long-term behaviour of nocturnal fauna in these areas. Impacts are more likely in the Kings Hill URA and HWC land, though impacts would be temporary in nature.

Construction activities would generate short-term dust emissions which could impact adjacent vegetation by smothering leaves and groundcover plants. Impacts are likely to be minor and localised. Dust emissions during operation are anticipated to be negligible.

Construction activities would result in localised and temporary noise and vibration impacts, however as most construction areas occur in urbanised areas that are currently subject to ambient noise, this increase in noise and vibration is not expected to have a significant impact on native fauna. Construction for the proposal is likely to result in increased localised noise levels which may impact on fauna, particularly roosting, breeding or less mobile species occupying vegetation adjacent to the Proposal. Operational noise impacts will occur in the immediate vicinity of any areas maintenance is occurring and at the WWPS. Fauna inhabiting native vegetation in Kings Hill URA and Irrawang Swamp, adjacent to the development site, would be most sensitive to impacts.

The impacts of construction noise on the Raymond Terrace Grey-headed Flying-fox camp (the camp) have been considered in further detail.

Grey-headed Flying-foxes would be most sensitive to construction noise during the months of August to February:

- During August, females are reaching the end of their gestation period and have been known to abort young when stressed
- During September to November, the females have given birth and are lactating. Stressed females have been known to drop young during this period. Stressed young are also at risk of falling to the ground which could result in starvation, predation and death
- In December, juveniles are easily stressed which could result in falling to the ground
- During January to February, flying foxes are prone to heat stress. During this time, additional potential stressors such as noise can increase the likelihood of an individual falling from a tree due to heat stress.

The camp is about 50 metres north-west of the development site at its closest point and lies adjacent to Adelaide Street. Existing background noise levels 1.5 kilometres further northeast (adjacent to Adelaide Street) are likely to be similar to those at the camp. Here they range from 33-49 dB(A) at night and 42-59 dB(A) in the day (Resonate 2019). Typical worst-case construction noise levels (LAeq 15 minute) have been modelled at the camp where they range between 70-75 dB(A) (Resonate, 2019) about 30 dB(A) above the average day and night noise levels. The majority of works would take place in the day when existing background levels are highest. The species typically exit the camp at dusk to forage through the night and therefore impacts at night are likely to be minor. Reasonable and feasible noise mitigation measures would be implemented when works are occurring in proximity to the Grey-headed Flying-fox camp and are included in Table 9-1.

Table 8-6 Summary of indirect impacts from reduced viability of adjacent habitat due to noise, dust or light spill

Assessment consideration	Assessment
Nature	Noise, dust and light spill impacting fauna habitat next to the development site during the construction period.
Extent	The extent of the impacts of the Proposal are likely to be limited, to areas of native vegetation adjoining the development site most of which are currently subject to edge effects and existing noise, dust and light spill.
Duration/Timing	Short periods as the construction progresses along the alignment over the 9 month period. For the entire duration of the 9 month construction period at the compounds. Light spill impacts would only occur during night works which will be avoided unless necessary.
Threatened species and communities that may be impacted	Threatened birds including: Scarlet Robin, Grey-crowned Babbler, Turquoise Parrot, Brown Treecreeper and Dusky Woodswallow. Threatened microbats Threatened forest owls Grey-headed Flying-fox Koala
Consequence of impacts for bioregional persistence of threatened species and communities	The area of habitat and number of individuals that may be impacted is negligible for most species in comparison to the amount of available habitat for these species in the locality and would not impact their persistence in the bioregion.

8.2.4 Transport of weeds and pathogens from the site to adjacent vegetation

Six exotic species recorded in the development site are listed as Priority Weeds in the Hunter region, which includes Port Stephens LGA: *Asparagus aethiopicus* (Asparagus Fern), *Hyparrhenia hirta* (Coolatai Grass), *Lantana camara* (Lantana), *Olea europaea* subsp. *cuspidata* (African Olive), *Rubus fruticosus sp. agg*. (Blackberry) and *Senecio madagascariensis* (Fireweed).

Invasive exotic grasses such as *Eragrostis curvula* (African Lovegrass), *Cenchrus clandestinus* (Kikuyu), *Hyparrhenia hirta, Paspalum dilatatum* and *Chloris gayana* (Rhodes Grass) that occur in the development site also represent a threat to native vegetation. An increase in the movement of people, vehicles, machinery, vegetation waste and soil during construction of the proposal may facilitate the introduction or spread of exotic grasses and other weeds that currently occur within the development site. The areas adjoining the development site are also currently subject to weed invasion, particularly roadside areas and tracks that have substantial cover of exotic grasses. Management measures would be required to minimise the risk of introduction and spread of weeds.

The project has the potential to increase the spread of pathogens that threaten native biodiversity values, such as the soil-borne pathogen Phytophthora (*Phytophthora cinnamomi*). Phytophthora infects roots and is associated with damage and death to native plants. It may be dispersed over large distances in flowing water, such as storm runoff, or may be spread within a site via mycelial growth from infected roots to roots of healthy plants. Propagules of Phytophthora may also be dispersed by vehicles (e.g. cars and earth moving equipment), animals, walkers and movement of soil. It is listed as a Key Threatening Process (defined as a process which threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community) under BC Act. There may be an increased risk of dispersal of Phytophthora as a result of the construction activities that involve soil disturbance.

Table 8-7 Summary of indirect impacts from transport of weeds and pathogens from the site to adjacent vegetation

Assessment consideration	Assessment
Nature	Construction activities may facilitate the introduction or spread of weeds that currently occur within the development site. There is also potential for dispersal of pathogens such as Phytophthora through soil disturbance.
Extent	The extent of the impacts of the Proposal are likely to be limited, given that areas adjoining the development site are also currently subject to weed incursion.
Duration/Timing	The highest risk of weed or pathogen introduction and spread would be during construction, when personnel and machinery movements and soil disturbance are occurring.
Threatened species and communities that may be impacted	TECs and threatened flora species in Irrawang Swamp, to the west of the development site, are most likely to be impacted by potential weed and pathogen transport from the development site. No threatened fauna species are likely to be impacted by weed introduction or spread as a result of the Proposal.
Consequence of impacts for bioregional persistence of threatened species and communities	TECs and threatened flora species in Irrawang Swamp are currently subject to weed invasion from upstream areas, and it any additional weed impacts as a result of the Proposal are expected to be minor in comparison.

8.3 Prescribed biodiversity impacts

Clause 6.1 of the NSW Biodiversity Conservation Regulation 2017 identifies actions that are prescribed as impacts to be assessed under the Biodiversity Offsets Scheme. Prescribed biodiversity impacts must be assessed in accordance with Section 9.2 of the Biodiversity Assessment Method.

The prescribed biodiversity impacts in the Biodiversity Assessment Method and their relevance to the proposal are listed in Table 8-8 Prescribed biodiversity impacts specified by the Biodiversity Assessment Method.

Table 8-8 Prescribed biodiversity impacts specified by the Biodiversity Assessment Method

Prescribed biodiversity impact (Biodiversity Assessment Method)	Relevance to current proposal
Impacts of development on the habitat of threatened species or ecological communities associated with karst, caves, crevices, cliffs and other features of geological significance	None – no karst, caves, crevices, cliffs or other features of geological significance in or adjoining the development site.
Impacts of development on the habitat of threatened species or ecological communities associated with rocks	No – no rock outcrops occur within or adjacent to the development site.
Impacts of development on the habitat of threatened species or ecological communities associated with human made structures	Yes – several nest boxes are present on Rees James Road in the development site. They may be inhabited by threatened fauna species such as woodland birds. Though they are within the development site, clearing of the trees and nest box removal can be avoided and nest boxes can be relocated if impacted. No other human made structures to be impacted are likely to be inhabited by threatened species or TECs.
Impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation	Yes – non-native vegetation occurs within and adjacent to the development site, as described in section 4.8. Trees and shrubs associated with non-native vegetation offers foraging, nesting and sheltering habitat to locally occurring threatened birds, arboreal mammals and Grey-headed Flying-fox. The removal of non-native vegetation from the development site may have direct and indirect impacts on these threatened species. The area of non-native vegetation that may be impacted is negligible in comparison to the amount of available habitat for these species in the locality, and the development would not impact their persistence in the bioregion.
Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	No – areas of habitat within and adjoining the development site are currently fragmented by linear infrastructure and residential and commercial development, and the Proposal will only marginally increase the existing fragmentation.
Impacts of the development on movement of threatened species that maintains their life cycle	

Prescribed biodiversity impact (Biodiversity Assessment Method)	Relevance to current proposal
Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities	No – no threatened fish habitat is identified in receiving waterways. The receiving waterways flow to Irrawang Swamp which contains TECs however, impacts to water quality and hydrological processes are anticipated to be minor or negligible and localised.
Impacts of wind turbine strikes on protected animals	No – Wind turbines are not proposed as part of this project.
Impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC	No – the Proposal is adjacent to existing roads but would not increase the width of existing roads or result in fauna being directed into road corridors.

8.4 Serious and irreversible impacts

The OEH (2017b) *Guidance to assist a decision-maker to determine a serious and irreversible impact* identifies threatened species and ecological communities most at risk of serious and irreversible impacts.

One species identified within the guidance document (OEH 2017b) is known to occur within the development site: Little Bentwing-bat (*Miniopterus australis*). However, OEH (2017b) specifies that, for this species, only breeding habitat is subject to assessment to determine serious and irreversible impacts.

Little Bentwing-bats form maternity colonies in summer, often formed in association with Eastern Bentwing-bats (DPIE 2019d). Only five maternity colonies are known in Australia, and none of these are within or near the development site. As the development site does not support breeding habitat for Little Bentwing-bat there is no further assessment of serious and irreversible impacts to this species.

8.5 Vegetation clearing activities

In accordance with the *State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017*, soil and water impacts of native vegetation clearing are required to be considered. Table 8-9 summarises the impacts of each soil and water aspect to be considered as required by the SEPP.

Table 8-9 Soil and water impacts associated with vegetation clearing

Aspect	Impact
Soil erosion	Vegetation clearing activities would result in soil disturbance. In areas that the soil types are prone to erosion, there is a risk of this occurring, though this would be contained to a narrow linear strip along the length of the development site and is likely to be easily managed with the implementation of standard erosion mitigation measures outlined in Section 9.
Salination	Nil.
Acidification	Acid sulphate soil disturbance from vegetation clearing is a risk in a small part of the development site. Investigations will be undertaken at detailed design to determine potential impacts and an Acid Sulphate Soils Management Plan would be prepared as part of the CEMP (section 7.1 of the EIS) to manage acid sulphate soils if a risk is identified.

Aspect	Impact
Land slip	Land clearing activities are unlikely to result in land slip. Though some of the soil landscapes on the development site have a mass movement hazard, vegetation to be cleared would be contained to a narrow linear strip on relatively flat land and is unlikely to trigger this.
Flooding	Vegetation clearing would result in minimal/negligible changes in local hydrology and are unlikely to affect flooding.
Pollution	Vegetation clearing activities will require use of some machinery and equipment with a risk of chemical or fuel leaks and spills. Offsite water quality pollution could occur in surrounding watercourses (see Section 8.6). Any impacts are likely to be localised and minor. Spill response management would be implemented as outlined in the mitigation measures in Section 7.2 of the EIS.
Other	Nil.

8.6 Aquatic impacts

Construction of the open trenched pipeline at the Kings Hill URA watercourse would result in soil disturbance over a small area of the channel and localised/downstream sedimentation and water quality impacts. Additional potential construction phase impacts include spills or leaks including fuels, lubricants and hydraulic oils from construction plant and equipment within the waterway. Impacts would be mitigated by the implementation of erosion and sediment controls and spill management, discussed further in Section 9. There would be minimal removal of aquatic habitat in the Kings Hill URA watercourse. A small area of aquatic sedges and some instream coarse woody debris may be impacted. Works would be undertaken during periods of no flow so that fish passage would not be impacted. No impacts to threatened fish are anticipated.

Acid sulphate soil disturbance is a risk in a small part of the development site. Investigations will be undertaken at detailed design to determine potential impacts and an Acid Sulphate Soils Management Plan would be prepared as part of the CEMP (section 7.1 of the EIS) to manage acid sulphate soils and reduce the risk of water quality impacts if disturbance is likely.

Offsite water quality impacts, including spills and sedimentation could occur in the watercourses of the Irrawang Spillway and Grahamstown spillway during construction in nearby areas. Any impacts are likely to be localised and minor as no works are occurring directly in these watercourses. No impacts to threatened fish are anticipated. No obstruction of fish passage would occur at these waterways.

Commissioning of the pipelines involves a discharging of water to adjacent land or watercourses following a flushing event. This could result in impacts such as scouring and increased sedimentation. Volumes are relatively small, and impacts are likely to be localised. Discharge of water into watercourses and overland flow paths that drain to Irrawang Swamp during pipeline flushing would be avoided. HWC's *Procedure EP0112 – Dechlorination of discharge water* would be followed which includes options to discharge water to tankers and taken off site.

Whilst unlikely, during the operational period there is the risk of the pipelines leaking or spillage during maintenance activities which could potentially impact the downstream water quality of nearby waterways. The extent of water quality impacts would depend on the volume of leakage/spill and spread.

Stormwater runoff volumes and pollutant loads could increase during the operational period at the proposed WWPS. Water quality and flow of nearby receiving waterways could be impacted, though impacts are likely to be minor.

8.7 Coastal Wetland

Clause 10(4) of the Coastal Management SEPP requires that sufficient measures have been, or will be, taken to protect, and where possible enhance, the biophysical, hydrological and ecological integrity of the coastal wetland. Clause 11 (1) requires that development on land in proximity areas will not significantly impact on the biophysical, hydrological or ecological integrity of the adjacent coastal wetland, or the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland or littoral rainforest. The below assessment outlines potential impacts to the biophysical, hydrological or ecological integrity of Irrawang Swamp as a result in changes to water quantity and quality from the Proposal.

Mitigation measures to protect the hydrological, biophysical and ecological functions of Irrawang Swamp are included in Section 9.

The Proposal would directly impact a small area of mapped Coastal Wetland and the associated proximity area; however the impact area is not within vegetation that conforms with the definition of a Coastal Wetland. The preliminary ecohydrology assessment completed by Alluvium (2019) determined that the critical impacts to vegetation associated with changes to hydrology were waterlogged soils, seasonal inundation and seasonal drying.

Predicted changes from the Kings Hill URA include increased volume and frequency of dry season flows and increased peak event flows. The Proposal could contribute to increased flow events during construction and operation through the clearing of vegetation and construction of hardstand at the WWPS, though these impacts would be minor.

There is also a risk of minor increase in inundation of the swamp during pipeline commissioning when flushed water is discharged. Volumes of water to be discharged are small: between 800kL and 1500kL over the length of the pipeline. Hydrological impacts are therefore likely to be minor. Nonetheless, discharge to flow paths that potentially drain to Irrawang Swamp would be avoided.

Increased sediment load and scouring from minor increases in runoff volumes, vegetation clearing activities and ground disturbance from trenching, machinery and truck movements has the potential to impact water quality in the adjacent Irrawang Swamp. There is also a risk of spills from oil and fuel leaks in the development site during construction and leaks in the pipeline during operation which could reach the fringes of the swamp. Impacts to water quality in the swamp and changes to biophysical properties are likely to be minor or negligible and localised during construction. During operation, a pipeline leak of wastewater could impact the water quality and soil in the swamp, though the extent of impact would be dependent on the nature of the leak.

Irrawang Swamp contains the following TECs (BIOCM, 2017, Alluvium, 2019):

- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (listed as Endangered under the BC Act and EPBC Act)
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (listed as Endangered under the BC Act)
- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (listed as Endangered under the BC Act)

Although no threatened flora species have been recorded in Irrawang Swamp, suitable habitat for two threatened flora species, *Maundia triglochinoides* and *Persicaria elatior*, has been identified (BIOCM, 2017). The predicted increases in dry season flows associated with the larger Kings Hill URA development are considered to be within the range of tolerance for most vegetation communities, with some management measures required to allow regeneration of Swamp Oak in some areas. Increased peak flows are not considered likely to be a significant threat to vegetation, given these are predicted to coincide with existing seasonal inundation and saturation of soils. Consequently, impacts to TECs and threatened flora species as a result of flow changes are considered unlikely.

8.8 Matters of National Environmental Significance

MNES identified by the Protected Matters Report for the Proposal are discussed in Section 6. No World Heritage Properties, National Heritage Places, Commonwealth Marine Reserves or Critical Habitats were identified within 10 kilometres of the development site. The Proposal does not adjoin any Commonwealth land or Commonwealth Heritage Place and will therefore not impact on any of these MNES. The Proposal is not connected to the Hunter Estuary Wetlands and will not impact on this or any other Nationally Important Wetland.

The likelihood occurrence for each EPBC Act listed threatened or migratory entity recorded with 10 kilometres of the development site is provided in Appendix D. The Protected Matters Report identified a number of EPBC Act listed Migratory species, however none of these are known or considered likely to occur at the development site. As such the Proposal will not impact on important habitat or an important proportion of the population for any Migratory species.

Four EPBC Act listed threatened fauna species are known or considered likely to occur at the development site:

- Regent Honeyeater
- Swift Parrot
- Koala
- Grey-headed Flying-fox

Significant Impact Assessments using the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Significant Impact Guidelines (DoE 2013) were undertaken for these threatened fauna species. The impact assessments are provided in Appendix E. A summary of the impact assessments is provided in Table 8-10 Summary of Significant Impact Criteria (EPBC Act).

The results of the significant impact criteria assessments determined that the Proposal would not significantly impact on any of the four threatened fauna species assessed. As such the Proposal is not considered likely to require referral to the Australian Government Minister for the Environment for impacts to MNES.

Of note, draft important areas for the Swift Parrot mapped by DPIE would be impacted by the Proposal. The areas to be impacted do not contain eucalypts/foraging habitat and are therefore unlikely to impact the species. Nonetheless, any eucalypts in these areas adjoining the development site would be protected during construction.

Table 8-10 Summary of Significant Impact Criteria (EPBC Act)

EPBC Act significant impact criteria assessments										
Threatened species	**Significant impact criteria[1]**									**Likely significant impact?**
	i[2, 3]	**ii**	**iii**	**iv**	**v**	**vi**	**vii**	**viii**	**ix**	
Regent Honeyeater [a]	N	N	N	N	N	N	N	N	N	No
Swift Parrot [a]	N	N	N	N	N	N	N	N	N	No
Koala (combined Qld, NSW and Act populations) [b]	N	N	N	N	N	N	N	N	N	No
Grey-headed Flying-fox [b]	N	N	N	N	N	N	N	N	N	No

Notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable, ?= unknown impact.

1. Significant impact criteria as set out in the EPBC Act:
   a. An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it would:
      i. Lead to a long-term decrease in the size of a population
      ii. Reduce the area of occupancy of the species
      iii. Fragment an existing population into two or more populations
      iv. Adversely affect habitat critical to the survival of a species
      v. Disrupt the breeding cycle of a population
      vi. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
      vii. Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat
      viii. Introduce disease that may cause the species to decline
      ix. Interfere with the recovery of the species
   b. An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:
      i. Lead to a long-term decrease in the size of an important population of a species
      ii. Reduce the area of occupancy of an important population
      iii. Fragment an existing important population into two or more populations
      iv. Adversely affect habitat critical to the survival of a species
      v. Disrupt the breeding cycle of an important population
      vi. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
      vii. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
      viii. Introduce disease that may cause the species to decline, or
      ix. Interfere with the recovery of the species
2. A 'population of a species' as determined by the EPBC Act is an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:
   a. a geographically distinct regional population, or collection of local populations, or
   b. a population, or collection of local populations, that occurs within a particular bioregion.
3. An 'important population' as determined by the EPBC Act is one that for a vulnerable species:
   a. is likely to be key source populations either for breeding or dispersal
   b. is likely to be necessary for maintaining genetic diversity
   c. is at or near the limit of the species range.

8.9 Groundwater dependent ecosystems

Potential groundwater dependent ecosystems (GDEs) with reliance on subsurface groundwater have been mapped within and adjoining the development site in the *Groundwater Dependent Ecosystem Atlas* (BOM 2019b). A total of 1.78 hectares mapped by BOM (2019) as potential GDEs would be removed for the Proposal.

Groundwater may be intercepted during construction or contaminated from wastewater leakage along the pipeline during operation. The nature and duration of impacts of either scenario are unknown and potential GDEs near the development site may be impacted.

8.10 Cumulative impacts

Cumulative impacts would arise from the concurrent development of the current Proposal and the Kings Hill URA, and associated stormwater channel and interchange proposals and other projects in the region. This would involve a greater loss of native vegetation, fauna habitat and hollow-bearing trees than development of the Proposal alone. A summary of potential impacts of other projects and proposals are provided in Table 8-11 Past, present and future projects.

Table 8-11 Past, present and future projects

Project	Construction impacts	Operational impacts
Past project: Stage 2 Augmentation of Grahamstown Dam	• Loss of native vegetation • Loss of fauna habitat	• Indirect impacts such as edge effects, weeds • Has resulted in an increased storage capacity of drinking water for the Hunter region
Future project: Kings Hill Stormwater Channel	• Loss of 18 ha of native vegetation • Loss of fauna habitat • Indirect impacts such as edge effects, weeds and noise • Fauna injury and mortality • Noise and vibration	• Indirect impacts such as edge effects, weeds and noise • Will prevent stormwater entering Grahamstown Dam for any rainfall event up to the 0.2% AEP, and would meet the stormwater management needs of the residential subdivision development at the Kings Hill urban release area
Future project: Kings Hill Interchange	• Loss of 12 ha of native vegetation • Loss of fauna habitat • Indirect impacts such as edge effects, weeds • Fauna injury and mortality • Noise and vibration	• Indirect impacts such as edge effects, weeds and noise • Will provide safe and suitable vehicular access from the Kings Hill site to the Pacific Highway
Future project: Kings Hill Urban Release Area	• Loss of 211 ha of native vegetation • Loss of fauna habitat • Indirect impacts such as edge effects, weeds and noise • Fauna injury and mortality • Noise and vibration	• Indirect impacts such as edge effects, weeds and noise • Will support a mix of general residential, mixed use and local centre land use zones and is expected to yield in excess of 3,500 residential dwellings over a twenty five year period.
This project: Water and wastewater pipelines to support the Kings Hill Urban Release Area	• Loss of 5 ha of native vegetation • Loss of fauna habitat • Indirect impacts such as edge effects, weeds and noise • Fauna injury and mortality • Noise and vibration	• Indirect impacts such as edge effects and weeds • Will facilitate water and wastewater services for the Kings Hill Urban Release Area.
Future project: M1 Pacific Motorway extension to	• Loss of native vegetation	• Will provide15 kilometres of dual carriageway motorway

Project	Construction impacts	Operational impacts
Raymond Terrace (currently in concept design development phase). Located approximately 9 kilometres south-west of the development site	• Loss of fauna habitat • Indirect impacts such as edge effects, weeds and noise • Fauna injury and mortality • Noise and vibration	with two lanes in each direction, bypassing Hexham and Heatherbrae. • Minimum flood immunity along the new roadway between Black Hill and Tomago for a one in 100 year flood event • Minimum flood immunity along the new roadway between Tomago and Raymond Terrace for a one in 20 year event. • Improved connection between the M1 Pacific Motorway and the Pacific Highway

9 MITIGATION OF IMPACTS

Table 9-1 Measures to be implemented to minimise impacts on biodiversity

Mitigation measure	Outcome	Responsibility	Timing
A Flora and Fauna Management Plan would be prepared and implemented as part of the CEMP. It will include, but not be limited to: • plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas • pre-clearing survey requirements • procedures for unexpected threatened species finds and fauna handling • procedures addressing relevant matters specified in the Policy and guidelines for fish habitat conservation and management (DPI Fisheries, 2013) • protocols to manage weeds and pathogens.	Flora and fauna impacts minimised	Design contractor, construction contractor	Pre-construction and construction
Site inductions for construction staff will include a briefing on the potential presence of threatened species and their habitat adjacent to the development site, their significance and locations and extents of no-go zones.	Protect threatened species	Construction contractor	Construction
Clearance of native vegetation would be minimised as far as is practicable.	Minimise biodiversity loss	Construction contractor	Pre-construction/ construction
The limits of vegetation clearing would be marked on plans and on site with signed fencing so that clearing activities are constrained to approved areas only.	Prevent accidental vegetation clearing	Construction contractor	Pre-construction/ construction
Where fauna species are identified in vegetation to be cleared, animals would be removed and relocated to adjacent bushland prior to felling. If this is not possible, the tree would be sectionally dismantled or soft felled under the supervision of an ecologist or wildlife carer, before relocating the animal.	Minimise fauna mortality and injury	Construction contractor Project ecologist	Pre-construction
Pre-clearance surveys would be undertaken to identify any breeding or nesting activities by native fauna in hollow-bearing trees and native	Minimise fauna mortality and injury	Construction contractor Project ecologist	Pre-construction

Mitigation measure	Outcome	Responsibility	Timing
vegetation. No breeding attempts or active nests should be disrupted, as far as practical.			
Prior to clearing, all hollow-bearing trees would be marked by an ecologist so that they are retained and avoided by contractors. Their location would be recorded using a GPS.	Minimise fauna mortality and injury, protect threatened species habitat	Construction contractor Project ecologist	Pre-construction
Eucalypts in Newbury Park and Boomerang Park adjacent to the development site would be protected during construction.	Protection of draft important areas for the Swift Parrot	Construction contractor Project ecologist	Construction
Hollow-bearing tree removal and disturbance of the tree drip line of any hollow-bearing trees would be avoided.	Prevention of injury and mortality of arboreal fauna inhabiting hollows. Retention of habitat for arboreal fauna.	Design contractor, construction contractor	Detailed design/construction
A two stage clearing process for the removal of hollow-bearing trees would occur.	Minimise fauna mortality and injury	Construction contractor Project ecologist	Pre-construction
The pipeline trench would be microsited to avoid tree protection zones. If tree protection zones cannot be avoided, encroachments would be minimised and an arborist consulted to avoid tree removal, where feasible.	Tree retention. Minimisation of likelihood of tree roots causing wastewater and water leakages leading to soil/weed impacts.	Design contractor, construction contractor	Detailed design/construction
Nest box removal would be avoided. Where this can not occur, nest boxes would be relocated to a suitable location in consultation with the owner/s. If required, nest box removal would be undertaken outside of spring/summer. If fauna are occupying any relocated nest boxes, they would be removed by a suitably qualified ecologist prior to relocation.	Protect supplementary fauna habitat	Construction contractor Project ecologist	Construction
A pre-start up check for sheltering native fauna of all infrastructure, plant and equipment and/or during relocation of stored construction materials would be undertaken.	Minimise fauna mortality and injury	Construction contractor Project ecologist	Pre-construction
If any pits/trenches are to remain open overnight adjacent to native vegetation, they would be securely covered, if possible. Alternatively, fauna ramps (logs or wooden planks) would be installed to provide an escape for trapped fauna.	Prevent fauna injury/starvation/mortality	Construction contractor Project ecologist	Construction
A Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP), or equivalent, would be incorporated into the Construction Environmental Management Plan (CEMP) for the	Minimise water quality impacts to receiving waterways	Construction contractor	Construction

Mitigation measure	Outcome	Responsibility	Timing
construction of the Proposal. The SWMP and ESCP would be developed in accordance with the principles and requirements of the 'Blue Book' as detailed in the EIS.			
Appropriate sediment and erosion controls would be installed prior to the commencement of earthworks and construction, around the impact area, to reduce run-off into adjoining vegetation and downstream to the Coastal Wetland.	Protect waterways and Irrawang Swamp	Construction contractor	Pre-construction/ construction
Discharge of water into watercourses and overland flow paths that drain to Irrawang Swamp during commissioning of pipes would be avoided. HWC's *Procedure EP0112 – Dechlorination of discharge water* would be followed.	Minimise hydrological changes to Irrawang Swamp	Construction contractor	Construction
Where possible, earthworks would be undertaken during dry weather conditions. Clearing of vegetation should be avoided during overland flow events.	Prevent erosion and downstream water quality impacts	Construction contractor	Construction
Soil or mulch stockpiles would be located away from key stormwater flow paths to limit potential transport of these substances into waterways and Irrawang Swamp	Prevent downstream water quality impacts	Construction contractor	Pre-construction/ construction
Works at the Kings Hill URA watercourse would be undertaken during periods of no flow so that fish passage is not blocked.	Retain fish passage	Construction contractor	Construction
Stabilisation of disturbed areas would be undertaken as soon as practicable after disturbance.	Prevent erosion and sedimentation in adjacent vegetation and waterways	Construction contractor	Construction
Regular maintenance checks are to occur along the pipelines to prevent leaks.	Prevent groundwater contamination and impacts to GDEs	Maintenance contractor	Operation
An incident response procedure would be developed in the event of a pipeline leak and monitoring of relevant adjacent waterways, Irrawang Swamp and/or vegetation communities would be undertaken where there is a risk of impact from the leak.	Prevent soil, water and groundwater contamination and impacts to GDEs, weed spread	Maintenance contractor	Operation
Construction activities within 250 metres of the Grey-headed Flying-fox Camp as shown in Figure 9-1 would only occur between March and July.	Protect breeding and heat-stressed individuals of the threatened Grey-headed Flying-fox	Construction contractor Project ecologist	Construction

Mitigation measure	Outcome	Responsibility	Timing
Reasonable and feasible noise mitigation measures would be implemented when any works occur within 250 metres of the Grey-headed Flying-fox Camp (between March and July) and would include the installation of temporary noise barriers where construction activities result in generating noise above average background levels (as outlined in Section 2.4 of the *Noise and Vibration Assessment* (Resonate, 2019)).	Protect the threatened Grey-headed Flying-fox from noise impacts	Construction contractor	Construction
The Grey-headed Flying-fox camp would be monitored at regular intervals (daily) by a suitably qualified ecologist during any construction activities occurring within 250 metres of the camp (between March and July) to detect any stress response signs. Noise monitoring would occur concurrently. If a stress response is detected, works would cease and mitigation measures would be reviewed/amended.	Protect the threatened Grey-headed Flying-fox from noise and disturbance impacts	Construction contractor Project ecologist	Construction
Construction activities within 100 metres of the Grey-headed Flying-fox camp as shown in Figure 9-1 generating noise above average background levels (as outlined in Section 2.4 of the *Noise and Vibration Assessment* (Resonate, 2019)) would be limited to a maximum of 2.5 hours in any 12 hour period, preferably at sunrise or sunset or during the night.	Protect the threatened Grey-headed Flying-fox from noise and disturbance impacts	Construction contractor Project ecologist	Construction
Species selection for any revegetation works within the development site would include species commensurate with the mapped PCT.	Maintain naturally occurring vegetation	Construction contractor	Post-construction
Equipment used for treating weed infestation would be cleaned prior to undertaking work in the development site to minimise the likelihood of transferring any exotic plant material and soil.	Prevent weed spread	Construction contractor	Construction
Soil stripped and stockpiled from areas containing known weed infestations would be stored separately and is not to be moved to areas free of weeds.	Prevent weed spread	Construction contractor	Construction
Vehicles, equipment, materials and footwear are to be clean on entry (free of soil, mud and/or seeds) to minimise the introduction or spread of *Phytophthora cinnamomi.*	Prevent pathogen transfer	Construction contractor	Construction

Figure 9-1 Grey-headed Flying-fox camp buffers

10 OFFSETTING IMPACTS

10.1 Impacts requiring offset

10.1.1 Impacts on native vegetation

The ecosystem credits required to offset the impacts of the project on areas of native vegetation, as determined using the BAMC, are listed in Table 10-1 Ecosystem credits summary. The full biodiversity offset credit reports are provided in Appendix F of this report.

Table 10-1 Ecosystem credits summary

Vegetation zone	PCT name	Area impacted (ha)	Vegetation integrity loss	Ecosystem credits required
North Coast bioregion				
1590 – Moderate	Spotted Gum/ Broad-leaved Mahogany/ Red Ironbark shrubby open forest	0.14	66.6	3
1590 – Road batter		0.36	28.3	4
1600 – Moderate	Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	1.32	33.3	22
Sydney basin bioregion				
1619 – Moderate	Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	0.41	45.4	7
1619 – Poor		0.66	25.8	6
Total		**2.89**		**42**

10.1.2 Impacts on threatened species

The species credits required to offset the impacts of the project, as determined using the BAMC, are listed in Table 10-2 Species credits summary.

Table 10-2 Species credits summary

Species	Vegetation zone name	Individuals/ Area (ha)	Biodiversity risk weighting	Species credits
North Coast bioregion				
Petaurus norfolcensis Squirrel Glider	1590_Moderate 1590_Poor 1600_Moderate	1.5	2	27
Phascogale tapoatafa Brush-tailed Phascogale	1590_Moderate 1590_Poor 1600_Moderate	1.5	2	27
Phascolarctos cinereus Koala	1590_Moderate 1590_Poor 1590_Road_batter 1600_Moderate	1.5	2	28

Species	Vegetation zone name	Individuals/ Area (ha)	Biodiversity risk weighting	Species credits
Sydney Basin Bioregion				
Myotis macropus Southern Myotis	1590_Poor	0.1	2	1
Petaurus norfolcensis Squirrel Glider	1590_Poor 1619_Moderate	0.5	2	10
Phascogale tapoatafa Brush-tailed Phascogale	1590_Poor 1619_Moderate	0.5	2	10
Phascolarctos cinereus Koala	1590_Poor 1619_Moderate	0.3	2	7
Total				110

10.2 Impacts not requiring offset

Several areas mapped as PCTs do not require offsets under the BAM as the vegetation integrity scores for these vegetation zones are below the offset threshold of 20 for non-TEC vegetation and also the offset threshold of 17 for threatened species habitat. These areas total 2.33 hectares in area and are listed in Table 10-3 Impacts to PCT vegetation that do not require offsets.

Table 10-3 Impacts to PCT vegetation that do not require offsets

Vegetation zone	PCT name	Area impacted (ha)	Vegetation integrity loss	Ecosystem credits required
North Coast bioregion				
1590 – Poor	Spotted Gum/ Broad-leaved Mahogany/ Red Ironbark shrubby open forest	0.03	11.8	0
Sydney basin bioregion				
1590 – Poor	Spotted Gum/ Broad-leaved Mahogany/ Red Ironbark shrubby open forest	0.07	14.6	0
1619 – Planted trees	Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	2.23	14.0	0
Total		**2.33**		**0**

10.3 Areas not requiring assessment

An additional 13.07 hectares of other vegetation dominated by exotic species that does not conform to the definition of any PCTs was also recorded in the development site. These areas comprise cleared grassland, exotic trees and urban verges, and do not require further assessment or offset in accordance with section 10.4 of the BAM.

10.4 Like-for-like and variation credits

The BAMC generated two reports prescribing the offset options for each credit class: a like-for-like credit report and a variation credit report. These reports set out the PCT classes, trading groups, requirement for offsets to contain hollow-bearing trees (HBTs) and IBRA

subregions that ecosystem credits must be sourced from, and the species and IBRA subregions that species credits must be sourced from, in order to satisfy the offset obligation.

For like-for-like offsets, ecosystem credits must be sourced from:

- for impacts in the North Coast bioregion: Karuah Manning,Hunter, Macleay Hastings, Mummel Escarpment and Upper Hunter subregions or any IBRA subregion that is within 100 kilometres of the outer edge of the impacted site.
- for impacts in the Sydney basin bioregion: Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong or Yengo subregions or any IBRA subregion that is within 100 kilometres of the outer edge of the impacted site.

For variation offsets, credits must be sourced from the same bioregion as the impact, or any IBRA subregion that is within 100 kilometres of the outer edge of the impacted site.

The like-for-like and variation offset options for ecosystem credits are listed in Table 10-4 Like for like and variation offset options for ecosystem credits.

Table 10-4 Like for like and variation offset options for ecosystem credits

PCT name	Credits required	HBTs required?	PCTS listed in credit report that can be used for like for like offsets	Variation offset options
1590 - Spotted Gum/ Broad-leaved Mahogany/ Red Ironbark shrubby open forest	7	Yes	Hunter-Macleay Dry Sclerophyll Forests This includes PCTs: 715, 904, 922, 1178, 1215, 1588, 1589, 1590, 1591, 1592, 1593, 1600, 1601, 1602, 1608, 1612, 1626, 1748	Any PCT in the Dry Sclerophyll Forests Shrub/grass sub-formation (Tier 7 trading group or higher). Must include HBTS (including artificial).
1600 - Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	22	Yes	Hunter-Macleay Dry Sclerophyll Forests This includes PCTs: 922, 1178, 1588, 1589, 1600, 1601, 1602, 1608	Any PCT in the Dry Sclerophyll Forests Shrub/grass sub-formation (Tier 6 trading group or higher). Must include HBTS (including artificial).
1619 - Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	13	Yes	Sydney Coastal Dry Sclerophyll Forests This includes PCTs: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Any PCT in the Dry Sclerophyll Forests Shrubby sub-formation (Tier 7 trading group or higher). Must include HBTS (including artificial).

For like-for-like offsets, species credits can be sourced from anywhere in NSW, as long as they are for the same species as that impacted.

For variation offsets, species credits must be sourced from:

- for impacts in the North Coast bioregion: Karuah Manning, Hunter, Macleay Hastings, Mummel Escarpment and Upper Hunter subregions or any IBRA subregion that is within 100 kilometres of the outer edge of the impacted site.
- for impacts in the Sydney basin bioregion: Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong or Yengo subregions or any IBRA subregion that is within 100 kilometres of the outer edge of the impacted site.

The like-for-like and variation offset options for species credits are listed in Table 10-5 Like for like and variation offset options for species credits.

Table 10-5 Like for like and variation offset options for species credits

Species	Credits required	Like-for-like offset options	Variation offset options
Myotis macropus Southern Myotis	1	Southern Myotis Anywhere in NSW	Any fauna species with vulnerable or higher conservation status
Petaurus norfolcensis Squirrel Glider	37	Squirrel Glider Anywhere in NSW	Any fauna species with vulnerable or higher conservation status
Phascogale tapoatafa Brush-tailed Phascogale	37	Brush-tailed Phascogale Anywhere in NSW	Any fauna species with vulnerable or higher conservation status
Phascolarctos cinereus Koala	35	Koala Anywhere in NSW	Any fauna species with vulnerable or higher conservation status

10.5 Delivery of offsets

The available options for delivery of offsets under the Biodiversity Offsets Scheme are as follows:

- An appropriate number and class of like-for-like biodiversity credits may be retired.
- If all the required like-for-like biodiversity credits cannot be sourced, an appropriate number and class of variation biodiversity credits may be retired. The use of variation offset rules must be approved by the consent authority. The use of variation offset rules cannot be approved unless an applicant can demonstrate that they have taken reasonable steps to secure like-for-like biodiversity credits.
- Alternatively, the Offsets Payment Calculator may be used to determine the cost of all or part of the credit obligations, and a payment may be made to the Biodiversity Conservation Fund.

KHD are currently considering the most suitable strategy for the delivery of these offsets. This strategy would be confirmed as part of detailed design of the Proposal.

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APPENDIX A EPBC ACT PROTECTED MATTERS SEARCH RESULTS

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

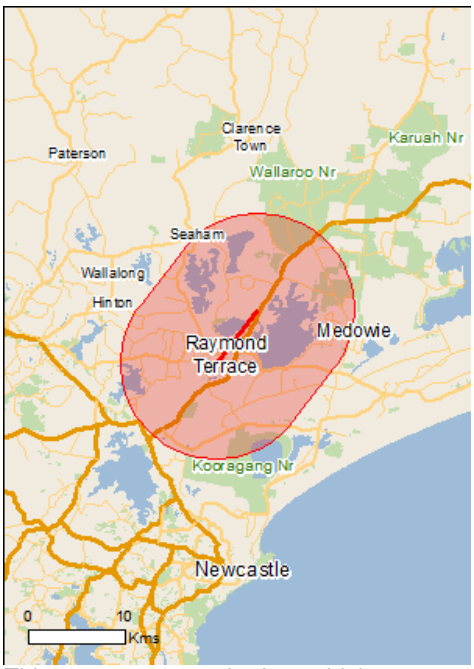
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 30/08/19 10:30:32

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



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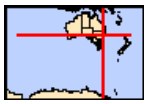

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	70
Listed Migratory Species:	62

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	8
Commonwealth Heritage Places:	1
Listed Marine Species:	70
Whales and Other Cetaceans:	1
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	7
Regional Forest Agreements:	1
Invasive Species:	44
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Hunter estuary wetlands	Within Ramsar site

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Central Hunter Valley eucalypt forest and woodland	Critically Endangered	Community may occur within area
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community likely to occur within area
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Status	Type of Presence
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable	Species or species habitat may occur within area
Fish		
Epinephelus daemelii Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat may occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat known to occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
Insects		
Synemon plana Golden Sun Moth [25234]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat likely to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Potorous tridactylus tridactylus		
Long-nosed Potoroo (SE Mainland) [66645]	Vulnerable	Species or species habitat likely to occur within area
Pseudomys novaehollandiae		
New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Angophora inopina		
Charmhaven Apple [64832]	Vulnerable	Species or species habitat known to occur within area
Asperula asthenes		
Trailing Woodruff [14004]	Vulnerable	Species or species habitat known to occur within area
Caladenia tessellata		
Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area
Commersonia prostrata		
Dwarf Kerrawang [87152]	Endangered	Species or species habitat known to occur within area
Cryptostylis hunteriana		
Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area
Cynanchum elegans		
White-flowered Wax Plant [12533]	Endangered	Species or species habitat known to occur within area
Dichanthium setosum		
bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus camfieldii		
Camfield's Stringybark [15460]	Vulnerable	Species or species habitat may occur within area
Eucalyptus parramattensis subsp. decadens		
Earp's Gum, Earp's Dirty Gum [56148]	Vulnerable	Species or species habitat known to occur within area
Grevillea parviflora subsp. parviflora		
Small-flower Grevillea [64910]	Vulnerable	Species or species habitat known to occur within area
Melaleuca biconvexa		
Biconvex Paperbark [5583]	Vulnerable	Species or species habitat may occur within area
Persicaria elatior		
Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat known to occur within area
Phaius australis		
Lesser Swamp-orchid [5872]	Endangered	Species or species habitat may occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269)		
a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area
Rutidosis heterogama		
Heath Wrinklewort [13132]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat likely to occur within area
Tetratheca juncea Black-eyed Susan [21407]	Vulnerable	Species or species habitat likely to occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur

Name	Threatened	Type of Presence within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur

Name	Threatened	Type of Presence within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting known to occur within area

Name	Threatened	Type of Presence
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Commonwealth Trading Bank of Australia
Commonwealth Land - Defence Housing Authority
Commonwealth Land - Defence Service Homes Corporation
Commonwealth Land - Director of War Service Homes
Commonwealth Land - Telstra Corporation Limited
Defence - RAAF BASE WILLIAMTOWN

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Historic		
Williamtown RAAF Base Group	NSW	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Breeding likely to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely

Name	Threatened	Type of Presence
		to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or