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# Cabbage Tree Road Sand Quarry

## Williamtown Sand Syndicate

Assessments against the EPBC Act Significant Impact Criteria

Cabbage Tree Road, Williamtown NSW

22 December 2016

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**Prepared for:**

**WILLIAMTOWN SAND SYNDICATE**

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| | | | | | |

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# 1. WETLANDS OF INTERNATIONAL IMPORTANCE

## 1.1 HUNTER ESTUARY WETLANDS

**An action is likely to have a significant impact on the ecological character of a declared Ramsar wetland if there is a real chance or possibility that it will result in:**

- areas of the wetland being destroyed or substantially modified

The Subject Land occurs approximately 590 m to the north of the Ramsar wetland. As such, the proposal will not directly impact on the Ramsar wetland and no areas of the wetland will be destroyed or substantially modified.

- *a substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland*

The Subject Land occurs upstream of Fullerton Cove, which forms part of the Hunter estuary wetlands. The final landform of the extraction area will be 1 m above the maximum predicted groundwater level. Extraction will occur to 70 cm above the maximum predicted groundwater level, and then 30 cm of topsoil will be re-distributed. The final landform will be monitored throughout the life of the quarry to ensure that the level above the maximum predicted groundwater level is maintained. Additionally, no extraction of groundwater is proposed as part of the action. As such, the proposal is unlikely to substantially modify the hydrological regime upstream of the Hunter estuary and it is unlikely that there will be any indirect impacts on the Ramsar Wetland.

- *the habitat or lifecycle of native species including invertebrate fauna and fish species, dependent upon the wetland being seriously affected*

The Subject Land occurs approximately 590 m to the north of the Hunter estuary wetlands and will not directly impact on habitat within the wetland. As outlined above, it is unlikely that there will be indirect impacts on the hydrology of the wetland. As such, it is unlikely that the proposal will impact on native species dependent upon the wetland.


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- *a substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health, or*

As outlined above, the proposed action is unlikely to modify the surface or groundwater hydrology of the area, and no water extraction is proposed as part of the action. As such, it is unlikely that the action will impact on the salinity levels in the downstream Ramsar Wetland.

As the proposed activity occurs within the Hunter Water Catchment and upstream of a Ramsar wetland, a number of mitigation measures have been implemented to limit the potential for impacts on water quality. These include, but are not limited to: the use of electric conveyors, stackers, screens and air separators in the extraction and processing rather than generators to limit diesel consumption; a concrete bunded area for refuelling of machinery onsite and tank refuelling within the workshop (i.e. under cover) to avoid surface water runoff; and, bunding under the electric screen and air separator plant to capture hydraulic leaks, see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

Due to the limited sources of potential contaminates, the relatively small volume of contaminates being used during the project, and the additional mitigation measures to be implemented, it is unlikely that the proposal will impact on the water quality of the Hunter estuary wetlands.

- *an invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.*

As the proposal will not occur within or directly adjacent to the wetland it is unlikely that it will cause the establishment or spread of an invasive species that is harmful to the wetland.


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# 2. LISTED THREATENED SPECIES AND ECOLOGICAL COMMUNITIES

## 2.1 BIRDS

### Regent Honeyeater and Swift Parrot

The Regent Honeyeater was once widespread throughout southeast Australia. Now it is mainly found in limited areas of northeast Victoria and central-east NSW. It has been observed breeding in several areas in north-eastern Victoria (Chiltern district, Killawarra State Forest, Benalla district), and along the western slopes of the Great Dividing Range in NSW (Bundarra-Barraba district, Capertee Valley). Regent Honeyeaters are nomadic feeders and can be found elsewhere throughout its previous range where there is suitable blossom occurring (Franklin *et al.* 1989). This species is mostly recorded in box-ironbark eucalypt associations. They prefer the wettest, most fertile sites within these associations, such as along creek flats, broad river valleys and foothills. In NSW, riparian forests of *Casuarina cunninghamiana* (River Oak), those with *Amyema cambagei* (Needle-leaf Mistletoe), are also important for feeding and breeding. At times of food shortage the birds also use other woodland types and wet lowland coastal forest dominated by *E. robusta* (Swamp Mahogany) or *Corymbia maculata* (Spotted Gum) (Franklin *et al.* 1989; Ley and Williams 1992; Webster and Menkhorst 1992; Geering and French 1998; Oliver *et al.* 1999). Nectar is the principal food, but sugary exudates from insects are also used (Oliver 1998, 2000).

The Swift Parrot is small migratory parrot (25 cm) that breeds in Tasmania and migrates to south-eastern Australia for the winter months. In Tasmania, the species is dependent on Blue Gums for both flower nectar and for nesting hollows, of which there has been large scale clearing of these trees in Tasmania over many years (Brereton 1997). On the mainland, the Swift Parrot feed trees include winter flowering species such as *E. robusta* (Swamp Mahogany), *C. maculata* (Spotted Gum), *C. gummifera* (Red Bloodwood), *E. sideroxylon* (Mugga Ironbark), and *E. albens* (White Box). Commonly used lerp infested trees include *E. macrocarpa* (Grey Box), *E. moluccana* (Grey Box) and *E. pilularis* (Blackbutt) (Brown 1989). Following winter they return to Tasmania where they breed from September to January, nesting in old trees with hollows and feeding in forests dominated by Tasmanian Blue Gum (Barrett *et al.* 2003).

There is one record of the Regent Honeyeater and six records of the Swift Parrot occurring within a 10 km radius of the Subject Land.


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Both of these species were assessed as having suitable habitat within the Subject Land, but were not identified during field surveys. As these species are nomadic and utilise resources within their range during different seasons and years, there is potential that these species forage within the Subject Land on occasion. The Swift Parrot breeds only in Tasmania and the Subject Land does not represent known breeding habitat for the Regent Honeyeater. In NSW the key breeding areas for the Regent Honeyeater are located in the Capertee Valley and the Bundarra-Barraba region. However, a breeding event was recorded in the Hunter Region (at the Hunter Economic Zone, Kurri Kurri) in 2007/ 2008.

The core area of occurrence within the Hunter Region for both of these species is around the Cessnock area, where they forage in Box-Ironbark Woodlands and Spotted Gum – Ironbark Forest associations.

**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 will:**

- *lead to a long-term decrease in the size of a population*

The proposed action is unlikely to lead to the long-term decline in the size of a population of these species, as; the vegetation within the extraction area does not provide breeding habitat for the species; the Subject Land is not within the core area of these species occurrence within the region; and, there is a high availability of suitable foraging habitat in the area adjoining the extraction area, both within the Subject Land, and to the north within the Tilligerry State Conservation Area (SCA). As such the removal of 40.38 ha of foraging habitat for these species is unlikely to significantly impact on a population.

- *reduce the area of occupancy of the species*

While the proposal will remove approximately 40.38 ha of suitable foraging habitat for these species. Given the large distribution of these species in the Hunter and the large area of available habitat to be retained within the offset are, it is unlikely that the proposed action will reduce their area of occupancy. Additionally, the proposed disturbance area will be progressively rehabilitated, as such there is the potential for these species to utilise the area as foraging habitat once the rehabilitation reaches a suitable age; see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

- *fragment an existing population into two or more populations*

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east, with suitable foraging habitat for these species occurring along


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this corridor. The proposal will temporarily remove a total of 40.38 ha of native vegetation from the edge of this corridor. As both of these species are highly mobile, and only foraging habitat is present within the Subject Land, the proposed action will not fragment any populations of these species.

- *adversely affect habitat critical to the survival of a species*

The National Recovery Plan for the Regent Honeyeater identifies that any breeding or foraging areas where the species is likely to occur is habitat critical to the survival of the species (Commonwealth of Australia 2016). The recovery plan maps the presence category of the Subject Land as 'Species likely to occur', as such the habitat within the Subject Land is critical to the survival of the species. The vegetation within the Subject Land likely provides opportunistic foraging habitat and supplementary foraging areas in times of low nectar resources in core foraging areas. Due to the large area of similar habitat types in the surrounding area (offset area and Tilligerry SCA), it is unlikely that the removal of 40.38 ha of foraging habitat within the extraction will adversely affect habitat critical to the survival of the Regent Honeyeater.

The National Recovery Plan for the Swift Parrot (Saunders and Tzaros 2011) outlines that 'habitat critical to the survival of the Swift Parrot includes; those areas of priority habitat for which the Swift Parrot has a level of site fidelity or possess phenological characteristics likely to be of importance to the Swift Parrot, or are otherwise identified by the recovery team'. As such, in Hunter region the 'important bird area' around Cessnock (Birdlife International 2016) is likely to be the only known area critical to the survival of the species due to the frequency in which this area is visited. As the Subject Land only provides opportunistic foraging habitat for the Swift Parrot, it is unlikely to be critical to the survival of the species. As such the proposed action will not impact on habitat critical to the survival of the Swift Parrot.

- *disrupt the breeding cycle of a population*

The Swift Parrot does not breed in on the mainland of Australia, as such the proposed action is unlikely to disrupt its breeding cycle.

Core breeding habitat for the Regent Honeyeater occurs in the Capertee Valley and the Bundarra-Barraba region. However, a breeding event was recorded in the Hunter Region (at the Hunter Economic Zone, Kurri Kurri) in 2007/ 2008. Breeding has not been recorded at any other locations within the region. As such, the Subject Land does not contain known breeding habitat for the species, and it is unlikely that the proposed action will disrupt the breeding cycle of the Regent Honeyeater.


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

As outlined above, the Subject Land likely provides opportunistic foraging habitat and supplementary foraging areas for both of these species. There is a large amount of suitable foraging habitat for these species to be retained within the Subject Land and in areas to the north within the Tilligerry SCA. As such, the removal of 40.38 ha of foraging habitat within the extraction area is unlikely to lead to the decline of these species.

- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

Competition for nectar resources from Feral Honeybees and other nectivorous birds (native and exotic), is identified as a potential threat to the Regent Honeyeater (Commonwealth of Australia 20106) and the Swift Parrot (Saunders and Tzaros 2011). Also, aggressive behaviour by over abundant Noisy Miners, a key threatening process, could also impact on the occurrence and abundance of these species in areas of habitat. It is not expected that the proposed action would increase the potential for either of these harmful species becoming established in habitat for these species.

- *introduce disease that may cause the species to decline, or*

Psittacine Beak and Feather Disease (PBFD) is a common and potentially deadly disease of parrots caused by a circovirus. A large number of Lorikeets that are rescued and rehabilitated often carry the disease when released into the wild. As the habitat of these species overlap, there is the potential that the virus can be transferred to Swift Parrots (Saunders and Tzaros 2011). There is the possibility that the proposed action could impact on parrot species during clearing activities. If any captured parrots are rehabilitated and released into the wild, there is the potential for them to spread PBFD. However, it is not expected that a significant number of parrots would be impacted on during clearing. The Environmental Management Plan (within Response to Submissions Part 7 (Major Projects Website)), details clearing procedures, including pre-clearing surveys and habitat tree felling procedures, to minimise impacts on locally occurring fauna species.

As both species are dependent upon Eucalypt dominated habitats for foraging in the region, impacts to their habitat from Myrtle Rust and *Phytophthora cinnamomi* are possible.

Evidence of these two diseases were not identified within the Subject Land, however, they are known to occur in the region. It is not expected that the proposal will introduce or exacerbate any of these diseases that may cause the species to decline. To limit the potential of spread,


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all machinery conducting clearing within the extraction area will be clean and free of any soil or vegetative material when it enters the site.

- *interfere with the recovery of the species.*

The proposed action is not consistent with one objective of the Recovery Plan for the Regent Honeyeater; 'improve the extent and quality of Regent Honeyeater habitat' (Commonwealth of Australia 2016).

The proposed action does not contravene any of the objectives of the Swift Parrot Recovery Plan (Saunders and Tzaros 2011).

The temporary loss of 40.38 ha of opportunistic foraging habitat for these two species is unlikely to impact on their recovery.

### Australasian Bittern

The Australasian Bittern occurs in reeds and marshes in terrestrial freshwater wetlands and, occasionally estuarine habitats, generally where there is permanent water. The Australasian Bittern is a cryptic bird, roosting during the day on the ground amongst dense reeds (Marchant & Higgins 1990). Foraging occurs mainly at night with typical prey consisting of small mammals, birds, amphibians, eels, crustaceans and insects. The breeding season is from October through to February with nests being built in stands of *Phragmites, Typha*, and rushes (*Juncus, Baumea* spp.). The nest is usually comprised of a well-constructed flat platform of rushes or reeds. The species may occur singly, in pairs, or in groups of up to 12 individuals (Marchant & Higgins 1990). The Australasian Bittern is generally sedentary but sometimes moves in response to flooding and drought (Smith *et al.* 1995).

The Tomago area (which includes the Hunter Wetlands National Park and Hunter Estuary Wetlands Ramsar site) are considered to represent vital habitat for the local Australasian Bittern population. In October 2011, the Hunter Bird Observers Club (HBOC) conducted an evening survey of lower Hunter wetlands and recorded six calling birds (five in Hexham Swamp and one in the Tomago wetlands) (HBOC 2012). In 2009, 2 – 4 birds were regularly recorded at the Tomago Wetlands between April and September and single birds were observed at Hexham Swamp and Deep Pond on Kooragang Island (HBOC 2009). Within the Hunter Region, the core breeding range is likely to be contained within the broader Hunter Estuary (i.e. Hexham Swamp, Kooragang Island, Tomago, Williamtown (Finegan *et al.* 2001)). The majority of preferred habitat for this species occurs in areas with some level of protection e.g. National Parks, Council reserves and in SEPP 14 wetlands (Roderick & Stuart 2010). Some areas remain unprotected and may be at threat from inappropriate hydrological practices and


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indirect impacts of nearby development. It is also noted that it is unclear what the impact will be on this species' local habitat of the returning of brackish/saline waters to some of these areas via the opening of the floodgates in Hexham Swamp and the Tomago wetlands (Roderick & Stuart 2010).

The species was not identified during field surveys, but suitable habitat for the species occurs within the Coastal Wet Sand Cyperoid Heath and the species is known from the locality. The habitat within the Subject Land was assessed as marginal. As outlined above, preferred habitat for the species occurs in the locality, to the south in the Tomago Precinct of the Hunter Estuary National Park and west of the Subject Land at Hexham Swamp.

**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 will:**

- *lead to a long-term decrease in the size of a population*

No areas of habitat for this species will be directly impacted, as such it is unlikely that the proposed action will lead to a long-term decrease in the size of a population.

- *reduce the area of occupancy of the species*

As the proposed action will not directly impact on any suitable habitat for the species it will not reduce the area of occupancy of the species.

- *fragment an existing population into two or more populations*

The proposed action will not directly impact on any habitat for the species, and will not create any barriers to movement between the habitat on site and other areas of habitat in the locality. As such the proposed action will not fragment a population.

- *adversely affect habitat critical to the survival of a species*

The proposed action will not directly impact on any areas of habitat for the species. The Subject Land does not occur directly upstream of the Tomago Precinct of the Hunter Wetlands National Park, and it is unlikely that impacts on the Subject Land would alter the hydrology of this area. Furthermore the proposed action is unlikely to modify the surface or groundwater hydrology of the area.

As such it is unlikely that there will be an adverse effect on critical habitat.

- *disrupt the breeding cycle of a population*


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The proposed action will not directly impact on any areas of suitable habitat for the species, i.e. Coastal Wet Sand Cyperoid Heath. Additionally, the extraction will be restricted to a depth of 0.7 m above the maximum predicted groundwater level, with the final landform at 1 m above the maximum predicted groundwater level. As such it is unlikely that there will be any significant indirect impacts on the species habitat through impacts to groundwater hydrology.

Therefore, the proposed action is unlikely to disrupt the breeding cycle of a population.

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

As the proposed action will not directly impact on the species habitat, and as indirect impacts from groundwater hydrology are not likely to be significant, it is unlikely that the proposal will impact on habitat such that the species is likely to decline.

- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

As the proposed action will not directly impact on any areas of habitat for the species, and as indirect impacts are unlikely, it is not expected that the action will result in an invasive species becoming established in the species habitat.

- *introduce disease that may cause the species to decline, or*

As the proposed action will not directly impact on any areas of habitat for the species, and as indirect impacts are unlikely, it is not expected that the action will introduce disease that may cause the species to decline.

- *interfere with the recovery of the species.*

As the proposed action will not directly impact on any areas of habitat for the species, and as indirect impacts are unlikely, it is not expected that the action will interfere with the recovery of the species.

### Wading Birds with Habitat in Fullerton Cove

**Critically Endangered and Endangered Species**

- Red Knot
- Curlew Sandpiper
- Great Knot
- Lesser Sand Plover
- Northern Siberian Bar-tailed Godwit


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- Eastern Curlew

All of these species utilise habitat in Australia for foraging only, with breeding territories primarily in Asia. Foraging habitat for these species occurs within Fullerton Cove. The proposed action will not directly impact on any areas of habitat for these species. There is the potential for indirect impacts through modification of surface and groundwater hydrology as the extraction area occurs upstream of the Hunter Estuary National Park.

**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 will:**

- *lead to a long-term decrease in the size of a population*

Suitable habitat for these species occur approximately 590 m to the south of the Subject Land within the Ramsar Wetland at Fullerton Cove. The proposed action will not directly impact on any areas of habitat for these species. There is the potential for indirect impacts on these species' habitat through modification of the groundwater hydrology, upstream of the Ramsar Wetland. The proposed extraction level will be restricted to a depth of 0.7 m above the maximum predicted groundwater level, with the final landform at 1 m above the maximum predicted groundwater level. As such it is unlikely that there will be any significant indirect impacts on habitat for these species, and subsequently it is unlikely that the proposed action will lead to the long-term decrease in a population of any of these species.

- *reduce the area of occupancy of the species*

As the proposed action will not directly impact on any suitable habitat for these species, and indirect impacts are unlikely (see above), the proposed action will not reduce the area of occupancy of any of these species.

- *fragment an existing population into two or more populations*

The proposed action will not directly impact on any habitat for these species, and will not create any barriers to movement between areas of habitat in the locality. As such the proposed action will not fragment a population.

- *adversely affect habitat critical to the survival of a species*

The proposed action will not directly impact on any areas of habitat for these species, and indirect impacts are unlikely. Therefore, it is unlikely that there will be an adverse effect on critical habitat for these species.


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- *disrupt the breeding cycle of a population*

Not applicable. None of these species breed in Australia.

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

As the proposed action will not directly impact on these species' habitat, and as indirect impacts from groundwater hydrology are not likely to be significant, it is unlikely that the proposal will impact on habitat such that these species are likely to decline.

- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

As the proposal will not occur within or directly adjacent to the habitat for these species (Hunter Estuary National Park), it is unlikely that it will cause the establishment or spread of an invasive species that is harmful to these species.

- *introduce disease that may cause the species to decline, or*

As the proposal will not occur within or directly adjacent to the habitat for these species (Hunter Estuary National Park) it is unlikely that it will introduce a disease that is harmful to these species.

- *interfere with the recovery of the species.*

As the proposal will not occur within or directly adjacent to the habitat for these species (Hunter Estuary National Park) it is unlikely that it will interfere with the recovery of these species.

**Vulnerable Species**

- Greater Sand Plover
- Bar-tailed Godwit

These two species utilise habitat in Australia for foraging only, with breeding territories in Asia or Northern Europe. Habitat for these species occurs within Fullerton Cove. The proposed action will not directly impact on any areas of habitat for these species. There is the potential for indirect impacts through modification of surface and groundwater hydrology as the extraction area occurs upstream of the Hunter Estuary National Park.

**An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:**


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

Suitable habitat for these species occurs approximately 590 m to the south of the Subject Land within the Ramsar Wetland at Fullerton Cove. The proposed action will not directly impact on any areas of habitat for these species. There is the potential for indirect impacts on these species' habitat through modification of the groundwater hydrology, upstream of the Ramsar Wetland. The proposed extraction level will be restricted to a depth of 0.7 m above the maximum predicted groundwater level, with the final landform at 1 m above the maximum predicted groundwater level. As such it is unlikely that there will be any significant indirect impacts on habitat for these species, and subsequently it is unlikely that the proposed action will lead to a long-term decrease in an important population of either of these species.

- *reduce the area of occupancy of an important population*

As the proposed action will not directly impact on any suitable habitat for these species, and indirect impacts are unlikely (see above), the proposed action will not reduce the area of occupancy of either of these species.

- *fragment an existing important population into two or more populations*

The proposed action will not directly impact on any habitat for these species, and will not create any barriers to movement between areas of habitat in the locality. As such the proposed action will not fragment an important population.

- *adversely affect habitat critical to the survival of a species*

The proposed action will not directly impact on any areas of habitat for these species, and indirect impacts are unlikely, as such it is unlikely that there will be an adverse effect on critical habitat for these species.

- *disrupt the breeding cycle of an important population*

Not applicable. Neither species breeds in Australia.

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

As the proposed action will not directly impact on these species' habitat, and as indirect impacts from groundwater hydrology are not likely to be significant, it is unlikely that the proposal will impact on habitat such that these species are likely to decline.


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- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

As the proposal will not occur within or directly adjacent to the habitat for these species (Hunter Estuary National Park) it is unlikely that it will cause the establishment or spread of an invasive species that is harmful to these species.

- *introduce disease that may cause the species to decline, or*

As the proposal will not occur within or directly adjacent to the habitat for these species (Hunter Estuary National Park) it is unlikely that it will introduce a disease that is harmful to these species.

- *interfere substantially with the recovery of the species.*

As the proposal will not occur within or directly adjacent to the habitat for these species (Hunter Estuary National Park) it is unlikely that it will interfere with the recovery of these species

## 2.2 MAMMALS

### Spotted-tailed Quoll

Historically the Spotted-tailed Quoll occupied a large range throughout eastern Australia. Following European settlement however, the species has undergone a dramatic decline as a result of habitat clearance, disease, and competition with the introduced fox and feral cat. Currently, the Spotted-tailed Quoll occupies a disjunct distribution along the coast and ranges of eastern Australia, from southern Queensland to Victoria, and into Tasmania. Small populations of a north Queensland sub-species also occur in the vicinity of Bundaberg. These animals are secretive and difficult to detect in their large home range. A community survey throughout NSW including the Port Stephens area, added almost 12% of additional records for this species.

The Spotted-tailed Quoll has been reported from a wide range of habitat types, including rainforest, wet and dry sclerophyll forest, woodland, coastal heathland, as well as along riparian forests in the inland. Spotted-tailed Quolls are generally solitary, nocturnal, and semi-arboreal species, occupying home-ranges of between 750 and 3,500 ha. Den and nest sites for the Spotted-tailed Quoll have been recorded in caves, rock crevices, tree hollows, and hollow logs (Edgar & Belcher 1995; Lunney & Matthews 2001). The Spotted-tailed Quoll is mostly nocturnal, although will hunt during the day, and consumes a variety of prey including


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gliders, possums, small wallabies, rats, birds, bandicoots, rabbits and insects; also eats carrion and takes domestic fowl.

The species was not recorded during the field surveys, however, suitable habitat for the species occurs within all vegetation types within the Subject Land.

**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 will:**

- *lead to a long-term decrease in the size of a population*

The species was not detected during field surveys and there is only one recent record of the species within 10 km (approximately 7 km north-west of the Subject Land, from January 2016; NSW BioNet). However, due to the cryptic nature of the species and the high availability of habitat along the Tomago Sandbeds, there is the potential for a local population to utilise the Subject Land.

A mitigation measure of the proposed action is the implementation of a vertebrate pest control program. If deemed appropriate, the control methods may involve the use of 1080 baiting. The proposed feral animal control program would be conducted in accordance with the 'EPBC Act Policy Statement 3.4 – Significant Impact Guidelines for the Endangered Spotted-tailed Quoll *Dasyurus maculatus maculatus* (Southeastern Mainland Population) and the use of 1080' and the 'Administrative Guidelines on Significance: Supplement for the Tiger Quoll (Southeastern Mainland Population) and the use of 1080', see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

The significant impact guidelines for the species outline that the following activities might have a significant impact on the Spotted-tailed Quoll: baiting in, or near, known isolated or fragmented populations; bating in areas at the extremities of the species' known range; and, baiting in areas not previously baited that may contain susceptible Spotted-tailed Quoll populations. None of these activities will be conducted, as; due to the high availability of suitable habitat to the north of the Subject Land (within the Tilligerry SCA) it is unlikely that any potentially occurring local population is isolated or fragmented; the species occurs along the east coast from Gladstone through NSW to Western Victoria, as such the Subject Land is not at the extremity of the species range; and, baiting is undertaken within the Tilligerry SCA to the north of the Subject Land.


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As such, provided the program is undertaken in accordance with the Significant Impact Guidelines and the supplementary information for the species, it is unlikely that the action will significantly impact on the species.

- *reduce the area of occupancy of the species*

The proposed action will temporarily remove 40.38 ha of habitat for the species. There is a large amount of habitat for the species that will be retained within the offset area and to the north of the Subject Land (Tilligerry SCA). Additionally, the proposed disturbance area will be progressively rehabilitated, as such there is the potential for the species to utilise the area as foraging habitat once the rehabilitation reaches a suitable age; see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

As outlined above, any baiting undertaken as part of a vertebrate pest control program within the Subject Land will be conducted in accordance with the Significant Impact Guidelines and the supplementary information for the species reducing the potential impact on the species. As such, it is unlikely that the proposed action will reduce the area of occupancy of the species.

- *fragment an existing population into two or more populations*

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east. The proposal will temporarily remove a total of 40.38 ha of native vegetation from the edge of this corridor. As such, the proposal will not fragment any areas of habitat extending off the site.

Within the Subject Land the proposal will cause some minor fragmentation of two areas of habitat in the west/south-west of the Subject Land. The proposed extraction area has been revised to ensure no areas of habitat will be isolated. As such, movement corridors within the Subject Land will be maintained. All areas of vegetation retained within the Subject Land will be linked to other areas of vegetation both within and adjacent to the site. Along the western boundary, areas of habitat will be linked through a retained strip of vegetation that is either 20 m or 50 m wide (depending on the point along the boundary). A corridor of vegetation between the northern and southern extraction areas will also be retained.

As such, the proposal will not fragment a potentially occurring local population.

- *adversely affect habitat critical to the survival of a species*

The National Recovery Plan for the Spotted-tailed Quoll *Dasyurus maculatus* (DELWP 2016) identifies habitat critical to the survival of the species as ‘large patches of forest with adequate


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denning resources and relatively high densities of medium-sized mammalian prey'. As such, the Subject Land is likely to form part of an area of critical habitat. The proposed action will not adversely affect this habitat due to the relatively small area of removal, considering the high availability of suitable within, and to the north of, the Subject Land.

- *disrupt the breeding cycle of a population*

Maternal dens sites for the species include rock crevices, caves, boulder tumbles, hollow logs, hollow tree roots and burrows (DELWP 2016). No dens sites were identified during field surveys, however, the proposed activity will remove approximately 56 hollow-bearing trees and 21 dead stags progressively over the life of the project. During the hollow-bearing tree survey conducted within and adjacent to the previously proposed extraction area, a further 109 hollow-bearing trees and dead stags were identified. The hollow-bearing tree survey was used during the re-design of the proposed extraction area, in order to reduce the impacts of the proposal on hollow-dependent fauna.

Due to the availability of suitable habitat to be retained within the Subject Land and the surrounding Tilligerry SCA, it is unlikely that the proposed action will disrupt the breeding cycle of a locally occurring population.

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

There is a large amount of suitable habitat for the species to be retained within the Subject Land and in areas to the north within the Tilligerry SCA. As such, the removal of 40.38 ha of habitat within the extraction area is unlikely to lead to the decline of the species.

- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

Competition and predation from introduced predators, such as Cats, Foxes and Wild Dogs is a potential threat to the species. The proposed action is unlikely to lead to an increase in the threat of these invasive species on the Spotted-tailed Quoll. Additionally, a vertebrate pest control program will be implemented as part of the proposed action, which will decrease potential predation pressures of these invasive species on the Subject Land and surrounds; see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).


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- *introduce disease that may cause the species to decline, or*

No diseases are listed as contributing the decline of the species. Additionally, it is unlikely that the proposed action would introduce or exacerbate Myrtle Rust and *Phytophthora cinnamomi* (which could impact on the species' habitat).

- *interfere with the recovery of the species.*

While the proposed action is not consistent with one objective of the Recovery Plan for the Spotted-tailed Quoll; 'Reduce the rate of habitat loss and fragmentation on private land' (DELWP 2016), the temporary loss of 40.38 ha habitat for this species is unlikely to impact on its recovery.

### Koala

The Koala occurs from north-eastern Queensland, south along the coast and ranges to south-western South Australia, including areas west of the Great Dividing Range (DECC 2008).

The species inhabits eucalypt woodlands and forests and feeds on the foliage of Eucalypt and non-Eucalypt species. Across their range, the species has been recorded as foraging or sitting in 69 different Eucalypt species and almost 30 non-Eucalypt species, however, most studies of Koala foraging habits noted that the species predominantly feeds on one or a few Eucalypt species at any site (Moore and Foley 2000). Within the Port Stephens area, *Eucalyptus robusta*, *E. parramattensis* and *E. tereticornis* were identified as preferred feed trees by Lunney *et al.* (1998). Additionally, vegetation associations containing *Eucalyptus signata* were also identified as important in this study.

The species is generally solitary (OEH 2015b), but they have a complex social hierarchy, living in breeding aggregations comprising of the territory of a dominant male overlapping a small number of mature females, also juveniles of various ages occur (DECC 2008; OEH 2015b). Across their range, adult Koalas generally exhibit long-term fidelity to their individual home range. Within the Port Stephens area studies have established home ranges of 0.2 ha to 500 ha, with an average of 80 – 90 ha (DECC 2008).

There is evidence that the population within the Port Stephens area is in decline. The mortality rate in 1995 was estimated to be 5 – 10% of the population. Since 1995 this rate has declined linearly to less than half that level. As trends in road mortality rates of animals can provide a good surrogate for animal abundance, this may indicate a substantial decline in the population at Port Stephens (TSSC 2012). Modelling of the impacts of fire and dogs on the Port Stephens population conducted by Lunney *et al.* (2007) also identified that these two pressures are


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impacting on the local population. The research estimated the population to be between 350 and 800 individuals, and modelled that under basic assumptions (impacts from dogs and fire), the population was unlikely to survive 50 years (Lunney *et al.* 2007).

The Subject Land falls within a key Koala population (Tomago Sandbeds Koala Management Unit (KMU); CKPOM 2002) in the Port Stephens LGA. There is a high number of records of the species within 1 km of the site. There are a total of nine Atlas records within the Subject Land; one from 2011 (accuracy of 10 m), one from 2008 (accuracy of 1,000 m) and the remaining seven in 1992 or prior (all accuracy of 1,000 m). Additionally, there are 37 records within 1 km of the Subject Land, of which five are within the last 10 years. This suggests that the area is potentially of high importance to the Koala in the area, particularly due to the occurrence of areas of preferred habitat.

The species was identified in the south of the Subject Land during surveys conducted by RPS (2011). However, surveys conducted by Umwelt (2015) in September 2015 did not return any activity during SAT surveys, which was attributed to the fire which occurred two years prior to the field surveys (October 2013). While the SAT surveys conducted by Umwelt in 2015 did not identify any Koala activity, the Subject Land would have contained habitat suitable for utilisation by the species. Matthews *et al*. (2007) identified that burnt trees could be utilised by Koalas from as little as three months after fire, as the epicormic growth provides sufficient nutrients. Un-burnt areas are important during wildfire events to maintain the population and service as a source of colonising individuals into areas of burnt bush (Matthews *et al.* 2007). It is likely that Koala re-colonisation of the habitat burnt in 2013 fire, including the Subject Land, is still occurring. This is supported by the lack of activity detected by Umwelt in 2015 (two years post fire), and the lack of Atlas records within burnt areas in close proximity to the Subject Land. Post 2013 fire event, there are seven records of the species within 5 km of the Subject Land (within the KMU). These occur along Medowie Road approximately 3 to 4 km to the east/north-east (4 records from 2014) and approximately 4 km north along Richardson Road (two records from 2014 and one record from 2015). The four records along Medowie Road all occur within areas that were not burnt during the fire and the three records along Richardson Road occur within 1 km of the mapped fire extent.

Due to the recent fire disturbance (October 2013), the precautionary principle was applied and the preferred habitat within the Subject Land is assumed to have the potential to support a medium (normal) usage category. As outlined by Phillips and Callaghan (2011), “low activity levels recorded in what might otherwise be med-high carrying capacity *P. cinereus* habitat may be a result of contemporary population dynamics, landscape configuration and/or historical disturbances including logging, mining, fire, agricultural activities and/or urban development”.


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The local population of Koalas which potentially occupy the Subject Land do not occur at the extent of the range of the species. However, the local population has been assessed as 'important' as the population of the species in the Port Stephens LGA is likely to be important for maintaining genetic diversity and/or breeding and dispersal.

**An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:**

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

The decline of the Koala population in the Port Stephens LGA has historically been attributed to habitat loss, however, impacts from fires, dogs (Lunney *et al.* 2007) and motor vehicles (Phillips *et al*. 1996) have been identified as significant threats to the species. The habitat loss due to the proposal (19.19 ha of preferred habitat and 21.19 ha of supplementary habitat) has been assessed as minor in the context of the sandbeds (approximately 1.01% of the preferred habitat within the KMU; see d (i) below). The proposal also has the potential for increased impact to the species from vehicle strikes as there will be an increase in traffic. However, traffic assessments concluded that the proposal will only cause a minor increase in traffic volume. At absolute maximum extraction rates, the proposal will increase traffic along Cabbage Tree Road by less than 3% in a 24 hour period. However, it is expected under average operational conditions that traffic increases along Cabbage Tree Road will be less than 1%. Additionally, the proposal will not increase dog numbers in the locality.

During clearing there is the potential for displacement of an individual if the extraction area forms part of its home-range. The removal of an area of an individual's home range may force it to move, potentially impeding on the home range of another individual. This could result in conflicts in the local area due to the high fidelity the species exhibit to their home range. Based on the assessment of an average home range in the Port Stephens area of 80 – 90 ha (DECC 2008), the proposal has the potential to impact on the home range of approximately one to two adult Koalas. While there is the potential to displace one to two individuals, this impact is unlikely to be significant due to the large area of available habitat within the Tomago Sandbeds KMU. Lunney *et al.* (2007) modelled the carrying capacity of the Port Stephens area to be a maximum of 2,500 individuals. However, the population within the same area was estimated to be only 350 – 800 individuals (Lunney *et al.* 2007). Based on this assessment, habitat availability is not the limiting factor for the Koala population in Port Stephens area and it is likely that there is a large amount of available habitat within the locality that is either un-occupied, or could potentially support a higher density of Koalas.


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Based on this information, it is unlikely that the proposal would lead to the long-term decline of an important population.

- *reduce the area of occupancy of an important population*

While the proposal will remove approximately 40.38 ha of suitable habitat for the species, it will not reduce the area of occupancy as a large area of suitable habitat will be retained in the offset area (approximately 104.78 ha). Given the large distribution of the species, this removal is not assessed as reducing the area of occupancy of an important population. Additionally, the proposed disturbance area will be progressively rehabilitated (with suitable habitat for the species; see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)), as such there is the potential for the species to re-occupy this area once the rehabilitation reaches a suitable age.

- *fragment an existing important population into two or more populations*

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east, with Koala habitat occurring along this corridor. The proposal will temporarily remove a total of 40.38 ha of native vegetation from the edge of this corridor. As such, the proposal will not fragment any areas of habitat for the Koala extending off the site.

Within the Subject Land the proposal will cause some minor fragmentation of two areas of habitat in the west/south-west of the Subject Land. The proposed extraction area has been revised to ensure no areas of Koala habitat will be isolated. As such, movement corridors within the Subject Land will be maintained. All areas of vegetation retained within the Subject Land will be linked to other areas of vegetation both within and adjacent to the site. Along the western boundary, areas of habitat will be linked through a retained strip of vegetation that is either 20 m or 50 m wide (depending on the point along the boundary). A corridor of vegetation between the northern and southern extraction areas will also be retained.

As such, the proposal will not fragment an important population.

- *adversely affect habitat critical to the survival of a species*

The *EPBC Act Referral Guidelines for the Vulnerable Koala Combined populations of Queensland, New South Wales and the Australian Capital Territory*, Commonwealth of Australia 2014, outline a Koala habitat assessment tool to determine if a site contains critical Koala habitat. The habitat within the extraction area has been assessed against the criteria,


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and is detailed in **Table 2** (the site occurs within a coastal area, as such these criterion have been used).

**Table 1: Assessment of habitat critical to the survival of the Koala**

| Attribute | Score | Discussion |
|---|---|---|
| Koala Occurrence | +1 | • EPBC PMST report identified the species or species habitat known to occur in area.<br>• The species was identified within the southern portion of the Subject Land (outside the extraction area) during surveys in 2011.<br>• No evidence of the species was identified within the extraction area (or the Subject Land) during surveys in 2015, however this is likely due to impacts from the 2013 bushfire.<br>• Post-2013 bushfire, there are seven records of the species within 5 km of the Subject Land (within the KMU). |
| Vegetation Composition | +2 | The vegetation associations in the extraction area have been mapped as either preferred or supplementary habitat (as defined by the CKPoM; PSC 2002). The rehabilitation area was defined as preferred habitat due to the occurrence of *Eucalyptus parramattensis* subsp. *decadens* and *Eucalyptus signata*, while the remnant forest is classified as supplementary habitat. |
| Habitat Connectivity | +2 | The extraction area is connected to a large expanse of vegetation (>500 ha) to the north of the Subject Land. |
| Key Existing Threats | +1 | Vehicle strikes and dog attacks have been identified as a key threat to the Port Stephens population. The exact level of vehicle strike and dog attacks in the area is not known. However, evidence of dogs (tracks) was observed within the Subject Land along the access track that runs through the extraction area. |
| Recovery Value | +1 | Uncertain whether the habitat is important for achieving the interim recovery objectives, as it is not known if the habitat is:<br>• Of sufficient size to be genetically robust/operate as a viable sub-population, or<br>• Free of disease or have low incidence of disease, or<br>• Breeding. |
| **Total Score** | **7** | **As such the impact area is classified as habitat critical to the survival of the species.** |

The above assessment is relevant to all areas of the extraction area, as such the extraction area contains a total of 40.38 ha of habitat critical to the survival of the species. Within the offset area, the Swamp Mahogany – Paperbark Swamp Forest, Coastal Sand Wallum Woodland-Heath and Tomago Sand Swamp Woodland are also classified as habitat critical to the survival of the Koala. While the Coastal Wet Cyperoid Heath and the Tomago Sand Swamp Heath, do not represent Koala habitat (full habitat assessment detailed in the Ecological


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Assessment Summary Report (Response to Submissions Part 3 (Major Projects Website)). As such, a total of 104.78 ha of habitat critical to the survival of the Koala will be retained within the Offset Area.

The impacts of the proposed action were assessed against the factors detailed in Figure 2 (Assessing adverse effects on habitat critical to the survival of the Koala) of the *EPBC Act Referral Guidelines* (detailed in the following sections). The assessment concluded that while the extraction area was assessed as critical habitat, the impacts of the proposal are unlikely to adversely affect habitat critical to the survival of the species due to the large area of habitat, with similar characteristics, occurring in the locality.

**Amount of Habitat Removal**

An analysis of the preferred and supplementary Koala habitat within the Tomago Sandbeds KMU was undertaken to inform the impact assessment. The analysis involved examining available vegetation mapping for the Tomago Sandbeds KMU and assigning each vegetation community type as preferred, supplementary or other Koala habitat based on comparison of the floristic descriptions of the vegetation mapping studies with the descriptions of preferred and supplementary habitat by Lunney *et al*. (1998) and PSC (2002). The desktop analysis was primarily based on the *Vegetation of the Tomago and Anna Bay Sandbeds* (Bell and Driscoll 2006), which covers most of the Tomago Sandbeds KMU and is the most accurate and recent vegetation mapping available. For areas not covered by the Bell and Driscoll (2006) mapping within the Tomago Sandbeds KMU, the *Lower Hunter and Central Coast Regional Environment Management Strategy* (LHCCREMS; NPWS, 2000) vegetation mapping was used. Additionally, the vegetation mapping within the Subject Land was added to the totals.

The assessment identified an estimated 1,900 ha of preferred and 2,716 ha of supplementary habitat within the Tomago Sandbeds KMU (**Table 2**). A map of the habitat within the KMU is presented on Figure 6 of the Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Project Website)).

**Table 2: Estimated preferred and supplementary Koala habitat and potential Koala habitat within the Tomago Sandbeds KMU.**

| Koala habitat category | Equivalent vegetation map units (MU) | | Total area (ha) of Koala habitat (including Subject Land) |
|---|---|---|---|
| | Bell and Driscoll (2006) | LHCCREMS (2000) | |
| Preferred | 5, 7, 9, 17-19, 21, 24 & 43 | 36 & 37 | 1,900 ha |
| Supplementary | 1-3, 11, 22 and 41 | 33 | 2,716 ha |
| Marginal, other and excluded | 20, 23, 25-29, 31-38 & 42 | 9, 12, 15, 17, 30, 34, 36a, 40, 44, 46 and 47 | N/A |
| | | **Total** | **4,616 ha** |


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The proposed action will temporarily remove 19.19 ha of preferred habitat and 21.19 ha of supplementary habitat from the KMU. This equates to 1.01% of the mapped preferred Koala habitat and 0.78% of the mapped supplementary habitat within the KMU. Due to the relatively small removal of habitat from the Tomago Sandbeds KMU, this impact on habitat is not considered to be adverse.

**Method of Clearing**

The proposed extraction area will be progressively cleared, and rehabilitated with native vegetation that will constitute Koala habitat.

Soft-felling clearing procedures will also be implemented to ensure that no individuals are negatively impacted during clearing. This will involve both nocturnal and diurnal surveys prior to clearing, and any Koalas identified within the clearing area will be captured, given a veterinary check and tracked (remote tracker) for a three month period.

See the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)) for details on mitigation measures.

**Density or Abundance of Koalas**

As outlined in the introduction, no Koala activity was detected within the Subject Land during surveys in 2015. These surveys occurred two years post fire, and suggest that the area is still being recolonised. While the abundance of the species in the area is not known, the habitat has the potential to support a medium (normal) usage category. However, as outlined above (response to long term decrease in important population criteria) habitat availability is unlikely to be the limiting factor of the Koala population in the Port Stephens area, and it is likely that a large amount of available habitat to the north of the Subject Land is either un-occupied, or could support a higher density of individuals.

**Level of Fragmentation**

As outlined above (response to habitat fragmentation criteria), no areas of habitat for the species will be completely isolated. There will be some fragmentation of habitat in the south-west of the Subject Land, however, all areas of habitat will be connected to habitat within and to the north of the Subject Land.


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- *disrupt the breeding cycle of an important population*

Disruptions to social interactions or creating barriers to movement and dispersal has the potential to impact on the breeding cycle of the species. The proposed action will not create any barriers to movement or dispersal as all areas of retained vegetation within and adjacent to the site will be connected.

As outlined above (response to long term decrease in important population criteria), there is the potential to displace individuals during clearing, forcing individuals closer together. However, it was also outlined that habitat availability is unlikely to be the limiting factor of the Koala population in the Port Stephens area. As such, it is likely that any displaced Koalas would be able to move into available habitat within or to the north of the Subject Land, and it is unlikely that they would be significantly impacted on, such that their breeding cycle would be disrupted.

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

As outlined above (response to adversely affect habitat critical to the survival of the species criteria), the proposed action will temporarily remove 19.19 ha of preferred habitat and 21.19 ha of supplementary habitat from the KMU. This equates to 1.01% of the mapped preferred Koala habitat and 0.78% of the mapped supplementary habitat within the KMU. Due to the relatively small removal of habitat from the Tomago Sandbeds KMU, this impact on habitat is unlikely to lead to the decline of the species.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

Dogs are a significant threat to the species. The proposed action will not lead to an increase in dogs in the locality. Additionally, the proposed action will implement a vertebrate pest control program within the Subject Land, with wild dogs as one of the target species, see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

- *introduce disease that may cause the species to decline, or*

Impacts from Chlamydia can be expressed in individuals when they undergo stress, such as habitat loss, interactions with predators, nutritional stress or overcrowding (DECC 2008). The proposed action will result in habitat loss. However, as outlined above (response to long term decrease in important population criteria) habitat availability is unlikely to be the limiting factor of the Koala population in the Port Stephens area, and there is likely a large amount of


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available habitat to the north of the Subject Land that is either un-occupied, or could support a higher density of individuals. Additionally, in order to access this habitat, Koalas would not be forced to cross any roads, which has the potential to cause further stress. As such, the potential for the proposed action to spread the Chlamydia disease such that it is likely to significantly reduce the reproductive output of the species is unlikely.

Myrtle Rust is a disease caused by the exotic fungus *Puccinia psidii*. It infects species of the Myrtaceae family and causes leaf deformation, defoliation, reduce fertility, dieback, stunted growth, and plant death. *Phytophthora cinnamomi* is a pathogen which infects the plant roots and causes disease and plant death. Infection of susceptible ecological communities can result in modification of the community, reduction in functionality and habitat loss or degradation for dependant flora and fauna species. The pathogen is spread in water, soil or plant material that contains the pathogen. *Phytophthora cinnamomi* occurs in all Australian states and territories (except NT), and is well established in many of the higher rainfall areas of the country. Evidence of these two diseases were not identified within the Subject Land, however, they are known to occur in the region. It is not expected that the proposal will introduce or exacerbate either of these diseases that may impact on Koala habitat. To limit the potential of spread, all machinery conducting clearing within the extraction area will be clean and free of any soil or vegetative material when it enters the site.

- *interfere substantially with the recovery of the species.*

The proposed action was assessed against the impacts detailed in Section 8 of the *EPBC Act Referral Guidelines* to determine if it is likely that the action will substantially interfere with the recovery of the species (detailed in the following sections). The assessment concluded that it is unlikely that the action will substantially interfere with the recovery of the Koala.

**Increasing Koala fatalities in habitat critical to the survival of the Koala due to dog attacks to a level that is likely to result in multiple, ongoing mortalities.**

The proposed action is unlikely to lead to the increase in dog attacks in the locality as it does not involve the construction of residential dwellings and associated pet ownership. Additionally, the proposed action will implement a vertebrate pest control program within the Subject Land, with wild dogs as one of the target species, see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).


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**Increasing Koala fatalities in habitat critical to the survival of the Koala due to vehicle-strikes to a level that is likely to result in multiple, ongoing mortalities.**

The proposal has the potential for increased impact to the species from vehicle strikes as there will be an increase in traffic. However, traffic assessments concluded that the proposal will only cause a minor increase in traffic volume. At absolute maximum extraction rates, the proposal will increase traffic along Cabbage Tree Road by less than 3% in a 24 hour period. However, it is expected under average operational conditions that traffic increases along Cabbage Tree Road will be less than 1%.

The proposed action will implement a recognised mitigation measure with a high effectiveness, through the installation of Koala proof fencing along Cabbage Tree Road and along internal roads with speed limits above 40 km/hour. It is recognised that this control is only applicable to the Subject Land.

**Facilitating the introduction or spread of disease or pathogens (e.g. Chlamydia or *Phytophthora cinnamomi*) that are likely to significantly reduce the reproductive output of Koalas or reduce the carrying capacity of the habitat.**

As outlined above (response to introduce disease criteria), it is unlikely that the proposed action will introduce or spread a disease or pathogen that is harmful to the species or its habitat. As such, the potential for the proposed action to reduce the reproductive output of the species is unlikely.

**Creating a barrier to movement to, between or within habitat critical to the survival of the Koala that is likely to result in a long-term reduction in genetic fitness or access to habitat critical to the survival of the Koala.**

As outlined above (response to habitat fragmentation criteria), no areas of habitat for the species will be completely isolated. There will be some fragmentation of habitat in the south-west of the Subject Land, however, all areas of habitat will be connected to habitat within and to the north of the Subject Land. As such, it is unlikely that the proposed action will lead to the long-term reduction in genetic fitness or access to habitat critical to the survival of the Koala.

**Change the hydrology which degrades habitat critical to the survival of the Koala to the extent that the carrying capacity of the habitat is reduced in the long-term.**

The final landform of the extraction area will be 1 m above the maximum predicted groundwater level. Extraction will occur to 70 cm above the maximum predicted groundwater level, and then


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30 cm of topsoil will be re-distributed. The final landform will be monitored throughout the life of the quarry, to ensure that the level above the maximum predicted groundwater level is maintained. Additionally, no extraction of groundwater is proposed as part of the action. As such, the proposal is unlikely to substantially modify the hydrological regime in the area.

### Long-nosed Potoroo (SE Mainland)

Preferred habitat for this species is coastal heath and wet or dry sclerophyll forest with a specific requirement of a dense ground cover and light soil. The home ranges of males and females differ with the range of the male (about 4 ha) generally overlapping the ranges of two or three females (just under 2 ha). The animals are mostly but not entirely nocturnal and use a 'pad' made of a small depression in the ground under thick grass cover as a nest. The diet of Long-nosed Potoroos is made up of insects and arthropods that are foraged for among leaf litter or dug for in the ground in a similar fashion to that of the bandicoots. An important part of the diet is the fruiting bodies of hypogeal fungi that are dug from the ground and it is thought that the animals play an important role in distributing the spores of these fungi throughout the forest. In turn these fungi form beneficial relationships with the roots of a number of eucalypts (Claridge *et al*. 1993; Johnston 1995; Long 2001).

The species was not identified within the Subject Land, but suitable habitat for the species occurs within all vegetation types within the Subject Land. There is only one record of the species in the locality (10 km), occurring approximately 2.5 km to the east of the extraction area. Higher densities occurring to the north (Barrington Tops National Park) and south (Watagans National Park). As such the population of the Long-nosed Potoroo in the locality was not assessed as an important population as it is unlikely to be a key source for breeding, dispersal or maintaining genetic diversity, and it is not near the limit of the species range.

**An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:**

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

A potentially occurring local population of the species was not assessed as an important population. As such the proposed action will not lead to the long-term decrease in the size of an important population of the species.


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- *reduce the area of occupancy of an important population*

A potentially occurring local population of the species was not assessed as an important population. As such the proposed action will not reduce the area of occupancy of an important population of the species.

- *fragment an existing important population into two or more populations*

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east. The proposal will temporarily remove a total of 40.38 ha of native vegetation from the edge of this corridor. As such, the proposal will not fragment any areas of habitat extending off the site.

Within the Subject Land the proposal will cause some minor fragmentation of two areas of habitat in the west/south-west of the Subject Land. The proposed extraction area has been revised to ensure no areas of habitat will be isolated. As such, movement corridors within the Subject Land will be maintained. All areas of vegetation retained within the Subject Land will be linked to other areas of vegetation both within and adjacent to the site. Along the western boundary, areas of habitat will be linked through a retained strip of vegetation that is either 20 m or 50 m wide (depending on the point along the boundary). A corridor of vegetation between the northern and southern extraction areas will also be retained.

- *adversely affect habitat critical to the survival of a species*

There is no recovery plan for this species, as such habitat critical to its survival has not been identified. As the proposed action will not directly impact on an area of habitat for an important population, it is unlikely that it will adversely affect habitat critical to the species survival.

- *disrupt the breeding cycle of an important population*

A potentially occurring local population of the species was not assessed as an important population. As such the proposed action will not disrupt the breeding cycle of an important population of the species.

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

The proposed action will temporarily remove 40.38 ha of available habitat for the species. Due to the high availability of suitable habitat to be retained within the Subject Land, and also to the north within the Tilligerray SCA, it is unlikely that the removal of the habitat from the extraction area will lead to the species decline.


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

Predation of the species by foxes, wild dogs and cats is a known threat. The proposed action is unlikely to lead to an increase in the threat of these invasive species on the Long-nosed Potoroo. Additionally, a vertebrate pest control program will be implemented as part of the proposed action, which will decrease any potential predation pressures of these invasive species in the Subject Land and surrounds; see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

- *introduce disease that may cause the species to decline, or*

No diseases are listed as contributing the decline of the species. Additionally, it is unlikely that the proposed action would introduce or exacerbate Myrtle Rust and *Phytophthora cinnamomi* (which could impact on the species habitat).

- *interfere substantially with the recovery of the species.*

The temporary removal of 40.38 ha of habitat for the species is unlikely to interfere with its recovery.

### New Holland Mouse

The New Holland Mouse is a small burrowing native rodent distinguished from the introduced House Mouse by its larger ears and eyes, bi-colour tail, the absence of a notch on its upper incisors (Strahan 2010, Menkhorst & Knight 2011) and the lack of any 'mousy odour' (Menkhorst & Knight 2011).

The New Holland Mouse has a fragmented distribution across the east coast of Australia with disjunct populations in New South Wales, Victoria, and Tasmania and is estimated to occur in only six to eight metapopulations based on relevant state wildlife atlas data (TSSC 2010). At a landscape level, these metapopulations appear to be based on specific habitat requirements (Fox & Fox 1978; Wilson & Laidlaw 2003) and a particular preference for soft substrates, generally sand (Strahan 2010) which is thought to be preferred for digging burrows (Wilson & Laidlaw 2003).

Habitat requirements for the New Holland Mouse includes open heathland, open woodland with a heathy understorey, and vegetated sand dunes. Areas with high floristic diversity, particularly in leguminous perennials (Kemper & Wilson 2008) coincide with this species distribution and diet requirements (largely granivorous).


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Research (Braithwaite & Gullan 1978; Fox & Fox 1978; Fox & Mckay 1981; Posamentier & Recher 1974; Wilson & Laidlaw 2003) has identified the New Holland Mouse as a species that readily occurs in areas subjected to disturbance, particularly fire and sand mining. In regards to fire, species abundance has been found to peak during early to mid-stages of vegetation succession three to five years following a fire event. In regards to sand mining, the New Holland Mouse first appears between four and five years post topsoil replacement, and peaks after eight to nine years (Fox & Fox 1978; Fox & Mckay 1981; Fox 1982; Fox & Fox 1984; Wilson 1991).

The New Holland Mouse lives for up to two years and can reach sexual maturity after 13 weeks. Breeding takes place late winter to early summer, followed by a gestation period of 32 – 39 days (Kemper & Wilson 2008). Timing of breeding events is related to abundance and quality of food resources which coincides with rainfall patterns and fire succession (Fox *et al*. 1993).

Key threats to the New Holland Mouse include habitat loss and modification, poorly managed fire regimes (too frequent), predation and competition mainly from introduced species such as the Red Fox, Cat and Dog, and climate change.

The New Holland Mouse has not been recorded in the Subject Land. However, the NSW Wildlife Atlas contains 40 records occurring within 10 km of the Subject Land in similar habitat types. Of these, 16 records are within 5 km of the Subject Land.

Within the Subject Land, the Coastal Sand Apple – Blackbutt Forest, Coastal Sand Wallum Woodland-Heath, and Tomago Sand Swamp Heath represent potential nesting and foraging habitat, and the Tomago Sand Swamp Woodland represents potential foraging habitat. A total of 116.60 ha of suitable habitat occurs within the Subject Land, of which 40.24 ha occurs within the extraction area.

All of the vegetation communities identified as suitable habitat for the species are typically structured with a medium density canopy, shrubby heath layer on a sandy substrate. Floristic surveys (Kleinfelder 2016) identified high floristic diversity across the site including 31 species of leguminous perennials which are favoured by the New Holland Mouse (Kemper & Wilson 2008) and a high occurrence of Common Bracken, also favoured by the species.

Recent disturbance history is evident across this area, with a fire event occurring in October 2013 and sand mining occurring in the 1970s. An assessment of previously sand mined areas identified that although the optimum time for New Holland Mouse succession into rehabilitated


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areas is long past (eight to nine years post rehabilitation), the current structural complexity of the area and the recent fire event make the area suitable habitat.

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This includes populations that are key source populations for breeding and/or dispersal, populations that are necessary for maintaining genetic diversity and/or populations that are on the edge of species' ranges.

Eleven metapopulations of the New Holland Mouse have been recorded since European settlement however, analysis of state wildlife data indicate there may be only six to eight populations (TSSC 2010) remaining. An estimate of total numbers is less than 10,000 individuals (Menkhorst *et al.* 2008) and is likely to be declining. As such, any remaining population of the New Holland Mouse must be considered as important.

**An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:**

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

The New Holland Mouse has not been recorded in the Subject Land, however; 113 ha of suitable habitat occurs within the site, suitable habitat occurs extensively in adjacent areas, 40 confirmed records occur within 10 km of the site, and a fire event in 2013 occurred within the site, making the likelihood of this species occurrence high. Based on this evidence, any individuals within the site would be part of the Port Stephens New Holland Mouse metapopulation.

The proposed project will result in the removal of 40.24 ha of suitable habitat within the Subject Land. This amount of habitat removal will no doubt have an impact on any individuals using the Subject Land. However, the fire that impacted the site in 2013 also covered a much larger area to the north of the Subject Land (Attachment_2). An assessment of the amount of suitable habitat for the New Holland Mouse within the area covered by the 2013 fire was undertaken to inform the assessment. Vegetation communities mapped by the *Vegetation of the Tomago and Anna Bay Sandbeds* (Bell and Driscoll 2006) within the fire affected area was assessed for habitat suitability. The following vegetation communities that were assessed as suitable habitat occurred within the fire affected area; Clay Wallum Scrub (3ai), Earp's Gum – Peppermint Scrubby Forest (3aii, 4ciii), Earp's Gum Sedge Woodland (4d), Forest Oak – Stringybark – Apple Forest (1e), Peppermint – Apple – Bloodwood Forest (1aii), Scribbly Gum – Apple – Bloodwood Forest (1b) and Tomago Blackbutt – Apple – Bloodwood Forest (1ai, 1aii). It should be noted that areas of rehabilitation have not been included in this assessment


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(as rehabilitated vegetation types cannot be confidently assumed as representing suitable habitat), as such it is likely that there is a much larger area of suitable habitat in the fire affected area.

A total of 1,543.90 ha of suitable habitat was assessed as occurring on the sandbeds within the fire affected area, combined with the 76.36 ha of suitable habitat retained within the Subject Land, there is a total of 1,620.26 ha available. As such, the proposed action will remove approximately 2.48% of the suitable habitat from the area. Additionally, the proposed extraction will occur progressively, with a maximum of 9.16 ha being cleared in the first two years. Assuming that the first two years of extraction occur in 2017 and 2018, the proposal will only be removing habitat within the optimal range for New Holland Mouse succession (three to five years post fire) for the first two years of extraction. Additionally, further habitat will be created through the progressive rehabilitation of the extraction area.

Due to the high availability of suitable habitat with the same disturbance history as that within the extraction area, it is unlikely that the proposed action will lead to the long-term decline of an important population of the species.

- *reduce the area of occupancy of an important population*

Due to the availability of suitable habitat adjacent to the extraction area, the proposed action will not reduce the area of occupancy of an important population.

- *fragment an existing important population into two or more populations*

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east. The proposal will temporarily remove a total of 40.38 ha of native vegetation from the edge of this corridor. As such, the proposal will not fragment any areas of habitat extending off the site.

Within the Subject Land the proposal will cause some minor fragmentation of two areas of vegetation in the west/south-west of the Subject Land. The proposed extraction area has been revised to ensure no areas of habitat will be isolated. As such, movement corridors within the Subject Land will be maintained. All areas of vegetation retained within the Subject Land will be linked to other areas of vegetation both within and adjacent to the site. Along the western boundary, areas of habitat will be linked through a retained strip of vegetation that is either 20 m or 50 m wide (depending on the point along the boundary). A corridor of vegetation between the northern and southern extraction areas will also be retained.


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- *adversely affect habitat critical to the survival of a species*

There is no recovery plan for the species, as such no critical habitat has been defined. However, it is reasonable to assume that due to the specific habitat requirements of the species, that areas of suitable habitat that have undergone the appropriate disturbance regime could be classified as critical to the survival of the species. As such, the habitat within the Subject Land could be classified as critical to the survival of the species.

The proposed action will impact on approximately 2.48% of identified suitable habitat for the species within the 2013 fire affected area. Due to the relatively small impact on this habitat, it is unlikely to adversely affect habitat critical to the survival of the species. Additionally, the proposed extraction will occur progressively, with a maximum of 9.16 ha being cleared in the first two years. Assuming that the first two years of extraction occur in 2017 and 2018, the proposal will only be habitat within the optimal range for New Holland Mouse succession (three to five years post fire) for the first two years of extraction. Additionally, further habitat will be created due to the proposal through the progressive rehabilitation of the extraction area.

- *disrupt the breeding cycle of an important population*

Breeding takes place late winter to early summer, followed by a gestation period of 32 – 39 days (Kemper & Wilson 2008). Timing of breeding events is related to abundance and quality of food resources which coincides with rainfall patterns and fire succession (Fox et al. 1993).

At present, suitable habitat within the Subject Land is three years post fire event, thus placing the habitat within the optimal range for New Holland Mouse succession (three to five years post fire). As such, successful breeding within any potentially occurring portion of the local population has the potential to be disturbed by the proposal.

Due to the stage nature and relatively small area of habitat removal, in the context of the available habitat in the area, it is unlikely that any potential disruption to the species breeding will be significant.

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

A total of 1,543.90 ha of suitable habitat was assessed as occurring on the sandbeds within the fire affected area, combined with the 76.36 ha of suitable habitat retained within the Subject Land, there is a total of 1,620.26 ha. As such, the proposed action will remove approximately 2.48% of the suitable habitat from the area. Additionally, the proposed extraction will occur progressively, with a maximum of 9.16 ha being cleared in the first two years. Assuming that


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the first two years of extraction occur in 2017 and 2018, the proposal will only be removing habitat within the optimal range for New Holland Mouse succession (three to five years post fire) for the first two years of extraction. Additionally, further habitat will be created due to the proposal through the progressive rehabilitation of the extraction area.

As such it is unlikely that the habitat impacts of the proposal will lead to the long term decline of the species.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

Predation of the species by foxes, wild dogs and cats is a known threat. The proposed action is unlikely to lead to an increase in the threat of these invasive species on the New Holland Mouse. Additionally, a vertebrate pest control program will be implemented as part of the proposed action, which will decrease any potential predation pressures of these invasive species in the Subject Land and surrounds; see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

- *introduce disease that may cause the species to decline, or*

No diseases are listed as contributing the decline of the species. Additionally, it is unlikely that the proposed action would introduce or exacerbate Myrtle Rust and *Phytophthora cinnamomi* (which could impact on the species habitat).

- *interfere substantially with the recovery of the species.*

The temporary removal of 40.38 ha of habitat for the species is unlikely to interfere with its recovery. Additionally, the progressive rehabilitation of the extraction area will create areas of suitable habitat for the species in the future.

### Grey-headed Flying-fox

The Grey-headed Flying-fox occurs along the eastern seaboard of Australia roosting in communal colony sites, which are used permanently, annually, or occasionally depending on food availability (Tidemann, 1995). Colonies can vary considerably in size from hundreds to many thousands of individuals, and fluctuate according to food resources (Parry-Jones & Augee 1991; Tidemann, 1995). Fruits from numerous rainforest trees and other myrtaceous species form a large component of their diet, and consequently mass nomadic movements occur throughout their range in response to fruit availability. Large colonies are very vocal even during the day, and can significantly damage roost trees by their sheer weight of numbers.


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"The Grey-headed flying fox must be acknowledged as being highly significant to the health and maintenance of many ecosystems in eastern Australia. The species performs the ecosystem services of pollination and seed dispersal for a wide range of native trees, including commercially important hardwood and rainforest species. It thus contributes directly to reproduction, regeneration and the evolutionary processes of forest ecosystems. Flying-foxes are unique in the large distances they disperse pollen and seeds. The population of Grey-headed flying fox must be of sufficient size for this to continue. If numbers were reduced to small or localised groups, then rainforest seed dispersal and hardwood pollination processes would be severely curtailed" (Eby, 2000).

The species was recorded foraging within the Subject Land during field surveys. No roosting camps were identified within the Subject Land. All areas of native vegetation within the extraction area and offset area are potential foraging habitat for the species.

It is unknown if the individuals utilising the Subject Land form part of an important population; while the Subject Land is not at the extent of the species range, the population may be an important source population for breeding or dispersal, or important for maintaining genetic diversity. As such the precautionary principle has been applied and the Subject Land was assessed as forming part of the range of an important population of the species.

**An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:**

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

The proposed action would temporarily remove 40.38 ha of foraging habitat for the species. Due to the high availability of foraging habitat to be retained within the offset area and also protected within the Tilligerry SCA, it is unlikely that the removal of the habitat from the extraction area would lead to the long term decline of the population.

- *reduce the area of occupancy of an important population*

Due to the availability of suitable habitat in the area surrounding the extraction area (both within and adjacent to the Subject Land), the proposed action will not reduce the area of occupancy of the species.

- *fragment an existing important population into two or more populations*

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east. The proposal will temporarily remove a total of 40.38 ha of


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native vegetation from the edge of this corridor. As such, the proposal will not fragment any areas of habitat extending off the site.

Within the Subject Land the proposal will cause some minor fragmentation of two areas of habitat in the west/south-west of the Subject Land, however, no barriers to movement will be created. Due to the highly mobile nature of these species the proposal will not cause the fragmentation of a population of the species.

- *adversely affect habitat critical to the survival of a species*

Based on the criteria detailed in the Draft National Recovery Plan for the Grey-headed Flying-fox, the habitat within the extraction area has the potential to be critical to the survival of the species as it may support a continuously occupied camp (DECCW 2009). The proposed action will not adversely affect this habitat due to the relatively small area of removal, considering the high availability of suitable habitat within, and to the north of, the Subject Land.

- *disrupt the breeding cycle of an important population*

As no camps were identified within the Subject Land, the proposed action is unlikely to disrupt the breeding cycle of an important population.

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

There is a large amount of suitable habitat for the species to be retained within the Subject Land and in areas to the north within the Tilligerry SCA. As such the removal of 40.38 ha of habitat within the extraction area is unlikely to lead to the decline of the species.

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

No introduced invasive species are identified as threatening the species. Competition with the Black Flying-fox is identified as a threat to the species (DECCW 2009). The proposed action in unlikely to increase the abundance or activity of the Black Flying-fox in the locality.

- *introduce disease that may cause the species to decline, or*

Australian bat lyssavirus can cause disease and mortality in Grey-headed Flying-foxes when Flying-foxes undergo significant ecological stress (DECCW 2009). The proposed action is unlikely to cause significant ecological stresses for the species, as such it is unlikely to lead to the species decline due to the relatively small area of temporary habitat removal.


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- *interfere substantially with the recovery of the species.*

The proposed action may contravene the objectives of the recovery plan if the habitat to be impacted is 'critical habitat'. However, the temporary loss of 40.38 ha habitat for this species is unlikely to impact on its recovery.

## 2.3 PLANTS

### *Commersonia prostrata*

*Commersonia prostrata* is a prostrate shrub forming dense mats to 1 m across and only 5 cm high. Stems and branches are sparsely covered with stellate hairs. Leaves are ovate to lanceolate. Flowering is mainly between October and November. Initially white, the petals turn pink with age. Fruits can be found during spring to summer (Harden 2000).

Habitat occurs on sandy, sometimes peaty soils in a wide variety of habitats: Snow Gum (*Eucalyptus pauciflora*) Woodland at Rose Lagoon; Blue-leaved Stringybark (*E. agglomerata*) Open Forest at Tallong; and in Brittle Gum (*E. mannifera*) Low Open Woodland at Penrose; Scribbly Gum (*Eucalyptus haemastoma*)/ Swamp Mahogany (*E. robusta*) Ecotonal Forest at Tomago (OEH 2015a).

Dwarf Kerrawang occurs on the Southern Tablelands (one plant at Penrose State Forest, one plant at Rowes Lagoon and one plant at Tallong) and on the North Coast (less than 100 plants at the Tomago Sandbeds north of Newcastle). It is also found in Victoria (OEH 2015a). A total of 10 records for this species occur in the Hunter-Central Rivers CMA region (NSW Wildlife Atlas). These records are confined to the Tomago Sandbeds to the north of the Subject Land, between Masonite Road and Oyster Cove Road. Nine of these records occur within 10 km of the Subject Land. The closest record is located approximately 900 m north-west.

Habitat for the species within the Subject Land occurs primarily within the Tomago Sand Swamp Woodland, with habitat also present along the peripheries of the Swamp Mahogany – Paperbark Swamp Forest, particularly the areas in the north-east of the Subject Land where the Swamp Forest intergrades with the Coastal Sand Wallum Woodland-Heath and the Coastal Sand Apple – Blackbutt Forest. No areas of Tomago Sand Swamp Woodland will be impacted on due to the proposal and 0.13 ha of Swamp Mahogany – Paperbark Swamp Forest will be removed.


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The species was not identified during the field surveys, however, all areas of suitable habitat for the species were not extensively searched as they occur outside the proposed disturbance area.

**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 will:**

- *lead to a long-term decrease in the size of a population*

The proposed action will impact on 0.13 ha of potential habitat for this species, the main area of suitable habitat for the species (Tomago Sand Swamp Woodland and peripheries of Swamp Forest in north-east) will not be impacted. Additionally, the proposed action will not substantially modify the ground or surface water hydrology, and it unlikely that there will be modification any areas of habitat for this species due to the proposed action. As such it is unlikely that the proposed action will lead to the long-term decline in a population.

- *reduce the area of occupancy of the species*

The proposed action will remove 0.13 ha of habitat for the species. There is a large amount of habitat for the species that will be retained within the offset area and to the north of the Subject Land (Tilligerry SCA). As such, it is unlikely that the proposed action will reduce the area of occupancy of the species.

- *fragment an existing population into two or more populations*

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east. The proposal will temporarily remove a total of 40.38 ha of native vegetation from the edge of this corridor. As such, the proposal will not fragment any areas of habitat extending off the site.

Within the Subject Land the proposal will cause some minor fragmentation of two areas of habitat in the west/ south-west of the Subject Land. The proposed extraction area has been revised to ensure no areas of habitat will be isolated. As such, corridors within the Subject Land will be maintained. All areas of vegetation retained within the Subject Land will be linked to other areas of vegetation both within and adjacent to the site. Along the western boundary, areas of habitat will be linked through a retained strip of vegetation that is either 20 m or 50 m wide (depending on the point along the boundary). A corridor of vegetation between the northern and southern extraction areas will also be retained.

As such, the proposal will not fragment a potentially occurring local population.


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- *adversely affect habitat critical to the survival of a species*

The National Recovery Plan for the Dwarf Kerrawang *Rulingia prostrata* (Carter and Walsh 2010) did not identify habitat critical to the survival of the species (to be conducted as part of a recovery action).

It is unlikely that the area of habitat to be impacted by the action (0.13 ha of Swamp Forest) is critical to the survival of the species. Higher quality habitat for the species occurs in the north of the Subject Land; Tomago Sand Swamp Woodland and the peripheries of the Swamp Mahogany – Paperbark Swamp Forest in the north-east. This area will not be impacted on due to the proposed action, at its closest point, the extraction area is 180 m from this area of habitat, and will not be impacted on

- *disrupt the breeding cycle of a population*

The proposed action will only impact on 0.13 ha of potential habitat and will not fragment or isolate any areas of habitat for the species. Additionally, the highest quality habitat for the species within the Subject Land occurs outside the extraction area and it is unlikely that there will be any indirect impacts on this habitat. As such, it is unlikely that the proposed action will disrupt the breeding cycle of a population.

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

There is a large amount of suitable habitat for the species to be retained within the Subject Land and in areas to the north within the Tilligerry SCA. As such the removal of 0.13 ha of habitat within the extraction area is unlikely to lead to the decline of the species.

- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

The recovery plan for the species identifies impacts from introduced and native environmental weeds as a threat to the species in Victoria, and populations in NSW appear to be less at risk (Carter and Walsh 2010). However, there is the potential for the proposal to introduce weed species into the retained habitat within the offset area. A weed control program will be implanted as part of the quarry, with regular inspections of the disturbance area interface being conducted, see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)). As there will be regular inspections and follow-up weed control for the life of the project (until rehabilitation is signed off) it is unlikely that a harmful species will become established within the species habitat.


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- *introduce disease that may cause the species to decline, or*

The species is susceptible to impacts from *Phytophthora cinnamomi*. *Phytophthora cinnamomi* is a pathogen which infects the plant roots and causes disease and plant death. Infection of susceptible ecological communities can result in modification of the community, reduction in functionality and habitat loss or degradation for dependant flora and fauna species. The pathogen is spread in water, soil or plant material that contains the pathogen. *Phytophthora cinnamomi* occurs in all Australian states and territories (except NT), and is well established in many of the higher rainfall areas of the country.

Evidence of these this disease was not identified within the Subject Land, however, it is known to occur in the region. It is not expected that the proposal will introduce or exacerbate the spread of this diseases. To limit the potential of spread, all machinery conducting clearing within the extraction area will be clean and free of any soil or vegetative material when it enters the site.

- *interfere with the recovery of the species.*

The proposed action does not contravene any of the objectives of the recovery plan for the species (Carter and Walsh 2010). Additionally, as the proposed action will only impact on 0.13 ha of habitat for the species it is unlikely that it will interfere with the recovery of the species.

### *Eucalyptus camfieldii*

*Eucalyptus camfieldii* is a tree or mallee to 10 m high with orbiculate, cordate, glossy green and hispid juvenile leaves. Adult leaves are broad-lanceolate, 7 – 10 cm long, 2 – 3 cm wide, green and glossy. Buds are sessile, broadly ovoid and angular. The species occurs in coastal shrub heath on sandy soils on sandstone, often of restricted drainage (Hill 2002).

The identification of the species on the Tomago Sandbeds (and other locations on the Central Coast) in the 1990's was an extension of the species range, which had previously been restricted to the Hawkesbury Sandstone geology of the Sydney Basin (Hill 2003; Bell and Driscoll 2006). The extent of the population on the Tomago Sandbeds in not well known, with only four Atlas records (two of which are within the Subject Land). Additionally, Bell and Driscoll (2006) noted that the individual occurred at five locations on the Tomago Sandbeds.

A total of 1,868 *E. camfieldii* individuals were recorded on the Subject Land. Of these individuals, 229 occur within the Coastal Sand Apple – Blackbutt Forest (Rehabilitation) and 1,639 occur naturally, predominantly within the Coastal Sand Wallum Woodland-Heath. The


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individuals within the Subject Land that occur within the Coastal Sand Apple – Blackbutt Forest (Rehabilitation) are not considered to be naturally occurring. It is highly unlikely that the species would have been present in this area prior to heavy mineral sand mining in the 1970's. The majority of the naturally occurring population within the Subject Land was identified at lower elevations, typically below 6 m elevation, within the Coastal Sand Wallum Woodland-Heath and Tomago Sand Swamp Heath. Only a few individuals were identified within the Coastal Sand Apple Blackbutt Forest; these individuals occur at elevations below 9 m in areas which are co-dominated by Eucalyptus piperita (Sydney Peppermint) and with Melaleuca nodosa (Prickly-leaved Paperbark) in the understorey. As such, it is likely that all individuals have been planted or seeded into this area during rehabilitation works.

A survey of the extent of the local population was undertaken. The total local population of *E. camfieldii* identified during these surveys was 2,263 individuals; 1,868 within the Subject Land, 334 within Mine Rehabilitation areas to the west and north, and 61 within an area of Peppermint – Apple – Bloodwood Forest (mapped by Bell and Driscoll (2006)), to the north of the Subject Land. However, it is likely that the local population is larger than that identified during the field surveys, as not all areas of rehabilitation or Peppermint – Apple – Bloodwood Forest within the locality were surveyed, see Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Project Website)).

All patches of *E. camfieldii* identified during the field surveys occur within 3 km of the individuals within the Subject Land and are within vegetation that is contiguous with the Subject Land. All of these individuals were assessed as being part of the local population as it is likely that they are cross-pollinating with individuals within the Subject Land, as highly mobile species, such as birds, bats and insects, are pollinators for *Eucalypts* (House 1997). As such, there is the potential for genetic material to be spread a long distance (Pots and Wiltshire 1997).

The proposal would result in the removal of 227 *E. camfieldii* individuals within the Coastal Sand Apple – Blackbutt Forest (Rehabilitation) on the Subject Land. This represents a total of 12% of the population within the Subject Land. In relation to the total estimated local population, the impacts equate to a total removal of 10% of the local population.

The proposal will remove individuals that are not naturally occurring as they have been seeded/ planted following rehabilitation. The majority of the area in which they occur was not assessed as potential habitat for the species. Suitable habitat for the species within the disturbance area occurs in low lying areas which adjoin the Coastal Sand Wallum Woodland-Heath. The species was identified in these ecotonal areas where *E. piperita* and M*. nodosa* occur.


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There is the potential for indirect impacts on 197 individuals occurring within 50 m of the extraction area. These individuals occur adjacent to the disturbance area and as such, there is the potential for indirect impacts through habitat modification. However, these impacts are unlikely to significantly impact on the reproductive potential or health of the retained individuals, as the disturbance will not be permanent, with progressive rehabilitation occurring within the disturbance area.

The proposal was assessed as not significantly modifying the hydrology of the area (surface or groundwater). As such, indirect impacts to the retained population due to changes in hydrology are unlikely to occur.

The proposal will remove approximately 10% of the local population (227 individuals), the majority of which (201 individuals) have been seeded/planted into the rehabilitation area and are not naturally occurring. The potential for indirect impacts (edge effects from the extraction area) on the adjacent population within the Subject Land will be temporary as the site will be progressively cleared and rehabilitated.

The location *of E. camfieldii* individuals within the Subject Land and the individuals identified as occurring within the local population is shown on Figure 2 of the Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Projects Website)). The population of *E. camfieldii* within the Subject Land was assessed as important as it occurs near the limit of the species range.

**An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:**

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

The proposal will require the removal of 227 individuals (10% of the local population). Due to the relatively small impact (10%) this is not assessed as a significant decrease in the population. Additionally, the species will be used within the rehabilitation of the disturbance area, which will re-instate the removed individuals. This mitigation measure has been proven to be successful for the species, which is evident through its presence within rehabilitation of the proposed disturbance area (see Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Projects Website)) for vegetation descriptions).


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- *reduce the area of occupancy of an important population*

While the proposal will remove some individuals from the local population, it will not reduce the area of occupancy as the majority of the local population, including a number of individuals within and directly adjacent to the Subject Land, will be retained.

- *fragment an existing important population into two or more populations*

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east. Habitat for the species occurs to the north of the Subject Land (Peppermint – Apple – Bloodwood Forest).

The local population that was identified as seven clusters of individuals that occur within approximately 3 km of each other. The proposal will remove a total of 19.01 ha of occupied vegetation (including 227 individuals) from the largest cluster within the local population. However, this removal will not cause the fragmentation into two or more populations. All individuals within the local population will still be connected via areas of remnant native vegetation post extraction, and the distance between clusters will not be increased (i.e. no additional distance for pollination vectors). Additionally, the disturbance area will not represent a hostile barrier as it will be progressively cleared and rehabilitated, including the use of E. camfieldii within the rehabilitation.

- *adversely affect habitat critical to the survival of a species*

The habitat in which the individuals within the disturbance area occur is unlikely to be critical to the survival of the species as it is was only assessed as marginal habitat. As outlined above the naturally occurring population within the Subject Land was typically in lower lying areas, within the Coast Sand Wallum Woodland-Heath (within the offset area). Within the disturbance area the low lying ecotonal areas which adjoin the Coastal Sand Wallum Woodland-Heath where *E. piperita* and *M. nodosa* occur, represent suitable habitat for the species. As the species can occur within these ecotonal areas, the exact area of suitable habitat is hard to define. As such, all areas in the north of the extraction area that occur below 9 m (highest elevation at which the species was identified on-site) and which adjoin the Coastal Sand Wallum Woodland-Heath were assessed as suitable habitat. Based on this definition, a total of 11.17 ha of suitable habitat for the species will be impacted (0.04 ha of Coastal Sand Wallum Woodland-Heath, 6.42 ha remnant Coastal Sand Apple – Blackbutt Forest and 4.7 ha of rehabilitation). Due to the small area of removal it is unlikely that the habitat to be removed is critical to the survival of the species.


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A total of 12.37 ha of suitable habitat for the species has the potential to be modified within the Subject Land, as it occurs within 50 m of the extraction area. However, due to the temporary nature of the disturbance (progressive clearing and rehabilitation) it is unlikely that the disturbance will adversely affect this area of habitat.

There is no national recovery plan for the species and no areas of critical habitat have been defined. The Office of Environment and Heritage has developed a targeted strategy for this species under the Saving Our Species program. This species has been assigned to the 'site-managed species' management stream as this species is considered to require 'site-based management in order to secure it from extinction in NSW for 100 years'. Four management sites have been established at Mangrove Creek Dam, Kur-ring-gai Chase National Park, North Head Sydney Harbour, and Royal National Park. The proposal does not impact on any of these management areas (all located over 50 km south of the Subject Land).

- *disrupt the breeding cycle of an important population*

The proposal will progressively remove 227 individuals from within the disturbance area, which will reduce the number of individuals within the local population (i.e. decrease the genetic pool). However, as the majority of the local population will be retained (90%), and will remain connected, it is unlikely that the removal of these individuals will impact on the breeding cycle of the population.

The proposal will also potentially cause edge effects to the surrounding occupied habitat (approximately 12.37 ha), as such there is the potential to disrupt pollinators. However, this is unlikely to be a significant disruption as operations will move progressively through the extraction area and any potential disturbances to pollinators (birds and bats) through increased noise and human activity will be limited.

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

As outlined above the proposal will impact on approximately 11.17 ha of suitable habitat, potentially modify (through indirect impacts) a further 12.37 ha of occupied habitat, and no habitat will be isolated. Due to the limited impacts of the proposal and the availability of habitat in the area (both within the Subject Land and in adjacent areas), it is unlikely that any impacts to habitat will cause the species to decline.


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- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

There is the potential for the proposal to introduce weed species into the retained habitat within the offset area. A weed control program will be implanted as part of the quarry, with regular inspections of the disturbance area interface being conducted, see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)). As there will be regular inspections and follow-up weed control for the life of the project (until rehabilitation is signed off) it is unlikely that a harmful species will become established within the species habitat.

- *introduce disease that may cause the species to decline, or*

Potential harmful diseases which *E. camfieldii* is susceptible to include Myrtle Rust and *Phytophthora cinnamomi*.

Myrtle Rust is a disease caused by the exotic fungus *Puccinia psidii*. It infects species of the Myrtaceae family and causes leaf deformation, defoliation, reduce fertility, dieback, stunted growth, and plant death.

*Phytophthora cinnamomi* is a pathogen which infects the plant roots and causes disease and plant death. Infection of susceptible ecological communities can result in modification of the community, reduction in functionality and habitat loss or degradation for dependant flora and fauna species. The pathogen is spread in water, soil or plant material that contains the pathogen. *Phytophthora cinnamomi* occurs in all Australian states and territories (except NT), and is well established in many of the higher rainfall areas of the country.

Evidence of these two diseases was not identified within the Subject Land, however, they are known to occur in the region. It is not expected that the proposal will introduce or exacerbate any of these diseases that may cause the species to decline. To limit the potential of spread, all machinery conducting clearing within the extraction area will be clean and free of any soil or vegetative material when it enters the site.

- *interfere substantially with the recovery of the species.*

Habitat loss and disturbance, and possible in-breeding in small populations have the potential to threaten the species. The proposal will directly impact on 11.17 ha of marginal habitat, and there is the potential to indirectly impact on 12.37 ha of habitat, and the proposal will temporarily remove approximately 10% of the local population. As outlined in the above sections, due to the small area of impact, within predominately marginal habitat, and as the


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species will be used in the rehabilitation, impacts of the proposal on the local population were not assessed as significant and it is unlikely to interfere with the recovery of the species.

### *Eucalyptus parramattensis* subsp. *parramattensis*

*Eucalyptus parramattensis* subsp. *decadens* is a small smooth-barked tree to 15 m tall (although generally around 7 m) with white or grey bark that does not shed cleanly. Leaves are 7-20 cm long and 4-3.5 cm wide; discolours and flowering occurs from November to January (Hill 2002). The species generally occurs in dry sclerophyll woodland with dry heath understorey on deep, low-nutrient sands, in areas subject to periodic inundation or which have relatively high water tables.

Bell (2006) identifies the *E. parramattensis* subsp. *decadens* individuals in the Subject Land as part of one of nine sub-populations of this species on the Tomago Sandbeds; the RAAF Williamtown West sub-population. The assessment conducted by Bell (2006), which is based on Atlas records, identifies the RAAF Williamtown West and the RAAF Williamtown East sub-populations as forming the majority of the meta-population on the Tomago Sandbeds.

A total of 864 *E. parramattensis* subsp. *decadens* individuals were recorded on the Subject Land. Of these individuals, 283 occur within the Coastal Sand Apple – Blackbutt Forest (Rehabilitation) and 581 occur naturally in the north of the Subject Land predominantly within the Tomago Sand Swamp Woodland. The individuals within the Subject Land that occur within the Coastal Sand Apple – Blackbutt Forest (Rehabilitation) are not considered to be naturally occurring. It is highly unlikely that the species would have been present in this area prior to heavy mineral sand mining in the 1970's as it does not represent potential habitat for the species, due to the elevation of this area. The naturally occurring population of the species on site occurs in lower lying areas subject to periodic inundation. As such, it is likely that all individuals have been planted or seeded into this area during rehabilitation works.

The local population of the species has conservatively been classified as the RAAF Williamtown West sub-population (as defined by Bell 2006). This is considered to be appropriate for the assessment as: the Subject Land is contiguous with the whole sub-population through vegetated areas; successive records within the sub-population are separated by less than 1 km (Bell 2006); and, the species is likely to be pollinated by foraging birds, bats and insects, as with most eucalypts, hence material has the potential to be spread kilometres (OEH 2011). The size of the local population was estimated as part of this assessment to be 40,214 individuals (see Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Projects Website)) for methodology).


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The proposal would result in the removal of 230 E*. parramattensis* subsp. *decadens* individuals within the Coastal Sand Apple – Blackbutt Forest (Rehabilitation) on the Subject Land. This removal represents a total of 27% of the population within the Subject Land. In relation to the total estimated local population, the impact equates to a total removal of 0.57% of the local population.

The proposal will remove individuals that are not naturally occurring as they have been seeded/ planted following rehabilitation. The area in which they occur was not assessed as potential habitat for the species, due to its elevation.

There is the potential for indirect impacts on 54 individuals occurring within the rehabilitation area that occur within 50 m of the extraction area. These individuals occur within close proximity to the disturbance area and as such, there is the potential for habitat modification.

The proposal was assessed as not significantly modifying the hydrology of the area (surface or groundwater). As such, indirect impacts to the retained population due to changes in hydrology are unlikely to occur.

**An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:**

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

The RAAF Williamtown West sub-population (of which the individuals within the Subject Land form part of) is part of the Tomago Sandbeds Meta-population. As this is only one of two meta-populations of the species, the individuals within the Subject Land have been classified as forming part of an important population as the local population is key for breeding and dispersal, and maintaining genetic diversity.

The proposal will remove approximately 230 planted/ seeded individuals, which was assessed as representing an impact on 0.57% of the local population. There is limited potential for indirect impacts on naturally occurring individuals within the Subject Land, as at its closest point the disturbance area occurs approximately 180 m from the naturally occurring population within the Subject Land. Additionally, the proposal will not significantly modify the hydrology of the area, indirect impacts from changes to hydrology area unlikely.

As the proposal will only impact on a small proportion of the local population and it is unlikely to cause indirect impacts, it is unlikely that it will lead to the long-term decline in the population.


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- *reduce the area of occupancy of an important population*

While the proposal will remove some individuals from the local population, it will not reduce the area of occupancy as the majority of the local population, including a number of individuals within and directly adjacent to the Subject Land, will be retained.

- *fragment an existing important population into two or more populations*

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east. Habitat for the species occurs to the north of the Subject Land, throughout the sub-population area (Clay Wallum Scrub and Earp's Gum Sedge Woodland displayed on Figure 4 of the shows the distribution of habitat for the species in the sub-population area; total of 393.13 ha).

The proposal will remove a total of 19.01 ha of occupied vegetation from the south of the local population, including 230 individuals. However, this removal will not cause the fragmentation into two or more populations. All individuals within the local population will still be connected via areas of remnant native vegetation post extraction, and the distance between individuals will not be increased (i.e. no additional distance for pollination vectors). Additionally, the disturbance area will not represent a hostile barrier as it will be progressively cleared and rehabilitated.

- *adversely affect habitat critical to the survival of a species*

A Draft National Recovery Plan (OEH 2011) has been prepared for this species. The plan outlines that the species occupies more than 2,500 hectares, and that it all contributes to the long-term conservation of the species. Other criteria used to assess the potential of a significant impact on the species are considered more useful (OEH 2011).

As outlined above the habitat to be impacted was not assessed as suitable for the species (due to its elevation and that it is not subject to periodic inundation). As such it is unlikely to be critical to the species survival.

- *disrupt the breeding cycle of an important population*

The removal of approximately 0.57% of the local population will not significantly reduce the genetic diversity of the local population. The proposed activity will not cause any parts of the local population to become isolated, and in-turn the breeding potential of any areas of the population will not be limited. Additionally, it is unlikely that there will be any indirect impacts on the naturally occurring individuals in the north of the Subject Land (approximately 180 m


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from the disturbance area). As such it is unlikely that the proposed action will disrupt the breeding cycle of an important population of the species.

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

As outlined above the proposal will not impact on any areas of suitable habitat for the species. Additionally, indirect impacts on habitat are unlikely as the disturbance area is located approximately 180 m from areas of suitable habitat and substantial modification of the surface and groundwater hydrology are unlikely to occur due to the action. As such it is unlikely that any impacts to habitat will cause the species to decline.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

As areas of suitable habitat for the species occur approximately 180 m from the proposed disturbance area, it is unlikely that the action will result in an invasive species becoming established in habitat for *E. parramattensis* subsp. *decadens*. Furthermore, to limit the potential spread of weeds from the disturbance area into the offset area, a weed control program will be implanted as part of the action. This will involve regular inspections of the disturbance area interface being conducted and follow-up weed control for the life of the project (until rehabilitation is signed off), see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

- *introduce disease that may cause the species to decline, or*

Potential harmful diseases which *E. parramattensis* subsp. *decadens* is susceptible to include Myrtle Rust and *Phytophthora cinnamomi*.

Myrtle Rust is a disease caused by the exotic fungus *Puccinia psidii*. It infects species of the Myrtaceae family and causes leaf deformation, defoliation, reduce fertility, dieback, stunted growth, and plant death.

*Phytophthora cinnamomi* is a pathogen which infects the plant roots and causes disease and plant death. Infection of susceptible ecological communities can result in modification of the community, reduction in functionality and habitat loss or degradation for dependant flora and fauna species. The pathogen is spread in water, soil or plant material that contains the pathogen. *Phytophthora cinnamomi* occurs in all Australian states and territories (except NT), and is well established in many of the higher rainfall areas of the country.


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Evidence of these two diseases were not identified within the Subject Land, however, they are known to occur in the region. It is not expected that the proposal will introduce or exacerbate any of these diseases that may cause the species to decline. To limit the potential of spread, all machinery conducting clearing within the extraction area will be clean and free of any soil or vegetative material when it enters the site.

- *interfere substantially with the recovery of the species.*

A Draft National Recovery Plan (OEH 2011) has been prepared for this species. Four specific recovery objectives are identified in this plan; Distribute information that assists in conserving and managing Earp's Dirty Gum; Ensure appropriate use of Earp's Dirty Gum in rehabilitation projects; Raise awareness of Earp's Dirty Gum and facilitate community involvement in the recovery plan; and, Ensure appropriate protection of the Fern Bay form. The proposed action will not interfere with these objectives.

Additionally, this recovery plan also identifies habitat loss and fragmentation, and habitat degradation due to frequent fire and human disturbance as the main threats to the survival of the species. The proposal will not result in any habitat loss or fragmentation, or will it result in frequent fires. Additionally, the proposal will further secure the Subject Land through installation of boundary fencing in the south and secure access points along Cabbage Tree Road, which will limit unauthorised human access to the site.

### *Grevillea parviflora* subsp. *parviflora*

*Grevillea parviflora* subsp. *parviflora* is a dense spreading low shrub growing to 1 m in height, occurring from Prospect and the lower Georges River, to Camden, Appin and Cordeaux Dam area. Disjunct northern populations also occur near Putty, Cessnock and Cooranbong (Makinson 2002). The species reportedly occurs in heath and shrubby woodland, in sandy or lightly clay soils usually over thin shales (Olde & Marriot 1995; Makinson 2002). The species is lignotuberous and is capable of resprouting following fire and other disturbances. Regionally, *G. parviflora* subsp. *parviflora* is known to occur within Karuah Nature Reserve (Port Stephens Shire: Bell 2002) and Lower Hunter National Park (Cessnock Shire; Bell 2001), although no information is available on population sizes.

A total of 102 individuals were identified in the northern part of the Subject Land, primarily within the Tomago Sand Swamp Woodland and Coastal Sand Wallum Woodland – Heath. Species occurs in the north of the Subject Land, it was noted during surveys off-site for other species that the population extends the north of the Subject Land (within the Tilligerry SCA). As the full extent of the population is not known, the precautionary principal was applied and it is assumed that the individuals within the Subject Land form part of an important population.


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As records of the species along the Sandbeds are scattered, the local population may be an important source or linking population to maintain genetic diversity along the Sandbeds.

**An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:**

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

The proposed action will not directly impact on the occurrence of the population within the Subject Land. Additionally, it is unlikely that the proposed action will impact on the habitat of the species retained within the Subject Land (modification of surface and groundwater hydrology unlikely) As such, it is unlikely that the proposed action will lead to the long-term decrease of an important population of the species.

- *reduce the area of occupancy of an important population*

The proposed action will not reduce the area of occupancy of an important population as the species will not be directly impacted on, and losses from indirect impacts are unlikely.

- *fragment an existing important population into two or more populations*

The population identified within the Subject Land occurs along the northern boundary and extents off-site to the north. Additionally, a record of the species occurs approximately 300 m to the west of the extraction area. As the proposed extraction area will not directly remove any individuals it will not fragment the known population within the Subject Land. Additionally, the population within the Subject Land will still be connected via areas of remnant native vegetation to the recorded individual to the west of the Subject Land.

- *adversely affect habitat critical to the survival of a species*

There is no recovery plan for the species, as such no critical habitat has been identified. It could be assumed that areas of high quality habitat (those with limited disturbance and a known population) would be critical to the survival of the species.

The proposed action will remove 40.38 ha of potential habitat for the species, however, 19.01 ha of this is rehabilitation and is unlikely to be high quality habitat. The proposed action was not assessed as substantially modifying the hydrology of area, as such indirect impacts on areas of retained habitat are unlikely. As such, the proposed action is unlikely to adversely affect habitat critical to the survival of the species.


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- *disrupt the breeding cycle of an important population*

As the known population within the Subject Land occurs approximately 350 m from the disturbance area (at its closest point), It is unlikely that there will be any indirect impacts on the individuals within the offset area, or any significant impacts on the species pollinators (insects). As such it is unlikely that the proposed action will disrupt the breeding cycle of an important population of the species.

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

As outlined above the proposal will impact on approximately 40.38 ha of potential habitat for the species (19.01 ha was not assessed as high quality), it is unlikely that the proposal will indirectly impact on habitat for the species and no habitat will be isolated. Due to the limited impacts of the proposal and the availability of habitat in the area (both within the Subject Land and in adjacent areas), it is unlikely that any impacts to habitat will cause the species to decline.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

There is the potential for the proposal to introduce weed species into the retained habitat within the offset area. A weed control program will be implanted as part of the quarry, with regular inspections of the disturbance area interface being conducted, see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)). As there will be regular inspections and follow-up weed control for the life of the project (until rehabilitation is signed off) it is unlikely that a harmful species will become established within the species habitat.

- *introduce disease that may cause the species to decline, or*

*Grevillea parviflora* subsp. *parviflora* is susceptible to *Phytophthora cinnamomi*, and Myrtle Rust can impact on the species habitat.

*Phytophthora cinnamomi* is a pathogen which infects the plant roots and causes disease and plant death. Infection of susceptible ecological communities can result in modification of the community, reduction in functionality and habitat loss or degradation for dependant flora and fauna species. The pathogen is spread in water, soil or plant material that contains the pathogen. *Phytophthora cinnamomi* occurs in all Australian states and territories (except NT), and is well established in many of the higher rainfall areas of the country.


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Myrtle Rust is a disease caused by the exotic fungus *Puccinia psidii*. It infects species of the Myrtaceae family and causes leaf deformation, defoliation, reduce fertility, dieback, stunted growth, and plant death.

Evidence of these two diseases were not identified within the Subject Land, however, they are known to occur in the region. It is not expected that the proposal will introduce or exacerbate any of these diseases that may cause the species to decline. To limit the potential of spread, all machinery conducting clearing within the extraction area will be clean and free of any soil or vegetative material when it enters the site.

- *interfere substantially with the recovery of the species.*

Habitat loss and disturbance, and weed invasion (from over abundant native species). The proposal will not directly impact on any individuals, additionally the proposed action will not significantly reduce the availability of quality habitat for the species. As such, it is unlikely that the proposed action will interfere with the recovery of the species.

### *Persicaria elatior*

*Persicaria elatior* is an erect herb to 90 cm tall, with stalked, glandular hairs (i.e. they are knobbed when seen under a lens) on most plant parts. Its leaves are up to 11 cm long and 30 mm wide. A sheath encircles the stem at the base of each leaf, which is characteristic of its plant family. Its tiny flowers are in long, narrow spikes to 5 cm long. The pink flower-segments are less than 4 mm long (Harden 2002).

Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests), and also occurs in Queensland. This species normally grows in damp places beside streams and lakes and occasionally in swamp forests or associated with disturbance (OEH 2014).

Habitat for the species within the Subject land occurs within the Swamp Mahogany – Paperbark Swamp Forest and Coastal Wet Cyperoid Heath, where areas of permanent water occur. The proposed action will remove on 0.13 ha of Swamp Mahogany – Paperbark Swamp Forest, which represents potential habitat for the species.

The species was not identified during the field surveys, however, all areas of suitable habitat for the species were not extensively searched as they occur outside the proposed disturbance area. Three records of the species in the locality (10 km), two approximately 4.5 km north-west


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near Raymond Terrace (from 2010) and a third approximately 450 m to the north of the Subject Land (from 1970).

Due to the scattered nature of records for the species along the east coast, it has been assumed that any potentially occurring local population in an important population.

**An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:**

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

The proposed action will impact on 0.13 ha of potential habitat for this species. Additionally, the proposed action will not substantially modify the ground or surface water hydrology, and it unlikely that there will be modification any areas of habitat for this species due to the proposed action. As such it is unlikely that the proposed action will lead to the long-term decline in a population.

- *reduce the area of occupancy of an important population*

The proposed action will remove 0.13 ha of habitat for the species. There is a large amount of habitat for the species that will be retained within the offset area and to the north of the Subject Land (Tilligerry SCA). As such, it is unlikely that the proposed action will reduce the area of occupancy of the species.

- *fragment an existing important population into two or more populations*

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east. The proposal will temporarily remove a total of 40.38 ha of native vegetation from the edge of this corridor. As such, the proposal will not fragment any areas of habitat extending off the site.

Within the Subject Land the proposal will cause some minor fragmentation of two areas of habitat in the west/ south-west of the Subject Land. The proposed extraction area has been revised to ensure no areas of habitat will be isolated. As such, corridors within the Subject Land will be maintained. All areas of vegetation retained within the Subject Land will be linked to other areas of vegetation both within and adjacent to the site. Along the western boundary, areas of habitat will be linked through a retained strip of vegetation that is either 20 m or 50 m wide (depending on the point along the boundary). A corridor of vegetation between the northern and southern extraction areas will also be retained.

As such, the proposal will not fragment a potentially occurring local population.


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- *adversely affect habitat critical to the survival of a species*

There is no recovery plan for the species, as no areas of critical habitat have been identified.

It is unlikely that the area of habitat to be impacted by the action (0.13 ha of Swamp Forest) is critical to the survival of the species. Large areas of potential habitat for the species occur within the Subject Land and along the Sandbeds to the north.

- *disrupt the breeding cycle of an important population*

The proposed action will only impact on 0.13 ha of potential habitat and will not fragment or isolate any areas of habitat for the species. Additionally, the highest quality habitat for the species within the Subject Land occurs outside the extraction area and it is unlikely that there will be any indirect impacts on this habitat. As such, it is unlikely that the proposed action will disrupt the breeding cycle of a population.

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

There is a large amount of suitable habitat for the species to be retained within the Subject Land and in areas to the north within the Tilligerry SCA. As such the removal of 0.13 ha of habitat within the extraction area is unlikely to lead to the decline of the species.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

There is the potential for the proposal to introduce weed species into the retained habitat within the offset area. A weed control program will be implanted as part of the quarry, with regular inspections of the disturbance area interface being conducted, see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)). As there will be regular inspections and follow-up weed control for the life of the project (until rehabilitation is signed off) it is unlikely that a harmful species will become established within the species habitat.

- *introduce disease that may cause the species to decline, or*

The species is susceptible to impacts from *Phytophthora cinnamomi*. *Phytophthora cinnamomi* is a pathogen which infects the plant roots and causes disease and plant death. Infection of susceptible ecological communities can result in modification of the community, reduction in functionality and habitat loss or degradation for dependant flora and fauna species. The pathogen is spread in water, soil or plant material that contains the pathogen. *Phytophthora*


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*cinnamomi* occurs in all Australian states and territories (except NT), and is well established in many of the higher rainfall areas of the country.

Evidence of these this disease was not identified within the Subject Land, however, it is known to occur in the region. It is not expected that the proposal will introduce or exacerbate the spread of this diseases. To limit the potential of spread, all machinery conducting clearing within the extraction area will be clean and free of any soil or vegetative material when it enters the site.

- *interfere with the recovery of the species.*

As the proposed action will only impact on 0.13 ha of habitat for the species it is unlikely that it will interfere with the recovery of the species.


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# 3. LISTED MIGRATORY SPECIES

### Eastern Osprey

The Osprey, also known as the Fish-Hawk or White-headed Osprey, is a long-lived, sedentary and cosmopolitan species (Marchant & Higgins 1993). Its core habitat includes bays, estuaries, mangrove swamps, beaches, dunes, cliffs, inshore waters of mainland and islands, and coral and rocky reefs (Roberts & Ingram 1976; Gosper 1981, 1983; Ekert & Brady 2004). In Australia, the Osprey mainly occurs in the coastal zone, covering approximately 75% of the mainland coastline. There are thought to be three disjunct populations: the northern and eastern population occurring from Broome, WA to the south coast of NSW; the southern population from Kangaroo Island to the Great Australian Bight and; the western population from Esperance to Cape Keraudren (Marchant & Higgins 1993).

In NSW, the Osprey occurs from the Queensland/NSW border to the south coast, with a number of inland records. The breeding season for the Osprey occurs from June to October. The Osprey is monogamous and very faithful to the nest-site and nesting territory, and returns to the same nest in successive years (Olsen 1995; Ekert & Brady 2004). The Osprey constructs a large nest, predominantly composed of dead sticks, branches, driftwood, seaweed, bark and woodchips. The nests are constructed on a variety of sites but most commonly in a fork or broken trunk in the upper part of a dead tree or dead crown of a live tree (Clancy 1993; Rose 2000). The diet of the Osprey mainly consists of fish, although small terrestrial vertebrates, seabirds and crustaceans have also been recorded (Marchant & Higgins 1993).

A juvenile individual was identified within the Subject Land during field surveys. A large stick nest was also identified within the Subject Land, however, no species were observed to be utilising the nest at the time of field surveys. The Subject Land occurs within 3 km of suitable foraging habitat for this species (Fullerton Cove), as such it has the potential to provide roosting and nesting habitat for the species. All vegetation within the Subject Land that has a tall canopy layer (all vegetation types except the Coastal Wet Sand Cyperoid Heath and the Tomago Sand Swamp Heath) were assessed as suitable nesting and roosting habitat for the Eastern Osprey. A total of 40.38 ha of habitat will be impacted due to the proposed action, and 103.47 ha will be retained within the Subject Land (of which 101.02 ha will be protected within the offset area).


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**An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:**

- *Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species*

There are 13 records of the species in the locality (10 km). The majority of the records in the locality (12 of the 13) occur on or within close proximity to Kooragang Island (one record within the Subject Land from field surveys). In the locality, Kooragang Island and other areas of the Hunter Wetlands National Park are likely to represent important habitat for the species as these areas provide both foraging habitat (open water), and roosting and nesting habitat. While the proposed action will impact on 40.38 ha of suitable habitat for the species (with 103.47 ha retained within the Subject Land), it is unlikely to represent important habitat for the species.

There is the potential for indirect impacts on habitat for this species through modification of the groundwater hydrology. The proposed extraction level will be restricted to a depth of 0.7 m above the maximum predicted groundwater level, with the final landform at 1 m above the maximum predicted groundwater level. As such it is unlikely that there will be any significant indirect impacts on habitat for this migratory species.

- *result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or*

Due to the lifecycle of the species, they are not threatened by invasive predators as they nest high in the tree canopy or high on artificial structures, and they hunt over water bodies rarely landing on the ground (occasionally to eat prey). As such, it is unlikely that the proposed action will result in the establishment of an invasive species that is harmful to the species.

- *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) or an ecologically significant proportion of the population of a migratory species.*

One juvenile individual was identified within the Subject Land. Additionally, a potential nest was observed, however, no species were identified as occupying the nest during field surveys. There is the potential that the juvenile individual identified within the Subject Land was dispersing and may not have been resident within the Subject Land. However, if there is a resident pair within the Subject Land, the proposed action has the potential to disrupt the lifecycle of these individuals. Any potentially occurring individuals within the Subject Land form part of the 'northern and eastern population' of the species which extends from Broome in WA through to the south coast of NSW. As such, they would form part of a large population, the


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exact numbers not known, however, surveys in 1997 – 1999 identified at least 40 pairs from Grassy Head to Old Bar (DoE 2016). As such, any potential impacts within the Subject Land would not affect an ecologically significant proportion of the population.

### Rufous Fantail

The Rufous Fantail (*Rhipidura rufifrons*) is a medium to small sized bird that is on average 16 cm long, with a wind span of 21 cm. In Australia the species is scattered in northern Australia, and widespread on the east of the Great Dividing Range along the east coast of NSW and into VIC. In NSW species mostly occurs in dense, moist habitats, mainly in wet sclerophyll forests, often in gullies and usually in areas with a dense understorey of acacias, shrubs, and herbs, and often ferns (Higgins *et al.* 2006).

**An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:**

- *Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species*

The Swamp Mahogany – Paperbark Swamp within the Subject Land represents potential habitat for this species. The proposed action will directly impact on 0.13 ha of habitat for this species. The proposed action will not substantially modify the ground or surface water hydrology, and it is unlikely that there will be modification to any areas of habitat for this species due to the proposed action.

Within the Subject Land, the proposal will cause some minor fragmentation of two areas of habitat in the west/south-west of the Subject Land. The proposed extraction area has been revised to ensure no areas of habitat will be isolated. As such, corridors within the Subject Land will be maintained. All areas of vegetation retained within the Subject Land will be linked to other areas of vegetation both within and adjacent to the site. Along the western boundary, areas of habitat will be linked through a retained strip of vegetation that is either 20 m or 50 m wide (depending on the point along the boundary). A corridor of vegetation between the northern and southern extraction areas will also be retained.

As such it is unlikely that the proposed action will lead to a long-term decline in a population.


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- *result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or*

No invasive species are listed as threatening the Rufous Fantail. However, there is the potential of predation on the species by Foxes. A vertebrate pest control program will be implemented as part of the proposed action.

- *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) or an ecologically significant proportion of the population of a migratory species.*

Due to the relatively small area of direct impacts on suitable habitat for the species (0.13 ha), it is unlikely that the proposed action will disrupt the lifecycle of an ecologically significant proportion of the population.

### Snipe Species

- Latham's Snipe
- Swinhoe's Snipe
- Pin-tailed Snipe

These species were not identified during field surveys, but suitable habitat for these species occurs within the Coastal Wet Sand Cyperoid Heath.

**An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:**

- *Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species*

The proposed action will not directly impact on any areas of habitat for these migratory species. There is the potential for indirect impacts on these species' habitat through modification of the groundwater hydrology. The proposed extraction level will be restricted to a depth of 0.7 m above the maximum predicted groundwater level, with the final landform at 1 m above the maximum predicted groundwater level. As such it is unlikely that there will be any significant indirect impacts on habitat for these migratory species.

- *result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or*

As the proposal will not occur within any areas of habitat for these species it is unlikely that it will cause the establishment or spread of an invasive species that is harmful to these species.


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- *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) or an ecologically significant proportion of the population of a migratory species.*

None of these species breed in Australia, as such it is unlikely that the proposed action will disrupt their breeding cycle.

These migratory species forage and roost in their Australian range, and migrate between these foraging grounds and breeding territories in the northern hemisphere. It is unlikely that the proposed action will disrupt the lifecycle of these species as the proposed action will not directly impact on their habitat and indirect impacts on habitat are unlikely. Additionally, no parts of the proposed action have the potential to seriously disrupt the lifecycles of an ecologically significant proportion of these species.

### Migratory Species with Habitat in Fullerton Cove

- Common Sandpiper
- Ruddy Turnstone
- Sharp-tailed Sandpiper
- Red Knot
- Curlew Sandpiper
- Pectoral Sandpiper
- Red-necked Stint
- Great Knot
- Double-banded Plover
- Greater Sand Plover
- Lesser Sand Plover
- Broad-billed Sandpiper
- Bar-tailed Godwit
- Eastern Curlew
- Little Curlew
- Whimbrel
- Ruff (Reeve)
- Pacific Golder Plover
- Grey Plover
- Little Tern
- Grey-tailed Tattler
- Common Greenshank
- Marsh Sandpiper


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All of these species utilise habitat in Australia for foraging only, with breed territories primarily in Asia, or Northern Europe. Habitat for these species occurs within Fullerton Cove. The proposed action will not directly impact on any areas of habitat for these species. There is the potential for indirect impacts through modification of surface and groundwater hydrology as the extraction area occurs upstream of the Hunter Estuary National Park.

**An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:**

- *Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species*

The proposed action will not directly impact on any areas of habitat for these migratory species. There is the potential for indirect impacts on these species' habitat through modification of the groundwater hydrology, upstream of the Ramsar Wetland. The proposed extraction level will be restricted to a depth of 0.7 m above the maximum predicted groundwater level, with the final landform at 1 m above the maximum predicted groundwater level. As such it is unlikely that there will be any significant indirect impacts on habitat for these migratory species.

- *result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or*

As the proposal will not occur within or directly adjacent to the habitat for these species (Hunter Wetlands National Park) it is unlikely that it will cause the establishment or spread of an invasive species that is harmful to these species.

- *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) or an ecologically significant proportion of the population of a migratory species.*

None of these species breed in Australia, as such it is unlikely that the proposed action will disrupt their breeding cycle.

These migratory species utilise Fullerton Cove for foraging and roosting, and migrate between these foraging grounds and breeding territories in the northern hemisphere. It is unlikely that the proposed action will disrupt the lifecycle of these species as the proposed action will not directly impact on their habitat and indirect impacts on habitat are unlikely. Additionally, no parts of the proposed action have the potential to seriously disrupt the lifecycles of an ecologically significant proportion of these species.


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