Kooragang Island Waste Emplacement Facility - Eastern Ponds Closure Works

Review of Environmental Factors

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Hunter & Central Coast Development Corporation

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Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
Draft	12/08/2020	First draft	Sam Bourke	Ada Zeng & Thomas Muddle	Thomas Muddle & Chris Thomson	Thomas Muddle
Final	4/09/2020	Final	Julia Bayada	Thomas Muddle	Thomas Muddle & Chris Thomson	Thomas Muddle
Final - Revision A	8/10/2020	Updated to incorporate University of Newcastle and Biodiversity and Conservation Division review comments.	Thomas Muddle & Chris Thomson	Thomas Muddle	Thomas Muddle & Chris Thomson	Thomas Muddle

REF Endorsement

I, Valentina Misevska, Chief Executive of the Hunter and Central Coast Development Corporation, have examined and considered the **Kooragang Island Waste Emplacement Facility - Eastern Ponds Closure Works** Review of Environmental Factors in accordance with the provisions of s5.5 of the *Environmental Planning and Assessment Act 1979* and *State Environmental Planning Policy (Three Ports) 2013* and determine that the proposed development may be carried out as development without consent, subject to compliance with the conditions to manage environmental impacts outlined within the REF.

SIGNED for and on behalf of
HUNTER AND CENTRAL COAST DEVELOPMENT CORPORATION ABN 94 688 782 063
by VALENTINA MISEVSKA without assuming
any personal liability and in the presence of:

_____
Signature of VALENTINA MISEVSKA

Delegated position: Acting Chief Executive

Contents

Executive Summary

Project summary

Hunter and Central Coast Development Corporation (HCCDC) propose to undertake the closure and rehabilitation of the Eastern Ponds (K24, K26, K31 and K32) area of the Kooragang Island Waste Emplacement Facility (KIWEF), near Newcastle NSW.

The Eastern Ponds is known to be highly contaminated by BHP Steelworks waste. The State's Landfill Closure work has also been complicated by presence of a protected amphibian, the Green and Golden Bell Frog (GGBF), which until recently (2016), was known to use the area as a breeding habitat,

The area has been monitored and managed under an Action Plan (Golder 2010), regulated by the EPA. The Action Plan requires HCCDC to undertake capping works when ecological values are observed to have declined to a threshold level, for a period of no less than 5 years.

Following recent ecological triggers for the works, HCCDC are obligated to complete landfill capping in a manner that meets EPA requirements, to manage contamination and rehabilitate the site back towards its previous state. The Proposal involves installation of drainage and sediment controls, capping and re-contouring of waste emplacement areas and creation of a hydrological features designed to manage surface water runoff and also restore habitat of the GGBF (Collectively referred to as the Closure Works throughout the report).

The basic principles of the Closure Works are to reduce surface water infiltration into the groundwater by the following means:

- Re-grading of the site to a minimum 1% grade to prevent ponding of surface waters
- Drainage improvements
- Provision of a capping layer to achieve a minimum thickness of 0.5 m, minimum grade of 1% and permeability of 1×10^{-7}
- Rehabilitation using existing and imported topsoil and alternative low nutrient and Chytrid free imported growth medium.

The intended outcome of the Closure Works is to achieve a site supporting similar levels of vegetation and providing similar surface water flows to surrounding ponds and habitat areas with a reduced contaminant load migrating from the fill material to the surrounding environment.

Environmental Context

KIWEF is a complex site that has been well studied in association with various proposed and completed projects. As a result of the development history, the site is highly disturbed. Currently the Eastern Ponds consist of a steep, slag wall sided depression in the landscape. The Eastern Ponds are surrounded by the NCIG Rail Loop and infrastructure to the north and east and previously completed K10 North capping to the South and West. The protruding slag wall runs north-south through its middle and each side of this wall is vegetated largely with weeds and other vegetation.

Because their elevation is below that of surrounding infrastructure and landforms, the eastern ponds do not discharge surface water. While historically holding water for extended periods, over recent years the ponds have dried out, with water infiltrating into groundwater or evaporating.

The Eastern Ponds is the last area of KIWEF to be closed having been identified as potentially supporting a viable breeding population of GGBF. The University of Newcastle (University of Newcastle, 2020) has completed annual monitoring program over the past five consecutive years and from this have concluded that although the Eastern Ponds are occasionally occupied by GGBF, there is no evidence of breeding taking place within them.

Statutory context

As concluded by legal advice separately obtained by HCCDC in relation to earlier stages of closure, and reconfirmed by HCCDC under current legislation, the Closure Works are best described as environmental management or environmental protection works as opposed to remediation works. Environmental Protection or Management Works are permissible without consent under State Environmental Planning Policy (Three Ports) 2014 (Three Ports SEPP). There are no triggers for the Proposal to be considered State significant or Designated Development. HCCDC are considered to be the Proponent and the determining authority for the Proposal and has a duty to fully consider the environmental impacts prior to commencing works. This duty is supported by the preparation of this document.

The site is a former licenced landfill regulated under the *Protection of the Environment Operations Act 1997* (POEO Act) and while site materials are contaminated as a result of historic landfilling practices the site is not regulated as a Contaminated Site under the *Contaminated Land Management Act 1997* (CLM Act*).*

Assessment purpose and approach

This document does not attempt to assess the environmental impacts of the application of waste to the site as this activity is not proposed and past landfilling practices are considered otherwise approved or permissible under the legislation that applied at the time the development commenced. As such the REF is strictly limited to the proposed landfill closure works. No future land use beyond that of a closed landfill are proposed and are not considered within this assessment.

This Review of Environmental Factors has been prepared under Part 5, Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to assess proposed landfill closure works within the Eastern Ponds area of KIWEF based on a significant body of publicly available information and in accordance with the principles established through previous assessments. This REF assesses the environmental impacts of the closure works on Eastern Ponds area of KIWEF, and on the basis that Surrender Notice conditions and any required mitigation measures are implemented.

Environmental Impact Assessment

Biodiversity

The Eastern Ponds are a series of partially filled waste emplacement cells. These cells historically comprised open water and over time have undergone a successive change to a more vegetated structure influenced by a change in surface hydrology, and specifically the gradual reduction of surface water.

The study area for the purposes of this biodiversity assessment includes the four partially filled waste emplacement cells referred to as the Eastern Ponds, and comprising a total area of approximately 4 hectares, in addition to an isolated parcel of land immediately adjacent (around 1.5 hectares), to the west of the ponds that is proposed as a stockpile area for any material used during remediation.

The inspection of the Eastern Ponds confirmed there are no threatened ecological communities listed under either the BC Act or EPBC Act located within the assessed area. This assessment identified three threatened fauna species that have been previously recorded within the locality and that are likely to occur within the Eastern Ponds area. These included:

- Green and Golden Bell Frog (*Litoria aurea*).
- Australasian Bittern (*Botaurus poiciloptilus*).
- Black Bittern (*Ixobrychus flavicollis*).

The Proposal would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, *Phragmites australis* and *Typha orientalis* (0.8 ha) and regrowth Swamp Oak (0.7 ha). All areas of native vegetation occur within the lower parts of the cells. The remaining areas of disturbance associated with the cell

walls, access roads and stockpile area, comprise only exotic and non-indigenous plant species that are not characteristic of native plant communities.

An assessment of significance is provided in Appendix C. The conclusion of these assessments has indicated that the proposed activity is not likely to have a significant impact on populations of the three assessed threatened fauna species. This is determined in the content of the size and low to marginal condition of the habitats present, and the range of better-quality habitats available across the broader, KIWEF, Kooragang Island and Hunter Wetlands National Park. The Proposal will temporarily remove an area of marginal foraging habitat for GGBF at the Eastern Ponds occupied by a small proportion of the Kooragang Island population. The removal of this habitat is not expected to have a long-term impact on the size of the Kooragang Island population. The Eastern Ponds and receiving water bodies do not represent key breeding areas for the GGBF, and any temporary hydrology changes are not expected to have a long-term negative impact on the GGBF population.

Hydrology

The low-lying nature of the Eastern Ponds means there is no immediate surface water drainage outlet and all surface water currently either infiltrates or evaporates.

The following potential impacts are identified and mitigation measures are proposed for their management:

- During construction of the Proposal, rainfall and inflows to the eastern ponds and stockpile areas may lead to mobilisation of sediments and exposed contaminants
- With no natural discharge point, risk of uncontrolled releases are low and active dewatering may be required
- Filling to accommodate capping may raise site levels and result in overtopping
- The provision of a reduced permeability cap would reduce infiltration and lead to risks of prolonged inundation of the cap or overflow in extreme rainfall events
- Inclusion of a low-permeability cap will reduce outflows via seepage and increase the frequency, extent and depth of ponding
- Either a passive or pumped outlet will be constructed to facilitate dewatering following extreme or prolonged wet weather, with surface water discharging into either Windmill Road Channel and/or Long Pond
- Discharges from the cap into these water bodies will occur during rain events when they are already receiving runoff, it is likely these water bodies may become marginally fresher and wetter sooner after rainfall
- In extreme rainfall events, a sudden outflow would be unlikely as there is no significant contributing catchment and the storage capacity between the proposed low-level outlet and the overflow level allows the capture and slow-release of water during large rainfall events such that contribution to flooding risks would be low.

With the implementation of recommended mitigation measures, no significant hydrology impacts are considered likely.

Land use and contamination

The Eastern Ponds do not support a current land use beyond the provision of habitat as described above. The Contamination status of the Eastern Ponds are identified in prior assessments as a significant area of environmental concern but as not significantly affecting downgradient receptors and not appearing to present a significant risk to the down gradient environment.

The approved Materials Management Plan (RCA, 2012) provides controls for the management of contaminated material as encountered and identifies that retaining contaminated material in situ is preferred, provided there is

no immediate danger to the environment or community and where it will be appropriately covered with at least 0.5 to 1 metre of material prior to being capped.

The design and construction methodology would be developed such that interaction with the ground surface is minimised. Nevertheless, there is a risk of interaction with, and exposure to existing contamination that requires management. The main contamination risk remains the potential for interaction of surface water with contaminated site materials during construction. However, uncontrolled discharges from site are unlikely as discussed above. On the basis that active dewatering would only be undertaken following confirmation of the suitability of water for discharge the risk of pollution of water or land is considered low and within the control of the Contractor and HCCDC. Following installation of cover material, the risk of contamination mobilisation in surface water would be removed.

The objective of the Proposal is to install a reduced permeability layer that will reduce infiltration through the known contamination. In doing so the Proposal would reduce the risks of impacts to down-gradient receptors and provide a barrier to direct contact in the event of future uses of the site. Following the completion of the Proposal it is considered likely that contamination risks to the surrounding environment would be reduced. The Proposal is considered to have an overall positive environmental impact in the long term when compared to a do-nothing scenario from a contamination perspective.

Transport

Access to the Proposal Area is via Windmill Road from Cormorant Road. Capacity upgrades to Tourle Street and Cormorant Road have recently been completed.

The construction traffic would involve:

- Heavy vehicles arriving and departing generally during standard construction hours only, some limited deliveries may be received after hours
- About 100 truck deliveries per day (100 movements in and 100 movements out) with maximum delivery per hour of 10 trucks if deliveries are limited to standard construction hours only
- Arrival of about 20 construction worker cars between 6:00am to 7:00am, and departure between 3:00pm to 6:00pm

No road closures are required as part of the Proposal and adequate capacity is considered to be available within the recently upgraded road network such that significant traffic impacts are unlikely.

Noise and vibration

The nearest residential receptor is located approximately 2 km away. In all cases, receivers are separated by active rail infrastructure with the nearest receptor also separated by busy roads and intersections and industrial areas.

The Proposal would involve noise generating activities including haulage, stockpiling, vegetation clearing, excavation and compaction activities. The potential for construction noise impacts is considered limited. This is predominantly due to the distance noise attenuation, existing background noise levels, construction activities being limited to standard construction hours and works predominantly being undertaken within the depression formed by the eastern ponds and be fully screened from receptors by surrounding landforms including completed closure works and NCIG Rail loop. After hours deliveries if required would be directly to the eastern ponds which is noted to be at an elevation below surrounding landform.

Plant and equipment is likely to be similar to that used on prior stages of closure works but with fewer items due to the limited space available. No noise complaints were received associated with prior stages which were notably closer to receptors and provided with reduced topological screening. Standard, reasonable and feasible noise mitigation measures would be adopted as per past Closure Works stages. No operational noise would be generated.

No vibration sensitive receptors are located within the vicinity of the Proposal and the detailed design and construction methodology will accommodate any necessary controls or setbacks to protect the NCIG rail infrastructure.

Visual

The visual catchment is highly disturbed and dominated by existing port, road and rail infrastructure. The Proposal area is entirely screened from public and sensitive receivers by topography, vegetation along Cormorant Road and existing infrastructure. If after hours deliveries are required, night lighting would be minimised and positioned within the depression formed by the eastern ponds and as such would not be visible off-site.

No significant visual impacts are likely.

Heritage

The Proposal is located in the Awabakal Local Aboriginal Land Council area. No recorded Aboriginal or listed non-Aboriginal heritage sites are present within the zone of influence of the Proposal.

Given the history of the area operating as a landfill, the Proposal is unlikely to pose a risk to indigenous or non-indigenous cultural heritage artefacts. No disturbance or excavation of natural soil is proposed and therefore risk of disturbing areas of archaeological potential is very low.

A chance finds procedure would be implemented for the Proposal.

Air Quality and Odour

Air quality in the region is influenced by emissions from industry including port and coal handling operations, domestic fuel burning and vehicle emissions.

During the construction of the Proposal, earthworks have the potential for dust generation and odours may be generated if significantly contaminated material is encountered.

There is limited potential for air quality impacts to affect human receivers during construction as the nearest residences are approximately 2km to the south. Dust impacts to neighbouring ponds and vegetation will require controls to be implemented.

No ongoing or long term air quality impacts will result from the operation of the Proposal and no significant air quality impacts are likely.

Socio-economic

Given the short-term nature of construction and the small scale of the works, minimal social impacts from the closure works is expected. Social impacts include the brief contribution of the construction works to the generation of local employment and support of local business. The works will not hinder the function of any other business or community activities in the area.

The works also provide a positive social benefit by reducing the potential exposure of contaminants to surrounding areas.

Cumulative Impacts

The site is surrounded by various major developments including operational coal terminals and other waste disposal facilities in various stages of closure. A scoping report has also been lodged for a proposed gas import facility that would affect traffic on Windmill Road and Cormorant Road during construction.

The Proposal's contribution to potential cumulative impacts is not considered significant based on the following:

- Impacts to fauna habitat will be of a short term duration and are not considered to be cumulative on the basis that the habitat will be returned post closure with completed stages of the Closure Works demonstrating positive biodiversity outcomes
- With the exception of changes to hydrology, all impacts are related to short term construction works only with no long-term detrimental consequences identified
- Water chemistry changes are predicted to be a general improvement with limited potential to exacerbate flooding risks
- Short term traffic impacts, if coinciding with the gas import facility construction, could lead to disruption in the area but are not considered to represent a significant environmental impact.

Mitigation measures

HCCDC's proposed approach to risk and impact management from completed stages of the Closure Works would be implemented for the Proposal. This includes the development of a Construction Environmental Management Framework and implementation through the development of detailed contractor's Construction Environmental Management Plans and work instructions. For potential environmental impacts, mitigation measures consistent with prior stages of the Closure Works are presented in the following sections and are considered to form part of the Proposal. These would be included in contract specifications and implemented by the construction contractor.

Conclusions

The Proposal as described in the REF best meets the project objectives but would still result in some impacts on biodiversity, hydrology, traffic, noise and contamination management. Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts.

The Proposal would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act. A Species Impact Statement is not required. The Proposal is subject to assessment under Division 5.1 of the EP&A Act. Consent from council is not required.

The Proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*. A referral to the Australian Department of Agriculture, Water and the Environment is not required.

1. Introduction

Hunter and Central Coast Development Corporation (HCCDC) propose to undertake the closure and rehabilitation of the Eastern Ponds (K24, K26, K31 and K32) area of the Kooragang Island Waste Emplacement Facility (KIWEF), near Newcastle NSW (Refer to Figure 1.1). The Proposal includes the installation of drainage and sediment controls, capping and re-contouring of waste emplacement areas and rehabilitation including the creation of a lined artificial water body designed to support a permanent water body and landscaped to provide habitat for Green and Golden Bell Frog (GGBF) (Collectively referred to as the Closure Works throughout the report).

The basic principles of the Closure Works are to reduce surface water infiltration into the groundwater by the following means:

- Re-grading of the site to a minimum 1% grade to prevent ponding of surface waters
- Drainage improvements
- Provision of a capping layer to achieve a minimum thickness of 0.5 m, minimum grade of 1% and permeability of 1×10^{-7}
- Rehabilitation using existing and imported topsoil and alternative low nutrient and Chytrid free imported growth medium.

The intended outcome of the Closure Works is to achieve a site supporting similar levels of vegetation and providing habitat areas with a reduced contaminant load migrating from the fill material to the surrounding environment.

The Closure Works is the final stage of KIWEF Closure. Previous stages have been assessed under the *Environmental Planning and Assessment Act 1979* (EP&A Act) and *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), and are complete as follows:

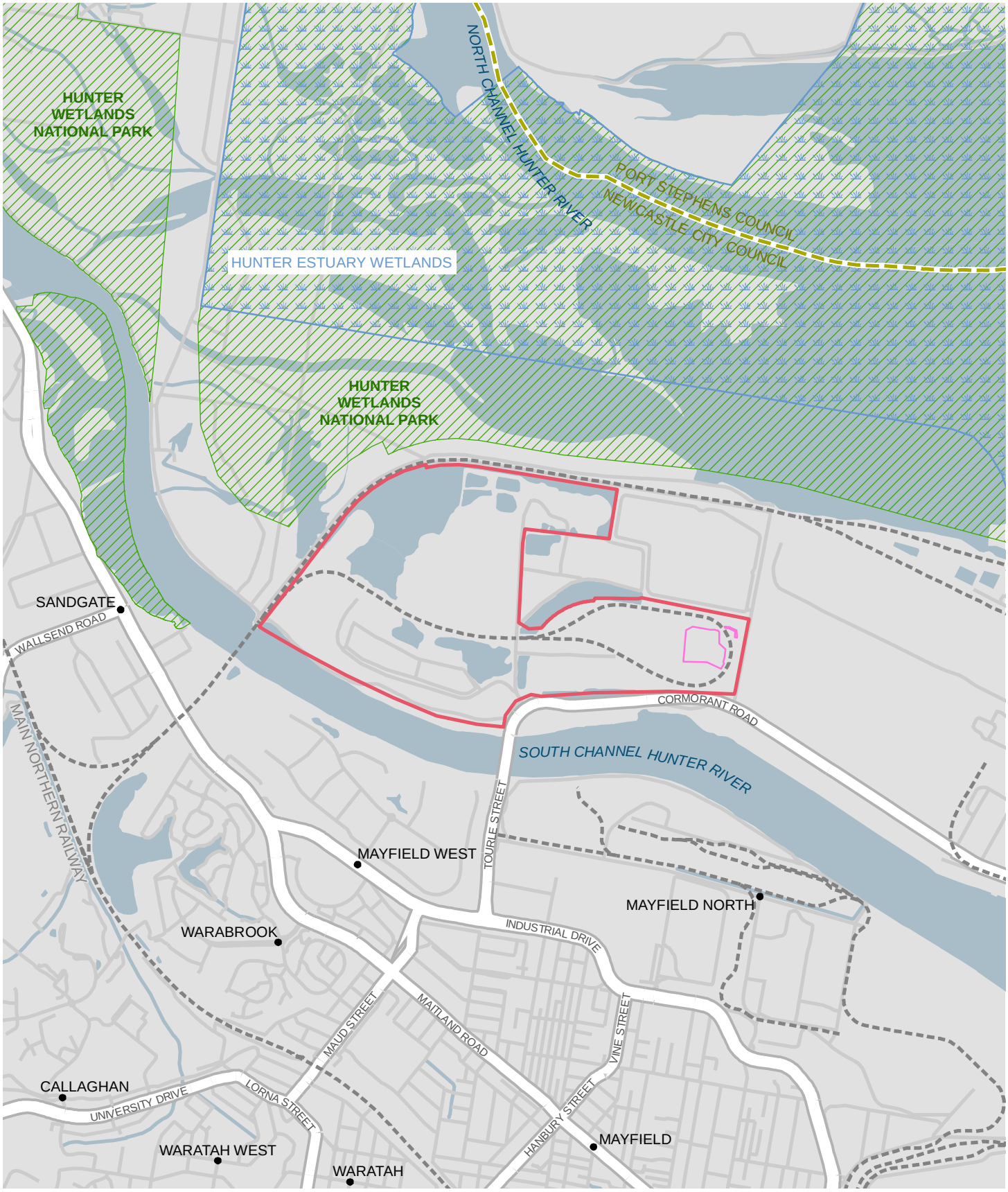
- Area 1 – K2 and K10 North completed in May 2015
- Area 3 – K10 South completed in February 2017
- Area 2 – North of Rail Line (K3 and K5) completed in July 2020.

The Eastern Ponds adjoin the K10 North area but were excluded from the Area 1 and 3 assessments while further monitoring and investigation of importance of the area to GGBF breeding was undertaken.

1.1 Site History

The site is a former landfill and continues to be regulated under the NSW *Protection of the Environment Operations Act 1997*. KIWEF ceased operation in 1999 and until this time was used by BHP as a landfill for disposal of waste from the Mayfield steelworks and associated operations. KIWEF was subject to Environmental Protection License (EPL) 6437 for the scheduled action of "Waste disposal by application to land" first issued in 1999 and subsequently transferred to Regional Land Management Corporation Pty Ltd in May 2003 and then the Hunter Development Corporation (now Hunter and Central Coast Development Corporation (HCCDC)) in January 2008.

HCCDC surrendered EPL 6437 on 8 December 2010 and the EPA issued conditional Surrender Notice 1111840 and subsequent variation notices being issued on 2 May 2013 (notice number 1510956) and 17 April 2014 (notice number 1520063) collectively referred to as the Surrender Notice for the remainder of this report. Surrender conditions relate primarily to the closure process and describe the capping that is required across much of the area through reference to the GHD (2009) Revised Final Landform and Capping Strategy (the Capping Strategy).



Legend

- Locality
- Railway
- Surrender Notice boundary
- Eastern Pond Closure Works
- Local Government boundary
- Ramsar Wetland
- NPWS Reserve
- Waterbody

N

Data sources
Ramboll 2018
© Department Finance, Services and Innovation Aug 2020
NSW DPIE 2020

GDA 1994 MGA Zone 56

1:30,000 at A4

0 500 m

Figure 1-1 Location

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The KIWEF Capping Strategy (GHD, 2009) identified and described the proposed stages of capping works to be progressively completed. Due to the development of portions of the KIWEF footprint by external stakeholders, the stages of capping works were revised within a Variation of the Conditions of Surrender (Notice 1510956, issued on 2 May 2013). The current Stages of works and their status are:

- Area 1 – K2 and K10 North closure works completed in May 2015
- Area 2 – North of Rail Line (K3 and K5) closure works completed in July 2020
- Area 3 – K10 South closure works completed February 2017.

The Capping Strategy was supported by a Flora and Fauna Assessment (GHD, 2010) with the aim of best managing the threat of significant environmental harm from the contaminants within the KIWEF whilst minimising risk to threatened fauna habitat. The EPA has provided an endorsement for the Revised Final Landform and Capping Strategy (GHD, 2009) as the best balance to achieve positive environmental outcomes for the site. The approach to closure is to implement minimal change in all site processes namely hydrology, vegetation and surface soils while further isolating potential contaminants. This is achieved by installing a low permeability capping layer to reduce infiltration and reduce the risk of contaminant migration.

The Eastern Ponds is the last area of KIWEF to be closed having been identified as potentially supporting a viable breeding population of GGBF. The GGBF is listed as vulnerable under the EPBC Act and endangered under the BC Act, and is a key threatened species under the nearby Ramsar wetlands, making the species a Matter of National Environmental Significance under the EPBC Act. The Surrender notice and capping strategy recognised this importance through the Eastern Ponds Action Plan (Golder, 2011a) which deferred closure while undertaking further investigations of the viability of the breeding population and significance of contamination. Recently the University of Newcastle researchers have determined that the Eastern Ponds no longer contain important breeding habitat. The Eastern Ponds has essentially dried out since the construction of the NCIG Rail Loop which encloses the site. The current dried out condition, combined with the success of earlier stages of KIWEF closure in protecting and providing breeding habitat for GGBF has triggered planning for closure of the Eastern Ponds.

The site history is summarised as follows:

- Prior to European settlement in 1850, Kooragang Island was a mosaic of deltaic islands and tidal channels
- Kooragang Island was subsequently settled for agriculture, including livestock grazing and the cultivation of crops
- The most significant human activity on Kooragang Island has been the reclamation of extensive areas of estuarine wetlands through the placement of culverts on creeks and land filling such that the morphology, hydrology and vegetation have been profoundly altered
- In 1951 dredged material from Newcastle Harbour was used to initiate the filling of the tidal channels between the islands of the Hunter River
- Clearing for agriculture removed the majority of the swamp forest and rainforest vegetation on the island by 1954
- Filling of land with industrial by-products resulted in substantial changes to the south-east corner of Kooragang Island by 1966
- The KIWEF parcel of land was transferred to BHP in 1979 however, the site had been used for the landfilling operations since 1972
- The Eastern Ponds were constructed using blast furnace rock slag before being partially filled with industrial wastes associated with steel making, including a mix of inert solid waste
- The site stopped receiving waste prior to 2002 when the land was transferred to the NSW Government.
- GGBF, a protected species, was identified on Kooragang Island in the late 1990's. Monitoring conducted by the State post BHP handover identified a significant breeding habitat of GGBF in the Eastern Ponds, which at that time was characterised by large body of open waters in three of the four landfill cells

- In 2010, NCIG completed construction of the embankment of the NCIG Rail Loop. The construction works included the filling and compaction of approximately 65% of ponds K32 and K26 (the north eastern and south eastern cells)
- At the time of NCIG baseline investigations (2009), NCIG identified very significant level of contamination in the Eastern Ponds, including presence of unexpected toxic liquid hydrocarbon waste
- In 2010 HCCDC surrendered the Environmental Protection Licence associated with the landfill and established an Action Plan (Golder 2010) which set out a plan of monitoring and management, whereby the area would be capped in the event that ecological function declined to be "unviable", or significant contamination was observed migrating offsite
- In 2013, the State Government completed the long-term lease of the Port of Newcastle. At that time, the area was being monitored for groundwater contamination migration and presence of GGBF. The contaminates were observed to be trending steady, and the area was still functioning as a viable and important GGBF breeding habitat, per definitions of the Action Plan
- In 2015-16, as part of the State's collaborative GGBF monitoring and research program with private industry and the university, GGBF monitoring recorded a year of very low GGBF activity along with other adverse observations of hydrology and vegetation morphology. Importantly, no GGBF breeding was recorded in that year
- Following five consecutive years of nil GGBF breeding and other key habitat value indicators (including adult refuge habitat)in the eastern ponds (2015-2020) and other indicators of GGBF habitat decline, HCCDC were triggered to commence planning of the Landfill Closure Works, to cap contaminated soils in accordance with EPA requirements while aiming to restore habitat functions to a baseline level

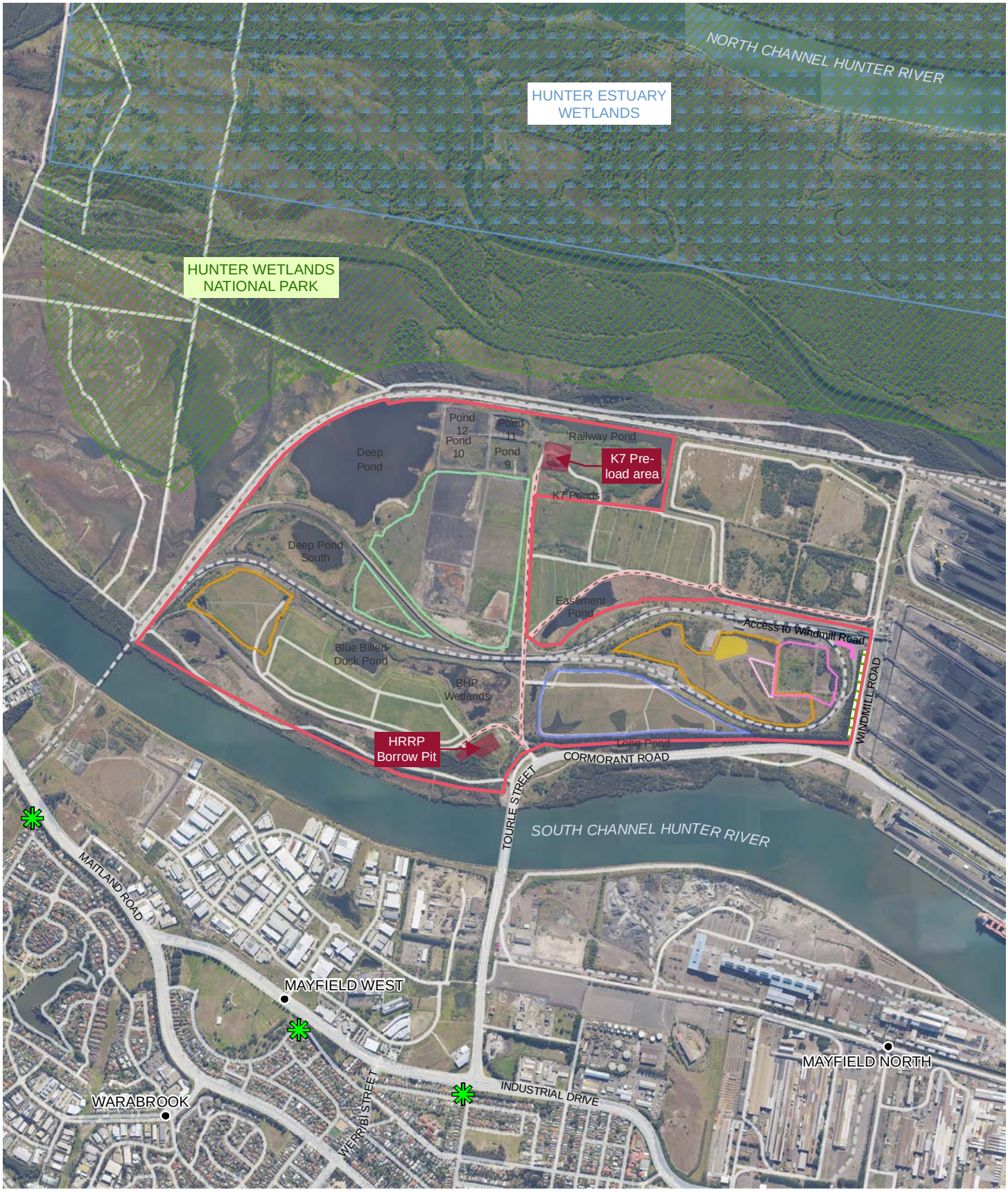
Design and approval processes commenced in mid-2020 following State land-owner confirmations with intent to commence capping works in 2020-21. On completion of works and confirmation of completion by the EPA, lands are expected to transfer to the Port of Newcastle, under a plan of management administered under the Port Lease.

1.2 Environmental Context

The environmental context of the Proposal is illustrated in Figure 1.2. As a result of the development history, the site is highly disturbed. Currently the Eastern Ponds consist of a steep, slag wall sided depression in the landscape. The Eastern Ponds are surrounded by the NCIG Rail Loop and dump station infrastructure to the north and east and previously completed K10 North capping to the South and West. The protruding slag wall runs north-south through its middle and each side of this wall is vegetated largely with weeds and other vegetation.

Because their elevation is below that of surrounding infrastructure and landforms, the eastern ponds do not discharge surface water. While historically holding water for extended periods, over recent years the ponds have dried out, with water infiltrating into groundwater or evaporating.

The University of Newcastle has completed Green and Golden Bell Frog monitoring of KIWEF and the Eastern Ponds over many years. This has included annual population monitoring and a summary of the impact and benefit to the GGBF and its habitat from the completion of Closure Works in KIWEF Areas 1 and 3.



Legend

- Sensitive receiver
- Locality
- Windmill Road Open Channel
- Haul road
- Railway
- Surrender Notice boundary
- Eastern Pond Closure Works
- Staging/parking area
- Area 1
- Area 2
- Area 3
- Existing material stockpiles
- Temporary stockpile
- Ramsar Wetland
- NPWS Reserve

N

Data sources
Jacobs 2020
Ramboll 2018
© Department Finance, Services and Innovation Aug 2020
NSW DPIE 2020
Aerometrex 2020

GDA 1994 MGA Zone 56

1:20,000 at A4

0 400 m

Figure 1-2 Proposal context

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The key findings of the population monitoring (University of Newcastle, 2017) of relevance to planning for the Closure Works is summarised as follows:

1. At a local scale, the best chance for persistence of bell frogs in good numbers seems to involve a mosaic of habitats that include:

i. A larger permanent wetland edged by emergent vegetation, but with some significant area of open water

ii. Nearby ephemeral wetlands that provide suitable breeding sites in wet years

iii. Other nearby semi-permanent wetlands that provide breeding or refuge sites in dry years.

iv. This mosaic of wetlands should be within a 0.5 km radius

v. It is not essential for the permanent wetland to be free of Gambusia, but the nearby ephemeral and semi-permanent wetlands should be Gambusia-free as much as possible.

2. At present, the NCIG CHEMP wetlands are very important for the GGBF in the NW island.

3. The BHP CHEMP wetlands are playing an important role in the Central part of the island.

4. The 'Northern Rail Corridor' remains the most important part of Kooragang Island for GGBF, with more than 50% of the animals detected with in this part of the industrial zone.

5. Bell frogs show high levels of site fidelity. This has important implications for any future mitigation of human activity on key wetlands (e,g. in the northern rail corridor).

6. Dispersal is evidently sufficient to allow colonisation of new ponds within a 0.5 kilometre radius, as evidenced by the presence of bell frogs at three constructed wetlands from which they were absent last year.

7. Female bell frogs may be reproducing earlier (in their second year) on Kooragang Island than occurs in the chytrid-free population on Broughton Island, perhaps as a result of rapid adaptation. If confirmed, this means that the survival of females into their third and fourth years may be less critical than previously believed.

8. Notwithstanding the previous point, very few animals survive to their third year. For the best chances of securing the Kooragang Island population against periods of prolonged drought, there should be sufficient permanent and semi-permanent wetlands capable of providing Gambusia*-free breeding habits through a succession of dry years.*

Point 5 of the above has subsequently been clarified through further work by the University of Newcastle which indicates a general finding that the high fidelity may be a bias in the statistics from 2017 on the basis that most individual recaptures are within six months of the initial capture, allowing less time for the individual to move into another wetland.

Point 7 above is also noted as conjectural only and is not intended to suggest the survival of GGBF into their third year is not important.

The key findings of the summary of the impact and benefit to the GGBF and its habitat from the completion of Closure Works in KIWEF Areas 1 and 3 (University of Newcastle, 2018) is reproduced as follows:

- *The Stage 1 Closure Works by HDC in Areas 1 and 3 have led to the creation of nine constructed wetlands that provide a large amount of habitat suitable for the green and golden bell frog Litoria aurea.*
- *Prior to the Closure Works, no suitable wetland habitat existed in those Areas and recorded occupancy by L. aurea was low (HDC response to SEWPaC, 2013)*

- *These nine new wetlands have improved wetland connectivity across the southern part of the T4 [Previously proposed private development within KIWEF] site.*

- *Between them, the HDC constructed wetlands have a range of hydroperiods. That range, combined with the spatial connectivity of these wetlands, has resulted in an improved habitat mosaic for L. aurea in the southern part of T4.*

- *All of the new wetlands have been occupied by L. aurea within two summer seasons of construction. Six of the nine were occupied within a year of construction.*

- *Prior to 2015, a very high proportion of the L. aurea detected in T4 were located in the northern part of the site. Since the construction of the HDC wetlands, the distribution of L. aurea across T4 has become more even, and the numbers across the southern part of the site have increased. These patterns can be attributed with confidence to the increase in habitat area and connectivity resulting from the Stage 1 Closure Works.*

- *Breeding has occurred in all of the nine of the wetlands constructed during Phase 1. These represent a large proportion of wetlands in T4 that are known breeding locations for L. aurea. In 2017-18, tadpoles and metamorphs (the strongest evidence of breeding at a given wetland) were detected at eight wetlands across T4; seven of these were at HDC constructed wetlands in Areas 1 and 3.*

- *The elevation and construction method of the new wetlands has effectively hydrologically isolated each from the pre-existing wetlands on T4. This will strongly reduce the possibility of the HDC wetlands from becoming infested by the invasive mosquito-fish Gambusia. As Gambusia are known to reduce successful breeding of L. aurea (by predation upon tadpoles), this feature is likely an important factor in the rapid success of the new wetlands as breeding habitat for L. aurea. Furthermore, the elevation of these wetlands is likely to provide a Gambusia-free habitat even after large flood events (such as January 2016).*

- *The success of the HDC constructed wetlands in providing habitat for L. aurea may serve as a model for construction of new habitat for this species.*

The University of Newcastle has also produced a memorandum titled GGBF 2019 - 20 survey preliminary summary: Eastern Ponds (McHenry, 2020). which focussed on establishing the importance of the Eastern Ponds for GGBF population survival in accordance with the K26/32 and K24/31 Ponds Action Plan (Golder, 2011a). This memorandum concluded that:

> *The abundance of GGBF in the Eastern Ponds over the 2019 - 2020 season was not zero, but was very low. In contrast, abundance of GGBF in nearby wetlands was much higher. The Eastern Ponds are infrequently occupied by GGBF and there is no evidence of breeding taking place within them. During the large dispersal event of March - April 2020, juvenile GGBF were present within the Eastern Ponds in much lower numbers than in the adjacent habitats. Data from the annual monitoring program indicate that for the last five consecutive years (2015 - 16, 2016 - 17, 2017 - 18, 2018 - 19, 2019 - 20) the Eastern Ponds have provided terrestrial and ephemeral aquatic habitat that is only occasionally occupied by GGBF.*

1.3 Assessment Approach

KIWEF is a complex site that has been well studied in association with various proposed and completed projects. This REF has been prepared under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to assess proposed landfill closure works within the Eastern Ponds area of KIWEF based on a significant body of publicly available information and in accordance with the principles established through previous assessments as follows:

- The site is a former licenced landfill regulated under the *Protection of the Environment Operations Act 1997* (POEO Act) and while site materials are contaminated as a result of historic landfilling practices the site is not regulated as a Contaminated Site under the *Contaminated Land Management Act 1997* (CLM Act)
- The REF does not attempt to assess the environmental impacts of the application of waste to the site as this activity is not proposed and past landfilling practices are considered otherwise approved or permissible

under the legislation that applied at the time the development commenced. As such the REF is strictly limited to the proposed closure works. Any previous or subsequent site activities are not considered within this assessment

- The completion of the closure of the landfill through the installation of a capping and drainage system are best defined as environmental management works under State Environmental Planning Policy (Three Ports) 2014 (Three Ports SEPP) as they are "*works for the purpose of avoiding, reducing, minimising or managing the environmental effects of development*" in this case the former landfill development
- While the same works meet the broad definition of remediation under the CLM Act the purpose of the development is not to remediate the site for a future land use.

This REF assesses the environmental impacts of the closure works on Eastern Ponds area of KIWEF, and on the basis that Surrender Notice conditions and any required mitigation measures are implemented.

1.4 Purpose of the report

This REF has been prepared by Jacobs on behalf of Hunter & Central Coast Development Corporation (HCCDC). For the purposes of these works, HCCDC is the proponent and the determining authority under Division 5.1 of Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The purpose of the REF is to describe the Proposal, to document the likely impacts of the Proposal on the environment, and to detail protective measures to be implemented.

The description of the proposed work and associated environmental impacts have been undertaken in the context of clause 228 of the *Environmental Planning and Assessment Regulation 2000*, the factors in *Is an EIS Required? Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979* (Is an EIS required? guidelines) (DUAP, 1995/1996), the *Biodiversity Conservation Act 2016* (BC Act), the *Fisheries Management Act 1994* (FM Act), and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In doing so, the REF helps to fulfil the requirements of:

- Section 5.5 of the EP&A Act that HCCDC examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the REF would be considered when assessing:

- Whether the Proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning and Public Spaces under Division 5.2 of the EP&A Act
- The significance of any impact on threatened species as defined by the BC Act and/or FM Act, in Section 1.7 of the EP&A Act and therefore the requirement for a Species Impact Statement or a Biodiversity Development Assessment Report.

The potential for significant impacts to Matters of National Environmental Significance that would require a referral under the EPBC Act has been assessed separately. A referral under the EPBC Act is not considered to be required.

2. Need and Options Considered

2.1 Strategic need for the Proposal

In 2010, an agreement was reached with between HCCDC and the EPA to close the KIWEF and relinquish the EPL subject to conditions specified within the Notice to Surrender the License (the Surrender Notice). A key condition of the Surrender Notice was to develop and implement a landfill closure plan for the site. The Proposal aims to achieve the requirements provided in the GHD 2009, KIWEF Revised Final Landform and Capping Strategy (the Closure Plan), the Golder 2011, K26/K32 and K24/K31 Ponds Action Plan (also referred to as the Eastern Ponds Action Plan) and EPL relinquishment conditions specified within the Notice to Surrender the License (the Surrender Notice).

KIWEF forms part of the Long-Term Lease to private investors of the Port of Newcastle and the landfill closure is required to facilitate the release of this land for their use. The Proposal would complement and support the Closure Works previously completed for surrounding areas of KIWEF and conclude the State's obligations for the ongoing management of legacy contamination issues on the site.

At completion of the Proposal, the Eastern Ponds Closure Works will achieve the primary objectives of the Closure Works, that may be stated as follows:

- Containing highly contaminated waste placed by BHP (1970-99) and reducing risk to the surrounding environment
- Conducting works in a manner that supports ongoing habitation of Litoria Aurea, an Endangered Species, present at KIWEF.

To meet our objectives, HCCDC must:

- Cap the site to a technical specification detailed in a GHD Capping Strategy (2010) - this establishes the performance criteria for capping surface grades, extent, thickness, permeability and serviceability
- Retain Litoria Aurea habitat - to restore habitat on the remediated landscape to an extent, quality and function consistent with baseline levels (recorded at the time of the Surrender Notice and Action Plan).

2.2 Proposal objectives and development criteria

The Proposal objectives are to:

- Satisfy the requirements of the Surrender Notice and in doing so reduce surface water infiltration to limit potential for migration of contaminants in groundwater
- Achieve landfill closure to conclude State obligations for KIWEF and facilitate transfer of site to Port of Newcastle
- Rehabilitate the site in a manner that supporting similar or improved levels of vegetation, providing habitat areas with a reduced contaminant load migrating from the fill material to the surrounding environment.

2.3 Alternatives and options considered

Options for the management of contamination within the Eastern Ponds have been considered since at least 2008. According to the K26/32 and K24/31 Ponds Action Plan (Golder Associates, 2011a), options considered over time have included:

- Further investigation and capping
- Excavation and treatment of contamination
- In-situ stabilisation.

With the installation of the NCIG rail loop, these options were limited to capping or in-situ treatment as the rail loop was identified as covering a significant proportion of the Eastern Ponds.

In-situ treatments such as chemical oxidation, thermal heating, and enhanced in-situ bioremediation were discounted by Golder (2011) due to unfavourable geological conditions rendering such treatments technically and financially unviable. As a result, regrading and capping as proposed in the Surrender Notice was identified by Golder (2011) as the only closure option remaining that was both feasible and viable.

The do-nothing option has been considered while the site remained identified as important for the GGBF population. With the importance to GGBF now considered reduced, the do nothing option no longer meets the objectives of the Proposal as the Eastern Ponds are no longer excluded from the application of the Surrender Notice. As a result, HCCDC considers the regrading and capping option as the preferred option. Various design iterations have been explored in an effort to balance constructability, safety, effectiveness and the need to manage water. The current preferred design (as described in Section 3) is considered by HCCDC to best meet the objectives of the Proposal.

3. Detailed description the Proposal

The Proposal is to undertake the closure of the K24, K26, K31 and K32 (Referred to throughout as the Eastern Ponds) of KIWEF in accordance with the Surrender Notice and Capping Strategy (GHD, 2009). The closure works are a part of the State Government's Closure Works required under approval of surrender of licence number 6437 (notice number 1111840).

Condition 4a of the surrender notice requires that the closure works be undertaken in accordance with:

- 'Hunter Development Corporation – Report on KIWEF – Revised Final Landform and Capping Strategy - August 2009 - Revision 2', prepared by GHD (the Capping Strategy)
- 'Green and Golden Bell Frog Management Plan – Kooragang Island Waste Emplacement Facility Closure Works' dated 19 April 2011 and prepared by Golder Associate
- 'K26/32 and K24/31 Ponds Action Plan – Kooragang Island Waste Emplacement Facility' dated 31 May 2011 and prepared by Golder Associates
- 'Materials Management Plan - Kooragang Island Waste Emplacement Facility' dated November 2012 prepared by RCA Australia.

The capping methodology is dictated by Condition 4h which requires validation that closure has been implemented in accordance with Chapter 7 of the GHD (2009) Revised Final Landform and Capping strategy and other relevant conditions of the Surrender Notice and in doing so specifies the mitigation measures within the documentation and management reports listed above.

Chapter 7 of GHD (2009) requires that the construction of the capping strategy will involve the following tasks:

- Establishment of erosion and sedimentation controls and construction of sedimentation basins as required
- Remove any vegetation and strip the top 100 mm of soil. Stockpile for re-use if deemed suitable
- Construct trunk drainage where required
- General earthworks (cut/fill) activities to establish the regraded surface with a final minimum 1% grade. If the stripped 100mm of soil is suitable for re-use, stockpile for use in revegetation, or screen and incorporate as fill for grading. Cut from within this area, if deemed suitable, may be used as fill and capped. Additional fill shall be sourced from an approved offsite source. Earthworks shall be compacted in accordance with the Technical Specification. Topsoil and re-vegetate the disturbed area if no further capping material is required.
- Place 0.5m capping material over the regraded surface at a final minimum 1% grade. Compact the capping material to achieve a maximum permeability of $1x10^{-7}$m/s. Construction of the capping layer "should ensure that the final surface provides a barrier to the migration of water into the waste (or fill), controls emissions to water and atmosphere, promotes sound land management and conservation, and prevents hazards and protects amenity" (EPA, 1998)
- Topsoil 100mm thick using stockpiled surface soils or imported topsoil and revegetate the disturbed area
- Any cut material which is considered geotechnically unsuitable to use as fill shall be relocated to the proposed unsuitable material containment area
- Any cut material which is significantly contaminated (as defined by the materials management plan) shall be either disposed of off-site or relocated to a nominated containment cell area as directed by the principal.

Departures from the above standard approach to capping were described by the Capping Strategy and excluded the Eastern Ponds until further GGBF and water quality monitoring were completed in accordance with Golder (2011a) Eastern Pond Action Plan (EPAP). In addition to identifying closure triggers that have now been met, Golder (2011a) provided a review of closure options and confirmed that only regrading and capping remained feasible and viable. A further departure from the standard approach for the Eastern Ponds is the need to

minimise ground interaction and as such the stripping of topsoil for re-use is not proposed and an alternate source of revegetation growth medium would be required.

3.1 Design

The following sections provide a description of the design criteria, major design features and engineering constraints of the Proposal as illustrated in Figure 3.1. These features have been based on the concept design and would be subject to refinement during detailed design.

3.1.1 Engineering constraints

The main issues and constraints considered by the Proposal included:

- Water balance: The Eastern Ponds currently comprise a zero surface water discharge catchment as they are formed from unfilled landfill cells surrounded by closed cells and NCIG Rail Infrastructure and reduced permeability requires that surface water be managed
- Soils: The likely presence of contamination within the surface layers requiring minimal ground disturbance while avoiding settlement issues from vegetation and other unfavourable ground conditions and achieving adequate cover and compaction
- Proposal staging: Minimising project construction duration to limit construction impacts while facilitating impact avoidance for GGBF
- Access: The site requires access through NCIG controlled area while Windmill Road is a left in left out configuration to Cormorant Road and the surrounding road network requiring a long round trip for return to material sources in KIWEF
- Existing Infrastructure: The Eastern Ponds are surrounded by completed KIWEF closure works to the west and south, NCIG Rail loop immediately to the East and NCIG access road to the north requiring careful consideration of potential impacts to existing infrastructure.

The concept design has considered these key engineering constraints and would be refined to minimise environmental impacts considered in this REF.

3.2 Construction activities

This section provides a summary of the likely construction methodology, work hours, plant and equipment and associated activities that would be used to construct the Proposal. For the purpose of this REF, an indicative construction plan has been considered based on understanding of prior stages of the Closure Works. Detailed construction plans, and methods would be confirmed following completion of the detailed design and engagement of the contractor. The detailed construction plans would adopt mitigation measures as nominated in this REF. The actual construction method may vary from the description in this chapter due to factors such as identification of on-site conditions during pre-construction activities, ongoing design refinement and consultation with property owners.

An environmental management framework to manage and mitigate impacts is presented in **Chapter 7**. The final construction plan and methods chosen by the contractor would be required to be consistent with this framework.

Legend

- Delineation rail corridor boundary
- Surrender Notice boundary
- Existing material stockpiles
- Area 1
- Area 2
- Area 3
- Proposed exclusion fence
- Area 2 closure works
- Eastern Pond Closure Works
- Staging/parking area
- Pavement works
- Temporary stockpile
- NPWS Reserve
- Pump system
- East Pond pipe option A
- East Pond pipe option B
- Haul road
- Existing grass drainage swale
- Stormwater drain
- Railway

Data sources
Ramboll 2018
© Department Finance, Services and Innovation Aug 2020
Aerometrex 2020

GDA 1994 MGA Zone 56

1:10,000 at A4

0 200 m

Figure 3-1 Proposal layout

Date: 4/09/2020 Path: \\Jacobs.com\ANZ\IE\Projects\04_Eastern\IS330300\31 Spatial\GIS\Directory\Templates\IS330300_REF_F002_Layout_r2v1.mxd
Created by : KM | QA by : XX

3.2.1 Work methodology

Construction activities would be guided by a Construction Environmental Management Plan (CEMP) to ensure construction work is carried out to HCCDC specifications within the specified work area. Detailed work methodologies would be identified by the construction contractor and would be refined to respond to engineering and environmental constraints relevant to the Proposal area. Before the start of each stage, the following general activities would be carried out:

- Implementation of environmental controls including:
  - Establishment and use of Chytrid Hygiene procedures such that the Chytrid fungus is not brought to site or transferred between areas of the site
  - Appropriate levels of GGBF pre-clearance/disturbance surveys and relocation to ensure to the extent possible that direct disturbance areas are free of GGBF on commencement of works in each area
  - Establishment of GGBF exclusion fencing in advance of works such that GGBF can move out of the site post dormancy, but the risk of GGBF re-entering surveyed areas is prevented
  - Establishment of clear boundaries of works areas such that unnecessary disturbance is avoided, particularly adjacent to existing ponds
  - Establishment of appropriate erosions and sediment controls to prevent sedimentation and pollution of waters providing GGBF habitat
  - Implementation of GGBF risk consideration to all decision making such that unintended consequences to GGBF can be avoided. This includes in considering suitability of imported materials from a Chytrid risk and nutrient perspective and use of chemicals including flocculants, herbicides and pesticides
- Establishment of lunch room and toilet facilities within previously completed area of K10 North and continued use of site office at KIWEF Area 2
- Establishment of a temporary stockpile area on previously completed capping works in Area K10 North adjacent to the Eastern Ponds
- Removal of vegetation within Eastern Ponds in a manner that protects GGBF to the extent possible. Removed vegetation will be relocated to an area outside the immediate works area to allow GGBF hiding within the vegetation to escape and the vegetation to compost and stabilise
- Engagement with topsoil layer to the minimum extent required as it is unlikely to constitute suitable growth medium under the Materials Management Plan
- Creation of a hydraulically contained system draining to a permanent lined sediment basin vegetated for stabilisation and to form GGBF preferred habitat
- Management of excess stormwater during construction using pumps (with suitable GGBF fencing around inlet, vegetation removal from within fenced area and confirmation that no frog are present prior to turning on the pump) to previously capped areas for filtration in established vegetation, evaporation and management through existing sediment basins; or via reinjection/infiltration into existing permeable structures onsite
- Regrading of existing slag walls within and around the Eastern Ponds to address stability issues
- Importation of capping and revegetation medium from offsite and stockpiles of surplus material from earlier stages of KIWEF closure (assessed separately) due to unsuitability of material within the Eastern Ponds for temporary storage in stockpile area prior to use in closure works
- Placement of fill material necessary to form capping base that facilitates drainage to the permanent sediment basin
- Establishment of trunk drainage, lined where necessary, to direct run-off to the sediment basin
- Placement and compaction of capping layer

- Placement and revegetation of growth medium and rehabilitation using species preferred by GGBF as identified in the rehabilitation management plan and suitable seasonal available terrestrial species of seed compatible with the remediation
- Establishment of a passive overflow pipeline from a highwater discharge point directing water to the northern end of Windmill Road Open Channel to allow post construction discharge under extreme and prolonged wet weather conditions or, if the passive systems is determined to be unfeasible, the installation of a remote solar powered pump system to discharge high waters from the sediment basin into the drainage channels on K10 north with ultimately discharging to Swan Pond
- Demobilisation of construction compound
- Removal of construction environmental controls once site has stabilised.

3.2.2 Construction hours and duration

The works would be generally undertaken during standard construction hours, being:

- Monday – Friday: 7am – 6pm
- Saturday: 7am – 1pm
- Sunday and public holidays: No work.

Deliveries of fill/capping materials may extend beyond the standard construction hours to enable the project to capitalise on availability of materials from 24hr operations such as the current Sydney Tunnelling Operations. Any works outside the standard construction hours will be restricted to delivery of materials only.

The staging of construction would be sequenced so construction can be completed within the minimum possible timeframe. The duration of works is likely to be six months followed by a three-month care and maintenance period. Works are scheduled to occur in 2020 and be completed in the first half of 2021.

3.2.3 Plant and equipment

An indicative list of plant and equipment that would typically be required is provided below. Additional equipment may be used and would be identified by the construction contractor.

- Excavators, graders and backhoes
- Compactors or vibratory rollers
- Franna
- Pulveriser
- Generators
- Loaders and trucks
- Concrete agitator truck
- Light vehicles
- Water cart
- Hand held power tools.

3.2.4 Earthworks

Earthwork material and estimated qualities would be confirmed as the design is progressed. Materials would be sourced from areas of KIWEF (assessed separately) or ongoing construction projects where demonstrated to meet waste exemptions and achieve required material specifications.

Approximately 50,000 cubic metres of fill, capping and topsoil materials would be required with approximately 18,000 sourced from stockpiled materials within KIWEF. Minimal quantities of other materials including liner materials, concrete for culverts, water, rock and mulch and regeneration growth medium and plants would be required.

The amount of water that would be required during construction is unknown at this stage as it would depend on material sources and methodologies applied by the contractor. Water for the work would be sourced from authorised off-site sources.

3.2.5 Traffic management and access

Haulage to site will turn left into Windmill Road from Cormorant Road with empty vehicles either returning to KIWEF via the PWCS Fines Disposal Facility / Delta Site Haul Road to the north or to external supplier location via left turn out onto Cormorant Road.

3.2.6 Ancillary facilities and activities

HCCDC currently intends to maintain a main works compound established previously on Area 2. Area 2 Closure Works have been separately assessed and were found unlikely to have a significant impact. As such, works compound in the vicinity of the Eastern Ponds would be limited to a lunch room and ablutions facilities. These facilities would be located adjacent to the Eastern Ponds in previously closed areas of K10 North.

Typically, the activities would include any of the following:

- Arrival and departure of workforce and daytime deliveries to compounds
- Plant storage, materials laydown and storage, stockpiling and construction parking
- Delivery of excavated material
- General stockpile management.

The exact location and proposed use of ancillary sites would be confirmed by the construction contractor before the start of construction. Where amendments or additional ancillary facilities are identified during construction outside of the Proposal area, the contractor would consult with HCCDC to confirm the suitability of the proposed amendment or additional facility, and whether any additional environmental assessment is required.

Following construction, the ancillary sites, work areas and stockpile areas would be removed, cleared of rubbish and materials and rehabilitated to their existing condition.

3.3 Public utility adjustment

No utilities are expected to change for the proposed works.

3.4 Property acquisition

No property acquisition would be required as part of the Proposal.

4. Statutory and Planning Framework

4.1 Identification and Justification of Approval Pathway

The *Environmental Planning and Assessment Act 1979* (EP&A Act) establishes the planning and approvals process in NSW. The EP&A Act provides for the making of Environmental Planning Instruments (EPIs), including Local Environmental Plans (LEP) and State Environmental Planning Policies (SEPPs), which set out requirements for particular localities and/or particular types of development. The applicable EPIs and the Regulations made under the EP&A Act, collectively determine the relevant planning approval pathway and the associated environmental assessment requirements for proposed development activities.

The environmental assessment pathway under the EP&A Act is generally dependent on the primary purpose and proponent (private or public authority). The scale of the development, including level of impact and/or capital investment value, will further refine the assessment process. Development can be exempt (does not require any approval or assessment) or can require various forms of approvals and assessment under Part 4, Part 4 Division 4.1, Part 5 and Part 5.1 of the EP&A Act.

Development that is permissible without consent is development subject to Division 5.1 of the EP&A Act. Such development is assessed either by way of Review of Environmental Factors required to demonstrate that the works are unlikely to have a significant environmental impact or Environmental Impact Statement where a significant impact is likely or certain development thresholds (usually capital investment value) are exceeded.

Part 4 applies to development that is permissible with consent and includes complying development. Depending on the location, size and capital costs the consent authority for a development subject to Part 4 (excluding complying development) can be the local Council (generally referred to as local development) or the Minister for Planning for state development (or delegate such as the Planning Assessment Commission).

4.1.1 Statutory definition of the proposed works

Previous stages of the Closure Works have considered the statutory framework and found:

- As concluded by legal advice separately obtained by HCCDC in relation to earlier stages of closure, and reconfirmed by HCCDC under current legislation, the Closure Works are best described as environmental management or environmental protection works as opposed to remediation works
- Environmental Protection or Management Works are permissible without consent under State Environmental Planning Policy (Three Ports) 2014 (Three Ports SEPP)
- While the Closure Works also meet the definition of remediation works under State Environmental Planning Policy 55 – Contaminated Land Remediation (Remediation SEPP), the Three Ports SEPP prevails to the extent of any inconsistency
- There remains a duty to notify Newcastle Council of the remediation works in advance of commencement under the State Environmental Planning Policy 55 – Remediation of Land (Remediation SEPP).

The basis for these findings is described below.

4.2 Applicable Environmental Planning Instrument

4.2.1 State Environmental Planning Policy (Three Ports) 2014

The site is within the Land Application Area of State Environmental Planning Policy (Three Ports) 2014 (Three Ports SEPP) and specifically is within the Three Ports Lease Area. The Three Ports SEPP is an environmental planning instrument created pursuant to the EP&A Act. As the applicable environmental planning instrument, the Three Ports SEPP establishes the approval pathway for the KIWEF site closure works.

Under Clause 18(3) of the Three Ports SEPP development may be carried out for the purpose of environmental protection works without development consent by or on behalf of a public authority on land within the Lease Area and as such be subject to assessment under Part 5 of the EP&A Act.

Environmental protection works are not defined in the Three Ports SEPP, and as per Clause 5 , expressions used have the same meaning as they have in the standard instrument set out at the end of the Standard Instrument (Local Environmental Plans) Order 2006 (the Standard Instrument), unless otherwise defined. Under the Standard Instrument "*environmental protection works means works associated with the rehabilitation of land towards its natural state or any work to protect land from environmental degradation, and includes bush regeneration works, wetland protection works, erosion protection works, dune restoration works and the like, but does not include coastal protection works*". Jacobs understands that HCCDC has obtained legal advice to the effect that, the closure works meet this definition.

The Three Ports SEPP does define "environmental management works" as:

> *(a) works for the purpose of avoiding, reducing, minimising or managing the environmental effects of development (including effects on water, soil, air, biodiversity, traffic or amenity); and*
>
> *(b) environmental protection works.*

Jacobs consider that the works to close the landfill by installation of a capping system are best defined as "environmental management works" in that they are exclusively aimed at minimising and managing the contamination related environmental effects of the landfill development and as such are also considered environmental protection works.

4.2.2 State Environmental Planning Policy (Infrastructure) 2007

Clause 32 of the Three Ports SEPP identifies that Division 1 of Part 2 of State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) applies to development carried out by or on behalf of a public authority in the same way that it applies to development referred to in that Policy. This division deals with consultation requirements for public authorities when undertaking works that are permissible without consent.

Clause 13, 14 and 15 of ISEPP require consultation with Council for activities:

- That will have a substantial impact on stormwater management services provided by a council
- Likely to generate traffic to an extent that will strain the capacity of the road system in a local government area
- Involving connection to, and a substantial impact on the capacity of, any part of a sewerage system owned by a council
- Involving connection to, and use of a substantial volume of water from, any part of a water supply system owned by a council
- Involving the installation of a temporary structure on, or the enclosing of, a public place that is under a council's management or control that is likely to cause a disruption to pedestrian or vehicular traffic that is not minor or inconsequential
- Involving excavation that is not minor or inconsequential of the surface of, or a footpath adjacent to, a road for which a council is the roads authority under the *Roads Act 1993* (if the public authority that is carrying out the development, or on whose behalf it is being carried out, is not responsible for the maintenance of the road or footpath)
- Likely to affect the heritage significance of a local heritage item, or of a heritage conservation area, that is not also a State heritage item, in a way that is more than minor or inconsequential
- That will change flood patterns other than to a minor extent.

While the Proposal would generate traffic during closure works this is limited to up to 12 vehicles per hour (one vehicle every 5 minutes) and is not considered to be to the extent that it would strain the capacity of the road network on the basis that this has not been the case for prior stages of the Closure Works. Further, while the site may discharge under prolonged and significant rain fall events, discharge would be limited to the capacity of the pipeline discharge capacity ultimately selected and due to attenuation time within the Eastern Ponds be unlikely to coincide with peak runoff from the existing drainage catchment. No other triggers for the need to consult are identified and no consultation with Council is deemed necessary under Clause 13, 14 or 15 of ISEPP.

Clause 15AA of ISEPP requires consultation with State Emergency services for development on flood liable land that is permissible without consent under a relevant provision. Relevant Provisions are limited to certain previsions of ISEPP and none align with the purposes of environmental protection, management or remediation works and consultation with State Emergency Services is not required.

Clause 15A of ISEPP requires consultation with Council for development within mapped Costal Vulnerability Area. The site is not mapped for this purpose.

Clause 16 of ISEPP requires consultation with other agencies in specified circumstances. HCCDC is not required to consult other agencies as no specified circumstances apply to the Proposal.

Public display of the REF is not proposed at this stage. HCCDC will communicate the proposed works through existing consultation channels to stakeholders with the potential to be affected by the Proposal. The Final REF will be made available to the public via HCCDC's website.

4.2.3 State Environmental Planning Policy (State and Regional Development) 2011

State Environmental Planning Policy (State and Regional Development) 2011 (SDSEPP) has the aim to identify development that is State significant development, State significant infrastructure and critical State significant infrastructure, or regionally significant development.

Development is declared to be State significant infrastructure for the purposes of the Act if:

- *the development on the land concerned is, by the operation of a State environmental planning policy, permissible without development consent under Part 4 of the Act, and*
- *the development is specified in Schedule 3.*

Schedule 3 identifies general public authority developments where a significant impact is identified as likely as State significant infrastructure. The assessments supporting this REF identify that no significant impacts are considered likely. There are no capital investment value triggers in the SDSEPP or Three Ports SEPP that would render environmental management or protection works State significant infrastructure.

Works permissible without consent are not declared State or Regionally significant development.

4.2.4 State Environmental Planning Policy (Coastal Management) 2018

The Coastal Management SEPP updates and consolidates into one integrated policy State Environmental Planning Policy 14 (Coastal Wetlands SEPP), State Environmental Planning Policy 26 (Littoral Rainforests SEPP) and State Environmental Planning Policy 71 (Coastal Protection SEPP), including clause 5.5 of the Standard Instrument – Principal Local Environmental Plan. These policies are now repealed.

The Coastal Management SEPP gives effect to the objectives of the *Coastal Management Act 2016* from a land use planning perspective, by specifying how development Proposals are to be assessed if they fall within the coastal zone. The coastal zone is comprised of four coastal management areas as follows:

- Coastal wetlands and littoral rainforests area; areas which display the characteristics of coastal wetlands or littoral rainforests that were previously protected by SEPP 14 and SEPP 26;
- Coastal vulnerability area; areas subject to coastal hazards such as coastal erosion and tidal inundation;

- Coastal environment area; areas that are characterised by natural coastal features such as beaches, rock platforms, coastal lakes and lagoons and undeveloped headlands. Marine and estuarine waters are also included; and
- Coastal use area; land adjacent to coastal waters, estuaries and coastal lakes and lagoons.

The Proposal area is surrounded by, but does not include, land mapped as coastal wetlands. Parts of the Proposal area are mapped as proximity area for Coastal Wetlands, Coastal Environment Area and Coastal Use Area. Importantly, the Proposal area is within the Lease Area under the Three Ports SEPP and the Coastal Management SEPP does not apply through the workings of Clause 7 of the Coastal Management SEPP.

4.2.5 State Environmental Planning Policy No 55 – Remediation of Land

State Environmental Planning Policy No 55 – Remediation of Land (SEPP 55) provides a State-wide approach to the remediation of contaminated land. The aim of SEPP 55 is to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment:

- By specifying when consent is required, and when it is not required, for a remediation work
- By specifying certain considerations that are relevant in rezoning land and in determining development applications in general and development applications for consent to carry out a remediation work in particular
- By requiring that a remediation work meet certain standards and notification requirements.

Under SEPP 55 remediation means removing, dispersing, destroying, reducing, mitigating or containing the contamination of any land, or eliminating or reducing any hazard arising from the contamination of any land. The proposed works to naturalise Eastern Ponds, while not for the purpose of remediation, are considered likely to require ancillary environmental management works which would also meet this broad definition. SEPP 55 identifies two remediation categories being:

- Category 1 remediation works requiring consent
- Category 2 remediation works not requiring consent.
- Category 2 remediation works is defined under clause 14 of SEPP 55 as follows:
  - (a) a remediation work that is not a work of a kind described in clause 9 (a)–(f), or
  - (b) a remediation work (whether or not it is a work of a kind described in clause 9 (a)–(f)) that:

    (i) by the terms of a remediation order, is required to be commenced before the expiry of the usual period under the Contaminated Land Management Act 1997 for lodgement of an appeal against the order, or

    (ii) may be carried out without consent under another State environmental planning policy or a regional environmental plan (as referred to in clause 19 (4)), or

    (iii) is carried out or to be carried out by or on behalf of the Director-General of the Department of Agriculture on land contaminated by the use of a cattle dip under a program implemented in accordance with the recommendations or advice of the Board of Tick Control under Part 2 of the Stock Diseases Act 1923, or

    (iv) is carried out or to be carried out under the Public Land Remediation Program administered by the Broken Hill Environmental Lead Centre.

Clause 19(4) of SEPP 55 identifies that if a provision of another State environmental planning policy or of a regional environmental plan, whether made before or after this Policy, permits a remediation work without development consent, a requirement in this Policy to obtain development consent to carry out the work does not prevail over that provision. The works proposed that generally align with the definition of remediation works are wholly ancillary to the purpose of Environmental Protection Works which includes Environmental Management Works defined as "*works for the purpose of avoiding, reducing, minimising or managing the environmental*

effects of development (including effects on water, soil, air, biodiversity, traffic or amenity)". On this basis the remediation works are considered permissible without consent as described above.

Category 1 remediation works is, amongst other triggers, defined as not being works to which Clause 14(b) applies. As Clause 14(b) is considered to apply, the proposed works meeting the broad definition of remediation are not considered Category 1 remediation.

Clause 15 of SEPP 55 specifies that Category 1 remediation work must be treated as such even if it is ancillary to development that may be carried out without consent. As the definition of Category 1 remediation works excludes works to which Clause 14(b) applies Clause 15 is not considered to require consent.

Under Clause 7(1) of SEPP 55, a consent authority must not consent to the carrying out of any development on land unless it has considered whether the land is contaminated and whether remediation is required. SEPP 55 also requires consideration of whether the land is suitable for the intended use. As the Proposal does not seek approval for any ongoing land use beyond landfill closure consideration of suitability for future use would be addressed in any future development application as necessary.

There remains a duty to notify Newcastle Council of the remediation works in advance of commencement under the State Environmental Planning Policy 55 – Remediation of Land (Remediation SEPP).

4.2.6 Newcastle Local Environmental Plan 2012

While located within the Newcastle Local Government Area the site is not located on land to which the Newcastle Local Environmental Plan 2012 (NLEP) applies. As such the NLEP is not considered further.

4.3 Other applicable legislation

4.3.1 Biodiversity Conservation Act 2016

The BC Act sets out the environmental impact assessment framework for threatened species, threatened ecological communities and Areas of Outstanding Biodiversity Value (formerly critical habitat) for Part 5 activities (amongst other types of development).

Part 7 of the BC Act requires that the significance of the impact on threatened species, populations and endangered ecological communities listed under the BC Act or FM Act, are assessed using a five-part test. Where a significant impact is likely to occur, a species impact statement (SIS) or Biodiversity Development Assessment Report (BDAR) must be prepared in accordance with the Director-General's requirements.

The biodiversity assessment carried out for the Eastern Ponds KIWEF site and concludes that the Proposal would not have a significant impact on threatened species, ecological communities or critical habitat and therefore a BDAR or SIS has not been prepared.

4.3.2 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act), as amended by the *Fisheries Management Amendment Act 2001*, has as part of its objectives the protection of threatened species and their habitats.

The FM Act includes provision to declare and list threatened species of fish and marine vegetation, endangered populations and ecological communities, and key threatening processes. These provisions are similar to those in the TSC Act and must be considered when referring to Section 5A of the EP&A Act. If the Proposal is likely to significantly impact threatened species, populations or ecological communities then a species impact statement (SIS) would be required.

No threatened fish species have been recorded within the Site or are considered to have the potential to occur, therefore there is no requirement for an SIS.

4.3.3 Water Management Act 2000

The *Water Management Act 2000* (WM Act) was introduced to provide a comprehensive singular piece of legislation to effectively manage and regulate access, and use of, the State's water resources. The objectives of the WM Act include:

- *to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and the water quality; and*
- *to recognise and foster the significant social and economic benefits to the state that result from the sustainable and efficient use of water.*

Chapter 3 Part 3 of the WM Act requires that approval be granted for works that are classified as "controlled activities" within waterfront land (as defined in the WM Act). A controlled activity is defined as:

(a) the erection of a building or the carrying out of a work (within the meaning of the Environmental Planning and Assessment Act 1979), or

(b) the removal of material (whether or not extractive material) or vegetation from land, whether by way of excavation or otherwise, or

(c) the deposition of material (whether or not extractive material) on land, whether by way of landfill operations or otherwise, or

(d) the carrying out of any other activity that affects the quantity or flow of water in a water source.

Section 91E of the WM Act provides that a person:

(a) who carries out a controlled activity in, on or under waterfront land; and

(b) who does not hold a controlled activity approval for that activity,

is guilty of an offence.

Clause 38 or the Water Management (General) Regulation 2011 provides that a public authority is exempt from Section 91E (1) of the WM Act in relation to all controlled activities that it carries out in, on or under waterfront land. As such a controlled activity approval is not required for the proposed activity.

Section 91A of the WM Act provides that a person is guilty of an offence*:*

(a) who uses water from a water source to which this Part applies, and

(b) *who does not hold a water use approval for that use.*

The WM Act defines a water source as the whole or any part of one or more rivers, lakes or estuaries, or one or more places where water occurs naturally on or below the surface of the ground and includes the coastal waters of the State. The water within the fill aquifer on KIWEF is not considered to occur naturally, no use of water in surface water bodies is proposed and no use of other naturally occurring water sources is proposed and as such a water use approval is not deemed necessary.

Section 91F of the WM Act provides that a person if guilty of an offence:

(a) who carries out an aquifer interference activity, and

(b) who does not hold an aquifer interference approval for that activity,

An aquifer is defined as a geological structure or formation, or an artificial landfill, that is permeated with water or is capable of being permeated with water. The WM Act defines an aquifer interference activity as that which involves any of the following:

- The penetration of an aquifer
- The interference with water in an aquifer
- The obstruction of the flow of water in an aquifer
- The taking of water from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations
- The disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations.

On the basis that interaction with the ground is to be minimised aquifer interference is not anticipated and an approval is not deemed necessary. Should the design be altered and involve aquifer interference or penetration the need for licencing or approvals should be reviewed.

4.3.4 Water Act 1912

Under the *Water Act 1912* a licence is required if water is extracted from a creek or if any waterways are proposed to be realigned.

The Proposal will not involve the extraction of water or the realignment of waterways therefore a licence under the *Water Act 1912* is not required.

4.3.5 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is the primary legislation that regulates waste and pollution in New South Wales. This act contains requirements relevant to the works proposed by HCCDC. The following sections detail how the POEO Act relates to the Proposal.

4.3.5.1 Waste

If material that meets the definition of 'waste' is received from off-site and applied to land associated with the KIWEF Eastern Ponds it would constitute a scheduled activity (according to Schedule1 (39)) under the POEO Act. Scheduled activities require an Environmental Protection Licence (EPL) and payment of a waste levee would apply. Exceptions include any waste that meets the requirements of a general or specific resource recovery order and exemption as detailed in Part 9 of the Protection of the Environment Operations (Waste) Regulation 2014. General exemptions are available in relation to excavated natural material and recovered aggregate.

According to Section 144 of the POEO Act a person who is the owner or occupier of any place and who uses the place, or causes or permits the place to be used, as a waste facility without lawful authority is guilty of an offence. Lawful authority is generally demonstrated through obtaining an EPL that specifically addresses the proposed use or through notifying the EPA of the intention to establish and operate an unscheduled waste facility. To be guilty of a waste related offence the material also has to be defined as waste.

The site previously held EPL 6437 as a waste disposal facility under the POEO Act, which has since been surrendered. An Approval of the Surrender of a Licence (1111840) has been issued to HDC under Section 80(1) of the POEO Act which states a number of site specific conditions and mitigation measures that must be implemented prior to the release of the land. Measures include capping specifications, monitoring requirements, environmental mitigation measures, the preparation of various reports and management plans.

The Proposal is intended to meet HCCDC's obligations under this surrender notice for the Eastern Ponds area of the Closure Works. No waste will be used in the Proposal except with lawful authority and in accordance with

general or specific resource recovery exemptions. The Proposal is therefore not considered to constitute a scheduled activity.

4.3.5.2 Pollution of Water

A person who pollutes any waters is guilty of an offence under Part 5.3 Section 120 of the POEO Act. The definition of pollution of waters is broad and includes the introduction of any prescribed matter that does not comply with any standard prescribed in respect of that matter, into water. Schedule 5 of the Protection of the Environment Operations (General) Regulation 2009 includes a list of specific substances (prescribed matter) which, if they are introduced onto or into waters, are automatically assumed to constitute pollution of waters. Prescribed matter includes soils, sand, stone and other inorganic matter.

It is a defence in proceedings against a person for an offence under Part 5.3 Section 122 of the POEO Act if the person establishes that:

- *the pollution was regulated by an environment protection licence held by the person or another person, and*
- *the conditions to which that licence was subject relating to the pollution of waters were not contravened.*

4.3.6 Contaminated Land Management Act 1997

The CLM Act provides a regime for investigating and, where appropriate, remediating land affected by contamination which represents a significant risk of harm to human health or the environment. The CLM Act specifies responsibilities for managing contaminated land and the role of the EPA in investigation, remediation and management of contaminated sites.

The site is not subject to a remediation order nor is it listed as a remediation site under the CLM Act.

It is noted that, while contaminated sites including some closed landfills in NSW are regulated under the CLM Act, active or recently closed landfills are managed through the landfill licensing process under the POEO Act and the minimum standards in associated guidelines. It is not the intention of the EPA to regulate the same site through both the CLM Act and POEO Act.

4.3.7 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) is the primary legislation dealing with Aboriginal cultural heritage in NSW. Items of Aboriginal cultural heritage (Aboriginal objects) or Aboriginal places (declared under Section 84) are protected and regulated under the NPW Act. Aboriginal objects are protected under Section 86 of the Act. Under section 90(1) of the Act the Director-General may issue an Aboriginal heritage impact permit (AHIP) for an activity which would harm an Aboriginal object.

No impacts to Aboriginal heritage are considered likely due to the highly disturbed nature of the site associated with the construction and partial filling of the landfill disposal cells and absence of potential for engagement with the natural ground surface.

4.3.8 Coastal Management Act 2016

The Coastal Management Act 2016 (CM Act) has the objective to manage the coastal environment of New South Wales in a manner consistent with the principles of ecologically sustainable development for the social, cultural and economic well-being of the people of the State. The objectives of the CM Act are given effect strategically through coastal management programs and local strategic planning, such as zoning and development assessment on a site-by-site basis that are informed by the Coastal Management SEPP.

The Proposal area is within the Coastal Environment Area as defined by the CM Act and as such is within the Coastal Zone.

Section 23 of the CM Act requires that a public authority such as HCCDC are to have regard to coastal management programs to the extent that those programs are relevant to the exercise of their functions. City of Newcastle has commenced a coastal management program for the Newcastle open coastline and Hunter River lower estuary, but this remains under development.

4.3.9 Heritage Act 1997

The *Heritage Act 1977* (Heritage Act) aims to provide for the identification, registration and conservation of items of State heritage significance.

No heritage value would be expected to be impacted in this area.

4.4 Commonwealth legislation

4.4.1 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) a referral is required to the Australian Government for proposed actions that have the potential to significantly impact on Matters of National Environmental Significance (MNES) or the environment of Commonwealth land.

Matters of national environmental significance (MNES) include:

- World heritage properties
- National heritage places
- Wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed)
- Nationally threatened species and ecological communities
- Migratory species
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mining)
- A water resource, in relation to coal seam gas development and large coal mining development.

A search of the Australian Government Department of Agriculture, Water and the Environment's EPBC Act Protected Matters Search Tool was carried out on 27 July 2020 for the Proposal, with a 10 kilometre search area. The searches found:

- No World Heritage Properties
- No National Heritage Places
- One Wetland of International Importance
- No Commonwealth Marine Areas
- Three listed Threatened Ecological Communities
- 64 listed Threatened Species
- 63 listed Migratory Species
- 70 Listed Marine Species
- 1 Whale or Other Cetaceans
- No Commonwealth Listed Heritage places
- No areas of Commonwealth Land.

It is the responsibility of the proponent to determine whether the Proposal, or action, has the potential to impact upon a MNES and constitute the need for a referral to the Commonwealth for determination. Based on the assessments carried separately no significant impacts to MNES or Commonwealth places are considered likely. Accordingly, the Proposal has not been referred to the Australian Government Department of Agriculture, Water and the Environment under the EPBC Act.

5. Consultation

As described in Chapter 4, no statutory requirements for consultation or concurrence are required in HCCDC's consideration of the Proposal. There remains a duty to notify Newcastle Council of remediation works in advance of commencement under the State Environmental Planning Policy 55 – Remediation of Land (Remediation SEPP).

HCCDC has advised that consultation with stakeholders is ongoing and involves consultation with Port Waratah Coal Services (PWCS), Newcastle Coal Infrastructure Group (NCIG), Port of Newcastle Lessor Pty Ltd (PoN Lessor), Port of Newcastle Lessee (consisting of the Port of Newcastle Operations Pty Ltd and Port of Newcastle Investments (Property) Pty Ltd) and EPA. A representative of the Department of Planning, Infrastructure and Environment – Biodiversity Conservation Group attended a Proposal briefing and has provided input into design considerations in relation to habitat and dewatering requirements.

Because of the site's previous land use, its highly modified nature and the nature of the Closure Works, it is considered that there is little to no potential for occurrence of items of indigenous heritage, and the cultural values of stakeholders. As such, no public consultation with Indigenous stakeholders has been held.

Due to the absence of sensitive receptors in proximity to the Proposal area, and limited optionality regarding the need or project design, no community consultation has been undertaken or is proposed. HCCDC keeps the general community of Newcastle informed of works at KIWEF through its website here: https://www.hccdc.nsw.gov.au/kooragang-island-waste-emplacement-facility.

6. Environmental Assessment

For the purpose of attaining the objects of the EP&A Act relating to the protection and enhancement of the environment, HCCDC in its consideration of an activity has a duty to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity. This Chapter documents the consideration of environmental matters by:

- Reviewing the environmental context in which the Proposal would be undertaken
- Considering the potential for impacts with retards to all environmental factors through a risk assessment process
- Provides more detailed assessment of risks and impacts for environmental aspects where necessary to draw conclusions as to the significance of such impacts.

6.1 Environmental Risk Identification and management

The assessment of the likely environmental consequences of the Project has involved:

- Project development team workshops to understand the scale, risks and likely impacts associated with Project
- Consideration of construction and operational stage impacts of development based on outcomes of closure works previously completed
- Desktop review of relevant databases, historical aerial photography, reports associated with the site
- Review of Draft Scoping and Environmental Impact Statement Guidelines issued by Department of Planning and Environment (now Department of Planning, Industry and Environment (DPIE))
- Outcomes of stakeholder consultation to date.

Based on prior assessments and outcomes of prior Closure Works stages the following are identified as risks for consideration in the REF:

- Biodiversity
- Hydrology and water quality
- Contamination
- Transport
- Noise

Other Environmental issues where the site context limits the potential for impacts are also considered as follows:

- Visual
- Air quality
- Aboriginal heritage
- Non-Aboriginal heritage
- Socio-economic
- Cumulative impacts.

HCCDC's proposed approach to risk and impact management from completed stages of the Closure Works would be implemented for the Proposal. This includes the development of a Construction Environmental Management Framework and implementation through the development of detailed contractor's Construction Environmental Management Plans and work instructions. For potential environmental impacts, mitigation measures consistent with prior stages of the Closure Works are presented in the following sections and are

considered to form part of the Proposal. These would be included in contract specifications and implemented by the construction contractor.

6.2 Biodiversity

The study area for the purposes of this biodiversity assessment includes the four partially filled waste emplacement cells referred to as the Eastern Ponds, and comprising a total area of approximately 4 hectares, in addition to an isolated parcel of land immediately adjacent (around 1.5 hectares), to the west of the ponds that is proposed as a stockpile area for any material used during remediation. This 'study area' accounts for the total construction footprint, any compound sites, stockpile sites and any other areas that would be temporarily disturbed. The study area is located in the Sydney Basin bioregion (Thackway and Cresswell, 1995) and within Hunter sub-region.

The aims of the biodiversity assessment are to:

- Describe the characteristics and ecological condition of the vegetation communities and habitats within the study area.
- Determine the occurrence, or likelihood of occurrence of threatened species, populations and communities listed under the Biodiversity Conservation Act 2016 (BC Act) and EPBC Act within the study area.
- Describe the potential impacts on biodiversity in the study area because of the Proposal.
- Undertake a test of significance for threatened species and communities that are confirmed or considered likely to occur within the study area in accordance with section 7.3 of the BC Act to determine whether the Proposal is likely to significantly affect threatened species.
- Undertake assessments in accordance with the Matters of National Environmental Significance: Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999 (Department of Environment, 2013) to consider impacts to nationally listed threatened species, ecological communities and migratory species
- Propose measures to mitigate impacts on ecological values.

6.2.1 Methodology

6.2.1.1 Background research

A background review of existing information was undertaken to identify the existing environment of the study area. The review focussed on database searches and relevant ecological reports pertaining to the KIWEF, particularly reports produced by the University of Newcastle which outline the methods and results of long-term monitoring of the Green and Golden Bell Frog (*Litoria aurea*).

The review was used to prepare a list of threatened species, populations and communities as well as important habitat for migratory species with a likelihood of occurrence in the study area and locality. The searches were also undertaken to identify if any Areas of Outstanding Biodiversity Value were present.

6.2.1.2 Habitat assessment

A habitat assessment was undertaken with consideration of the identified list of threatened flora and fauna species known or predicted to occur in the Hunter Interim Biogeographic Regionalisation of Australia (IBRA) subregion that have been recorded within proximity to the study area (see Appendix B for the habitat assessment results). This list was identified from databases and literature as well as past surveys. The habitat assessment compared the preferred habitat features for these species with the type and quality of the habitats identified in the study area. This habitat assessment was completed to make an assessment of the likelihood of the species being present in the study area (ie subject species). The habitat assessment formed the basis for assessing potential impacts on threatened species. The results of the habitat assessment are provided in Appendix B.

6.2.1.3 Site inspection

A site inspection was conducted within the study area on 5 June 2020 to ground-truth the results of the background research and habitat assessment.

6.2.2 Existing environment

6.2.2.1 Hydrology

The low-lying nature of the Eastern Ponds means there is no immediate surface water drainage from the site. The lowest points are in the north-west and south-east cells, and these locations exhibit wetland vegetation (predominantly Phragmites australis and Typha orientalis) which are consistent with a habitat that is periodically inundated. Low-lying areas are filled with rainfall and runoff from the adjoining slag walls and access tracks.

Because their elevation is below that of surrounding infrastructure and landforms, the eastern ponds are a zero surface water discharge area. While historically holding water for extended periods, over recent years the ponds have dried out and with water infiltrating into groundwater or evaporating.

6.2.2.2 Vegetation and fauna habitat

The Eastern Ponds are a series of partially filled waste emplacement cells. These cells historically comprised open water and over time have undergone a successive change to a more vegetated structure influenced by a change in surface hydrology, and specifically the gradual reduction of surface water. The overall pattern of open water reduction and vegetation succession is described by the University of Newcastle (University of Newcastle, 2019a)) and has been summarised from this document for the purpose of providing historical context to the current environment. Following construction of the NCIG rail loop (2009-2010) these wetlands were either filled in or decreased significantly in hydroperiod.

Plate 6-1 and the accompanying text illustrates the change in structure from an aquatic habitat to a predominantly shallow and drier habitat. As the former shallow surface water has retreated this has favoured colonisation by the common reed (*Phragmites australis*) in low areas, with Swamp Oak (*Casuarina glauca*), Wattles (*Acacia* spp) and exotic vegetation colonising the slighted elevated lands fringing the former ponded open water areas .

Plate 6-1 Map series showing successional change in vegetation in the K108 pond 2009 to 2018 (source UoN 2019).

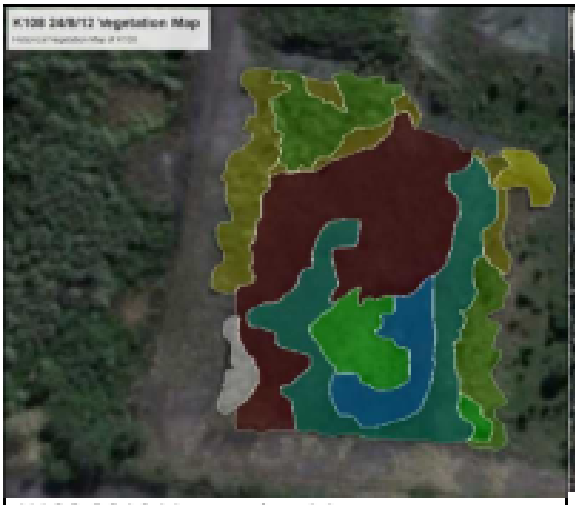
K108 2009 Vegetation Map

In 2009 a relatively large body of open water is present in the south-east of the wetland, surrounded by a mix of emergent reeds (*Typha* and *Phragmites*). The latter indicate areas that are often under standing water; the open water and reeded area corresponds with the floor of the cell. Surrounding those are stands of terrestrial shrubs (*Juncus*, pampas, and grasses) to the west, rocky ground to the north east, east, and south.

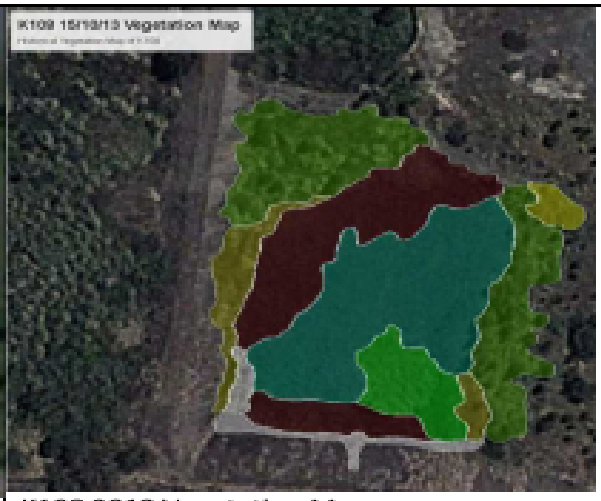
K108 2010 Vegetation Map

K108 2011 Vegetation Map

A reduction in open water and *Phragmites* dominating the floor of the cell in the north-west in 2010 and 2011. As *Phragmites* tends to occupy more shallow wetlands, this successional process suggests a reduction in water levels (*Typha* and/or *Phragmites* often occupy wetlands with a water depth less than 70cm) This process may be driven by climate and/or hydrology. There is also an increase in the extent of terrestrial shrubs on the eastern edge of the wetland.



K108 2012 Vegetation Map

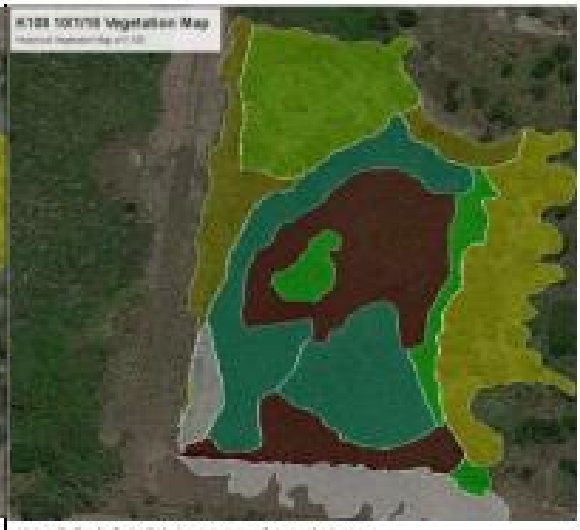


K108 2013 Vegetation Map

K108 2014 Vegetation Map

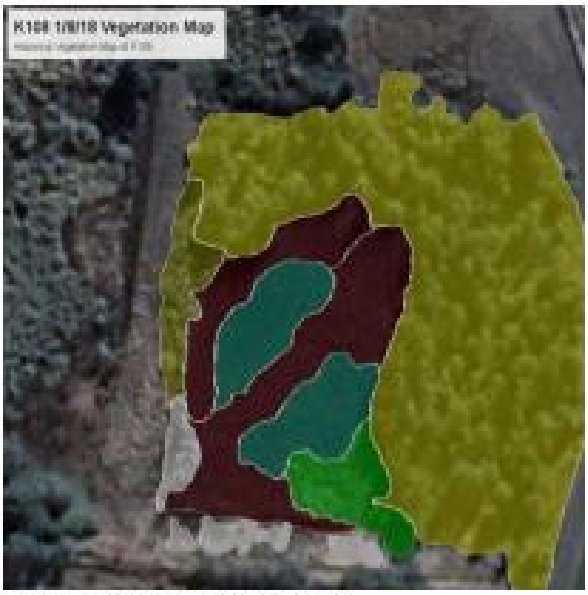
From 2012-14 there was an overall – but not uniform – continuation of this trend. The amount of open water fluctuated but continued to shrink until the wetland was completely closed by *Phragmites* and *Typha* in 2014, with *Phragmites* dominating. On the eastern bank, *Casuarina* trees expanded their range, whist a mixed stand of *Casuarina* and *Acacia* trees emerge on the north-western corner of the cell.

K108 2015 Vegetation Map



K108 2016 Vegetation Map

K108 2017 Vegetation Map

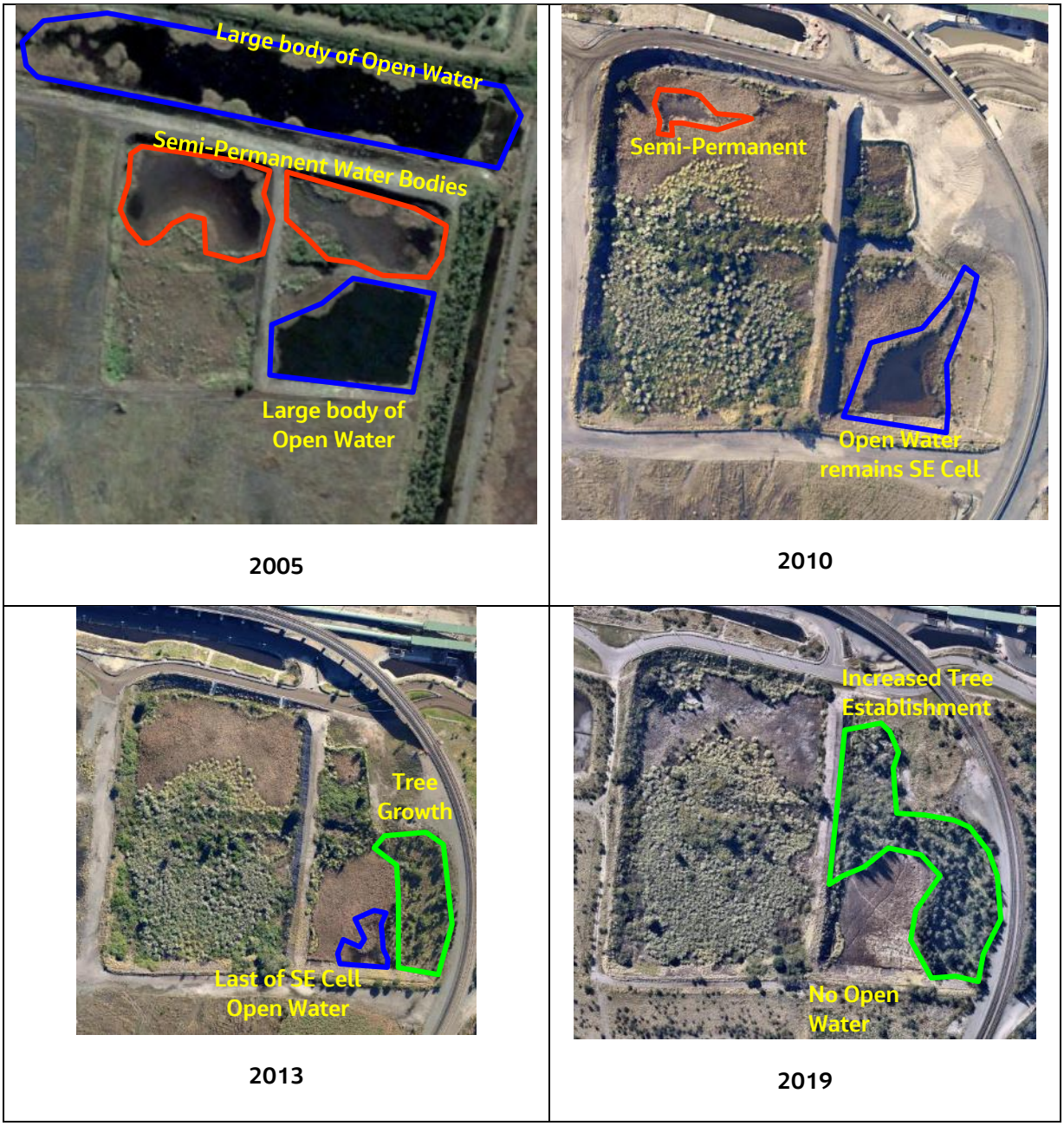


K108 2018 Vegetation Map

From 2015-18 the growth of these tree stands continues, with the trees on the eastern edge extending outwards. Within the wetland, there is some increase in the proportion of *Typha* following wetter periods (see below), but overall K108 is dominated by *Phragmites* and there is no open water present during this period.

This pattern of change over time in K108 (the south eastern cell) has also been observed in the adjacent cell K108B (north western cell) and is illustrated in Plate 6-2. The large body of open water in the north was completely removed for construction of the rail loop between 2009 and 2010.

Plate 6-2. Map series showing successional change in vegetation over remaining eastern ponds.



An inspection of the vegetation in the eastern ponds was conducted on 5 June 2020 to validate the images provided in the UoN (2019a). The inspection confirmed the successful change from an open water environment to a landscape now occupied by reeds (*Phragmites australis* and *Typha orientalis*) with very limited surface water within the cells. The presence of these native reeds, in addition to a low diversity of other semi aquatic plant species (*Hydrocotyle bonariensis* and the exotic *Juncus acutus*) indicates that shallow surface water periodically occurs within the Eastern Ponds, and is likely influenced by rainfall totals, with this condition likely to change rapidly in drier periods.

Slightly higher elevated portions of the cells floor, where surface water does not persist are dominated by a dense cover of exotic plant species, in particular *Cortaderia selloana* (Pampas Grass), as well non-indigenous Wattles (*Acacia* spp). The constructed slag walls of the cells and the dividing slag barrier between the cells are

also occupied by a dense cover of exotic weeds as well as grasses, with the exception of a stand of *Casuarina glauca* (Swamp Oak) along the eastern and central parts of the K108 fringe and below the rail loop. A relatively small area of young regrowth Swamp Oak occurs in land fringing the cell floor on the eastern and northern section of K108. This vegetation is in very low condition, with the mid and groundcover strata dominated by a suite of exotic plant species, including *Chrysanthemoides monilifera* (Bitou Bush), Pampas Grass, *Olea europaea subsp cuspidata* (African Olive), and *Ligustrum lucidum* (Large-leaved Privet), *Verbena bonariensis* (Purple Tops) and *Ambrosia artemisiifolia* (Ragweed). Due to its small patch size and dominance of weeds in the groundcover layer. An open area of land to the immediate west of the Eastern Ponds has been selected as a site for storing fill material to be used in the closure works. This site has been historically cleared of any native-vegetation and foreign fill material during previous closure work stages. Currently, the site has a cover of exotic grasses and weeds.

The distribution and extent of the vegetation described is shown on Figure 6.1.

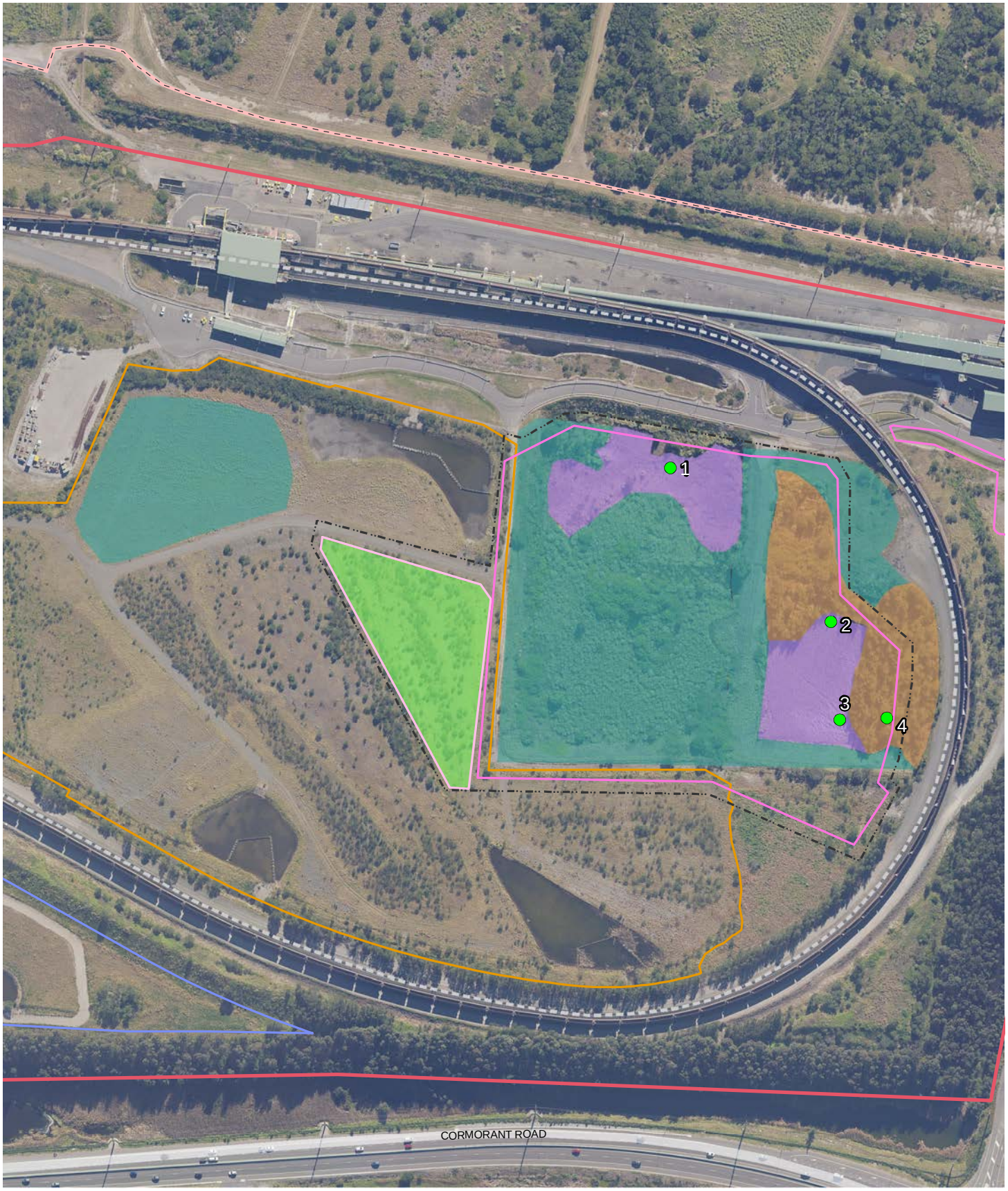
A discussion on the value of the habitat for the Green and Golden Bell Frog is provided in the following section. The value of the habitat for other threatened and migratory fauna species (MNES) is considered low. This assessment is based on the dominance of exotic vegetation and the lack of open water to provide foraging and breeding opportunities for amphibians and migratory birds.

Photo 1. Dense cover of exotic Pampas Grass dominating the south western cell

Photo 2. Phragmites australis (Common Reed) across south eastern cell (K108), this species favours very shallow surface water and a wetting / drying regime. Linear patch of regrowth Casuarina glauca along perimeter

Photo 3. Cell embankments covered with exotic Fountain Grass

Photo 4 Proposed soil stockpile site to be used during remediation, showing cover of exotic grasses and weeds.



Legend

- Surrender Notice boundary
- Area 1
- Area 3
- Proposed exclusion fence
- Eastern Pond Closure Works
- Staging/parking area
- Haul road
- Railway
- Vegetation plot location

PCT

- Disturbed / non-native
- Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion (1071)
- Rehabilitation / Acacia
- Swamp Oak coastal forest on coastal lowlands of the Central Coast and Lower North Coast (1729)

Data sources
Jacobs 2020
Ramboll 2018
© Department Finance, Services and Innovation Aug 2020
Aerometrex 2020

GDA 1994 MGA Zone 56

1:3,000 at A4

0 50 m

Figure 6-1 Plant community types

Date: 4/09/2020 Path: \\Jacobs.com\ANZ\IE\Projects\04_Eastern\IS330300\31 Spatial\GIS\Directory\Templates\IS330300_REF_F004_PCT_r2v1.mxd
Created by : KM | QA by : XX

6.2.2.3 Threatened ecological communities

The inspection of the Eastern Ponds confirmed there are no threatened ecological communities listed under either the BC Act or EPBC Act located within the assessed area. Search of the Protected Matters Search Tool (PMST) identified the endangered ecological community Coastal Swamp Oak (*Casuarina glauca*) forest of New South Wales and South East Queensland ecological community as potential to occur in the locality. Further to this, Swamp oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions, is also listed under the BC Act and known from the study area, as is Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions, also listed endangered ecological community.

The presence of regrowth Swamp Oak (*Casuarina glauca*) was noted in the Eastern Ponds from the site inspection, as well as a freshwater wetland community dominated by Phragmites australis and Typha orientalis.

The Swamp Oak that is present above the floor of the cells has colonised areas of previously capped landfill waste, which is approximately 2-5 metres above the water level of the Eastern Ponds. This raised area is artificial and well above the surrounding natural coastal floodplain formation and is therefore not considered part of the EEC. The soil, on which the Swamp Oak is growing, is mixed landfill material and imported materials placed during the construction of the NCIG rail embankment and is not representative of the soil types that characterise this EEC. This community was considered absent from the Closure Works area. Similar, based on the very small patch size, isolation of the patch and the dominance of exotic plant species (99% of the species recorded from mapped swamp oak forest), this vegetation does not meet the criteria for listing as a MNES under the EPBC Act.

A description of the Swamp Oak community listing under the EPBC Act also associates this community with unconsolidated sediments, including alluvium deposits, and where soils formed during the Quaternary period as a result of sea-level rise during the Holocene period. These are most typically hydrosols, which are saturated with water for long periods of time (typically grey-black clay-loam and/or sandy loam soils). Occurrence of Swamp Oak trees on rocky headlands or other consolidated substrates are not considered to be part of the nationally listed ecological community (Department of Environment and Energy, 2018). In the context of the findings of the survey and review of historical data it is evident that the growth medium is not representative of the soil types that characterise this nationally listed EEC. This community is therefore considered absent from the Eastern Ponds area.

The freshwater wetland community described from the site survey comprises wetland plant species that are characteristic of the freshwater wetland EEC. However as described above, this community has established on mixed landfill material and imported filling materials and is not representative of the soil types that characterise this natural floodplain community EEC. Further to this, artificial wetlands created on previously dry land specifically for purposes such as sewerage treatment, stormwater management and farm production, are not regarded as part of this community, although they may provide habitat for threatened species. This is consistent with the freshwater wetlands within the Eastern Ponds which have been constructed.

6.2.2.4 Threatened species

This assessment identified three threatened fauna species that have been previously recorded within the locality and that are likely to occur within the Eastern Ponds area. These included:

- Green and Golden Bell Frog (*Litoria aurea*).
- Australasian Bittern (*Botaurus poiciloptilus*).
- Australian Painted Snipe (*Rostratula australis*)

The following sections describe the likelihood of occurrence and identifies the need or otherwise for an assessment of significance for these species newly listed species.

6.2.2.5 Protected Matters (EPBC Act)

The presence of the listed vulnerable species, Green and Golden Bell Frog (*Litoria aurea*) has been confirmed and reported at the eastern ponds (UoN 2019) and constitutes part of the larger population extending across Kooragang Island.

The potential presence of other MNES in the study area has been determined from review of the PMST. Using the PMST, a search area of 10 km was placed around the eastern ponds. The resulting EPBC Act protected matters report identified

- 1 wetland of international importance
- 4 listed threatened ecological communities (TECs)
- 78 listed threatened species, and
- 75 listed migratory species

Wetlands of International Significance

The PMST has identified the Hunter estuary wetlands occurs within the locality, this is a Ramsar wetland of international importance and protected under the EPBC Act. The Kooragang component of the Hunter Estuary Wetlands Ramsar site is located in the estuary of the Hunter River, to the north of the KIWEF and the proposed activity for remediation of the Eastern Ponds will not directly or indirectly impact on the Hunter estuary wetlands.

It is noted that the Department of Agriculture, Water and Environment have previously considered the GGBF species to form a key component of the Hunter Estuary Wetlands Ramsar site. A discussion of the impacts from the Closure Works on the GGBF species is also provided below.

Threatened Ecological Communities

The PMST identified four threatened ecological communities that are known from a 10 km radius of the site, these include:

1. Central Hunter Valley eucalypt forest and woodland (Critically Endangered)
2. Lowland Rainforest of Subtropical Australia (Critically Endangered)
3. Subtropical and Temperate Coastal Saltmarsh (Vulnerable)
4. Coastal Swamp oak (Casuarina glauca) Forest of the New South Wales and South East Queensland ecological community (Endangered)

An inspection of the vegetation in the eastern ponds was conducted on 5 June 2020 which confirmed a landscape largely occupied by exotic and non-indigenous native plant species, interspersed around areas of native reeds (*Phragmites australis* and *Typha orientalis*) in the lowest lying parts of the cells. The vegetation is not consistent with the listed threatened communities.

Threatened and migratory species

The list of threatened species identified from the PMST are shown in Appendix A, with a description of the preferred habitat for each species, and the likelihood of the species occurring or utilising the habitat at the eastern ponds. Of the 78 species identified, several of these are marine seabirds or marine mammals that would not occur at the site and these are not assessed further.

The PMST identified 18 listed plant species that have been recorded in the locality or have a modelled distribution which may include the locality surrounding the study site. An assessment of the likelihood of each of these species is provided in Appendix A and concludes that none of the threatened plant species listed is expected to occur in the Eastern Ponds. This is supported by the results of the site inspection, in which no

threatened species were observed, and the fact that the ponds are an artificially created landscape, dominated by exotic plant species, with limited areas of native regrowth.

The PMST identified 22 listed fauna species (threatened and migratory species) that have been recorded in the locality or have a modelled distribution which may include the locality surrounding the study site. An assessment of the likelihood of each of these species is provided in Appendix A. The Green and Golden Bell Frog, is known from the Eastern Ponds and a further two species are considered to have a moderate chance of occurrence, at least on occasion, as identified below:

- Green and Golden Bell Frog (*Litoria aurea*) (Vulnerable species EPBC Act)
- Australasian Bittern (*Botaurus poicilioptilus*) (Endangered species EPBC Act)
- Australian Painted Snipe (*Rostratula australis*) (Endangered and Migratory species EPBC Act)
- Potential impacts on the three threatened fauna species are described in the following sections.

Green and Golden Bell Frog population monitoring – Eastern Ponds

A primary component of the KIWEF Eastern Ponds Action Plan (Golder 2011) is due consideration for GGBF and their habitat. Trigger values are identified with a focus on monitoring the viability of the habitat to support the GGBF breeding population.

In response to the action plan, the University of Newcastle has conducted regular monitoring of the GGBF population over the KIWEF since 2011. This work involves repeated visual encounter surveys during the breeding season targeting a range of artificially created ponds which has included the Eastern Ponds. The K108 wetland (SE cell of the Eastern Ponds) has been surveyed for GGBF two to three times per summer season since 2011-12 (UoN 2019a).

The results of the monitoring program are used to inform the triggers for management intervention prescribed in Golder 2011. These include

- Water quality: if concentrations of contaminants in surface water in the Ponds demonstrate an increasing trend and malformed individuals of GGBF and/or dead individuals are identified at the Ponds,
- Habitat: significant die-off (that is, greater than 60% as determined by visual assessment) of emergent vegetation in the Ponds during the breeding season is observed.
- Population: the population of breeding individuals in the Ponds (as determined by numbers of calling males) drops by more than 50% over one sampling period, and this occurs during favourable climatic conditions that are conducive to GGBF

The University of Newcastle has reported regular encounters of frogs in K108 from surveys conducted between 2011-16 leading to assessment in 2014 that this pond comprises a healthy population (Clulow 2014). Since 2013-14 however, the overall pattern of GGBF in the Eastern Ponds has been one of decline (UoN 2019a), a phenomenon that is consistent with the reported gradual reduction in the area of open water available to frogs over this same period. Indeed both 2016-17 and 2017-18 were dry years and no GGBF were recorded in the Eastern Ponds at this time (UoN 2019a). Very low numbers were reported in the following wetter season of 2019-20 however these number remain low compared to the ponds in the remainder of the KIWEF (McHenry 2020).

The most recent surveys in 2019-20 have described the habitat in the Eastern Pond as being infrequently occupied by GGBF and there is no evidence of breeding taking place within them. This is consistent with data from the University's annual monitoring program which shows that for the last five consecutive years (2015-20) the Eastern Ponds have provided terrestrial and ephemeral aquatic habitat that is only occasionally occupied by GGBF (McHenry, 2020).

McHenry (2020) describes the Eastern Ponds as ephemeral and semi-permanent wetlands, considered to have limited 'refuge' habitat value for GGBF due to the lack of open water. While the UoN (2019a) describes that

ephemeral and semi-permanent ponds such as these are preferred as breeding sites on Kooragang Island, however the key indicator has been that 'all wetlands in which breeding has been detected have areas of open water' (UoN 2019a) a condition which is absent at the Eastern Ponds.

The results of the monitoring at the Eastern Ponds and indeed the greater KIWEF area has indicated that the population of breeding individuals in the Eastern Ponds has indeed declined by > 50% over recent sampling events, and that this has occurred during a period that breeding activity has been high in other ponds in the KIWEF. Further to this, a decline in the area of open water and a transition to a more terrestrial environment has been noted and is the major factor leading to the lower value of the habitat for GGBF and absence of breeding.

These data are consistent with the habitat and population triggers prescribed in the KIWEF action plan and support remediation of the eastern ponds at this time.

6.2.3 Potential impacts

Key assumptions of the works area that:

- All vegetation within the Eastern Ponds site boundary will be cleared which includes the stockpile site, and overflow pipeline to be trenched.
- There will be no direct impacts during construction outside of the proposed works site boundary.
- Overflow water from the Eastern Ponds would ultimately discharge to Long Pond to the south of the Eastern Ponds. This would occur only during prolonged extreme weather events when the drainage system is already charged.

Removal of native vegetation

The total area of the Eastern Ponds is around 4.3 hectares including the raised slag walls and the proposed activity would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, *Phragmites australis* and *Typha orientalis* (0.8 ha) and regrowth Swamp Oak (0.7 ha). All areas of native vegetation occur within the lower parts of the cells. The remaining areas of disturbance associated with the cell walls, access roads and stockpile area, comprise only exotic and non-indigenous plant species that are not characteristic of native plant communities. No nationally listed threatened ecological communities will be impacted.

Changes to hydrology

The area of rushland associated with a periodically flooded wetland provide marginal habitat for the Green and Golden Bell Frog as well as the Australian Bittern and Australia Painted Snipe. The area of rushland to be removed equates to around 0.8 hectares, although of this, the better quality habitat is located within cell K108 (around 0.4 ha).

The low elevation of the completed cap site means there will be no outflow of surface water from the Eastern Ponds. In addition to this, the presence of a low-permeability cap will result in reduced water loss through seepage and infiltration and therefore higher water levels in low-lying ponded areas than is currently present. To avoid uncontrolled discharges from the ponds in large rainfall events, a controlled outlet will be constructed to draw-down water from the cap surface (SMEC 2020). At this concept design stage, the outlet is assumed to be via a gravity pipe flowing into Windmill Road Channel (K100A) and then into Long Pond (K100E); or via a pump with discharge into the NCIG rail corridor drain, which eventually outlets into Long Pond (K100E) adjacent Cormorant Road (SMEC 2020).

K100A is a deep permanent wetland alongside Windmill Road, on the eastern edge of the Industrial Zone. It is surrounded by dense stands of Casuarina trees and contains Gambusia in very high densities. It often has relatively large numbers of GGBF but does not appear to support breeding (UoN 2019a). This status is similar to the Long Pond along Cormorant Road (K100E) which also has historically reported low numbers of males, and no confirmed breeding (UoN 2017). Discharge to K100A would not occur during construction, and only be

facilitated following reestablishment of vegetation in the Eastern Ponds. Hydrology impacts in K100A are discussed in Section 6.3.

Green and Golden Bell Frog (Litoria aurea) (Endangered species BC Act / Vulnerable species EPBC Act)

The habitat within the Eastern Ponds is not considered critical habitat for the GGBF. The University of Newcastle has reported regular encounters of frogs in the Eastern Ponds (K108) from surveys conducted between 2011-16. Since 2013-14 the overall pattern of GGBF in the Eastern Ponds has been one of decline (UoN 2019), and frogs were absent during dry years in 2016-17 and 2017-18 (UoN 2019). Very low numbers were reported in the following wetter season of 2019-20 however these number remain low compared to the ponds in the remainder of the KIWE (McHenry 2020).

McHenry (2020) describes the Eastern Ponds as ephemeral and semi-permanent wetlands, considered to have limited 'refuge' habitat value for GGBF due to the lack of open water. While the UoN (2019a) describes that ephemeral and semi-permanent ponds such as these are preferred as breeding sites on Kooragang Island, however the key indicator has been that 'all wetlands in which breeding has been detected have areas of open water' (UoN 2019a) a condition which is absent at the Eastern Ponds. The site is therefore considered suitable for dispersal and foraging, but not breeding habitat.

On this basis the Proposal will temporarily remove an area of marginal foraging habitat at the Eastern Ponds occupied by a small proportion of the Kooragang Island population. The removal of this habitat is not expected to have a long-term impact on the size of the Kooragang Island population.

The work proposed at the Eastern Ponds is not expected to fragment the Kooragang Island GGBF population. Monitoring of this population has shown the GGBF is effective at movements and dispersal across spatially separated ponds (UoN 2019). The Eastern Ponds do not provide an important linkage to other areas of habitat for the species. The majority of the works will be in disturbed areas dominated by exotic species, with very limited surface water present and railway lines and associated embankments that limit dispersal. Wetlands areas and open lands to the south and west of the ponds that are known to be used by this species and provide potential movement opportunities, will not be impacted and no fragmentation of the population is anticipated.

The discharge of surface water from Eastern Ponds would transfer to the Windmill Road drain (K100A) and Long Pond (K100E), and these two habitats also provide non-breeding habitat for GGBF. This discharge would only be required during periods of prolonged high rainfall when the capped Eastern Ponds have filled. At this time, the existing drainage system would be charged and receiving flow from a variety of surface runoff sources, suggesting that a change in water quality or inundation levels would already be expected.

These habitats do not represent key breeding areas for the GGBF, and any temporary hydrology changes are not expected to have a long-term negative impact on the GGBF population.

Australasian Bittern (Botaurus poicilioptilus) (Endangered species BC Act and EPBC Act)

There is a moderate likelihood that this species could use the habitat within the eastern ponds on occasion for foraging and breeding. The lack of open water and associated food resources would suggest that the habitat is only marginal or low quality and not likely to support resident birds.

The species occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. The Australasian Bittern's preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus) or cutting grass (Gahnia) growing over a muddy or peaty substrate.

Australian Painted Snipe (Rostratula australis) (Endangered species BC Act and EPBC Act, Migratory)

There is a moderate likelihood that this species could use the habitat within the eastern ponds on occasion for foraging and breeding. The lack of open water and associated food resources would suggest that the habitat is only marginal or low quality and not likely to support resident birds.

Most records are from south east Australia, particularly the Murray Darling Basin, with scattered records across northern Australia. They generally inhabit shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum Muehlenbeckia or canegrass. Breeding habitat requirements may be quite specific; shallow wetlands with areas of bare wet mud and both low cover and canopy cover nearby; nest records nearly all from or near small islands in freshwater wetlands. Has also been recorded nesting in and near swamps, canegrass swamps, flooded areas including samphire, grazing land, among cumbungi, sedges and grasses; one nest has been found in the centre of a cow-pat in a clump of long grass.

6.2.3.1 Assessment of significance

Threatened species

An assessment of significance is provided in Appendix C. The conclusion of these assessments has indicated that the proposed activity is not likely to have a significant impact on populations of the three assessed threatened fauna species. This is determined in the content of the size and low to marginal condition of the habitats present, and the range of better-quality habitats available across the broader, KIWEF, Kooragang Island and Hunter Wetlands National Park.

Migratory bird species

An assessment of impact significance for listed migratory bird species is provided in Appendix C and concluded that the Eastern Ponds remediation is considered unlikely to significantly impact on an area of important habitat for a listed migratory bird species.

An assessment of significance pursuant to the Significant Impact Guidelines (DoE 2013) was completed for the 17 migratory species with a moderate or high likelihood of occurrence by the Closure Works area and is included in Appendix B. It is concluded that the project is unlikely to result in a significant impact on migratory species listed under the EPBC Act.

6.2.4 Safeguards and management measures

Mitigation measures applied to previous stages of closure would be implemented. **Table 6.1** specifies required biodiversity safeguards and management measures and forms the flora and management plan for the Proposal.

Table 6.1: Biodiversity management measures

Flora and Fauna Management Plan	
Objective	To comply with contractual and legislative requirements and ensure that native fauna and flora are protected from construction activities.
Targets	No death or injury to fauna including the Green and Golden Bell Frog No unapproved destruction of habitat
Legal, Contractual & Other Requirements	*Environmental Protection and Biodiversity Conservation Act 1999* *Biodiversity Conservation Act 2016*

Flora and Fauna Management Plan	
Site specific planning / approval conditions / licence conditions	**State Documents** NSW EPA (2010), Approval of the Surrender of a Licence – License 6437, (Ref: 1111840, and as varied by notice number 1510956 and 1520063) Golders (2011), KIWEF Closure Works, Green and Golden Bell Frog Management Plan (Ref: 117623029-001-R-Rev0) Jacobs (2020) KIWEF Eastern Ponds Closure Works Review of Environmental Factors (IS330300_02) **Commonwealth Documents** Jacobs (2020), KIWEF Eastern Ponds Closure Works EPBC Self-Assessment (IS330300_01)
General Flora and Fauna Mitigation Measures and Controls	General mitigation measures to be considered include: ▪ Adequate run-off, erosion and sedimentation controls should be in place during construction, particularly in areas where run-off has the potential to impact on nearby waterways, surrounding native vegetation, EEC regrowth, and existing drainage line and dam areas ▪ Care should be taken that any noxious weeds occurring on the site are not further dispersed as a result of the Proposal. A follow up Weed Control Program may be necessary to control the encroachment of these species into surrounding areas. The landowner has a legal responsibility to control and suppress these species on their property under the *Biosecurity Act 2015*. The Weed Control Program should require removal of weeds by physical means and avoid the use of herbicides ▪ Stockpiling of soil that may contain seeds of exotic species shall be stockpiled away from adjacent vegetation or drainage lines where they could be spread during rainfall events ▪ Placement of soil stockpiles away from vegetated areas ▪ Utilising existing disturbed corridors such as cleared areas, roads, tracks and existing easements, where possible for set up of equipment, stockpile areas and site facilities ▪ Noxious weeds to be managed in accordance with the expectations under the *Biosecurity Act 2018*. It is recommended that the plants be removed by physical removal where practicable, as herbicides may impact GGBFs and their habitat ▪ Open excavations and storage areas to be inspected regularly for the presence of fauna species ▪ Plant and equipment brought on to site must be cleaned and free of deleterious material, mud and other material that may harbour weed seeds ▪ Standard construction hours are to be maintained to restrict noise and light impacts on nocturnal fauna, to the extent practical. Any after hour activities will be limited to delivery of materials, environmental surveys, or other action that has been assessed to have a minimal impact to nocturnal fauna ▪ Utilise an onsite ecologist during construction to re-locate any native fauna which may be displaced ▪ Avoid rubbish and other waste build up to deter feral animals ▪ Habitat features such as woody debris that may be utilised by fauna within the construction area would be retained and set-aside during the construction period for reinstatement at completion of works ▪ Any water required for dust suppression will be drawn from ponds established for the purpose. No water for dust suppression will be drawn from existing ponds on the site. The establishment of dedicated dust suppression ponds will be undertaken to prevent the potential spread of Plague Minnow into ponds currently free of this species. The

Flora and Fauna Management Plan	
	location and procedure for those dedicated dust suppression ponds will be communicated during the site induction and training ▪ No night works are permitted without additional assessment of potential noise and light impacts ▪ Lighting of site compounds, if required for safety and security, will avoid light spill outside of the construction works footprint and will be undertaken in accordance with *Australian Standard 4282—1997 Control of the obtrusive effects of outdoor lighting.*
GGBF Management	GGBF impact avoidance is to be based on the following: ▪ Establishment and use of Chytrid Hygiene procedures such that the Chytrid fungus is not brought to site or transferred between areas of the site as described in the following row ▪ GGBF pre-clearance/disturbance surveys and relocation to ensure to the extent possible that direct disturbance areas are free of GGBF on commencement of works in each area ▪ Establishment of GGBF exclusion fencing such that the risk of GGBF re-entering surveyed areas is prevented ▪ Establishment and maintenance of a vegetation/structure buffer (nominally 1-2m wide) outside of the GGBF exclusion fencing to minimise potential for GGBF to use overgrown vegetation or existing fencing to gain access into the works footprint. The buffer is to be managed proactively, through implementing lessons learnt from prior incidents and to minimise potential for frogs to become trapped and exposed which may include provision of habitat refuge, mulch cover over exposed surfaces, watering and regular inspections ▪ Establishment of clear boundaries of works areas such that unnecessary disturbance is avoided, particularly adjacent to existing ponds ▪ Establishment of appropriate erosions and sediment controls to prevent sedimentation and pollution of waters ▪ Implementation of GGBF risk consideration to all decision making such that unintended consequences to GGBF can be avoided. This includes in considering suitability of imported materials from a Chytrid risk and nutrient perspective and use of chemicals including flocculants, herbicides and pesticides ▪ Where unintended impacts to GGBF are identified all necessary efforts to reduce the severity and avoid reoccurrence are to be implement ▪ Rehabilitation using species preferred by GGBF (refer to rehabilitation management plan).
Chytrid Fungus hygiene protocol	A Chytrid Hygiene procedure in accordance with the NSW Threatened Species Management Information Circular No.6 – Service Hygiene Protocol for the Control of Disease in Frogs (April (2008) or most recent revision of that document, must be implemented on the Closure Works site during all works and any other activities undertaken as part of the action. This procedure is to include: ▪ Dedicated disinfection bays established at site entry and all vehicles required to enter via this bay ▪ All disinfection processes will be monitored and controlled at the Closure Works entry point ▪ The location of these disinfection bays, and the obligations of disinfection, will be communicated during the site induction and training ▪ Cleaning and disinfection of workers boots upon entry and exit from the site

Flora and Fauna Management Plan	
	▪ Procedures will be implemented to inspect mobile plant entering the Project site during construction activities to control soil and/or organic matter and to disinfect tyres and wheels of vehicles entering the Project site ▪ Vehicles arriving at site muddy will be sent away for more intensive cleaning prior to disinfection.
Chytrid Fungus Risk Assessment Process	The contractor is to demonstrate that suitable risk assessment has been undertaken by an appropriately qualified and experienced ecologist on all imported capping and revegetation materials to demonstrate that it contains a low risk of containing Chytrid. Risk assessment should consider as a minimum: ▪ Material not sourced from known, suspected or likely amphibian habitat areas, or material has been isolated for sufficient period to eliminate chytrid risk ▪ Material unlikely to have had contact with amphibians and no amphibians present in material ▪ Material are not to be stored in, or come in contact with material sourced from, areas of known, suspected or likely amphibian habitat prior to transport Material has been subject to temperature exceeding 28 degree which is considered to exceed the thermal tolerance of chytrid fungus.
Pre-clearance survey design and clearance methodology.	The Contractor will be responsible for developing a pre-clearance survey and clearing methodology suitable for implementation with the contractors specific construction methods that minimises potential harm to GGBF species. The survey methodology should give consideration to the following factors: ▪ Level of effort warranted in different areas and habitats ▪ Seasonal factors on GGBF use of habitat ▪ Need for night time surveys ▪ Survey effort required is likely to include: Targeted active searches of potential GGBF habitat located within the disturbance footprint Conducted to minimise disruption of breeding activities: relocated tadpoles or metamorphs ▪ Be conducted in accordance with hygiene protocol ▪ Habitat resources including all wet areas as well as rocks, logs, tussock forming vegetation, and other cover will be searched during diurnal visual inspections ▪ A nocturnal habitat search including visual search, spotlighting and call playback may be conducted to assess nocturnal use (breeding/calling) in the habitat supported in disturbance area, if the surveys are conducted during core breeding season (spring/summer) ▪ Any GGBF observed within the disturbance footprint will be relocated in accordance with relocation procedure provided in the GGBF Management Plan (or procedure otherwise endorsed by HCCDC in consultation with the University of Newcastle) prior to commencement of disturbance ▪ The survey methodology implemented should allow the qualified and experienced ecologist to confirm that the risk of GGBF mortality has been reduced to the extent reasonable and feasible for the applicable habitat type/area. The clearing methodology should include the following: ▪ Consideration of most appropriate time to install frog exclusion fences ▪ Presence of an appropriately qualified and experienced ecologists during clearing

Flora and Fauna Management Plan	
	▪ Gradual degradation of higher risk habitat areas progressing from areas furthest away from pond towards areas of refuge ▪ Relocation of cleared vegetation to areas away from immediate works that allow remaining amphibians to escape ▪ Construction of ramps on the internal side of the exclusion fence to allow for GGBF to escape from within the site, whilst maintaining a perimeter and restricting fauna entry to the work site.
Amphibian Relocation	If any frog specimens thought to be a GGBF are observed and are within project disturbance area the following relocation procedure will be implemented: ▪ Observer to notify Site supervisor who in turn is to notify the HCCDC, a suitably qualified ecologist, and the Contractor's supervisor of the frog's location immediately ▪ Contractor supervisor to halt work in the immediate vicinity to prevent accidental interaction with the frog ▪ The ecologist or HCCDC's environmental representative will determine whether the frog is likely to be harmed by works or is likely to migrate to an area that it could be harmed ▪ If likely to be harmed by works the GGBF will be captured by the ecologist or suitably trained frog handler following GGBF handling and Hygiene procedures ▪ A one frog per bag policy will be observed with disinfection of all equipment undertaken immediately following any contact with frogs of any description ▪ If healthy the frog will be relocated outside the impact footprint as soon as possible to a nearby wetland with suitable habitat and water (note that the requirement of the GGBF Management Plan to hold frogs until night time has been superseded by advice from the University of Newcastle) ▪ ; ▪ GGBF showing Chytrid symptoms will be handled in accordance with the GGBF management requirements unless otherwise agreed with HCCDC in consultation with the University of Newcastle.
Actions	The contractors CEMP is required to establish the actual pre-clearance and clearance methodology, exclusion fence designs and Chytrid Risk assessment and documentation proposed.
Responsibilities	Contractor's Ecologist is responsible for ensuring risks to Fauna is minimised to the extent reasonable and feasible. Contractor's Project Manager is responsible for allowing sufficient time within program to conduct pre-clearance and clearance in a manner that maximises survival of GGBF and other fauna following the advice of the Ecologist. Contractor is responsible for notifying the Principal of any sick or dead GGBF. All personnel are responsible for ensuring that the clearing limits are addressed and native flora and fauna species are protected. All site personnel to undertake toolbox talks in relation to the reporting process for injury/ death to fauna or clearing of flora occurring beyond the required limits for construction.
Timeframe	Duration of the works.
Monitoring & Reporting	Daily visually monitoring by site supervisors for obvious signs of fauna and the functioning of controls including fences and Chytrid hygiene stations. Inspection of inside and outside of exclusion fencing and provision of water in microhabitats when temperature is forecast to exceed 30 degrees with less than 50% humidity.

Flora and Fauna Management Plan	
	Weekly inspections to be documented on a Weekly Environmental Inspection Checklist. Outcomes of pre-clearance surveys are to be documented and provided to the HCCDC. Observed sick or dead GGBF are to be notified to the Principal immediately.

Table 6.2: Rehabilitation management measures

Table 6.1Table 6.2 represents to rehabilitation management plan for the Proposal.

Rehabilitation Management Plan	
Objective	To comply with State and Commonwealth approvals requirements and related conditions. To provide a post construction environment that is revegetated to stabilise the capping surface; and planted with species known to be favoured by GGBF.
Targets	The capped surface is stabilised and vegetated within 12 months of construction completion. Provide a revegetated capped surface that includes species of flora known to be favoured by GGBF.
Key Documents	**State Documents** NSW EPA (2010), Approval of the Surrender of a Licence – License 6437, (Ref: 1111840, and as varied by notice number 1510956 and 1520063) Golders (2011), KIWEF Closure Works, Green and Golden Bell Frog Management Plan (Ref: 117623029-001-R-Rev0) GHD (2009), Report on KIWEF, Revised Final Landform and Capping Strategy (Ref: 22/14371/85882 R4).
Mitigation Measures and Controls	General mitigation measures to be considered include: ▪ Care should be taken that any noxious weeds occurring on the site are not further dispersed as a result of the Proposal. A follow up Weed Control Program may be necessary to control the encroachment of these species into surrounding areas. The landowner has a legal responsibility to control and suppress these species on their property under the *Noxious Weeds Act 1995*. The Weed Control Program should be remove weeds by physical means and avoid the use of herbicides ▪ Stockpiling of soil that may contain seeds of exotic species shall be stockpiled away from adjacent vegetation or drainage lines where they could be spread during rainfall events ▪ Placement of soil stockpiles away from vegetated areas ▪ Utilising existing disturbed corridors such as cleared areas, roads, tracks and existing easements, where possible for set up of equipment, stockpile areas and site facilities ▪ Bitou Bush and Crofton Weed would be managed by following the Local Noxious Weed Control Plans (NCC 2006). It is recommended that the plants be removed by physical removal, as herbicides may impact GGBFs and their habitat ▪ Plant and equipment brought on to site must be cleaned and free of deleterious material, mud and other material that may harbour weed seeds ▪ Works associated with the closure of the KIWEF must only occur within the closure works area (project footprint); and must be restricted to the extent required to satisfy the Surrender Notice requirements ▪ All disturbed surfaces will be revegetated within 1 month of final land forming and in compliance with the landscaping plans

Rehabilitation Management Plan	
	▪ Any capping materials that are imported from outside the KIWEF facility must be sourced from an area that is assessed as having a low risk of containing Chytrid Fungus. ▪ The contractor is to demonstrate that suitable risk assessment has been undertaken by an appropriately qualified and experienced ecologist on all imported capping and revegetation materials to demonstrate that it contains a low risk of containing chytrid. Risk assessment should consider as a minimum: o Material not sourced from known, suspected or likely amphibian habitat areas, or material has been isolated for sufficient period to eliminate chytrid risk o Material unlikely to have had contact with amphibians and no amphibians present in material o Material stored in a dry location prior to transport o Material has been subject to temperature exceeding 28 degree which is considered to exceed the thermal tolerance of chytrid fungus. ▪ Topsoil to be used for surface layers must be sourced from within KIWEF to the extent possible and will otherwise be assessed as low in added nutrients (manufactured soils and boosted with fertilisers, or waste exempt sludges and processed topsoils (eg recycled waste) which are high risk of causing eutrophication in enclosed waters) and having a low risk of containing Chytrid Fungus to be protective of adjacent MNES habitat ▪ Upon completion of works, the works area will be rehabilitated with vegetation species known to be favoured by GGBF ▪ Open stormwater infrastructure across the KWIEF site will be planted with species known to be favoured by GGBF. This revegetation and rehabilitation strategy will include a 2m wide buffer on either side of the stormwater drains. The intention is to provide movement corridors for GGBF across the site ▪ Drainage culverts will, where practicable, be vegetated and lined with rocks and objects that may provide temporary frog refuge, in the event that a frog seeks to traverse the future capped area of KIWEF ▪ Habitat features such as woody debris that may be utilised by fauna within the construction area would be retained and set-aside during the construction period for reinstatement at completion of works Prior to the Construction Completion dates the Contractor is required to seed the vegetation layer above the capping layer and reseed areas where sparse vegetation coverage is achieved by the end of the care and maintenance period.
Species Mix	<u>Aquatic vegetation:</u> ▪ Selection of reeds that provide good habitat cover such as Typha, Bolboshoenus, Phragmites, and Juncus ▪ A mixed community is preferable to single species stands ▪ GGBF prefer wetlands with sections of open water. Water depth should be deep enough to prevent Typha spreading across the entire pond area; the reeds should be mainly at the edge of ponds ▪ Substrate at edges should be suitable for reed growth (i.e. not too many pebbles, sandbags, etc.) ▪ Areas of low blanketing vegetation are also desirable for GGBF breeding, for example, Paspalum grass and Shoenoplectus rush; ▪ Establishing aquatic plants with planting after Closure Works: will maximise structural suitability of wetland to immigrating GGBF as soon as construction is completed. <u>Terrestrial vegetation:</u>

Rehabilitation Management Plan	
	▪ Stabilise new works with suitable seasonal available terrestrial species of seed that are compatible with the capping ▪ Retain seed bank in fill taken from site (to be reused) ▪ Avoid large tree species unless identified as compatible with capping ▪ Allow terrestrial species to re-colonise. Drainage culverts will, where practicable, be vegetated and lined with rocks and objects that may provide temporary frog refuge, in the event that a frog seeks to traverse the future capped area of KIWEF.
Performance Criteria	Establish adequate vegetation coverage across the closure area. Where vegetation regrowth is sparse (ie less than 50% growth) in areas of greater than 10m^2, the performance criteria will be considered to have failed and contingency measures are required. No deep-rooted vegetation (ie large shrubs or trees) on top of capped surface
Contingency Measures	Where Vegetation Coverage has been identified to be insufficient, the area will be reseeded. Where deep-rooted vegetation is identified on top of capped surface. The vegetation will be removed (mechanically where possible).
Responsibilities	The Contractor is responsible for undertaking the work, monitoring and maintenance of all elements of the revegetation management plan, until the completion of the construction maintenance period (indicatively 3 months post construction completion). The State (or its agent) is responsible for the monitoring and maintenance of all elements of the revegetation management plan and any rectification works, following the completion of the construction maintenance period.
Timeframe	For the duration of the construction works; and the construction maintenance period.
Monitoring & Reporting	Vegetation establishment will be visually monitored monthly during the construction works and construction maintenance period to identify any areas where vegetation is failing to establish. Should vegetation not establish within the construction maintenance period then targeted seeding and/or planting would be undertaken.

6.3 Hydrology

HCCDC has engaged SMEC (SMEC, 2020) to undertake a water balance consideration as an input to the design process. The consideration of hydrology impacts is based on the findings of this document.

6.3.1 Existing environment

The Eastern Ponds consist of four partially filled waste emplacement cells (cells K26/K32 and K24/K31). The low-lying nature of the Eastern Ponds means there is no immediate surface water drainage outlet. This results in ponding within the cells. The lowest points are in the north-west and south-east cells. These locations exhibit different vegetation which are consistent with inundation and ponded water. Survey shows that the south-eastern cell is the lowest area within the Eastern Pond complex, and historically has been observed to contain ponded water.

Key features of the Eastern Ponds site hydrology are summarised by SMEC (2020) as follows:

- Water Inflows:
  - Direct rainfall of the area within the Eastern Ponds
  - Surface water runoff from the adjoining slag walls and adjacent areas. This includes

    - Localised runoff from access tracks between the Eastern Ponds and K10 South capping works. Runoff flows to a low-point on the western slag wall before entering the Eastern Ponds
    - Runoff from the small portion of the NCIG access road along the northern boundary of the ponds, which discharges into two concrete drains that outlet into the Eastern Ponds
  - Groundwater interaction. This includes inflows from the fill aquifer, and potentially inflows from the underlying confined estuarine aquifer. This is discussed further in the following section
  - Inflows may also include infiltration through the slag walls surrounding the Eastern Ponds.
- Water outflows:
  - Evaporation from ponded water
  - Evapotranspiration from vegetation
  - Infiltration into the estuarine and fill aquifers
  - Seepage into the permeable slag walls that form the cell walls
  - Overtopping of the Eastern Ponds, which is the only surface-water drainage outlet, although unlikely to occur (discussed further in the water balance).

Key elements of conceptual groundwater model include:

- Groundwater beneath the site is present in two principal aquifers: an upper unconfined aquifer within the fill strata (the Fill Aquifer), and a deeper confined aquifer within the estuarine sediments (the Estuarine Aquifer)
- Between the two aquifers there is a layer of soft natural clays, forming a 'leaky' aquitard that separate the two aquifers, however in some locations the aquitard may be absent
- Groundwater exchanges from both the estuarine and fill aquifers may occur with surface water in the Eastern Ponds.

Capping and closure works across KIWEF, as well as activities by other parties including construction of the NCIG rail loop, are expected to have altered groundwater levels at the Eastern ponds.

The water balance indicated that the contribution of the Eastern Ponds water out flows to down-stream receivers were not significant in relation to the flow contributions of the catchment (<5%) and therefore further hydro-salinity modelling was not considered warranted.

6.3.2 Potential Impacts

6.3.2.1 Construction

The low elevation of the capped site means there will be no direct surface water drainage outlet, and ponding on the cap will occur. Filling to accommodate capping may raise site levels and result in overtopping. To prevent this occurring, areas of the site that are vulnerable to overflow would be raised.

During construction of the Proposal, rainfall and inflows to the eastern ponds and stockpile areas may lead to mobilisation of sediments and exposed contaminants that will require management. With no natural outlet, surface water would either infiltrate or require management to dewater the works area. The design and construction methodology include the establishment of a permanent water management basin that would be sized in accordance with construction guidelines. Following rainfall, the water level in this basin would require active management to return to capacity. Ongoing management would involve treatment to reduce turbidity and other contaminants and dewatering of sediment basins established for previously completed stages of the Closure Works; or via reinjection into permeable materials. With the implementation of water quality monitoring and management measures to prevent pollution, water quality impacts would be limited.

6.3.2.2 Post closure

Inclusion of a low-permeability cap will reduce outflows via seepage as well as the frequency, extent and depth of ponding. The capping concept design largely reflects the existing topography, and ponding on the cap will occur at locations similar to the existing site.

The design incorporates either a passive or pumped outlet to facilitate dewatering following extreme or prolonged wet weather to prevent excessive infiltration and uncontrolled discharges. Modelling predicts that the outlet pipe (or pump trigger level) would be active an average of 22 days per year, typically flowing over a number of days following a large rainfall event and when water levels over the cap are already high. This draw-down of water would equate to an average flow rate of approximately 7 L/s per active day. This water will discharge into either Windmill Road Channel and/or Long Pond.

In extreme rainfall events, a sudden outflow would be unlikely as there is no significant contributing catchment. The storage capacity between the proposed low-level outlet (RL 3.8m AHD) and the overflow level (4.7m AHD) allows the capture and slow-release of water during large rainfall events.

Water quality (salinity) within the water pond over the cap is expected to be similar to, or fresher than the existing water quality. This is a result of "fresher" surface water runoff from the cap, and reduction of potential saline interactions within the cell. The receiving water bodies, Windmill Road Channel and/or Long Pond, receive surface-water runoff from the NCIG rail operations (east of the rail loop), Windmill Road, Cormorant Road, and the K10 South cap. These surrounding water bodies may also receive groundwater from the Fill or Estuarine aquifers. Discharges from the cap into these water bodies will occur during rain events when they are already receiving runoff. Hydro-salinity modelling of these receiving water bodies has not been undertaken, however it is likely these water bodies may become marginally fresher and wetter sooner after rainfall.

6.3.3 Mitigation Measures

Table 6.3 provides a framework water quality management plan for the Proposal.

Table 6.3: Water quality management plan

Water Quality Management Plan	
Objective	To comply with State and Federal approval requirements. To prevent water discharges from construction works area to the extent possible. To manage water discharged to avoid impact to receiving waters.
Targets	No sediment or water quality impacts to the surrounding environment and waterways from the construction works.
Key Documents	**State Documents** NSW EPA (2010), Approval of the Surrender of a Licence – Licence 6437, (Ref: 1111840, and as varied by notice number 1510956 and 1520063). GHD (2009), Report on KIWEF, Revised Final Landform and Capping Strategy (Ref: 22/14371/85882 R4).
Controls	Erosion and sediment control will be designed, installed and managed as follows: ▪ Progressive erosion and sediment control plans (ESCPs) will be developed by the Contractor and implemented prior to the commencement of topsoil stripping and earthworks ▪ The construction design for permanent sediment basins is to be in accordance with the environmental protection standards for sensitive environments based on Managing Urban Stormwater - Soils and Construction, (Landcom, 2004), as well as documents

Water Quality Management Plan	
	from other States and internationally (such as "International Erosion Control Association – Australasia") ▪ The Contractor is required to install the permanent sediment basins as per the for construction design and any necessary temporary erosion and sediment control measures in advance of bulk-earthworks reporting to each basin ▪ Alternative arrangements proposed by the Contractor are also required to be in accordance with these standards ▪ Erosion and sediment control structures are to be regularly inspected and maintained, particularly in advance of and following significant rainfall events ▪ Any water discharges are required to be managed to avoid pollution of waters having regard to the sensitivity of the receiving environment. ▪ Stockpiles to be not greater than 2.0m in height. All stockpiles will be located clear of watercourses and drainage works ▪ Wastewater management facilities shall only be provided through proprietary storage and pump out systems ▪ All disturbed surfaces will be revegetated as soon as possible ▪ All temporary ESC works will be removed immediately prior to final completion and all surfaces will be returned to pre-existing condition ▪ Provision of shaker grids or rumble strip at site egress points ▪ if contaminated materials are encountered, they are to be managed in accordance with Materials Management Plan, and as a minimum isolated and covered to avoid runoff.
Performance Criteria	Discharge quality must comply with Performance Criteria: ▪ ▪ pH: Between 6.5 and 8.5 ▪ Otherwise able to be demonstrated not to have caused pollution of waters The use of flocculants to manage turbidity is not supported for the site; on the basis that construction discharge waters will be directed through onsite sedimentation basins designed to blue book standards, prior to release into Long Pond and the Hunter River.
Contingency Measures	If Water Quality performance criteria is not suitable for discharge, other management measures must be implemented prior to discharge. These may include such things as: ▪ ▪ Dosing with appropriate buffers to neutralise water ▪ Other mitigation measures deemed appropriate which may include a purpose constructed soak-away where a suitable location is agreed with HCCDC such that contamination in fill is not likely to be mobilised.
Responsibilities	The Contractor is responsible for undertaking the work, monitoring and maintenance of all elements of the water quality management plan until the completion of the construction maintenance period (indicatively 3 months post construction completion). The State (or its agent) is responsible for the monitoring described under the KIWEF Annual Water Monitoring and the KIWEF Continuous Data Logging.
Timeframe	Construction Water Quality and Erosion Sediment Controls will be maintained and monitored throughout the duration of site works.
Monitoring and Reporting	▪ Daily visual monitoring by site supervisors ▪ Documented post rainfall checks of sediment basin water level and water quality and erosion and sediment control functioning

Water Quality Management Plan	
	▪ Weekly documented inspections ▪ Maintenance activities for ESCPs shall be documented ▪ Sediment basin discharge or dewatering water quality sampling and analysis suitable to demonstrate pollution of water has/will not occur. All water quality data including quantity, quality and dates of water release will be maintained within the project records.

6.4 Land use and Contamination

6.4.1 Existing environment

The site is a former licenced landfill regulated under the *Protection of the Environment Operations Act 1997* (POEO Act) and while site materials are contaminated as a result of historic landfilling practices the site is not regulated as a Contaminated Site under the *Contaminated Land Management Act 1997* (CLM Act). The site is currently unused but supports some habitat values as described in Section 6.2.

Golder (2011a) provides a detailed summary of the contamination status of the Eastern Ponds. A summary of the contamination status based on this document, as provided by HCCDC is as follows:

There have been many contamination assessments completed at the KIWEF since the cessation of the waste disposal. The fill associated with the former BHP Steelworks is generally inert waste from steelmaking activities. However, a range of contaminants have been identified at KIWEF associated with steelworks operations, demolition refuse and waste products. These contaminants generally include:

- Ammonia
- TPHs
- Phenols
- Cyanide
- Heavy metals
- PAHs
- Asbestos
- Acids and bases.

Several areas of KIWEF have been identified in previous studies as containing elevated levels of soil contamination that may pose higher risk levels, if not managed appropriately. The contamination status of the Eastern Ponds is summarised as:

- Revised Final Landform and Capping Strategy (GHD, 2009) reported dry tar residues within containment cells K26/K32 (and to a lesser degree in K24/K31) at the surface of several boreholes. Tar staining and semicontinuous layers of tar were evident throughout the fine coal washery rejects and natural clays within cells K32/K26 indicating wide spread impacts through the cells. Additionally, tar and oil sheens were also observed within the natural sands at two boreholes located within cell K32. The dumped tar appears to have migrated through cracks and pores both on a vertical and lateral basis
- Accumulation of tar within more porous fill layers and over less permeable layers has occurred. The confining clay layer is less than 0.1 m thick at the north eastern end of the cells and as a result it appears that the tar material has migrated through the clay and into the underlying sands. It is likely that several different migration mechanisms are open for tar migration within these clays
- Based on the field and laboratory results, containment cells K32/K26 and K31/K24, were considered significant areas of environmental concern.

- Golder (2011a) concluded that Golder that the soil contamination identified at the Eastern Ponds was not significantly affecting downgradient receptors and does not appear to present a significant risk to the down gradient environment.

These findings contributed to the deferral of the Closure Works in the Eastern Ponds while their importance to as GGBF was assessed.

6.4.2 Potential impacts

The REF does not attempt to assess the environmental impacts of the former use of the site for waste disposal as this activity is not proposed and past landfilling practices are considered otherwise approved or permissible under the legislation that applied at the time the development commenced. No post closure land use is proposed and the consideration provided in this REF is strictly limited to the proposed closure works. Any previous or subsequent site activities are not considered within this assessment. The Proposal will facilitate the transfer of land to the Port of Newcastle and would lead to positive outcomes in relation to the economic use of land. Any future use of land would be subject to assessment and approval in accordance with the EP&A Act.

The objective of the Proposal is to install a reduced permeability layer that will reduce infiltration through the known contamination. In doing so the Proposal would reduce the risks of impacts to down-gradient receptors and provide a barrier to direct contact in the event of future uses of the site. Following the completion of the Proposal it is considered likely that contamination risks would be reduced. The Proposal is considered to have an overall positive environmental impact in the long term when compared to a do-nothing scenario from a contamination perspective.

Construction activities would have the following potential impacts on soils and contamination:

- **Soil erosion and loss of topsoil:** This could result from the disturbance of the ground surface during site preparation, earthwork, excavation and other construction activities. Earth-moving activities could also expose loose soils and mobilise these materials
- **Exposure and oxidation of acid sulphate soils:** NSW SEED mapping indicates that potential acid sulphate soils are present within soils underlying the Proposal area and would require management in the event of ground disturbance activities
- **Disturbance of contaminated soil:** Where contamination is present in the Proposal area excavations would have the potential to disperse contaminated materials. Disturbance of potentially contaminated materials may also expose construction workers to these contaminants if appropriate controls are not put in place
- **Spills and leaks:** There would also be potential for construction activities to result in contamination of soil and/or water due to leaks and spills of potentially contaminating materials.

The design and construction methodology would be developed such that interaction with the ground surface is minimised. Unlike prior stages of the Closure Works, the winning of a top soil for use in rehabilitation is not proposed. The establishment of a competent base on which capping can be installed will require the removal of existing vegetation which would otherwise lead to settlement issues as it breaks down. Vegetation removal would be likely to result in some disturbance of soils and there is a risk of interaction with, and exposure to existing contamination that requires management. The design deliberately avoids the need for cut and fill of the existing landform to reduce the risk of encountering significantly contaminated material.

The approved Materials Management Plan (RCA, 2012) provides controls for the management of contaminated material as encountered. As part of the management plan, any significantly contaminated materials encountered is to be sampled and actively managed to prevent interaction with surface water run-off and dictates the handling and disposal requirements of all materials based on contamination properties. Importantly, RCA (2012) identifies that retaining contaminated material in situ is preferred, provided there is no immediate danger to the environment or community and where it will be appropriately covered with at least 0.5 to 1 metre of material prior to being capped. Material may also be relocated to a designated area where adequate cover can be provided or classified for off-site disposal.

Based on the above the main contamination risk remains the potential for interaction of surface water with contaminated site materials during construction. In the absence of appropriate controls there is a risk of mobilisation of contaminants in stormwater. However, uncontrolled discharges from site are unlikely as discussed in Section 6.3.2. On the basis that active dewatering would only be undertaken following confirmation of the suitability of water for discharge the risk of pollution of water or land is considered low and within the control of the Contractor and HCCDC.

Following installation of cover material, the risk of contamination mobilisation in surface water would be removed. This would be schedule immediately following vegetation removal and ground disturbance activities.

In the event that water cannot be discharged during construction for any reason it would be retained within the Eastern Ponds and infiltrate as per the existing situation, or via reinjection into areas of known permeable materials within the Eastern Ponds. Prior to the installation of the cap there is limited risk of uncontrolled discharge that would release contaminants into surface waters.

Minimal volumes of material requiring off-site disposal have been encountered in previous stages of Closure Works. In the event that such material is encountered it will be classified in accordance with the Waste Classification Guidelines (2015) and disposed of to a landfill legally able to accept the waste. All other wastes and contaminated materials will be managed on site in accordance with the Materials Management Plan (RCA, 2012).

Based on the above, and implementation of recommended mitigation measures, no significant contamination impacts are considered likely.

6.4.3 Mitigation measures

Table 6.4 provides a framework Materials Management Plan for the Proposal.

Table 6.4: Materials Management Plan

Materials Management Plan	
Objective	To comply with legislative requirements and ensure that hazardous / contaminated material from construction activities does not cause an environmental nuisance / harm and is handled, categorised, tracked and placed in accordance with the RCA (2012) Materials Management Plan.
Targets	▪ No exacerbation of contamination during construction ▪ No environmental incidences involving contaminated/ hazardous materials ▪ No pollution events of the surrounding environmental and water ways by contaminated material ▪ The movement and ultimate fate of materials is fully tracked.
Key Documents	NSW EPA (2010), Approval of the Surrender of a Licence – License 6437, (Ref: 1111840, and as varied by notice number 1510956 and 1520063) GHD (2009), Report on KIWEF, Revised Final Landform and Capping Strategy (Ref: 22/14371/85882 R4) RCA (2012) 'Materials Management Plan - Kooragang Island Waste Emplacement Facility' dated November 2012.
Material Classification	**Level 1** material is any material not exhibiting characteristics indicative of other categories. **Level 2** material is identified as material with any of the following characteristics: strong hydrocarbon odour, ammonia odour, asbestos containing material, evidence of PCB impact (dark staining and phenolic odour), materials with an average

Materials Management Plan	
	concentration of >2,000 mg/kg PAH or material represented by individual PAH concentration >2,500 mg/kg. **Level 3** material is material containing Separate Phase Hydrocarbons.
Mitigation Measures and Controls	The following is generally reproduced from RCA (2012).
Contaminated material identification and management	The Contractors Materials Management Plan is to be adequate to ensure that material management is undertaken in accordance with RCA (2012) in addition to meeting the performance expectations of the Contract Specifications and this CEMF. The Contractors Materials Management Plan is to incorporate a protocol for identification and management of Contaminated Materials that is to include the following: ▪ Appropriate resourcing for real-time supervision of all ground disturbance activities by a suitably qualified and environmental practitioner ▪ Stop work requirements (localised) if any soils are encountered which have distinguishing Level 2 or Level 3 characteristics ▪ Characterising and delineated Level 2 and Level 3 materials in-situ or at the place of storage following excavation including input from occupational hygienist or other appropriately qualified specialist (Contractor's Specialist) to identify the substance ▪ Consultation with third party advisors, the State and the auditor to confirm management expectations. All contaminated material encountered during the landfill closure works will be assessed and categorised in accordance with RCA (2012). All material is to be adequately tracked such the that the composition and location of all Level 2, Level 3 and asbestos waste fate is documented and able to be validated. Uncovering of suspected level 2, level 3 or otherwise hazardous material requires the following steps to be undertaken: ▪ Immediately cease work and contact the Site Supervisor ▪ Demarcate the 'unexpected find' to prevent access and install appropriate environmental and safety controls ▪ Follow the management steps specified below in relation to each material classification ▪ If substance is assessed as level 1 material not presenting an unacceptable risk to human health the Site Supervisor to remove controls and continue work.
Level 1 Material management	There is no specific management required for Level 1 material on the site and Level 1 material has unrestricted onsite re-use classification (Section 5.6.1 of RCA 2012). Level 1 material may be used for: ▪ Topsoil where sourced from top 100mm of existing landform ▪ General land forming ▪ Buffer material to be placed above Level 2 and Level 3 Material ▪ Interim bunding for stockpiled material ▪ Site capping material. Level 1 material properties are to be validated in accordance with the Tender Specifications for testing and analysis.

Materials Management Plan	
Level 2 Material management	Level 2 material is designated as having restricted site use and where encountered is to be managed as follows: ▪ Where suspected Level 2 soils are encountered then the nature and extent of the materials should be validated by laboratory testing to assess whether the materials are still to be classified as Level 2 or Level 3 materials ▪ If Level 2 material is encountered but is to remain in place and will have sufficient cap (ie >500mm), the vertical extent does not need to be validated ▪ The Contractor is to develop a notification detailing material type, location, estimated quantity and potential contaminants ▪ The Contractor is to notify the State or its representative within 24 hours of encountering Level 2 material ▪ Level 2 material may be relocated to a lined and covered short-term stockpiling or skip-bin for further quantification, characterisation and categorisation ▪ Confirmed Level 2 contaminated material is to be isolated by covering with at least 500mm of Level 1 material, plus 500 mm of cap with preference for material to be left in situ provided there is no immediate risk to the environment or community or otherwise be relocated to an on-site location.
Level 3 Material Management	Level 3 material is designated as having restricted site use and must managed as follows: ▪ The Contractor is to develop a notification detailing material type, location, quantity and potential contaminants ▪ The contractor is to notify the HCCDC as soon as possible and on the day the material is encountered. ▪ HCCDC will then notify the EPA ▪ Level 3 material may be relocated to a lined and covered stockpile or skip bin for further characterisation and categorisation and while a decision is made by HCCDC on the preferred manner of ultimate disposal. The HCCDC will provide direction as to the required treatment of Confirmed Level 3 contaminated material which may include: ▪ Isolated by covering with at least 1000mm of Level 1 material, plus 500mm of cap with preference for material to be left in situ provided there is no immediate danger to the environment or community or otherwise be relocated to an on-site location with the area having appropriate controls in place ▪ Transported off-site for disposed in a legal manner.
Asbestos Management	Asbestos materials (and ACM) should be managed generally as follows as specified in RCA MMP (2012): ▪ Where at all possible, materials containing bonded asbestos wastes would be fully delineated, be assessed to be at least 1m below final capping, and remain as undisturbed materials managed by in-situ containment ▪ Should any fill materials containing bonded asbestos wastes require excavation as they are not in-situ more than 1m from the final cap in the earthworks, then consideration would be given to removing the materials and emplaced at a depth of 1m ▪ Friable asbestos would be assessed and considered for emplacement at a depth of 2.5m below the underside of the capping layer within a purpose built excavation at a location to be agreed with HCCDC

Materials Management Plan	
	▪ Final location of any asbestos discovered shall be thoroughly documented including accurate survey of the emplacement area ▪ Where asbestos waste is found in fill that also contains volatile organic compounds or separate phase hydrocarbons, appropriate treatment for recorded contaminants will be required ▪ All asbestos is to be managed and handled in accordance with the recommendations of an appropriately licensed Asbestos Assessor/handler. The use of in-situ or ex-situ treatment approach for any materials containing bonded and friable asbestos wastes will be assessed on a case by case basis in relation to volume and risk to human health.
Other waste management	Minimal volumes of material requiring off-site disposal have been encountered in previous stages of KIWEF closure works. In the event that such material is encountered it will be classified in accordance with the Waste Classification Guidelines (2015) and disposed of to a landfill legally able to accept the waste. Wastes generated in completing the capping works are also required to disposed of off-site. All other contaminated materials will be managed on site in accordance with the Materials Management Plan. Waste management measures to be implemented include: ▪ Licensed waste contractors will be utilised to remove waste ▪ All waste is to be disposed of at a lawful facility (Note: A lawful facility includes one that has the appropriate Development Consent, Environment Protection Licence or is complying with EPA approved conditions and requirements) ▪ Waste must be classified prior to disposal – refer to NSW EPA Waste Classification Guidelines (2015) ▪ Records of the quantity and final locations of all on and offsite waste will be maintained ▪ Provision of skip bins (or equivalent) to be used to collect all general wastes generated during the works ▪ Provide an adequate number of skip bins on site to contain all general waste generated throughout the works ▪ Provide bins to enable waste segregation ▪ Provide recycling services (e.g. Paper, Concrete, Steel, Cardboard, Timber) ▪ Ensure housekeeping is maintained and waste is disposed of to the appropriate bin ▪ Retain waste disposal permits and figures on the amount of waste that has been removed from site.
Monitoring & Reporting	**Real-time Supervision** - Real-time observation of all ground disturbances by a suitably qualified environmental practitioner to identify and manage suspected contaminated material. Inspection of imported materials to confirm suitability and retention waste exemption evidence. **Sampling and analysis** of material properties for categorisation and validation purposes in accordance with the tender specifications. The **daily record of material management** is required to summarise material interaction for the day and include: ▪ Description of earthworks activity undertaken

Materials Management Plan	
	▪ Description of cut to fill or cut to stockpile activities including locations ▪ Notification to HCCDC of suspected contaminated or otherwise hazardous material encountered and description of handling, current location, further assessment required ▪ Summary of any handling of previously notified material including update on current location. All notifications are also to be tracked through a notifications register to record final disposal location. **Monthly Progress Reporting** is to include details of the implementation environmental management requirements including: ▪ Update on any environmental risks and opportunities, and significant environmental impacts associated with the works ▪ Progress against environmental objectives, targets and measures of performance ▪ Management actions, including environmental controls, training, inspections and testing. Specifically, the environmental monthly reporting is to include such items as: ▪ Characterisation, site management and fate of contaminated material, collated materials tracking information ▪ Quality assurance on placed material ▪ non-compliances and corrective actions ▪ environmental monitoring requirements ▪ monthly logs and photographs and other records of the progressive compilation of information that will be integrated into the Validation Report on completion. A **Validation Report** is required to satisfy Condition 4h of the Surrender Notice which requires that there is written confirmation the cap was established in accordance with relevant specifications.
Actions	The Contractor's CEMP is to include specific procedure for monitoring, management and documentation of materials management suitable for implementation to achieve the intent of the Materials Management Plan and Surrender Notice under the Contractors specific construction methodology.
Responsibilities	The Contractor is to ensure that appropriate resources and processes are in place and that appropriate records are kept to allow validation that materials have been managed in accordance with the Surrender Notice.
Timeframe	Duration of site activities where works may encounter potentially contaminated fill materials.

6.5 Transport

6.5.1 Existing Environment

Access to the Proposal Area is via Windmill Road from Cormorant Road. Windmill Road is a two way, undivided access road with limited line markings beyond the intersection with Cormorant Road and has a sign posted speed limit of 40 Km/h. Cormorant Road is a divided 4-lane road with a sign posted speed limit of 80 km/h. Cormorant Road is approximately a distance of 200m south of the Proposal area and connects Toule Street in Mayfield to the coal loaders at Kooragang and Port Stephens. No on road parking is available on Cormorant Road while pull over bays are available on Windmill Road. On road cycleway is provided on Cormorant Road with road markings distinguishing the shared road cycle lanes from Left Turn lane into Windmill Road.

Capacity upgrades to Tourle Street and Cormorant Road have recently been completed.

The intersection configuration for Windmill Road to Cormorant Road is Left and Right turn in and Left turn out only all with designated turning lanes. No acceleration lane is provided on the left out turn to Cormorant Road.

Material won from previous Closure Works stages under separate approvals would be require haulage vehicles to access Cormorant Road via a left turn out. No acceleration lane is provided on the left out turn to Cormorant Road.

No public vehicle access is provided to the Proposal area. Access to the Proposal area would be provided by existing restricted access gates and roads controlled by NCIG under existing access rights.

No designated parking areas are available but adequate space within previously completed Closure Works stages is available.

6.5.2 Potential Impacts

It is anticipated that the vast majority of truck movements to and from the site would be truck and dogs with only equipment being delivered or picked up with larger vehicles. The construction traffic would involve:

- Heavy vehicles arriving and departing generally during standard construction hours and avoiding peak periods to the extent feasible (without extending construction duration)
- Some limited deliveries may be received after hours particularly deliveries of fill/capping materials from 24hr operations such as the current Sydney Tunnelling Operations if materials are suitable and become available. Any works outside the standard construction hours will be restricted to delivery of materials only
- Heavy vehicle generation: About 100 truck deliveries per day (100 movements in and 100 movements out) with maximum delivery per hour of 10 trucks if deliveries are limited to standard construction hours only
- Construction workers vehicle traffic generation: Arrival of about 20 construction worker cars between 6:00am to 7:00am, and departure between 3:00pm to 6:00pm
- Trucks would not be permitted to park in any area that is not a work zone or parking area, including on existing streets in the area. The volume of trucks expected at the site would be coordinated by the contractors to not be required to wait for the previous truck to exit the site.

No road closures are required as part of the construction and impacts on emergency and service vehicles would be minimal. Traffic controls on Windmill Road may be required to facilitate safe turning of vehicles returning to existing stockpiles within KIWEF as they enter the PWCS Fines Disposal Facility / Easement PondDelta Site Haul Road. There would be no impacts to bus services associated with these works.

Post construction, the proposed works would not result in any changes to the existing road network or generate any traffic and therefore would not have any impacts on its existing operation or efficiency.

Based on the above the following risks remain that require management:

- Haulage vehicles accessing Cormorant Road either full or empty with no acceleration lane
- Access conflicts with NCIG access road.

All truck movements would be undertaken in accordance with a code of conduct outlining driver expectations. Haulage would be planned to avoid queuing of trucks in or around the construction site and to accommodate site security requirements in consultation with NCIG. The contractor will ensure that:

- All laden trucks entering or exiting the site have their loads covered
- Appropriate measures are in place to minimise the tracking of material onto the road by vehicles leaving the site
- All vehicles are managed to prevent parking or queuing on public roads around the site

- No trucks queue at the entrance to the site before 7am Monday to Friday and 8am Saturday
- All trucks adhere to the nominated haulage routes.

Adequate capacity is considered to be available within the recently upgraded road network such that significant traffic impacts are unlikely.

6.5.3 Mitigation Measures

Table 6.5 provides a framework Traffic Management Plan for the Proposal.

Table 6.5: Traffic Management Plan

Traffic Management	
Objective	To ensure that additional traffic from construction activities does not cause an environmental nuisance.
Targets	No valid complaints resulting from congestion from construction traffic Comply with traffic management standards
Legal, Contractual and Other Requirements	*Protection of the Environment Operations Act 1997* *Roads Act 1993* RTA Traffic Control at Worksites Roads (General) Regulation 2000 *Local Government Act 1993*
Controls (means and resources)	The Contractor is required to develop a Traffic Management Plan detailing the route to the site, times of activity, types of machinery, signage, traffic control measures, once the source of any imported materials has been identified. The following traffic management control measures to be implemented are to be detailed in Construction Traffic Management Procedures (CTMP): ▪ Traffic will be required to adhere to routes and speed limits designated by the Contractor, in consultation with the HCCDC, ARTC, NCIG and TfNSW ▪ Worksite speed limits will be determined for areas of the site based on road type, road condition and adjacent work activity ▪ Normal road rules apply unless specifically stated otherwise ▪ Barrier systems may be used at the discretion of the Contractor to define the designated routes ▪ The need for traffic controls on Windmill Road will be confirmed by haulage contractor and any necessary approvals sought ▪ All project personnel will be required to undertake the site induction that will specify appropriate traffic practices on site ▪ Site staff with responsibilities for control of construction activities will perform site inspections aimed at maintaining traffic at determined worksite speed limits ▪ Following site surface stabilisation/ rehabilitation works to control erosion, foot and vehicular traffic will be avoided on recently stabilised areas wherever practical ▪ Water spraying (where appropriate) will be used to minimise the generation of dust from roadway surfaces ▪ An inspection system will be established by the Contractor to assess effectiveness of traffic control measures. The assessments will determine if any modification is required to practices on site or the CTMP

Traffic Management	
	▪ An incident management procedure for emergencies relating to traffic management for the project works.
Actions	Contractor to incorporate the above traffic management measures into Contractor's Traffic Management Plans.
Responsibilities	The Contractor is responsible for ensuring traffic management plans are developed, approved and implemented.
Timeframe	Duration of site works.
Monitoring and Reporting	Daily inspection, checks and regular maintenance to be completed for traffic control measures.

6.6 Noise and Vibration

6.6.1 Existing environment

The Eastern Ponds are enclosed by the NCIG Rail loop. The nearest suburbs containing sensitive receptors are:

- Mayfield located 2 km to the south
- Sandgate located approximately 2.8 km to the west
- Tomago located approximately 4.5 km to the north
- Stockton located approximately 4 k to the east.

Existing daytime and night time ambient noise levels near the Proposal are heavily influenced by Industrial operations and road and rail traffic as follows:

- Coal trains on the NCIG rail loop and Kooragang Island mainline
- NCIG rail unloading station
- NCIG coal stackers and reclaimers
- Traffic on Tourle Street and Cormorant Road
- Ship loading infrastructure
- Metal recycling.

6.6.2 Potential Impacts

The Proposal would involve the following noise generating activities:

- Receipt and stockpiling of capping materials
- Vegetation clearing
- Minor cut and fill activities and excavation works to stabilise slag walls and create competent base layer
- Placement and compaction of capping layers.

A detailed list of plant and equipment and their sound levels has not been established for the Project and it is considered that noise modelling is not warranted on the following basis:

- Works will be limited to standard construction hours; with the potential exception of delivery of suitable capping/fill materials from 24 hour operations such as Sydney Tunnelling Projects, if available
- Plant and equipment is likely to be similar to that used on prior stages of closure works but with fewer items due to the limited space available

- With the exception of the receipt and stockpiling of materials at the temporary stockpile (if required), all activities will occur within the depression formed by the eastern ponds and be fully screened from receptors by surrounding landforms including completed closure works and NCIG Rail loop. Out of hours deliveries, if required, would not be delivered to the temporary stockpile location
- No noise complaints were received associated with prior stages which were notable closer to receptors and provided with reduced topological screening
- Road noise would not be exacerbated due to the existing high volume of traffic and compositely minor volume of traffic generated during closure works
- No operational noise generation meaning noise would be limited to the duration of construction only
- Standard, reasonable and feasible noise mitigation measures would be adopted as per past Closure Works stages.

The nearest residence is over 2 km from the Proposal area and is separated by operational rail embankments and set either beyond other industrial operations or amongst light industrial operations. Existing noise producers in the area include rail and road traffic, activities associated with the coal loaders and various industrial activities within the industrial estates.

Noise from the Proposal is likely to be inaudible above traffic noise at the nearest residents and of negligible annoyance in relation to usual ambient noise exposure. Noise exceedances of noise affected levels (background plus 10 decibels) related to the proposed works are unlikely given the type and small amount of plant, the distance to the closest residential receiver and likely elevated existing noise levels.

Given that the types of machine to be used during construction do not have significant impact energy and that blasting is not required, vibrations resulting from the activities are not likely to be detectable to the nearest residents. The use of vibratory rollers during construction may generate vibration impact to surrounding receivers. No vibration sensitive receptors are located within the vicinity of the Proposal and the detailed design and construction methodology will accommodate any necessary controls or setbacks to protect the NCIG rail infrastructure as necessary.

6.6.3 Mitigation measures

Table 6.6 provides a framework noise and vibration management plan for the Proposal.

Table 6.6: Noise and Vibration Management Plan

Noise and Vibration	
Objective	To ensure that noise and vibration from construction activities does not cause environmental nuisance or unnecessarily disturb fauna.
Targets	No valid noise / vibration complaints resulting from construction works. No unreasonable noise or vibration. No noise and vibration impacts on external receptors.
Legal, Contractual and Other Requirements	Works are to be undertaken in accordance with the Interim Construction Noise Guidelines with works to be restricted to: ▪ 7 am to 6 pm Monday – Friday ▪ 7 am to 1 pm Saturdays Opportunistic receipt of materials from 24 hour operations such as Sydney Tunnelling Projects may be delivered after hours, but will be restricted to material delivery only. No work outside of these hours without further consideration and HCCDC's approval (except for emergency situations).

Noise and Vibration	
	Protection of the Environment Operations Act 1997 *Protection of the Environment Operations (Noise Control) Regulation 2000*
Site specific planning / approval conditions / licence conditions	All activities associated with the closure, capping, rehabilitation and post-closure maintenance and monitoring at the premises must be carried out in a competent manner. This includes: ▪ The processing, handling, movement and storage of materials and substances used at the premises ▪ The treatment, storage, processing, reprocessing, transport and disposal of any waste generated by the activity. All plant and equipment installed at the premises or used in connection with the closure, capping, rehabilitation and post-closure maintenance and monitoring activities at the premises must be: ▪ Maintained in a proper and efficient condition ▪ Operated in a proper and efficient manner.
Controls (means and resources)	No work will be undertaken outside of the agreed hours without prior approval (except in an emergency situation). Delivery operations or other noise generating activities at compound and storage areas will take place during the standard construction hours nominated above, unless specifically required by Police or Transport for NSW requirements. 24 hour delivery of material directly to the eastern ponds depression would be discontinued if audible at receptors and generating complaints. Reasonable and feasible mitigation measures to be considered as required include: ▪ Avoiding where practical the use of noisy plant simultaneously close together or adjacent to sensitive receptors ▪ All plant will be maintained in accordance with the manufacturer's requirements ▪ Stationary noise generating equipment to be orientated away from sensitive areas ▪ Undertaking loading and unloading activities away from sensitive areas and during designated construction hours ▪ Selection of the most appropriate plant and equipment to minimise noise generation and include where necessary screening and enclosures ▪ Regular checks are to be undertaken to ensure all equipment and vehicles are in good working order and are operated correctly ▪ Awareness training and information will be provided to project personnel in relation to the vibration requirements on the project and the need to minimise vibration when in close proximity to operational areas (rail corridor).
Responsibilities	Contractor
Timeframe	Duration of site works.
Monitoring and Reporting	Vehicle inspections to be recorded on daily vehicle pre-start checks.

6.7 Visual

6.7.1 Existing environment

The visual catchment is highly disturbed and dominated by existing port, road and rail infrastructure. The topography of the Proposal area is generally flat and elevated above the natural ground surface as a result of

KIWEF development which consisted of the creation of approximately nine metre high slag walls around disposal cells that have been predominantly filled, capped and rehabilitated associated with prior stages of Closure Works. The base of the eastern ponds are at an elevation below these surrounding completed Closure Works areas. The topography of the Proposal area has also been altered by the NCIG rail loop which completely surrounds the Proposal area. The Proposal area is entirely screened from public and sensitive receivers by topography, vegetation along Cormorant Road and existing infrastructure.

6.7.2 Potential Impacts

No significant visual impacts are likely based on the following considerations:

- No public or sensitive viewpoints exist for the Proposal area
- Views into the Proposal area would be limited to staff and visitors of NCIG and train drivers on the NCIG rail loop
- Construction visual impacts would be temporary and limited to fencing, tree removal and earthworks activities
- Night works (if required) would be limited to the delivery of materials within the Eastern ponds for a short duration. Some lighting may be used to illuminate the unloading area for safety purposes.
- Once construction is complete, the site would be rehabilitated to reflect the existing environment
- The Eastern Ponds would remain at an elevation below that of surrounding areas.

6.7.3 Mitigation Measures

The following mitigation measures would be implemented:

- Night works would be limited to delivery of capping material
- Lighting would be limited to that necessary for safety purposes and turned off when deliveries are not occurring
- Lighting would be positioned and directed such that light spill to habitat is avoided and does not interfere with safe operation of NCIG rail loop

6.8 Heritage

6.8.1 Existing Environment

The Proposal is located in the Awabakal Local Aboriginal Land Council area.

An AHIMS search was conducted on 20 July 2020 with a 200m buffer to identify registered (known) Aboriginal sites or declared Aboriginal places near the Proposal. This search returned no recorded Aboriginal sites.

Other searches found that the Proposal area does not appear on the National Heritage List, Commonwealth Heritage List, State Heritage Register and Register of Declared Aboriginal Places.

A search of all available heritage registers was carried out on 28 July 2020 and covered the following searches:

- State Heritage Register (SHR)
- State Heritage Inventory (SHI)
- NSW Roads and Maritime Services Section 170 Heritage and Conservation Register
- Relevant LEPs
- Register of National Estate (RNE)
- Commonwealth Heritage List (CHL)
- National Heritage List (NHL)

- World Heritage List (WHL).

No listed heritage items are located within or next to the Proposal.

6.8.2 Potential Impacts

Given the history of the area operating as a landfill, the Proposal is unlikely to pose a risk to indigenous or non-indigenous cultural heritage artefacts. Due to the previous land use, its' highly modified nature and the nature of the closure works, it is considered that there is no potential for occurrence of items of indigenous heritage.

No disturbance or excavation of natural soil is proposed and therefore risk of disturbing areas of archaeological potential is very low. It is unlikely that Aboriginal or non-Aboriginal heritage items would be present within the project footprint.

6.8.3 Mitigation Measures

Table 6.7 provides a framework heritage management plan for the Proposal.

Table 6.7: Framework Heritage Management Plan

Heritage Management	
Objective	To ensure that undiscovered heritage and archaeological items are protected from construction activities.
Targets	Unknown or undocumented heritage sites are not knowingly destroyed, defaced or damaged. Identify and protect any new artefacts or heritage sites before any harm can take place.
Legal, Contractual & Other Requirements	*Heritage Act 1977* *National Parks and Wildlife Act 1974*
Controls (means & resources)	No known heritage items or areas have been identified within the project site or surrounds. As such, heritage mitigation measures are limited to restricting access beyond the project boundary and the implementation of the following 'chance find' protocol: ▪ In the event that potential Aboriginal and Historic heritage items are discovered, STOP ALL WORK in the vicinity of the find and immediately notify the relevant Construction Supervisor and Environmental Manager ▪ Contact HCCDC to notify of the find as soon as they receive notification ▪ In the event of uncovering remains that are potentially human, the NSW Police are also to be contacted immediately ▪ Record the details and take non-intrusive photos of the find and relay information to HCCDC ▪ HCCDC will contact a qualified archaeologist to get advice regarding the nature and potential significance of the find ▪ If the qualified archaeologist advises that the find is not a potential heritage item, work will recommence in consultation with HCCDC ▪ If the qualified archaeologist advises that the find is a potential heritage item HCCDC will contact and notify the relevant authority ▪ Work is not to recommence in the area of the identified find until clearance is received from HCCDC.
Responsibilities	All persons are responsible for reporting items of potential cultural or heritage value.

	Contractor's representative will ensure the implementation of the above chance finds protocol in the event that items of potential cultural or heritage value are uncovered.
Timeframe	Duration of site works
Monitoring & Reporting	Ongoing visual observations for previously unidentified items. Reporting of any chance finds in accordance with the above protocol.

6.9 Air Quality and Odour

Air quality in the region is influenced by emissions from industry including port and coal handling operations, domestic fuel burning and vehicle emissions. The Proposal is located adjacent to the NCIG Coal terminal and surrounded by the NCIG rail loop.

Due to the vegetation covering of the Eastern Ponds it is considered that there would be minimum air quality impacts currently originating from Proposal area.

6.9.1 Potential Impacts

Activities associated with the closure, capping, rehabilitation and post-closure maintenance and monitoring at the premises including truck, machinery and vehicle movements would be carried out in a manner that will minimise the emission of dust from the premises. Air quality impacts during construction of the Proposal would largely result from dust generated during earthworks and stockpiling of materials. During the construction of the Proposal, temporary impacts on air quality and odour may arise from:

- Clearing of vegetation and topsoil by bulldozers and backhoes where required
- Excavation and levelling of soil by bulldozers, backhoes, graders, excavators and/or scrapers
- Movement of soil and fill by dump trucks and other construction vehicles
- Wind erosion from unsealed surfaces and stockpiles
- Wheel generated dust by construction vehicles travelling along unsealed areas
- Emissions (primarily diesel exhaust) from plant and machinery and other construction traffic
- Odours may be generated if significantly contaminated material is encountered.

There is limited potential for air quality impacts to affect human receivers during construction as the nearest residences are approximately 2km to the south. Dust impacts to neighbouring ponds and vegetation will require controls to be implemented.

Exposed areas would be stabilised as quickly as possible and appropriate dust suppression methods and practices would be used to keep dust impacts to a minimum.

The air quality of the locality and nature of the Proposal is such that no significant impact on air quality is expected from the works. Some local, short term emissions may be experienced during construction due to dust from earthworks and engine exhausts, however such emissions will be minor and short-term during dry weather conditions. Should significantly odorous materials be encountered during the works, they will be segregated and covered to the extent practicable, in accordance with the sites Materials Management Plan. No ongoing or long term air quality impacts will result from the operation of the Proposal and no significant air quality impacts are likely.

6.9.2 Mitigation Measures

Table 6.8 provides a framework air quality and odour management plan for the Proposal.

Table 6.8: Framework Air Quality and Odour

Dust and Air Quality	
Objective	To ensure that dust and other air emissions from construction activities do not cause impacts on sensitive receivers and equipment.
Targets	No visible dust (or offensive odours) leaving site and reaching: ▪ Identified or potential GGBF habitat, particularly water bodies and fringing vegetation ▪ Cormorant Road or neighbouring coal loader operations.
Legal, Contractual and Other Requirements	Contract specification *Protection of the Environment Operations Act 1997* *Protection of the Environment Operations (Clean Air) Regulation 2002*
Site specific planning / approval conditions / licence conditions	All activities associated with the closure, capping, rehabilitation and post-closure maintenance and monitoring at the premises must be carried out in a manner that will minimise the emission of dust from the premises.
Controls (means and resources)	Mitigation measures include amending the nature of work in the event that construction works do not meet the above Objective. Operation of all facilities and equipment on the site will be performed so as to minimise reduce the emission of dust, odour and other air impurities including: ▪ Use of water sprays to reduce dust emission from trafficable areas, work areas, stockpiles and other exposed areas but not to draw water from existing ponds as per the flora and fauna management plan ▪ Where necessary, stabilisation of long term stockpiles ▪ Reduce the number and extent of disturbed areas at a given time during closure works ▪ Control of haul loading vehicles, whereby the load will not exceed the height of the haul boards and tailboards on the vehicles ▪ The vehicle speed shall be restricted along the haul roads on site to minimise dust generation and potential spilling of hauled material ▪ Cleaning/maintenance of the access and haul roads where they interface with public roads to prevent sediment tracking ▪ Loads of soil or contaminated material entering and leaving site will be covered. Internal material transport will also require a cover if material is likely to or observed to be generating dust ▪ Any excavated material likely to generate odours will be covered ▪ Maintenance and servicing of plant and vehicles to minimise reduce emission of air pollutants ▪ Observations of prevailing (and forecast) weather conditions, to program site activities in order to minimise air quality issues ▪ Modify work practices during dry and windy conditions ▪ Progressively stabilise and/or revegetate as areas of works as completed ▪ Provide shaker grids or rumble strip at site egress points and where aggregate is used, minimum size is 150mm ▪ Remove mud from haul vehicles prior to entering public roads ▪ Remove spilt mud by construction equipment or vehicles on public roads

Dust and Air Quality	
	▪ Provide awareness training in the need to minimise dust during site inductions and toolbox talks.
Actions	Contractor to implement reasonable and feasible measures from the above to achieve air quality objectives.
Responsibilities	Contractor
Timeframe	Duration of site works. Water tankers and other measures available at the commencement of earthworks. Spilt mud and sediment to be removed from public roads as soon as practicable, and at least prior to the end of each shift.
Monitoring and Reporting	Daily observations of dust generation, mud tracking, vehicle emissions, site generated odours and weather conditions (wind direction and strength). Weekly inspect to record functioning of air quality controls.

6.10 Socio-economic

Given the short-term nature of construction and the small scale of the works, minimal social impacts from the closure works is expected. Social impacts include the brief contribution of the construction works to the generation of local employment and support of local business. The works will not hinder the function of any other business or community activities in the area.

The works also provide a positive social benefit by reducing the potential exposure of contaminants to surrounding areas.

6.11 Cumulative Impacts

The site is surrounded by various major developments including operational coal terminals and other waste disposal facilities in various stages of closure. Neighbouring projects identified include:

- Operational NCIG coal terminal and rail loop
- Completed KIWEF Closure Works in Areas 1, 2 and 3
- Completed Tourle Street Bridge duplication Cormorant Road upgrades
- Proposed Newcastle GasDock Terminal (GasDock).

As such the activity has the potential to contribute to cumulative impact on the following environmental conditions:

- Additional construction traffic on existing road networks with adequate capacity
- dust and other air impurities contributing to existing local and regional air quality concerns during construction
- clearing of habitat for fauna species
- generation of waste requiring landfill disposal
- changes hydrology and water quality.

The Proposal is surrounded by the NCIG rail loop. The NCIG development has implemented landfill closure obligations on parts of KIWEF in the process of completing the development. The NCIG rail loop contributes to noise and air quality conditions in the vicinity of the site and has also altered site hydrology. As the proposed activity impacts are limited to the construction stage only it is not considered that any impacts would become significant as a result of relationship to the NCIG rail loop operation.

The closure of other areas of KIWEF has been completed and no cumulative construction impacts with these projects is possible. The Proposal would provide a positive contribution to long term contamination management and biodiversity outcomes that have been identified as resulting from completed stages of the Closure Works.

The completion of the Tourle Street Bridge duplication and Cormorant Road upgrades means there is no potential for cumulative traffic impacts from that Project. The improved capacity of the road network would not be exceeded by the short term increase in construction traffic generated by the Proposal.

Cumulative impacts with GasDock would arise if capping and construction works coincide as GasDock scoping report identifies that excavations and traffic control on Windmill Road would be required. As the Environmental Impact Statement is yet to be exhibited, HCCDC will have the opportunity to make a submission which would need to be considered in determining the Project. HCCDC will consult as necessary with the Proponent of the GasDock to minimise and potential cumulative impacts.

The proposed activity's contribution to potential cumulative impacts has been assessed in prior sections. The contribution of project impacts are not considered significant based on the following:

- Impacts to fauna foraging habitat will be of a short term duration and are not considered to be cumulative on the basis that the habitat will be returned post completion of construction with completed stages of the Closure Works demonstrating positive biodiversity outcomes
- With the exception of changes to hydrology, all impacts are related to short term construction works only with no long term detrimental consequences identified
- Water chemistry changes are predicted to be a general improvement with potential changes to salinity levels not considered to significantly increase risk of chytrid fungus mortality in GGBF
- Short term traffic impacts if coinciding with GasDock construction could lead to disruption in the area but are not considered to represent a significant environmental impact.

7. Summary of mitigation measures that form part of the Proposal

Mitigation measures applied to previous stages of closure would be implemented. **Table 7.1** outlines the environmental safeguards and management measures applicable to the overall Proposal to assist in minimising any potential adverse impacts arising from the proposed works on the surrounding environment.

Table 7.1: Summary of mitigation measures

Sequence of Work Activities	Controls/Mitigation Measures
Tender and award	▪ Establish all required approvals under EPBC Act, EPA Act, POEO Act and other agency and neighbours (traffic, access, monitoring data) ▪ Integrate above requirements into EMP describing the series of specific management plans for construction and site management for inclusion in tender specifications ▪ Tender documents shall prescribe that Principal Contractor(s) shall have demonstrated capability to develop and implement suitable EMP systems, procedures and measures for the works. (Environmental Management System has been accredited under the NSW Government Environmental Management Systems Guidelines (EMS Guidelines) or equivalent)
Pre-earthworks monitoring and ongoing EPL Surrender Notice monitoring.	▪ Update relevant GGBF abundance survey data and water level and salinity logger data ▪ Undertake annual surface and groundwater monitoring as per EPL Surrender notice
Pre-earthworks planning meeting/toolbox talk	▪ Principal Contractor to incorporate Principal's EMP requirements as necessary and undertake all necessary environmental inductions prior to proceeding with works ▪ A primary focus of inductions should be the GGBF, hygiene protocols, installing and maintaining temporary fencing (including vegetation suppressant buffers) and erosion and sediment control
Site Establishment	▪ Implement hygiene protocol as required for the Closure Works area (NSW Threatened Species Management Information Circular No.6 (April 2008)) ▪ Temporary frog exclusion fencing to surround the Proposal site and ensure adjacent GGBF habitat is protected from unauthorised access prior to works commencing ▪ Temporary frog fencing will include passive release system consisting of ramps on inside of the exclusion fence to allow egress of any GGBF caught within the exclusion fence prior to commencement ▪ Temporary frog fencing will include the establishment of a vegetation suppressant buffer (minimum 1m wide) on the exterior side of the fence. The buffer will be maintained to suppress vegetation growth and ensure any objects that may provide a potential GGBF access route over the exclusion fencing are removed ▪ The buffer is to be managed proactively, through implementing lessons learnt from prior incidents and to minimise potential for frogs to become trapped and exposed which may include provision of habitat refuge, mulch cover over exposed surfaces, watering and regular inspections ▪ Conduct pre-clearance surveys by a qualified ecologist prior to works commencing works in areas or their parts

Sequence of Work Activities	Controls/Mitigation Measures
	▪ Apply erosion and sediment controls as per sensitive environments (Managing Urban Stormwater – Soils and Construction (Landcom 2004)) ▪ Chemicals proposed to be used on site are required to be known and verified as being safe in sensitive environments and particularly in relation to amphibians. The use of flocculants is not supported ▪ Prepare stockpile area with adequate space for "topsoil" level 1, 2 and 3 material and erosion and sediment controls as per ESCP and Materials Management Plan (RCA Australia 2012) ▪ Level 2 and level 3 interim stockpile areas are to be lined in accordance with materials management plan (RCA Australia 2012) as necessary ▪ Store all hazardous liquids and chemicals in covered, bunded areas with capacity to retain 110% of largest container in the event of a spill. Proprietary available spill mats, drip trays and pallets can be used as appropriate ▪ Provide fully stocked spill kit/s and ensure that operators are aware of the location of these kits and are trained in their use.
Bulk earthworks	▪ Use of imported capping material assessed as having a low risk of containing Chytrid Fungus ▪ Use of revegetation medium materials demonstrated to be low in added nutrients (eg manufactured soils boosted with fertilisers, or waste exempt sludges and processed topsoils (eg recycled waste) which are high risk of causing eutrophication in enclosed waters) and assessed as having a low risk of containing Chytrid Fungus in accordance with revegetation management plan ▪ Works are to be staged to reduce area of exposure and minimise dust, infiltration and sediment laden run-off ▪ Qualified ecologist to be available on call during earthworks in the event that any GGBF individuals are encountered during works, the ecologist must be called in to capture and relocate the individuals ▪ Materials will be managed in accordance with the approved Materials Management Plan and GGBF management plan ▪ Cleared vegetation to be stored separately in prepared stockpile areas as per detailed design documentation. Subsequent processing which should include consideration of mulching should account for the potential presence of fauna ▪ Stockpiles to be stored for long periods are to be wrapped, covered, re-seeded or wet to minimise dust generation as necessary ▪ Cut to base of excavations as per detailed design documentation insuring minimum 1% grade. Cut material to be used as fill and capping in accordance with materials management plan decision matrix ▪ The final surface of both capped and uncapped areas will be protected by a vegetative layer ▪ Upon completion of the works, the works areas must be rehabilitated with local native vegetation species ▪ Dispose of materials unsuitable for reuse in accordance with materials management plan ▪ All waste to be removed upon completion

Sequence of Work Activities	Controls/Mitigation Measures
	▪ Upon completion, site facilities, frog exclusion fencing and security fencing shall be removed as necessary ▪ Non-permanent erosion and sediment controls are to remain in place until they are no-longer required ▪ Sediment basins and drains will remain in place as landscape features until they are no longer required ▪ Refuelling is not to occur in the vicinity of sediment dams, drainage lines or water bodies ▪ Refuel plant using drip trays/spill mats and other spill containment devices ▪ Store all hazardous liquids and chemicals in covered, bunded areas with capacity to retain 110% of largest container in the event of a spill. Proprietary available spill mats, drip trays and pallets can be used as appropriate ▪ Do not leave chemical containers open outside or inside of the bunded areas ▪ Provide fully stocked spill kit/s and ensure that operators are aware of the location of these kits and are trained in their use ▪ Spills are to be immediately contained and absorbed using materials provided in the spill kit ▪ All personnel are to be trained in the appropriate use and disposal of spill kit materials.
Construction Monitoring	▪ Daily prestart checks on amphibian disease hygiene station, to confirm the station is functioning (appropriate water level and disinfectant dosing with water top-up); and weather forecast noting predicted wind and rain ▪ Real-time classification of soils to nominated thresholds in accordance with the Materials Management Plan decision matrix ▪ Inspection of imported material for suitability and compliance with applicable waste exemptions ▪ Post rainfall checks of sediment dam water level and water quality and erosion and sediment control functioning ▪ Weekly site inspection checklist covering sediment dam water levels and water quality, erosion and sediment control structures, frog fences, fuel and chemical storage, stockpile bunding and covers ▪ Pre-discharge physical water quality condition (temperature; dissolved oxygen; pH; electrical conductivity (EC)) and chemical water quality condition in sediment dams ▪ Noise monitoring of any out of hours construction works in accordance with interim construction noise guidelines ▪ Inspection of inside and outside of exclusion fencing and provision of water in microhabitats when temperature is forecast to exceed 30 degrees with less than 50% humidity. Were unintended impacts to GGBF are identified all necessary efforts to reduce the severity and avoid reoccurrence are to be implement.
Defect liability period	▪ Check and maintain the erosion and sediment controls regularly, especially after rainfall, to ensure that they remain effective including: Collected sediment is to be removed from the controls as necessary to ensure they remain effective

Sequence of Work Activities	Controls/Mitigation Measures
	Collected sediment is to be combined with planting medium for reuse on the site – if appropriate ▪ All vehicle wheels, tracks and undercarriages must be cleaned prior to exiting the site and travelling on public roads ▪ Three month vegetation maintenance program to include, watering, weeding as appropriate but excluding the use of fertilisers and pesticides and herbicides ▪ Pre and post discharge surface water monitoring in sediment dams and receiving waters ▪ Revegetation monitoring and maintenance to ensure adequate cover.

8. Conclusions

This chapter provides the justification for the Proposal taking into account its biophysical, social and economic impacts, the suitability of the site and whether or not the Proposal is in the public interest. The Proposal is also considered in the context of the objectives of the EP&A Act, including the principles of ecologically sustainable development as defined in Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*.

8.1 Justification

HCCDC is working to complete its requirement to close the former landfill areas referred to as the KIWEF Eastern Ponds. The Proposal would complement the previous rehabilitation of adjacent land through improved habitat and connectivity. The Proposal would establish a high quality rehabilitation area that provides a semi-permanent waterbody.

While there would be some environmental impacts as a consequence of the Proposal such as biodiversity impacts, hydrology impacts and traffic impacts they have been avoided or minimised wherever possible through design and site-specific safeguards. The beneficial effects of the Proposal in providing the final rehabilitation of the KIWEF site, fostering biodiversity connectivity and improved contamination management is considered to outweigh the temporary adverse construction impacts and risks.

8.1.1 Social factors

The Proposal would have minor short-term negative social impacts related to traffic and noise. Mitigation measures are proposed that would prevent significant social impacts. The long-term effect would be an overall social benefit, by reducing risk of mobilisation of contamination from KIWEF.

8.1.2 Biophysical factors

The potential impacts on biophysical factors associated with the Proposal were assessed in the REF. The key environmental matters assessed were:

- hydrology and water quality;
- aquatic and terrestrial ecology;
- air quality.

The REF provides an assessment of these biophysical factors and it is concluded that construction of the proposed capping would not result in significant adverse environmental impacts to factors with the implementation of appropriate safeguards and mitigations.

The Proposal has the potential to impact ecology due to the presence of protected fauna species within the surround area. The construction of the Proposal would require clearing of vegetation and direct mortality of fauna species cannot be ruled out. Following construction, the site would be rehabilitated and an overall improvement in habitat would result from the establishment of a more permeant water body.

With the implementation of the recommended mitigation measures, construction impacts would be minimised to the extent possible. Previously completed stages of the Closure Works have demonstrated improved biodiversity outcomes post construction.

No significant or long term impacts to biophysical factors are considered likely.

8.1.3 Economic factors

The Proposal would generate short term construction jobs and local spend by construction workers. The completion of the Proposal would facilitate the release of KIWEF for future land uses.

No significant economic disruption is considered likely on the basis that the design and construction methodology will avoid conflicts and impacts to existing use of surrounding land by NCIG.

8.1.4 Public interest

The public interest is best served through the equitable distribution of resources, and investment in public infrastructure that fulfils the needs of the majority. The Proposal represents a cost-efficient investment in the closure of a former landfill. By reducing infiltration through the former landfill, the risk of contamination migration would be reduced. Through the minimisation of biodiversity impacts through implementation of proposed mitigation measures and the rehabilitation with improved habitat outcomes for threatened species, the public would also benefit from the preservation of a species important to the Internationally Important Hunter Estuary Wetlands.

Although the Proposal, would result in some short-term inconvenience and impacts on amenity these would be outweighed by the long-term benefits once the Proposal is operational. As a result, the Proposal is considered to be in the public interest.

8.2 Objects of the EP&A Act

The objects of the EP&A Act, and how these are addressed in the Proposal, are presented in **Table 8.1.**

Table 8.1: Consideration of the Objectives of the EP&A Act

Object	Comment
1.3 (a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	The Proposal would provide a rehabilitated area to increase biodiversity and avoid contamination. The Proposal landscape design, impacts, safeguards and management measures detailed in this REF allow for the proper management, development and conservation of natural and other resources. The Proposal is considered to have long term positive social and economic benefits with limited environmental impacts during construction.
1.3 (b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	Ecologically sustainable development is considered in Sections 8.2.1 to 8.2.4. In summary the Proposal: ▪ Would benefit future generations by rehabilitating a landfill ▪ Has considered environmental and social issues in the option process and incorporated the value upon environmental resources (improved valuation, pricing and incentive mechanisms).
1.3 (c) To promote the orderly and economic use and development of land.	A key objective of HCCDC and the Proposal is to facilitate the orderly and economic use and development of land. The Proposal is the final works to close the KIWEF site and when completed would trigger the release of the site to the Port of Newcastle. In the absence of a future use for the site, the Proposal would assist in improving habitat for threatened species and provide a rehabilitated area that is in keeping with the surrounding environment characteristics.

Object	Comment
1.3 (d) To promote the delivery and maintenance of affordable housing.	Not relevant to the Proposal.
1.3 (e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	Impacts to native animals and plants, including threatened species, populations and ecological communities and their habitats were considered in Section 6.2. All natural aquatic habitat and riparian features of Eastern Ponds have been historically removed and replaced by a landfill. There are no aquatic plant species occurring in the existing landfill and no mangrove trees remain. While the Eastern Ponds provide habitat for threatened species, the REF has found that the Proposal would be unlikely to have a significant impact to any threatened species, population or ecological community.
1.3 (f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The Proposal would not directly impact on any listed non-Aboriginal or Aboriginal heritage items and it is not considered likely that artefacts or relics have the potential to be present and be disturbed by the Proposal.
1.3 (g) To promote good design and amenity of the built environment.	Not relevant to the Proposal.
1.3 (h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	Not relevant to the Proposal.
1.3 (i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	Not relevant to the Proposal.
1.3 (j) To provide increased opportunity for community participation in environmental planning and assessment.	HCCDC will communicate the findings of the REF in accordance with their community consultation processes.

8.2.1 The precautionary principle

This principle states: "if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation".

The Proposal has sought to take a precautionary approach to minimising environmental impact. This has been applied through the development of a range of environmental safeguards to address the impacts identified in Chapter 7. These safeguards would be implemented during construction of the Proposal.

No safeguards have been postponed as a result of lack of scientific certainty. The selected construction contractor would be required to prepare environmental management documentation before commencing

construction. No mitigation measures or management mechanisms would be postponed as a result of a lack of information.

8.2.2 Intergenerational equity

The principle states: "the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations".

The Proposal has the objective of minimising the risk of contamination migration from the former landfill and as such is aimed at reducing risks for future generations associated with historic waste disposal practices. Implementation of the safeguards contained in this REF would ensure that the health, diversity and productivity of the environment is maintained for the benefit of future generations.

It is acknowledged that the Proposal may have some adverse impact on the current generation, generally through temporary construction impacts. However, these are not considered to be of a nature or extent that would disadvantage future generations.

8.2.3 Conservation of biological diversity and ecological integrity

This principle states: "the diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival".

An assessment of the existing local environment has been carried out to identify and manage any potential impact of the Proposal on local biodiversity. The Proposal is located in an area that has previously been modified as a result historic landfilling practice. The Closure Works for the Eastern Ponds has deliberately been delayed while the importance of the site to the survival of Green and Golden Bell Frog has been established. With the completion monitoring over a five year period it has now been concluded that the Eastern Ponds no longer provide critical breeding habitat and the further delay of Closure Works is no longer warranted. The potential impact of the Proposal on biodiversity would be limited to loss of habitat during construction and potential for some direct mortality. With the implementation of proposed mitigation measures these impacts will be reduced to the extent possible.

The Proposal would not significantly fragment or isolate any existing large patches of vegetation and would not compromise biological diversity or ecological integrity. No significant impact to flora and fauna species has been identified.

8.2.4 Improved valuation, pricing and incentive mechanisms

This principle is defined as:

> *Improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services, such as:*
>
> *(i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,*
>
> *(ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,*
>
> *(iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.*

The Proposal represents a significant investment by HCCDC in the closure of a former private company owned landfill. While HCCDC are not the polluter, they are the agency tasked by the State government to undertake the works using funds provided by the original private company for this purpose.

Environmental and social issues were considered in the strategic planning and establishment of the need for the Proposal, and in consideration of various Proposal options. The value placed on environmental resources is evident in the extent of the planning and environmental investigations, and in the design of the proposed mitigation measures and safeguards. The cost of the Closure Works overall has been minimised to the extent possible while still achieving the Proposal objectives.

8.3 Conclusion

The Proposal is subject to assessment under Division 5.1 of the EP&A Act. The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This has included consideration relevant legislation and impacts on threatened species, populations and ecological communities and their habitats and other protected fauna and native plants. Potential impacts to matters of national environmental significance listed under the Federal EPBC Act have been considered separately and concluded that significant impacts to matters of national environmental significance are unlikely.

The Proposal as described in the REF best meets the project objectives but would still result in some impacts on biodiversity, hydrology, traffic, noise and contamination management. Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts.

8.3.1 Significance of impact under NSW legislation

The following factors, listed in clause 228(2) of the *Environmental Planning and Assessment Regulation 2000*, have also been considered to assess the likely impacts of the Proposal on the natural and built environment.

Table 8.2: Consideration of Clause 228 of the EP&A Regulation

Factor	Impact
Any environmental impact on a community? The Proposal would have an acceptable risk profile in relation to sociocultural factors such as short term effects of audible noise at nearest sensitive receivers.	Nil Negligible noise, air quality and visual impacts of a temporary nature.
Any transformation of a locality? The Proposal would involve capping and revegetation aimed at returning the site to its current vegetated state and as such will have no transformative impact on the locality.	Nil
Any environmental impact on the ecosystems of the locality? In general, improvements in water quality and provision of permeant water body due to the Proposal would provide ecological benefits. Any negative changes would not be of a magnitude that would significantly impact on flora, fauna and ecological communities. The Proposal would also provide significant benefits to the environment in general by reducing the potential for contaminated material from the fill migrating into the surrounding environment.	Positive; Localised positive effects by improved water quality in the medium to long term. Short term disturbance of on-site foraging habitat. Long term provision of habitat for listed threatened species.
Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality? There would be no reduction in the aesthetic, recreational, scientific or other environmental quality in the locality from the Proposal.	Nil
Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical,	Nil

scientific or social significance or other special value for present or future generations? The Proposal will not affect a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations. Given the engineered landform that currently exists there is limited potential for any significant items to be present.	
Any impact on the habitat of protected animals (within the meaning of the Biodiversity Conservation Act 2016 The Proposal would involve the clearing of previously disturbed land. Impacts to foraging habitat are noted but will be limited to the duration of construction. Following completion, the Proposal area will be revegetated to return similar ground cover and habitat structure.	Positive; Short term, low level and localised negative impacts and long term benefits.
Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? Based on the EPBC Act and BC Act assessments undertaken, the Proposal is unlikely to have a significant impact on MNES, or NSW listed flora and fauna providing that the range of mitigation measures and management strategies recommended to reduce impacts are successfully implemented. A summary of impacts to biodiversity is as follows: ▪ The Proposal would limit the potential for contaminated material from emplaced fill leaching into surrounding habitats ▪ Improvements in water quality due to the Closure Works would provide ecological benefits to protected species ▪ Potential negative effects during Closure Works and revegetation would not be of a magnitude that would significantly impact on flora, fauna or ecological communities ▪ It is highly unlikely that the proposed works would disrupt the breeding cycle of any species as the site is no longer identified as important breeding habitat ▪ Areas of appropriate foraging and breeding habitat would be retained within and adjacent to the Closure Works area.	Positive; Short term, low level and localised negative impacts and long term benefits.
Any long-term effects on the environment? The proposed works are predicted to result in long term environmental improvement through limiting the potential for contaminated material from emplaced fill leaching into the surrounding environment and associated improvements in water quality.	Positive; Short term, low level and localised negative impacts and long term benefits.
Any degradation of the quality of the environment? The Proposal intends to rehabilitate a previously degraded artificial landform (a waste emplacement facility) to minimise environmental risks from historical contamination associated with the KIWEF Landfill. No further degradation of the quality of the environment is likely to result from the Proposal.	Positive; Short term, low level and localised negative impacts and long term benefits.
Any risk to the safety of the environment? Minor, short term environmental effects resulting from the Proposal including risk to water quality with increased risk of sedimentation, oil, chemical and waste spills during construction. The risk of long term changes to hydro-salinity regimes and associated impacts to the habitat	Positive; Short term, low level and localised negative impacts and long term benefits.

value of proximate water bodies has been assessed and considered minor with no significant adverse impacts. The proposed works will provide long term improvement in safety and risk associated with existing contamination and slope stability.	
Any reduction in the range of beneficial uses of the environment? The Proposal would not result in a reduction in the range of beneficial uses of the environment. Construction activity would allow surrounding port related uses to continue. Following capping, the site would be released for use by the Port of Newcastle and in the absence of alternative uses would continue to provide suitability habitat for GGBF.	Positive
Any pollution of the environment? The proposed Closure Works are predicted to result in long term environmental improvement through limiting the potential for contaminated material from emplaced fill leaching into the surrounding environment and associated improvements in water quality.	Positive Short term, low level and localised negative impacts and long term benefits.
Any environmental problems associated with the disposal of waste? Waste within the KIWEF has the potential to cause environmental effects and may have in the past. The design of the Proposal is such that problematic waste would be retained in situ in accordance with the Materials Management Plan that applies to the site.	Negative Short term, low level and localised negative impacts.
Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply? The Proposal would not increase demands on resources that are, or are likely to become, in short supply. The Proposal seeks to re-use capping and topsoil to the extent possible or surplus spoil from other Projects as a preference to quarried material to the extent that this is covered by waste exemptions and can achieve the performance expectations of the Surrender Notice.	Nil
Any cumulative environmental effect with other existing or likely future activities? No increase in long term cumulative effects will result from the proposed works. Short term construction emissions of noise levels at sensitive receivers are predicted to be minor in nature. No loss of habitat is predicted to result from the Proposal in the medium to long term with all disturbed areas to be rehabilitated and, as such, the Proposal do not contribute to cumulative loss of habitat. Cumulative traffic impacts would result if construction coincides with that of the GasDock project and would require management.	Short-term, minor, negative
Any impact on coastal processes and coastal hazards, including those under projected climate change conditions? The Proposal are located within a coastal zone, but would not result in any impact on coastal processes and coastal hazards.	Nil

The Proposal would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act. A Species Impact Statement is not required. The Proposal is subject to assessment under Division 5.1 of the EP&A Act. Consent from council is not required.

8.3.2 Significance of impact under Australian legislation

The Proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*. A referral to the Australian Department of the Environment is not required.

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National Environmental Significance: Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999 (Department of Environment, 2013)

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Appendix A. Protected Matters and likelihood of occurrence

The following table of threatened flora and fauna species have all been identified from the Protected Matters Search Report (PMST). The report identifies species that have confirmed records within a 10 km radius of the assessment site, or their presence has been modelled based on the location and types of habitat expected in the locality. The likelihood that each species would occur in the habitats of the Eastern Ponds has been assessed individually considering the type and condition of the habitat present. In assessing the 'likelihood of occurrence' the following criteria are used:

- **Unlikely** - Species highly restricted to certain geographical areas not within the Proposal area; specific habitat requirements are not present in the study area
- **Low** - Species not recorded during field surveys and fit one or more of the following criteria: 1. Have not been recorded previously in the study area/surrounds and for which the study area is beyond the current distribution range; 2. Use specific habitats or resources not present in the study area
- **Moderate** - Species not recorded during the field surveys that fit one or more of the following criteria: 1. Have infrequently been recorded previously in the study area/surrounds; 2. Use specific habitats or resources present in the study area but in a poor or modified condition; 3. Are unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration**; 4.** Are cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded
- **High** - Species recorded during the field surveys or species not recorded that fit one or more of the following criteria: 1. Have frequently been recorded previously in the study area/surrounds; 2. Use habitat types or resources that are present in the study area that are abundance and/or in good condition within the study area; 3. Are known or likely to maintain resident populations surrounding the study area**; 4.** Are known or likely to visit the site during regular seasonal movements or migration

A.1 Threatened Flora

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
FLORA				
Angophora inopina	Charmhaven Apple	V	Endemic to the Central Coast region of NSW. The known northern limit is near Karuah where a disjunct population occurs; to the south populations extend from Toronto to Charmhaven with the main population occurring between Charmhaven and Morisset. There is an unconfirmed record of the species near Bulahdelah. Approximately 1250 ha of occupied habitat has been mapped in the Wyong–southern Lake Macquarie area. This species is a member of the A. bakeri complex, which also includes A. crassifolia, A. paludosa and A. exul. It is most similar to A. crassifolia from which it is distinguished by the broader leaves with shorter petioles. None of these related species are known from the same area as A. inopina, although A. bakeri does occur sporadically in the ranges to the west, and near Kurri Kurri. Occurs most frequently in four main vegetation communities: (i) Eucalyptus haemastoma–Corymbia gummifera–Angophora inopina woodland/forest; (ii) Hakea teretifolia–Banksia oblongifolia wet heath; (iii) Eucalyptus resinifera–Melaleuca sieberi–Angophora inopina sedge woodland; (iv) Eucalyptus capitellata–Corymbia gummifera–Angophora inopina woodland/forest.	Unlikely

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
Caladenia tessellata	Thick-lipped Spider-orchid	V	The Thick Lip Spider Orchid is known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. It was also recorded in the Huskisson area in the 1930s. The species occurs on the coast in Victoria from east of Melbourne to almost the NSW border. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	Unlikely
Commersonia prostrata	Dwarf Kerrawang	E	Dwarf Kerrawang occurs on the Southern Highlands and Southern Tablelands (one plant at Penrose State Forest, one plant at Tallong, a small population near the Corang and about 2000 plants at Rowes Lagoon), a larger population in the Thirlmere Lakes area (within 10 km of the study area), and on the North Coast (less than 100 plants at the Tomago sandbeds north of Newcastle). It is also found in Victoria. Occurs on sandy, sometimes peaty soils in a wide variety of habitats: Snow Gum (Eucalyptus pauciflora) Woodland and Ephemeral Wetland floor at Rowes Lagoon; Blue leaved Stringybark (E. agglomerata) Open Forest at Tallong; and in Brittle Gum (E. mannifera) Low Open Woodland at Penrose; Scribbly Gum (E. haemostoma)/ Swamp Mahogany (E. robusta) Ecotonal Forest at Tomago. Associated native species may include Imperata cylindrica, Empodisma minus and Leptospermum continentale. Appears to respond positively to some forms of disturbance (e.g. some Victorian records are from gravel road surfaces and the Tomago population is on an area previously subject to sandmining), however, there are conflicting reports about the response of the species to fire.	Low, not observed
Cryptostylis hunteriana	Leafless Tongue-orchid	V	The Leafless Tongue Orchid has been recorded from as far north as Gibraltar Range National Park, south into Victoria around the coast as far as Orbost. Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum (Eucalyptus sclerophylla), Silvertop Ash (E. sieberi), Red Bloodwood (Corymbia gummifera) and Black Sheoak (Allocasuarina littoralis); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (C. subulata) and the Tartan Tongue Orchid (C. erecta).	Unlikely
Cynanchum elegans	White-flowered Wax Plant	E	Occurs from the Gloucester district to the Wollongong area and inland to Mt Dangar. Typically occurs in rainforest gullies, scrub and scree slopes and at the ecotone between dry rainforest vegetation and dry subtropical forest/woodland communities. Other associated vegetation types include littoral rainforest; Coastal Tea-tree (Leptospermum laevigatum) – Coastal Banksia (Banksia integrifolia subsp. integrifolia) coastal scrub; Forest Red Gum (Eucalyptus tereticornis) aligned open forest and woodland; Spotted Gum (Corymbia maculata) aligned open forest and woodland; and Bracelet Honeymyrtle (Melaleuca armillaris) scrub to open scrub.	Unlikely

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
Diuris praecox	Newcastle Doubletail	V	Known from between Bateau Bay and Smiths Lake. Grows on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey. Exists as subterranean tubers most of the year. It produces leaves and flowering stems in winter.	Low
Eucalyptus camfieldii	Camfield's Stringybark	V	Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace area south to Waterfall. Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include stunted specimens of E. oblonga (Narrow-leaved Stringybark), E. capitellata (Brown Stringybark) and E. haemastoma (Scribbly Gum).	Unlikely
Eucalyptus parramattensis subsp. decadens	Earp's Gum	V	There are two separate meta-populations of E. parramattensis subsp. decadens. The Kurri Kurri meta-population is bordered by Cessnock—Kurri Kurri in the north and Mulbring—Abedare in the south. Large aggregations of the subspecies are located in the Tomalpin area. The Tomago Sandbeds meta-population is bounded by Salt Ash and Tanilba Bay in the north and Williamtown and Tomago in the south. Generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant. In the Kurri Kurri area, E. parramattensis subsp. decadens is a characteristic species of 'Kurri Sand Swamp Woodland in the Sydney Basin Bioregion', an endangered ecological community under the BCAct. In the Tomago Sandbeds area, the species is usually associated with the 'Tomago Swamp Woodland' as defined by NSW NPWS (2000). Very little is known about the biology or ecology of this species. Flowers from November to January. Propagation mechanisms are currently poorly known. Seed dispersal is likely to be effected by wind and animals.	Low, not observed
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	Sporadically distributed throughout the Sydney Basin with the main occurrence centred around Picton, Appin and Bargo. Separate populations are also known further north from Putty to Wyong and Lake Macquarie on the Central Coast, and Cessnock and Kurri Kurri in the Lower Hunter. Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks.	Unlikely

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
Grevillea shiressii	-	V	Known from two populations near Gosford, on tributaries of the lower Hawkesbury River north of Sydney (Mooney Mooney Creek and Mullet Creek). Both populations occur within the Gosford Local Government Area. There is also a naturalised population at Newcastle. Grows along creek banks in wet sclerophyll forest with a moist understorey in alluvial sandy or loamy soils. Flowers mainly late winter to Spring (July-December), with seed released at maturity in October. Flowers are bird pollinated and seeds are dispersed by ants. A fire sensitive obligate seeder that is highly susceptible to local extinction due to frequent fire, however, fire is likely to be relatively infrequent in the habitat of G. shiressii. Seed germination does occur in the absence of fire, however some physical disturbance is likely to promote seed germination.	Unlikely
Melaleuca biconvexa	Biconvex Paperbark	V	Found only in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Low, not observed
Persicaria elatior	Tall Knotweed	V	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). This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Low, not observed
Phaius australis	Lesser Swamp-orchid	E	Occurs in Queensland and north-east NSW as far south as Coffs Harbour. Historically, it extended farther south, to Port Macquarie. Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas.	Unlikely
Prasophyllum sp. Wybong (C.Phelps ORG 5269)	-	CE	Endemic to NSW, it is known from near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area. A perennial orchid, appearing as a single leaf over winter and spring. Flowers in spring and dies back to a dormant tuber over summer and autumn. Known to occur in open eucalypt woodland and grassland.	Unlikely
Pterostylis gibbosa	Illawarra Greenhood	E	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). It is apparently extinct in western Sydney which is the area where it was first collected (1803). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark (Eucalyptus crebra), Forest Red Gum (Eucalyptus tereticornis) and Black Cypress Pine (Callitris endlicheri).	Unlikely

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
Rutidosis heterogama	Heath Wrinklewort	V	Recorded from near Cessnock to Kurri Kurri with an outlying occurrence at Howes Valley. On the Central Coast it is located north from Wyong to Newcastle. There are north coast populations between Wooli and Evans Head in Yuraygir and Bundjalung National Parks. It also occurs on the New England Tablelands from Torrington and Ashford south to Wandsworth south-west of Glen Innes. Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides.	Unlikely
Syzygium paniculatum	Magenta Lilly Pilly	V	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the south coast it occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast it occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	Low, not observed
Tetratheca juncea	Black-eyed Susan	V	Confined to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion in the local government areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock. It is usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. However, it has also been recorded in heathland and moist forest. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. While the species has a preference for cooler southerly aspects, it has been found on slopes with a variety of aspects. It generally prefers well-drained sites and occurs on ridges, although it has also been found on upper slopes, mid-slopes and occasionally in gullies.	Unlikely

A.2 Threatened Fauna

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
BIRDS				
Anthochaera phrygia	Regent Honeyeater	CE	The Regent Honeyeater that has a patchy distribution between south-east Queensland and central Victoria. It mostly inhabits inland slopes of the Great Dividing Range, in areas of low to moderate relief with moist, fertile soils. It is most commonly associated with box-ironbark eucalypt woodland and dry sclerophyll forest, but also inhabits riparian vegetation such as sheoak (Casuarina spp) where it feeds on needle-leaved mistletoe and sometimes breeds. It sometimes utilises lowland coastal forest, which may act as a refuge when its usual habitat is affected by drought. It also uses a range of disturbed habitats within these landscapes including remnant patches in farmland and urban areas and roadside vegetation. It feeds primarily on the nectar of eucalypts and mistletoes and, to a lesser extent, lerps and honeydew; it prefers taller and larger diameter trees for foraging. It is nomadic and partly migratory with its movement through the landscape being governed by the flowering of select eucalypt species. There are four known key breeding areas: three in NSW and one in Victoria. Breeding varies between regions, and corresponds with flowering of key eucalypt and mistletoe species. It usually nests in horizontal branches or forks in tall mature eucalypts and Sheoaks.	Unlikely
Botaurus poiciloptilus	Australasian Bittern	E	Occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. The Australasian Bittern's preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus) or cutting grass (Gahnia) growing over a muddy or peaty substrate	Moderate
Calidris canutus	Red Knot	E, M	Common in all the main suitable habitats around the coast of Australia. Mainly inhabit intertidal mudflats, sand flats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs.	Unlikely

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
Calidris ferruginea	Curlew Sandpiper	CE	In Australia, Curlew Sandpipers occur around the coasts of all states and are also quite widespread inland, though in smaller numbers. They occur in Australia mainly during the non-breeding period but also during the breeding season when many non-breeding one year old birds remain. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They generally roost on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh and in mangroves.	Low
Calidris tenuirostris	Great Knot	CE, M	In NSW, the species has been recorded at scattered sites along the coast down to about Narooma. It has also been observed inland at Tullakool, Armidale, Gilgandra and Griffith. Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sand flats, including inlets, bays, harbours, estuaries and lagoons. Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms. Migrates to Australia from late August to early September, although juveniles may not arrive until October-November.	Low
Charadrius leschenaultii	Greater Sand-plover	V	The Greater Sand-plover breeds in central Asia from Armenia to Mongolia, moving further south for winter. In Australia the species is commonly recorded in parties of 10-20 on the west coast, with the far northwest being the stronghold of the population. The species is apparently rare on the east coast, usually found singly. In NSW, the species has been recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders.	Low

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
Charadrius mongolus	Lesser Sand-plover	E	The Lesser Sand-plover breeds in central and north eastern Asia, migrating further south for winter. In Australia the species is found around the entire coast but is most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW. Individuals are rarely recorded south of the Shoalhaven estuary, and there are few inland records. Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sand flats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms. Highly gregarious, frequently seen in flocks exceeding 100 individuals; also often seen foraging and roosting with other wader species. Roosts during high tide on sandy beaches, spits and rocky shores; forage individually or in scattered flocks on wet ground at low tide, usually away from the water's edge.	Low
Erythrotriorchis radiatus	Red Goshawk	V	This unique Australian endemic raptor is distributed sparsely through northern and eastern Australia, from the western Kimberley Division of northern Western Australia to north-eastern Queensland and south to far north-eastern NSW, and with scattered records in central Australia. The species is very rare in NSW, extending south to about 30°S, with most records north of this, in the Clarence River Catchment, and a few around the lower Richmond and Tweed Rivers. Formerly, it was at least occasionally reported as far south as Port Stephens. Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers.	Unlikely
Grantiella picta	Painted Honeyeater	V	Lives in dry forests and woodlands. Primary food is the mistletoes in the genus Amyema, though it will take some nectar and insects. Its breeding distribution is dictated by presence of mistletoes which are largely restricted to older trees. Less likely to be found in in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks (Garnett and Crowley, 2000).	Unlikely
Hirundapus caudacutus	White-throated Needletail	V, M	Widespread in eastern and south-eastern Australia. Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. They also commonly occur over heathland but less often over treeless areas, such as grassland or swamps.	Low

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
Lathamus discolor	Swift Parrot	CE	The swift parrot breeds in Tasmania during the summer and the entire population migrates north to mainland Australia for the winter. Whilst on the mainland the swift parrot disperses widely to forage on flowers and psyllid lerps in eucalypt species, with the majority being found in Victoria and NSW. In NSW they forage in forests and woodlands throughout the coastal and western slopes regions each year. Coastal regions tend to support larger numbers of birds when inland habitats are subjected to drought. Non-breeding birds preferentially feed in inland box-ironbark and grassy woodlands, and coastal swamp mahogany (E. robusta) and spotted gum (Corymbia maculata) woodland when in flower; otherwise often in coastal forests. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Eucalyptus robusta, Corymbia maculata, C. gummifera, E. sideroxylon, and E. albens. Commonly used lerp infested trees include E. microcarpa, E. moluccana and E. pilularis.	Unlikely
Limosa lapponica baueri	Bar-tailed godwit (western Alaskan)	V	The bar-tailed godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. During the non-breeding period, the distribution of bar-tailed godwit (western Alaskan) is predominately New Zealand, northern and eastern Australia. The migratory bar-tailed godwit (western Alaskan) does not breed in Australia. The bar-tailed godwit (western Alaskan) occurs mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	Low
Limosa lapponica menzbieri	Bar-tailed godwit (northern Siberian)	CE	The bar-tailed godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. During the non-breeding period, the distribution of L. l. menzbieri is predominantly in the north and north-west of Western Australia and in south-eastern Asia. The migratory bar-tailed godwit (northern Siberian) does not breed in Australia. The bar-tailed godwit (northern Siberian) occurs mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	Low
Numenius madagascariensis	Eastern Curlew	CE, M	Within Australia, the Eastern Curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sand flats, often with beds of seagrass.	Low

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
Rostratula australis	Australian Painted Snipe	E, M	Most records are from south east Australia, particularly the Murray Darling Basin, with scattered records across northern Australia. They generally inhabit shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum Muehlenbeckia or canegrass. Breeding habitat requirements may be quite specific; shallow wetlands with areas of bare wet mud and both low cover and canopy cover nearby; nest records nearly all from or near small islands in freshwater wetlands. Has also been recorded nesting in and near swamps, canegrass swamps, flooded areas including samphire, grazing land, among cumbungi, sedges and grasses; one nest has been found in the centre of a cow-pat in a clump of long grass.	Moderate
Sternula nereis nereis	Australian Fairy Tern	V, M	Within Australia, the Fairy Tern occurs along the coasts of Victoria, Tasmania, South Australia and Western Australia; occurring as far north as the Dampier Archipelago near Karratha. The subspecies has been known from New South Wales (NSW) in the past, but it is unknown if it persists there. The Fairy Tern (Australian) nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The subspecies has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands and mainland coastline. The bird roosts on beaches at night.	Unlikely
Thinornis rubricollis	Hooded Plover (eastern)	V, M	The Hooded Plover is endemic to southern Australia and is nowadays found mainly along the coast from south of Jervis Bay, NSW, south through Victoria and Tasmania to the western side of the Eyre Peninsula (South Australia). In south-eastern Australia Hooded Plovers prefer sandy ocean beaches, especially those that are broad and flat, with a wide wave-wash zone for feeding, much beach cast seaweed, and backed by sparsely vegetated sand-dunes for shelter and nesting. Occasionally Hooded Plovers are found on tidal bays and estuaries, rock platforms and rocky or sand-covered reefs near sandy beaches, and small beaches in lines of cliffs. They regularly use near-coastal saline and freshwater lakes and lagoons, often with saltmarsh.	Unlikely
FISH				

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
Epinephelus daemelii	Black Cod	V	In Australia, the distribution of black cod ranges from southern Queensland through NSW to northern Victoria. However, records from Queensland and Victoria are rare, and the NSW coastline forms the species' main range, both in Australia and internationally. It generally inhabits near-shore reefs at depths down to 50 m from southern Queensland through NSW to northern Victoria. Small juvenile black cod are often found in coastal rock pools while slightly older juveniles are often found in estuary systems. The use of estuaries may be an important part of the ecology of juvenile black cod in NSW waters.	Unlikely
FROGS				
Heleioporus australiacus	Giant Burrowing Frog	V	The Giant Burrowing Frog is distributed in south eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites, some of which are used repeatedly. The home ranges of both sexes appear to be non-overlapping suggesting exclusivity of non-breeding habitat. Home ranges are approximately 0.04 ha in size.	Unlikely
Litoria aurea	Green and Golden Bell Frog	V	Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). There is only one known population on the NSW Southern Tablelands. Ephemeral and permanent freshwater wetlands, ponds, dams with an open aspect and fringed by Typha and other aquatics, free from predatory fish.	High - known population
Litoria littlejohni	Littlejohn's Tree Frog	V	Distribution includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria. This species breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.	Unlikely
INVERTEBRATES				

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
Synemon plana	Golden Sun Moth	CE	The Golden Sun Moth's NSW populations are found in the area between Queanbeyan, Gunning, Young and Tumut. The species' historical distribution extended from Bathurst (central NSW) through the NSW Southern Tablelands, through to central and western Victoria, to Bordertown in eastern South Australia. Occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands in which groundlayer is dominated by wallaby grasses Austrodanthonia spp. Grasslands dominated by wallaby grasses are typically low and open - the bare ground between the tussocks is thought to be an important microhabitat feature for the Golden Sun Moth, as it is typically these areas on which the females are observed displaying to attract males. Habitat may contain several wallaby grass species, which are typically associated with other grasses particularly spear-grasses Austrostipa spp. or Kangaroo Grass Themeda australis.	Unlikely

Note: This habitat assessment table does not consider habitat for species such as migratory marine birds (i.e. albatross and petrels), marine fish, whales, dolphins, sharks, rays, or turtles as the Proposal will not impact on habitat for these species.
* Distribution and habitat requirement information adapted from:

- Australian Government Department of the Environment http://www.environment.gov.au/biodiversity/threatened/index.html
- NSW Department of Planning, Industry and Environment http://www.environment.nsw.gov.au/threatenedspecies/
- Department of Primary Industries – Threatened Fish and Marine Vegetation http://pas.dpi.nsw.gov.au/Species/All_Species.aspx

+ Data source includes

- Identified from the Protected Matters Search Tool (PMST) Australian Government Department of Sustainability, Environment, Water, Populations and Community http://www.environment.gov.au/epbc/pmst/index.html

Key:
EP = endangered population
CE = critically endangered
E = endangered
V = vulnerable
M = migratory

Appendix B. Threatened Species (BC Act) Likelihood of Occurrence

Species name	Common name	BC Act Status	Distribution and habitat	No. records in locality	Likelihood of occurrence
Cynanchum elegans	White-flowered Wax Plant	E	Occurs from the Gloucester district to the Wollongong area and inland to Mt Dangar. Typically occurs in rainforest gullies, scrub and scree slopes and at the ecotone between dry rainforest vegetation and dry subtropical forest/woodland communities. Other associated vegetation types include littoral rainforest; Coastal Tea-tree (Leptospermum laevigatum) – Coastal Banksia (Banksia integrifolia subsp. integrifolia) coastal scrub; Forest Red Gum (Eucalyptus tereticornis) aligned open forest and woodland; Spotted Gum (Corymbia maculata) aligned open forest and woodland; and Bracelet Honeymyrtle (Melaleuca armillaris) scrub to open scrub.	1	Low
Eucalyptus parramattensis subsp. decadens		V	There are two separate meta-populations of E. parramattensis subsp. decadens. The Kurri Kurri meta-population is bordered by Cessnock—Kurri Kurri in the north and Mulbring—Abedare in the south. Large aggregations of the subspecies are located in the Tomalpin area. The Tomago Sandbeds meta-population is bounded by Salt Ash and Tanilba Bay in the north and Williamtown and Tomago in the south. Generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant. In the Kurri Kurri area, E. parramattensis subsp. decadens is a characteristic species of 'Kurri Sand Swamp Woodland in the Sydney Basin Bioregion', an endangered ecological community under the BC Act. In the Tomago Sandbeds area, the species is usually associated with the 'Tomago Swamp Woodland' as defined by NSW NPWS (2000). Very little is known about the biology or ecology of this species. Flowers from November to January. Propagation mechanisms are currently poorly known. Seed dispersal is likely to be effected by wind and animals.	92	Low
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	Sporadically distributed throughout the Sydney Basin with the main occurrence centred around Picton, Appin and Bargo. Separate populations are also known further north from Putty to Wyong and Lake Macquarie on the Central Coast, and Cessnock and Kurri Kurri in the Lower Hunter. Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-	2	Low

Species name	Common name	BC Act Status	Distribution and habitat	No. records in locality	Likelihood of occurrence
			lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks.		
Syzygium paniculatum	Magenta Lilly Pilly	E	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the south coast it occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast it occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	1	Unlikely
Tetratheca juncea	Black-eyed Susan	V	Confined to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion in the local government areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock. It is usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. However, it has also been recorded in heathland and moist forest. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. While the species has a preference for cooler southerly aspects, it has been found on slopes with a variety of aspects. It generally prefers well-drained sites and occurs on ridges, although it has also been found on upper slopes, mid-slopes and occasionally in gullies.	1	Unlikely
Zannichellia palustris		E	A submerged aquatic plant. In NSW, known from the lower Hunter and in Sydney Olympic Park. Grows in fresh or slightly saline stationary or slowly flowing water. Flowers during warmer months. NSW populations behave as annuals, dying back completely every summer.	27	Unlikely, due to absence of pond and water
Anseranas semipalmata	Magpie Goose	V	Mainly found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges. Equally at home in aquatic or terrestrial habitats; often seen walking and grazing on land; feeds on grasses, bulbs and rhizomes. Activities are centred on wetlands, mainly those on floodplains of rivers and large shallow wetlands formed by run-off; breeding can occur in both summer and winter dominated rainfall areas and is strongly influenced by water level; most breeding now occurs in monsoonal areas; nests are formed in trees over deep water; breeding is unlikely in south-eastern NSW.	76	Low

Species name	Common name	BC Act Status	Distribution and habitat	No. records in locality	Likelihood of occurrence
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	The Dusky Woodswallow has two separate populations. The eastern population is found from Atherton Tableland, Queensland south to Tasmania and west to Eyre Peninsula, South Australia. The other population is found in south-west Western Australia. The Dusky Woodswallow is found in open forests and woodlands, and may be seen along roadsides and on golf courses.	1	Low
Botaurus poiciloptilus	Australasian Bittern	E	Occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. The Australasian Bittern's preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus) or cutting grass (Gahnia) growing over a muddy or peaty substrate	19	Moderate
Calidris ferruginea	Curlew Sandpiper	E	In Australia, Curlew Sandpipers occur around the coasts of all states and are also quite widespread inland, though in smaller numbers. They occur in Australia mainly during the non-breeding period but also during the breeding season when many non-breeding one year old birds remain. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They generally roost on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh and in mangroves.	900	Low

Species name	Common name	BC Act Status	Distribution and habitat	No. records in locality	Likelihood of occurrence
Calidris tenuirostris	Great Knot	V	In NSW, the species has been recorded at scattered sites along the coast down to about Narooma. It has also been observed inland at Tullakool, Armidale, Gilgandra and Griffith. Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sand flats, including inlets, bays, harbours, estuaries and lagoons. Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms. Migrates to Australia from late August to early September, although juveniles may not arrive until October-November.	25	Low
Calyptorhynchus lathami	Glossy-black Cockatoo	V	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of Sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods. Inland populations feed on a wide range of Sheoaks, including Drooping Sheoak, *Allocasuarina diminuta*, and *A. gymnanthera*. Belah is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (Casuarina cristata).	1	Unlikely
Charadrius leschenaultii	Greater Sand plover	V	The Greater Sand-plover breeds in central Asia from Armenia to Mongolia, moving further south for winter. In Australia the species is commonly recorded in parties of 10-20 on the west coast, with the far northwest being the stronghold of the population. The species is apparently rare on the east coast, usually found singly. In NSW, the species has been recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders.	6	Low

Species name	Common name	BC Act Status	Distribution and habitat	No. records in locality	Likelihood of occurrence
Charadrius mongolus	Lesser Sand Plover	V	The Lesser Sand-plover breeds in central and north eastern Asia, migrating further south for winter. In Australia the species is found around the entire coast but is most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW. Individuals are rarely recorded south of the Shoalhaven estuary, and there are few inland records. Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sand flats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms. Highly gregarious, frequently seen in flocks exceeding 100 individuals; also often seen foraging and roosting with other wader species. Roosts during high tide on sandy beaches, spits and rocky shores; forage individually or in scattered flocks on wet ground at low tide, usually away from the water's edge.	33	Low
Circus assimilis	Spotted Harrier	V	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	4	Low
Daphoenositta chrysoptera	Varied Sittella	V	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy. Nests in an upright tree fork high in the living tree canopy.	2	Low

Species name	Common name	BC Act Status	Distribution and habitat	No. records in locality	Likelihood of occurrence
Ephippiorhynchus asiaticus	Black-necked Stork	E	In Australia, Black-necked Storks are widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Bulahdelah. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries. Storks usually forage in water 5-30cm deep for vertebrate and invertebrate prey. Eels regularly contribute the greatest biomass to their diet, but they feed on a wide variety of animals, including other fish, frogs and invertebrates (such as beetles, grasshoppers, crickets and crayfish). Black-necked Storks build large nests high in tall trees close to water. Trees usually provide clear observation of the surroundings and are at low elevation (reflecting the floodplain habitat).	61	Low
Epthianura albifrons	White-fronted Chat	V	The White-fronted Chat is found across the southern half of Australia, from southernmost Queensland to southern Tasmania, and across to Western Australia as far north as Carnarvon. Found mostly in temperate to arid climates and very rarely sub-tropical areas, it occupies foothills and lowlands up to 1000 m above sea level. In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas. Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground. Have been observed breeding from late July through to early March, with 'open-cup' nests built in low vegetation. Nests in the Sydney region have also been seen in low isolated mangroves. Nests are usually built about 23 cm above the ground (but have been found up to 2.5 m above the ground).	89	Low

Species name	Common name	BC Act Status	Distribution and habitat	No. records in locality	Likelihood of occurrence
Falco subniger	Black Falcon	V	Widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres (Marchant & Higgins 1993). The Black Falcon occurs as solitary individuals, in pairs, or in family groups of parents and offspring.	1	Low
Glossopsitta pusilla	Little Lorikeet	V	In NSW it is found from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. The species forages primarily in the canopy of dry open eucalypt forest and woodland but also utilises paperbark (*Melaleuca* sp.) dominated forests. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country (e.g. paddocks, roadside remnants) and urban trees also help sustain viable populations of the species. Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked eucalypts. Entrance is small (3 cm) and usually high above the ground (2–15 m). These nest sites are often used repeatedly for decades, suggesting that preferred sites are limited; riparian trees are often chosen, including non-eucalypt species such as she-oaks.	5	Low
Haematopus longirostris	Pied Oystercatcher	E	The species is distributed around the entire Australian coastline, although it is most common in coastal Tasmania and parts of Victoria, such as Corner Inlet. In NSW the species is thinly scattered along the entire coast, with fewer than 200 breeding pairs estimated to occur in the State. Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. The chisel-like bill is used to pry open or break into shells of oysters and other shellfish. Nests mostly on coastal or estuarine beaches although occasionally they use saltmarsh or grassy areas. Nests are shallow scrapes in sand above the high tide mark, often amongst seaweed, shells and small stones.	7	Unlikely

Species name	Common name	BC Act Status	Distribution and habitat	No. records in locality	Likelihood of occurrence
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	Distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. Found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. Habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, and the sea). It feeds opportunistically on a variety of fish, birds, reptiles, mammals and crustaceans, and on carrion. It generally forages over large expanses of open water; this is particularly true of birds that occur in coastal environments close to the sea-shore. However, the it will also forage over open terrestrial habitats (such as grasslands). Nests may be built in a variety of sites including tall trees (especially Eucalyptus species), bushes, mangroves, cliffs, rocky outcrops, caves, crevices, on the ground or even on artificial structures.	66	Low
Hieraaetus morphnoides	Little Eagle	V	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.	7	Low
Irediparra gallinacea	Comb-crested Jacana	V	Occurs on freshwater wetlands in northern and eastern Australia, mainly in coastal and subcoastal regions, from the north-eastern Kimberley Division of Western Australia to Cape York Peninsula then south along the east coast to the Hunter region of NSW, with stragglers recorded in south-eastern NSW (possibly in response to unfavourable conditions further north). Inhabit permanent freshwater wetlands, either still or slow-flowing, with a good surface cover of floating vegetation, especially water-lilies, or fringing and aquatic vegetation.	7	Low
Ixobrychus flavicollis	Black Bittern	V	The Black Bittern is found along the coastal plains within NSW, although individuals have rarely being recorded south of Sydney or inland. It inhabits terrestrial and estuarine wetlands such as flooded grasslands, forests, woodlands, rainforests and mangroves with permanent water and dense waterside vegetation. The Black Bittern typically roosts on the ground or in trees during the day and forages at night on frogs, reptiles, fish and invertebrates. The breeding season extends from December to March. Nests are constructed of reeds and sticks in branches overhanging the water.	1	Low

Species name	Common name	BC Act Status	Distribution and habitat	No. records in locality	Likelihood of occurrence
Lathamus discolor	Swift Parrot	E	The swift parrot breeds in Tasmania during the summer and the entire population migrates north to mainland Australia for the winter. Whilst on the mainland the swift parrot disperses widely to forage on flowers and psyllid lerps in eucalypt species, with the majority being found in Victoria and NSW. In NSW they forage in forests and woodlands throughout the coastal and western slopes regions each year. Coastal regions tend to support larger numbers of birds when inland habitats are subjected to drought. Non-breeding birds preferentially feed in inland box-ironbark and grassy woodlands, and coastal swamp mahogany (*E. robusta*) and spotted gum (*Corymbia maculata*) woodland when in flower; otherwise often in coastal forests. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as *Eucalyptus robusta, Corymbia maculata, C. gummifera, E. sideroxylon*, and *E. albens*. Commonly used lerp infested trees include *E. microcarpa, E. moluccana* and *E. pilularis*.	1	Unlikely
Limicola falcinellus	Broad-billed Sandpiper	V	The eastern form of this species breeds in northern Siberia before migrating southwards in winter to Australia. In Australia, Broad-billed Sandpipers overwinter on the northern coast, particularly in the north-west, with birds located occasionally on the southern coast. In NSW, the main site for the species is the Hunter River estuary, with birds occasionally reaching the Shoalhaven estuary. There are few records for inland NSW. Broad-billed Sandpipers favour sheltered parts of the coast such as estuarine sand flats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches.	17	Low
Limosa limosa	Black-tailed Godwit	V	A migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently found at Kooragang Island (Hunter River estuary). Occurs in sheltered bays, estuaries and lagoons with large intertidal mudflats and sand flats. Also found at inland mudflats, swamps.	273	Low

Species name	Common name	BC Act Status	Distribution and habitat	No. records in locality	Likelihood of occurrence
Lophoictinia isura	Square-tailed Kite	V	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by Eucalyptus longifolia, Corymbia maculata, E. elata, or E. smithii. Individuals appear to occupy large hunting ranges of more than 100 km2. They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	1	Low
Neophema pulchella	Turquoise Parrot	V	Range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	1	Low
Ninox strenua	Powerful Owl	V	In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. Now at low densities throughout most of its eastern range, rare along the Murray River and former inland populations may never recover. The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine *Syncarpia glomulifera*, Black She-oak *Allocasuarina littoralis*, Blackwood *Acacia melanoxylon*, Rough-barked Apple *Angophora floribunda*, Cherry Ballart *Exocarpus cupressiformis* and a number of eucalypt species.	5	Low

Species name	Common name	BC Act Status	Distribution and habitat	No. records in locality	Likelihood of occurrence
Oxyura australis	Blue-billed Duck	V	Endemic to south-eastern and south-western Australia. It is widespread in NSW, but most common in the southern Murray-Darling Basin area. Birds disperse during the breeding season to deep swamps up to 300 km away. It is generally only during summer or in drier years that they are seen in coastal areas. Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached. Partly migratory, with short-distance movements between breeding swamps and overwintering lakes with some long-distance dispersal to breed during spring and early summer. Usually nest solitarily in Cumbungi over deep water between September and February. They will also nest in trampled vegetation in Lignum, sedges or Spike-rushes, where a bowl-shaped nest is constructed. The most common clutch size is five or six. Males take no part in nest-building or incubation.	4	Low
Pandion cristatus	Eastern Osprey	V	The Osprey has a global distribution with four subspecies previously recognised throughout its range. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.	15	Low
Petroica boodang	Scarlet Robin	V	The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and re-growth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. This species' nest is built in the fork of tree usually more than 2 metres above the ground; nests are often found in a dead branch in a live tree, or in a dead tree or shrub.	3	Unlikely
Ptilinopus magnificus	Wompoo Fruit-dove	V	Occurs along the coast and coastal ranges from the Hunter River in NSW to Cape York Peninsula. It is rare south of Coffs Harbour. Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests. Feeds on a diverse range of tree and vine fruits and is locally nomadic - following ripening fruit. Thought to be an effective medium to long-distance vector for seed dispersal.	1	Unlikely

Species name	Common name	BC Act Status	Distribution and habitat	No. records in locality	Likelihood of occurrence
Rostratula australis	Australian Painted Snipe	E	Most records are from south east Australia, particularly the Murray Darling Basin, with scattered records across northern Australia. They generally inhabit shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum Muehlenbeckia or canegrass. Breeding habitat requirements may be quite specific; shallow wetlands with areas of bare wet mud and both low cover and canopy cover nearby; nest records nearly all from or near small islands in freshwater wetlands. Has also been recorded nesting in and near swamps, canegrass swamps, flooded areas including samphire, grazing land, among cumbungi, sedges and grasses; one nest has been found in the centre of a cow-pat in a clump of long grass.	2	Moderate
Stagonopleura guttata	Diamond Firetail	V	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (*Eucalyptus pauciflora*) Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. Birds roost in dense shrubs or in smaller nests built especially for roosting.	1	Unlikely
Sternula albifrons	Little Tern	E	Migrating from eastern Asia, the Little Tern is found on the north, east and south-east Australian coasts, from Shark Bay in Western Australia to the Gulf of St Vincent in South Australia. In NSW, it arrives from September to November, occurring mainly north of Sydney. Almost exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records). Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands.	22	Unlikely

Species name	Common name	BC Act Status	Distribution and habitat	No. records in locality	Likelihood of occurrence
Tyto longimembris	Eastern Grass Owl	V	Eastern Grass Owls have been recorded occasionally in all mainland states of Australia but are most common in northern and north-eastern Australia. In NSW they are more likely to be resident in the north-east. Eastern Grass Owl numbers can fluctuate greatly, increasing especially during rodent plagues. Eastern Grass Owls are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. They are also found in agricultural land (mainly sugar cane and sorghum, and rice fields in fallow) (Birdlife Australia).	20	Low
Tyto novaehollandiae	Masked Owl	V	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. Dry eucalypt forests and woodland, typically prefers open forest with low shrub density. Requires old trees for roosting and nesting.	1	Low
Xenus cinereus	Terek Sandpiper	V	A rare migrant to the eastern and southern Australian coasts, being most common in northern Australia, and extending its distribution south to the NSW coast in the east. The two main sites for the species in NSW are the Richmond River estuary and the Hunter River estuary. The latter has been identified as nationally and internationally important for the species. In Australia, has been recorded on coastal mudflats, lagoons, creeks and estuaries. Favours mud banks and sandbanks located near mangroves, but may also be observed on rocky pools and reefs, and occasionally up to 10 km inland around brackish pools.	273	Low

Species name	Common name	BC Act Status	Distribution and habitat	No. records in locality	Likelihood of occurrence
Crinia tinnula	Wallum Froglet	V	Wallum Froglets are found along the coastal margin from Litabella National Park in south-east Queensland to Kurnell in Sydney. Wallum Froglets are found in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They typically occur in sedgelands and wet heathlands. They can also be found along drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests. The species breeds in swamps with permanent water as well as shallow ephemeral pools and drainage ditches. Breeding is thought to peak in the colder months, but can occur throughout the year following rain. Eggs of 1.1-1.2mm are deposited in water with a pH of <6 and tadpoles take 2-6 months to develop into frogs. Wallum Froglets shelter under leaf litter, vegetation, other debris or in burrows of other species. Shelter sites are wet or very damp and often located near the water's edge. Males may call throughout the year and at any time of day, peaking following rain.	2	Unlikely
Litoria aurea	Green and Golden Bell Frog	E	Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). There is only one known population on the NSW Southern Tablelands. Ephemeral and permanent freshwater wetlands, ponds, dams with an open aspect and fringed by Typha and other aquatics, free from predatory fish.	6900	High

Species name	Common name	BC Act Status	Distribution and habitat	No. records in locality	Likelihood of occurrence
Uperoleia mahonyi	Mahony's Toadlet	E	Endemic to the mid-north coast of New South Wales (NSW) and to date has been found between Kangy Angy and Seal Rocks. Inhabits ephemeral and semi-permanent swamps and swales on the coastal fringe of its range. Known records occur in heath or wallum habitats almost exclusively associated with leached (highly nutrient impoverished) white sand. Also is known to occur in wallum heath, swamp mahogany-paperbark swamp forest, heath shrubland and Sydney red gum woodland. Known records are associated with shallow ephemeral/semi-permanent water bodies with limited flow of water. Aquatic vegetation at breeding sites includes sedges (Shoenoplectus spp., Baumea spp. and Lepironia articulata) and Broadleaf Cumbungi (Typha orientalis). Females have been recorded up to 400m from water-bodies indicating moderate dispersal distances and use of multiple habitat types.	2	Low
Micronomus norfolkensis	Eastern Freetail-bat	V	Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roosts mainly in tree hollows but will also roost under bark or in human-made structures.	67	Low
Miniopterus australis	Little Bentwing-bat	V	East coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	56	Low
Miniopterus orianae oceanensis	Large Bentwing-bat	V	Occurs on east and north west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other manmade structures.	25	Low
Myotis macropus (*Myotis adversus*)	Southern Myotis	V	Generally roost in groups close to water in caves, mine shafts, hollow-bearing trees, and storm water channels, buildings, under bridges and in dense foliage. Forages over streams and pools catching insects and small fish.	41	Low
Petaurus norfolcensis	Squirrel Glider	V	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey.	14	Unlikely

Species name	Common name	BC Act Status	Distribution and habitat	No. records in locality	Likelihood of occurrence
Phascolarctos cinereus	Koala	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	146	Unlikely
Pteropus poliocephalus	Grey-headed Flying-fox	V	Generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. In times of natural resource shortages, they may be found in unusual locations. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young.	40	Low
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	Wide-ranging species found across northern and eastern Australia. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	5	Low
Scoteanax rueppellii	Greater Broad-nosed Bat	V	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings.	23	Low
Vespadelus troughtoni	Eastern Cave Bat	V	Found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.	7	Low

Appendix C. Assessment of Significance

C.1 Environment Protection and Biodiversity Conservation Act 1999

Tests of significance have been conducted for threatened species, populations and communities that have been identified as having a moderate or high potential to occur in the study area based on the presence of habitat (see Appendix A).

Significance assessments have been completed in accordance with the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (Department of Environment, 2013). Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is affected, and upon the intensity, duration, magnitude and geographic extent of the impacts (Department of Environment, 2013). Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility (Department of Environment, 2013). This advice has been considered while undertaking the assessments.

Endangered Species

Australasian Bittern (*Botaurus poliocephalus*)

1) Lead to a long-term decrease in the size of a population

The Australasian Bittern inhabits temperate freshwater wetlands and occasionally estuarine reedbeds (NSW Scientific Committee, 2009). The species has been rarely recorded from Kooragang Island, although is known to be present and recorded from targeted surveys conducted arounds areas of permanent water (HBOC, 2006 and 2010). The BioNet/Atlas of NSW Wildlife (2020) database records for Kooragang Island also indicate that the species inhabits locations predominantly near permanent water.

The habitat within the Eastern Ponds is of low quality and marginal for this species, which prefers open water for foraging resources and adjacent reed beds for shelter, and breeding. There is a lack of water at the Eastern Ponds and any use of the site by this species would likely be limited to temporary shelter from transient birds. The clearing of the reed beds within the eastern ponds is not expected to lead to a long-term decrease in local populations of this species.

The discharge of surface water from Eastern Ponds would transfer to the Windmill Road drain (K100A) and Long Pond (K100E), and these two habitats also provide potential habitat. This discharge would only be required during periods of prolonged high rainfall when the capped Eastern Ponds have filled. At this time, the existing drainage system would be charged and receiving flow from a variety of surface runoff sources, suggesting that a change in water quality or inundation levels would already be expected. These habitats do not represent high quality foraging and breeding areas for the Australasian Bittern, and any temporary hydrology changes are not expected to have a long-term negative impact on local populations.

2) Reduce the area of occupancy of the species

Considering the absence of recent records for the species at the Eastern Ponds (monitoring results since 2008) and the limited disturbance to potential wetland habitat for the species, the Closure Works are considered very unlikely to disrupt the lifecycle of the species or a local viable population.

The habitat within the Eastern Ponds is around 2 hectares of regrowth reed land of low quality and considered marginal for this species, which prefers open water for foraging resources and adjacent reed beds for shelter, and breeding. There is a lack of water at the Eastern Ponds and any use of the site by this species would likely be limited to temporary shelter from transient birds. The removal of this small area of potential habitat is not expected to reduce the area of occupancy across the Hunter estuary wetlands.

3) Fragment an existing population into two or more populations

Importantly, the action would not result in fragmentation of habitat for the Australasian Bittern. This species is highly mobile and the action would not affect the movement of birds between habitat patches or fragment a population.

4) Adversely affect habitat critical to the survival of a species

The habitat in the eastern ponds and discharge receiving ponds do not represent critical habitat for the Australasian Bittern. The closure of the Eastern Ponds is restricted to the cells K108a and K108b, as well as the adjacent stockpile site. There is potential for overflow from the ponds during prolonged extreme weather events to be discharged to an artificial drainage channel and small wetland to the south. This would occur during periods of water charge in the system. The areas assessed in this report are not considered critical to the survival of the species.

The discharge of surface water from Eastern Ponds would transfer to the Windmill Road drain (K100A) and Long Pond (K100E), and these two ponds are not known sites for Australasian Bittern and provide marginal habitat and any temporary hydrology changes are not expected to have a long-term negative impact on the Australasian Bittern population.

5) Disrupt the breeding cycle of a population

The habitat at the Eastern Ponds has been described as low quality and marginal for this species, and this is due to the absence of open water and fringing emergent reeds. There are large areas of suitable habitat for this species associated with the wider Kooragang Island and Hunter Wetlands National Park. The Eastern Ponds are unlikely to be favoured for breeding.

The habitat within the Windmill Road drain (K100A) and Long Pond (K100E) impacted by occasional discharge of surface water, are not known breeding sites for Australasian Bittern.

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

The total area of the Eastern Ponds is around 4.3 hectares including the raised walls and the proposed activity would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, Phragmites australis and Typha orientalis (0.8 ha) and regrowth Swamp Oak (0.7 ha). All areas of native vegetation occur within the lower parts of the cells. The remaining areas of disturbance associated with the cell walls, access roads and stockpile area, comprise only exotic and non-indigenous plant species that are not characteristic of native plant communities. The reed land habitat is considered marginal and of low quality, and the removal of this habitat will not lead to a decline in the species.

7) Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat

The vegetation at the site will be removed, and as described in the report there is a high density of weeds present that will need to be removed and disposed of. Mitigation procedures have been described in this report that provide guidance on the correct procedure for avoiding dispersal of weeds from the site.

8) introduce disease that may cause the species to decline, or

There are no known disease issues affecting this species in relation to the action. The action would be unlikely to increase the potential for significant disease vectors to affect local populations.

9) interfere substantially with the recovery of the species.

The *Draft National Recovery Plan for the Australasian Bittern Botaurus poicilioptilus* (Department of Environment Climate Change and Water, 2019) outlines the following actions:

1. Implement management strategies to reduce threats to Australasian Bittern and their habitat
2. Enhance protection, improve the quality and increase the extent of suitable habitat for the Australasian Bittern

3. Improve knowledge of the biology and ecology of Australasian Bittern and implement a monitoring strategy to identify population trends
4. Increase stakeholder participation in Australasian Bittern conservation and management
5. Coordinate, review and report on recovery process

The recovery actions listed above are largely not applicable to the action and the action is not expected to interfere substantially with the recovery of the species.

Conclusion

No breeding habitat or other important habitat would be impacted by this activity. The action would not interfere with the recovery of the Australasian Bittern and would not contribute to the key threats to this species. After consideration of the factors above, an overall conclusion has been made that the action is unlikely to result in a significant impact to the *Australasian Bittern*.

Australian Painted Snipe (*Rostratula australis*)

1) Lead to a long-term decrease in the size of a population

The Australian Painted Snipe is considered to occur in a single, contiguous breeding population (Garnett & Crowley 2000) and the total population size has been estimated to range from a few hundred individuals to 5000 breeding adults (Garnett & Crowley 2000).

The habitat within the Eastern Ponds is of low quality and marginal for this species, which prefers open water for foraging resources and adjacent reed beds for shelter, and breeding. There is a lack of water at the Eastern Ponds and any use of the site by this species would likely be limited to temporary shelter from transient birds. The clearing of the reed beds within the eastern ponds is not expected to lead to a long-term decrease in the size of the population.

2) Reduce the area of occupancy of the species

The area of occupancy of the Australian Painted Snipe is estimated, with low reliability, to be 1000 km^2 (Garnett & Crowley 2000). The Eastern Ponds provide 0.8 ha of low quality, marginal habitat and the removal of this is not expected to reduce the area of occupancy across the species range.

3) Fragment an existing population into two or more populations

Importantly, the action would not result in fragmentation of habitat for the Australasian Painted Snipe. This species is highly mobile and the action would not affect the movement of birds between habitat patches or fragment a population.

4) Adversely affect habitat critical to the survival of a species

The total area of the Eastern Ponds is around 4.3 hectares including the raised walls and the proposed activity would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, Phragmites australis and Typha orientalis (0.8 ha) and regrowth Swamp Oak (0.7 ha). All areas of native vegetation occur within the lower parts of the cells. The remaining areas of disturbance associated with the cell walls, access roads and stockpile area, comprise only exotic and non-indigenous plant species that are not characteristic of native plant communities. The reed land habitat within the Eastern Ponds is considered marginal and of low quality, and is not critical to the survival of the Australian Painted Snipe..

5) Disrupt the breeding cycle of a population

The Australian Painted Snipe is considered to occur in a single, contiguous breeding population (Garnett & Crowley 2000) and the total population size has been estimated to range from a few hundred individuals to 5000 breeding adults (Garnett & Crowley 2000). The Eastern Ponds provide 0.8 ha of low quality, marginal habitat and the removal of this is not expected to disrupt the breeding cycle of the population.

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

The total area of the Eastern Ponds is around 4.3 hectares including the raised walls and the proposed activity would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, Phragmites australis and Typha orientalis (0.8 ha) and regrowth Swamp Oak (0.7 ha). All areas of native vegetation occur within the lower parts of the cells. The remaining areas of disturbance associated with the cell walls, access roads and stockpile area, comprise only exotic and non-indigenous plant species that are not characteristic of native plant communities. The reed land habitat is considered marginal and of low quality, and the removal of this habitat will not modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7) Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat

The vegetation at the site will be removed, and as described in the report there is a high density of weeds present that will need to be removed and disposed of. Mitigation procedures have been described in this report that provide guidance on the correct procedure for avoiding dispersal of weeds from the site.

8) Introduce disease that may cause the species to decline, or

There are no known disease issues affecting this species in relation to the action. The action would be unlikely to increase the potential for significant disease vectors to affect local populations.

9) Interfere substantially with the recovery of the species.

The primary factor in the decline of the Australian Painted Snipe has probably been a loss and alteration of wetland habitat. The two major sources of this have been the drainage of wetlands and the diversion of water to agriculture and reservoirs, the latter process reducing flooding and precluding the formation of temporary shallow wetlands (Garnett & Crowley 2000). The Eastern Ponds provide 0.8 ha of low quality, marginal habitat and the removal of this is not expected to interfere with the recovery of the species.

Conclusion

No breeding habitat or other important habitat would be impacted by this activity. The action would not interfere with the recovery of the Australasian Painted Snipe and would not contribute to the key threats to this species. After consideration of the factors above, an overall conclusion has been made that the action is unlikely to result in a significant impact to the Australian Painted Snipe.

Vulnerable species

Green and Golden Bell Frog (*Litoria aurea*)

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

The Green and Golden Bell Frog population within Kooragang Island can be considered an important population and one of the Key Populations in the Lower Hunter, for which there is a draft Management Plan (OEH 2007). The University of Newcastle (UoN 2019a) has conducted regular monitoring of the Green and Golden Bell Frog (GGBF) population over the KIWEF since 2011. This work involves repeated visual encounter surveys during the breeding season targeting a range of artificially created ponds which has included the Eastern Ponds (K108 wetland located in SE cell of the Eastern Ponds). From these surveys the UoN (2019a) has reported regular encounters of frogs in K108 (Eastern Ponds) from surveys conducted between 2011-16 leading to assessment in 2014 that this pond comprises a healthy population (Clulow 2014). Since 2013-14 however, the overall pattern of GGBF in the Eastern Ponds has been one of decline (UoN 2019a), a phenomenon that is consistent with the reported gradual reduction in the area of open water available to frogs over this same period. Indeed both 2016-17 and 2017-18 were dry years and no GGBF were recorded in the Eastern Ponds at this time (UoN 2019). Very low numbers were reported in the following wetter season of 2019-20 however these numbers remain low compared to the ponds in the remainder of the KIWEF (McHenry 2020).

The most recent surveys in 2019-20 describe the pattern of a gradual retreat of open water within Eastern Ponds and identify that as a consequence the habitat in the Eastern Pond is being infrequently occupied by GGBF, with no evidence of breeding taking place within them in recent years. This is consistent with data from the University's annual monitoring program which shows that for the last five consecutive years (2015-20) the Eastern Ponds have provided terrestrial and ephemeral aquatic habitat that is only occasionally occupied by GGBF (McHenry, 2020). These data suggest the ponds do continue to provide foraging habitat for a small proportion of the GGBF population, although the ponds are not important breeding sites. Indeed, McHenry (2020) describes the Eastern Ponds as ephemeral and semi-permanent wetlands, considered to have limited 'refuge' habitat value for GGBF due to the lack of open water.

The Proposal will therefore temporarily remove an area of marginal foraging habitat at the Eastern Ponds occupied by a small proportion of the Kooragang Island population. However, the removal of this habitat is not expected to have a long-term impact on the size of the Kooragang Island population.

2) Reduce the area of occupancy of an important population

The proposed activity at the Eastern Ponds will remove an area of around 2 hectares of identified marginal foraging habitat used by this population, and so will reduce the area of occupancy of an important population.

The most recent surveys in 2019-20 have described the habitat in the Eastern Pond as being infrequently occupied by GGBF and there is no evidence of breeding taking place within them. This is consistent with data from the University's annual monitoring program over the broader KWIEF which shows that for the last five consecutive years (2015-20) the Eastern Ponds have provided terrestrial and ephemeral aquatic habitat that is only occasionally occupied by GGBF (McHenry, 2020). Therefore, the area of habitat to be removed is not considered breeding habitat or high quality refuge and foraging habitat.

3) Fragment an existing important population into two or more populations

The work proposed at the Eastern Ponds is not expected to fragment the Kooragang Island GGBF population. Monitoring of this population has shown the GGBF is effective at movements and dispersal across spatially separated ponds (UoN 2019). The Eastern Ponds do not provide an important linkage to other areas of habitat for the species. The majority of the works will be in disturbed areas dominated by exotic species, with very limited surface water present and railway lines and associated embankments that limit dispersal. Wetlands areas and open lands to the south and west of the ponds that are known to be used by this species and provide potential movement opportunities, will not be impacted and no fragmentation of the population is anticipated.

4) Adversely affect habitat critical to the survival of a species

Habitat critical to the survival of a species refers to areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species
- To maintain genetic diversity and long-term evolutionary development, or
- For the reintroduction of populations or recovery of the species.

The habitat within the Eastern Ponds is not considered critical habitat for the species. The most recent surveys in 2019-20 have described the habitat in the Eastern Pond as being infrequently occupied by GGBF and there is no evidence of breeding taking place within them. This is consistent with data from the University's annual monitoring program which shows that for the last five consecutive years (2015-20) the Eastern Ponds have provided terrestrial and ephemeral aquatic habitat that is only occasionally occupied by GGBF (McHenry, 2020).

The University of Newcastle has conducted regular monitoring of the Green and Golden Bell Frog (GGBF) population over the KIWEF since 2011, which has included the Eastern Ponds. It is evident from this work, that critical habitat is present and dispersed throughout the KIWEF and broader Kooragang Island and Ash Island. This includes breeding ponds, as well as foraging areas and open areas between ponds that are used for dispersal.

5) Disrupt the breeding cycle of an important population

The most recent surveys in 2019-20 have described the habitat in the Eastern Pond as being infrequently occupied by GGBF and there is no evidence of breeding taking place within them. This is due to the lack of open water in the Eastern Ponds. The UoN (2019) identifies that ephemeral and semi-permanent ponds such as these are preferred as breeding sites on Kooragang Island, however the key indicator has been that 'all wetlands in which breeding has been detected have areas of open water' (UoN 2019) a condition which is absent at the Eastern Ponds. On this basis, the Eastern Ponds are not considered important breeding habitat for the GGBF population and the removal of this habitat will not disrupt the breeding cycle of the population.

6) 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 closure works will temporarily remove an area of marginal foraging habitat (2.0 ha) for the GGBF population by removal of vegetation and draining any residual surface water. Mitigation will be applied to prevent frogs entering the site area during the closure works (i.e. frog fencing with adjacent vegetation suppression zone), and this activity may temporarily impact habitat availability, and the movements and survival of low numbers of frogs in the vicinity of the eastern ponds. The most recent surveys in 2019-20 have described the habitat in the Eastern Pond as being infrequently occupied by GGBF and there is no evidence of breeding taking place within them, and therefore any impact from the closure activity is unlikely to lead to a significant decline in the population.

After the works are complete the area will be capped, revegetated and new ponds established, therefore the loss of available habitat and interruption to movements of frogs is considered temporary. This area impacted represents a small proportion of the total potential foraging habitat available to the species in the KIWEF and it is likely that the temporary loss of a small proportion of foraging habitat and any interruption or impact on frogs from proposed mitigation will not result in an overall significant decline to the Kooragang Island GGBF population.

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

Weeds are prevalent at the Eastern Ponds and dominant within areas of terrestrial habitat, including noxious weeds. The works provide an opportunity to reduce the prevalence of noxious weeds within the capping area, upon revegetation. Appropriate controls will be implemented to vehicles and equipment to avoid the introduction of any other invasive species to the site. The wetland areas should be considered restricted areas for personnel and no material should be exchanged between other wetland areas which may transport Eastern Gambusia, an invasive species which predates tadpoles.

8) Introduce disease that may cause the species to decline, or

The Project is not expected to introduce any diseases that may cause the species to decline. Chytrid fungus has been linked to declines in the GGBF, however the pathogen is considered widespread on Kooragang island (DECC 2007) and therefore it is unlikely that the proposed works will cause any further spread.

Nevertheless hygiene procedures will be implemented for personnel and equipment in order to prevent any spread of the disease. The proposed works are considered unlikely to change the hydrological conditions and water quality parameters to a level that would constitute an impact on the GGBF population through spread of Chytrid fungus.

9) Interfere substantially with the recovery of the species.

The decline of this species can be attributed to a number of likely factors including Chytrid fungus, predation of tadpoles by the Eastern Gambusia and habitat loss. The proposed works will not impact on an identified area of important habitat and breeding habitat will remain unaffected by this Proposal. It is anticipated that the Proposal will not affect the recovery of the species and the carrying capacity of the habitat within the area will remain largely unchanged. Appropriate mitigation measures and hygiene controls will prevent other factors such as

Chytrid fungus and Gambusia becoming prevalent in the species habitat. The proposed works are considered a low risk to the species recovery.

Conclusion

The proposed closure of the Eastern Ponds avoids impacts to important breeding and refuge habitat for the Kooragang Island important population of Green and Golden Bell Frog. Based on the results of long-term monitoring of the population by University of Newcastle (UoN 2019a) it is evident that potential impacts will be limited to the temporary removal of an area of marginal foraging habitat only. The site is considered to be of low value as refuge habitat and breeding has not been recorded here since around 2014-15 as a result of changes in the quality of the habitat.

Migratory Species

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

1) 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;
2) 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
3) Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a Migratory species.

Under the EPBC Act, 'important habitat' is a key concept for migratory species. According to the EPBC Act Significant Impact Guidelines (SIG 1.1) (Commonwealth of Australia 2013), an area of 'important habitat' for a migratory species is defined as:

- habitat used by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or
- habitat that is of critical importance to the species at particular life-cycle stages; and/or
- habitat used by a migratory species which is at the limit of the species range; and/or
- habitat within an area where the species is declining.

The widely accepted and applied approach to identifying internationally important shorebird sites throughout the world has been through the use of criteria adopted under the Ramsar Convention on Wetlands (Commonwealth of Australia 2009). According to this approach, a wetland should be considered internationally important if it regularly supports:

- one per cent of the individuals in a population of one species or subspecies of waterbird; or
- a total abundance of at least 20,000 waterbirds; or
- or 0.1 % of the flyway population.

Given the short timeframe of the project, a targeted survey for shorebirds was not conducted, rather the assessment has relied on existing data and reports to assess the potential importance of the Eastern Ponds for migratory shorebirds. The Hunter Estuary Wetlands Ramsar site comprises two parts: the former Kooragang Nature Reserve and the Hunter Wetlands Centre Australia. This Hunter Estuary Wetlands Ramsar site is well known and reported to be a major international non-breeding foraging site for migratory waders.

The Eastern Ponds are located outside of the Hunter Estuary Wetlands Ramsar site and are not a formal part of the site. Herbert (2007) provides a detailed account of significant wetlands in the Hunter Estuary for migratory birds, based on long-term monitoring which has identified the species visiting these wetlands and the abundance of birds. Several of these wetlands are mapped to the east, west and north of the Eastern Ponds although the Eastern Ponds and surrounding lands have not been identified as important foraging or roosting habitat.

Typically, the types of habitats consistently reported at important wetland sites for migratory shorebirds include:

- estuarine waters
- inter-tidal mud, sand or salt flats
- Inter-tidal marshes; includes salt marshes, salt meadows, saltings, raised salt marshes; includes tidal and brackish marshes
- Inter-tidal forested wetlands; includes mangrove swamps, tidal and freshwater swamp forests (I)
- tree-dominated wetlands

The Eastern Ponds are not in a tidal area and are characterised as a freshwater ephemeral habitat, as described in the report, the area of open water within these ponds has gradually transitioned to a more vegetated cell. While the occasional visitation from a migratory shorebird species may occur at the Eastern Ponds, it is reasonable to expect that these ponds do not constitute an area of 'important habitat' for listed migratory shorebirds.

On this basis it is concluded that the site does not constitute 'important habitat' as defined under the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (DoE 2013), in that the study area does not contain:

- a region that supports an ecologically significant proportion of a population of migratory species; or
- habitat utilised by a migratory species which is at the limit of the species range; or
- habitat within an area where the species is declining.

As such, it is unlikely that the action would significantly affect migratory species.

C.2 Biodiversity Conservation Act, 2016

Green and Golden Bell Frog (*Litoria aurea*)

The Green and Golden Bell Frog population within Kooragang Island is one of the Key Populations in the Lower Hunter, for which there is a draft Management Plan (OEH 2007). The University of Newcastle (UoN 2019) has conducted regular monitoring of the Green and Golden Bell Frog (GGBF) population over the KIWEF since 2011. This work involves repeated visual encounter surveys during the breeding season targeting a range of artificially created ponds which has included the Eastern Ponds (K108 wetland located in SE cell of the Eastern Ponds). From these surveys the UoN (2019) has reported regular encounters of frogs in K108 (Eastern Ponds) from surveys conducted between 2011-16 leading to assessment in 2014 that this pond comprises a healthy population (Clulow 2014). Since 2013-14 however, the overall pattern of GGBF in the Eastern Ponds has been one of decline (UoN 2019), a phenomenon that is consistent with the reported gradual reduction in the area of open water available to frogs over this same period. Indeed both 2016-17 and 2017-18 were dry years and no GGBF were recorded in the Eastern Ponds at this time (UoN 2019). Very low numbers were reported in the following wetter season of 2019-20 however these numbers remain low compared to the ponds in the remainder of the KIWEF (McHenry 2020).

The most recent surveys in 2019-20 describe the pattern of a gradual retreat of open water within Eastern Ponds and identify that as a consequence the habitat in the Eastern Pond is being infrequently occupied by GGBF, with no evidence of breeding taking place within them in recent years. This is consistent with data from the University's annual monitoring program which shows that for the last five consecutive years (2015-20) the Eastern Ponds have provided terrestrial and ephemeral aquatic habitat that is only occasionally occupied by GGBF (McHenry, 2020). These data suggest the ponds do continue to provide foraging habitat for a small proportion of the GGBF population although are not important breeding sites. Indeed, McHenry (2020) describes the Eastern Ponds as ephemeral and semi-permanent wetlands, considered to have limited 'refuge' habitat value for GGBF due to the lack of open water.

The Proposal will therefore temporarily remove an area of marginal foraging habitat at the Eastern Ponds occupied by a small proportion of the Kooragang Island population. However, the removal of this habitat is not expected to have a long-term impact on the size of the Kooragang Island population.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Proposal will temporarily remove an area of marginal foraging habitat (2.0 ha) for the GGBF population by removal of vegetation and draining any residual surface water. . Mitigation will be applied to prevent frogs entering the site area during the closure works (i.e. frog fencing with adjacent vegetation suppression zone), and this activity may temporarily impact habitat availability, and the movements and survival of low numbers of frogs in the vicinity of the eastern ponds. The most recent surveys in 2019-20 have described the habitat in the Eastern Pond as being infrequently occupied by GGBF and there is no evidence of breeding taking place within them, and therefore any impact from the closure activity is unlikely to lead to a significant decline in the population or increased risk of extinction. The removal of this habitat is not expected to have a long-term impact on the size of the Kooragang Island population. Breeding habitat / activities will not be impacted and the habitat is considered to have limited 'refuge' habitat value only.

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable.

c. in relation to the habitat of a threatened species or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.

The total area of the Eastern Ponds is around 4.3 hectares including the raised slag walls and the proposed activity would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, Phragmites australis and Typha orientalis (0.8 ha) and regrowth Swamp Oak (0.7 ha) that may be used on occasion by this species. The disturbance would only be temporary. Mitigation will be applied to prevent frogs entering the site area during the closure works (i.e. frog fencing with adjacent vegetation suppression zone), and this activity may temporarily impact habitat availability, and the movements and survival of low numbers of frogs in the vicinity of the eastern ponds.

The discharge of surface water from Eastern Ponds would transfer to the Windmill Road drain (K100A) and Long Pond (K100E), and these two habitats also provide non-breeding habitat for GGBF. This discharge would only be required during periods of prolonged high rainfall when the capped Eastern Ponds have filled. At this time, the existing drainage system would be charged and receiving flow from a variety of surface runoff sources, suggesting that a change in water quality or inundation levels would already be expected. These habitats do not represent key breeding areas for the GGBF, and any temporary hydrology changes are not expected to have a long-term negative impact on the GGBF population.

After the works are complete the area will be capped, revegetated and new ponds established, therefore the loss of available habitat and interruption to movements of frogs is considered temporary. This area impacted represents a small proportion of the total potential foraging habitat available to the species in the KIWEF and it is likely that the temporary loss of a small proportion of foraging habitat and any interruption or impact on frogs from proposed mitigation will not result in an overall significant decline to the Kooragang Island GGBF population. Importantly, the action would not result in any long-term fragmentation of habitat for the GGBF. This species is known to move between habitats within the KIWEF and will be able to navigate around the Eastern Ponds, using wetlands constructed during previous closure work stages.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The Proposal would not impact on any declared area of outstanding biodiversity value.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

With respect to the Green and Golden Bell Frog, the Proposal is consistent with three key threatening processes listed under the BC Act:

- Clearing of native vegetation
- Chytridiomycosis due to amphibian Chytrid Fungus.

The extent of native vegetation clearing and habitat removal associated with the Proposal is considered unlikely to be significant in terms of available habitat for the Green and Golden Bell Frog in the surrounding landscape.

The disease Chytridiomycosis already exists across Kooragang Island and as such it is unlikely that the Proposal would further exacerbate this Key Threatening Process. Construction activities should follow frog hygiene practises to limit the spread of this disease.

Conclusion

The Proposal is considered unlikely to result in a significant impact to the Green and Golden Bell Frog.

Australasian Bittern (*Botaurus poliocephalus*)

Although records of Australasian Bittern in the locality are rare, this is in part due to the secretive behaviour of the species and naturally low population densities. The freshwater wetland habitats present within the Eastern Ponds provide preferred habitat, although marginal due their small size and lack of standing water, and this species is assessed has having a moderate likelihood of occurring.

The total area of the Eastern Ponds is around 4.3 hectares including the raised slag walls and the proposed activity would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, Phragmites australis and Typha orientalis (0.8 ha) and regrowth Swamp Oak (0.7 ha) that may be used on occasion by this species.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Threats to the Australasian Bittern are associated with drainage of wetlands for agriculture, salinisation of wetlands and overgrazing of wetland vegetation (Garnett, 1992 in Smith et al., 1995; Garnett and Crowley, 2000). Vegetation and aquatic habitat associated with Eastern Ponds offers potential foraging, and temporary

roosting habitat, although is unlikely to constitute an important breeding area. The lack of standing water in the cells suggest that food resources are scarce, and the ponds are unlikely to be frequented nor provide critical habitat for life cycle activities, particularly as large areas of high-quality habitat exist throughout Kooragang Island and the Hunter Estuary National Park.

The total area of the Eastern Ponds is around 4.3 hectares including the raised slag walls and the proposed activity would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, Phragmites australis and Typha orientalis (0.8 ha) and regrowth Swamp Oak (0.7 ha) that may be used on occasion by this species. The disturbance would only be temporary.

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable.

c. in relation to the habitat of a threatened species or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.

The total area of the Eastern Ponds is around 4.3 hectares including the raised slag walls and the proposed activity would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, Phragmites australis and Typha orientalis (0.8 ha) and regrowth Swamp Oak (0.7 ha) that may be used on occasion by this species. The disturbance would only be temporary.

Importantly, the action would not result in fragmentation of habitat for the Australasian Bittern. This species is highly mobile and the action would not affect the movement of birds between habitat patches or fragment a population.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The Proposal would not impact on any declared area of outstanding biodiversity value.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The proposed activity will involve 'clearing of native vegetation', which is listed as a key threatening process under the BC Act. The extent of clearing proposed is considered minor, and also temporary, and is considered unlikely to be significant for this species in terms of impacting on life-cycle activities or a significant loss from the landscape, particularly considering the extensive areas of better-quality habitat available in the surrounding landscape.

Conclusion

The Proposal is considered unlikely to result in a significant impact to the Australasian Bittern.

Australian Painted Snipe (*Rostratula australis*)

The freshwater wetland habitats present within the Eastern Ponds provide suitable habitat, although marginal for this wide-ranging species, due their small size and lack of standing water, and this species is assessed has having a moderate likelihood of occurring. Any visitation would be infrequent, and the habitat Is considered unlikely to support all life-cycle activities of the species.

The total area of the Eastern Ponds is around 4.3 hectares including the raised slag walls and the proposed activity would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, Phragmites australis and Typha orientalis (0.8 ha) and regrowth Swamp Oak (0.7 ha) that may be used on occasion by this species.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Vegetation and aquatic habitat associated with Eastern Ponds offers potential foraging, and temporary roosting habitat for this species, although is unlikely to constitute an important breeding area. The lack of standing water in the cells suggest that food resources are scarce, and the ponds are unlikely to be frequented nor provide critical habitat for life cycle activities, particularly as large areas of high-quality habitat exist throughout Kooragang Island and the Hunter Estuary National Park.

The total area of the Eastern Ponds is around 4.3 hectares including the raised slag walls and the proposed activity would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, Phragmites australis and Typha orientalis (0.8 ha) and regrowth Swamp Oak (0.7 ha) that may be used on occasion by this species. The disturbance would only be temporary. This impact is unlikely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

b. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable.

c. in relation to the habitat of a threatened species or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.

The total area of the Eastern Ponds is around 4.3 hectares including the raised slag walls and the proposed activity would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, Phragmites australis and Typha orientalis (0.8 ha) and regrowth Swamp Oak (0.7 ha) that may be used on occasion by this species. The disturbance would only be temporary.

Importantly, the action would not result in fragmentation of habitat for the Australian Painted Snipe. This species is highly mobile and the action would not affect the movement of birds between habitat patches or fragment a population.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The Proposal would not impact on any declared area of outstanding biodiversity value.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The proposed activity will involve 'clearing of native vegetation', which is listed as a key threatening process under the BC Act. The extent of clearing proposed is considered minor, and also temporary, and is considered unlikely to be significant for this species in terms of impacting on life-cycle activities or a significant loss from the landscape, particularly considering the extensive areas of better-quality habitat available in the surrounding landscape.

Conclusion

The Proposal is considered unlikely to result in a significant impact to the Australian Painted Snipe.

Appendix D. Survey Plot Data

Plot 1			**Covers**	**Native**	Trees	Shrubs	Grass	Forb	Fern	Other	**Exotic**	HighThreat
E38			**# spp**	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
			14	**0**	0	0	0	0	0	0	**14**	5
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			61	**0**	0	0	0	0	0	0	**61**	18
Phragmites australis	80	1000	GG									
Cirsium vulgare	10	20	EX								10	
Gomphocarpus fruticosus	8	1	EX								8	
Bidens pilosa	6	2	EX								6	
Sonchus oleraceus	5	35	EX								5	
Senecio madagascariensis	5	2	HT									5
Plantago lanceolata	5	22	EX								5	
Cortaderia selloana	5	500	HT									5
Acacia saligna	4	1	EX								4	
Juncus acutus	4	20	HT									4
Araujia sericifera	3	1	HT									3
Silybum marianum	2	5	EX								2	
Asperula arvensis	2	1	EX								2	
Galinsoga parviflora	1	20	EX								1	
Tecoma stans	1	15	HT									1

Plot 2			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
E38			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			7	2	1	0	1	0	0	0	5	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			44	15	5	0	10	0	0	0	29	0
Phragmites australis	80	1000	GG									
Typha orientalis	10	20	GG				10					
Hydrocotyle bonariensis	8	1	EX								8	
Aster subulatus	6	2	EX								6	
Verbena bonariensis	5	35	EX								5	
Cirsium vulgare	5	2	EX								5	
Sonchus asper	5	22	EX								5	
Casuarina glauca	5	500	TG		5							

Plot 3			5	2	0	0	2	0	0	0	3	1
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			34	20	0	0	20	0	0	0	14	7
Phragmites australis	15	9	GG				15					
Juncus acutus	7	1	HT									7
Hydrocotyle bonariensis	5	30	EX								5	
Typha orientalis	5	1	GG				5					
Aster subulatus	2	1000	EX								2	

Plot 4			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
E38			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			11	1	0	0	1	0	0	0	10	2
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			79	5	0	0	5	0	0	0	74	21

Casuarina glauca	20	30	TG		20							
Cortaderia selloana	18	1000	HT									18
Bidens pilosa	15	1000	EX								15	
Ambrosia confertiflora	12	3	EX								12	
Verbena bonariensis	10	12	EX								10	
Plantago lanceolata	8	500	EX								8	
Cynodon dactylon	5	1	GG				5					
Ligustrum vulgare	3	12	EX								3	
Olea europaea	3	800	HT									3
Urtica dioica	2	12	EX								2	
Acacia saligna	2	30	EX								2	
Asperula arvensis	1	60	EX								1	