



Review of Environmental Factors

**Kooragang Island Waste Emplacement Facility
Area 2 Closure Works**

Hunter Development Corporation

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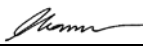

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Kooragang Island Waste Emplacement Facility

Area 2 Closure Works

Review of Environmental Factors

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Hunter Development Corporation

March 2016

0320327 Final

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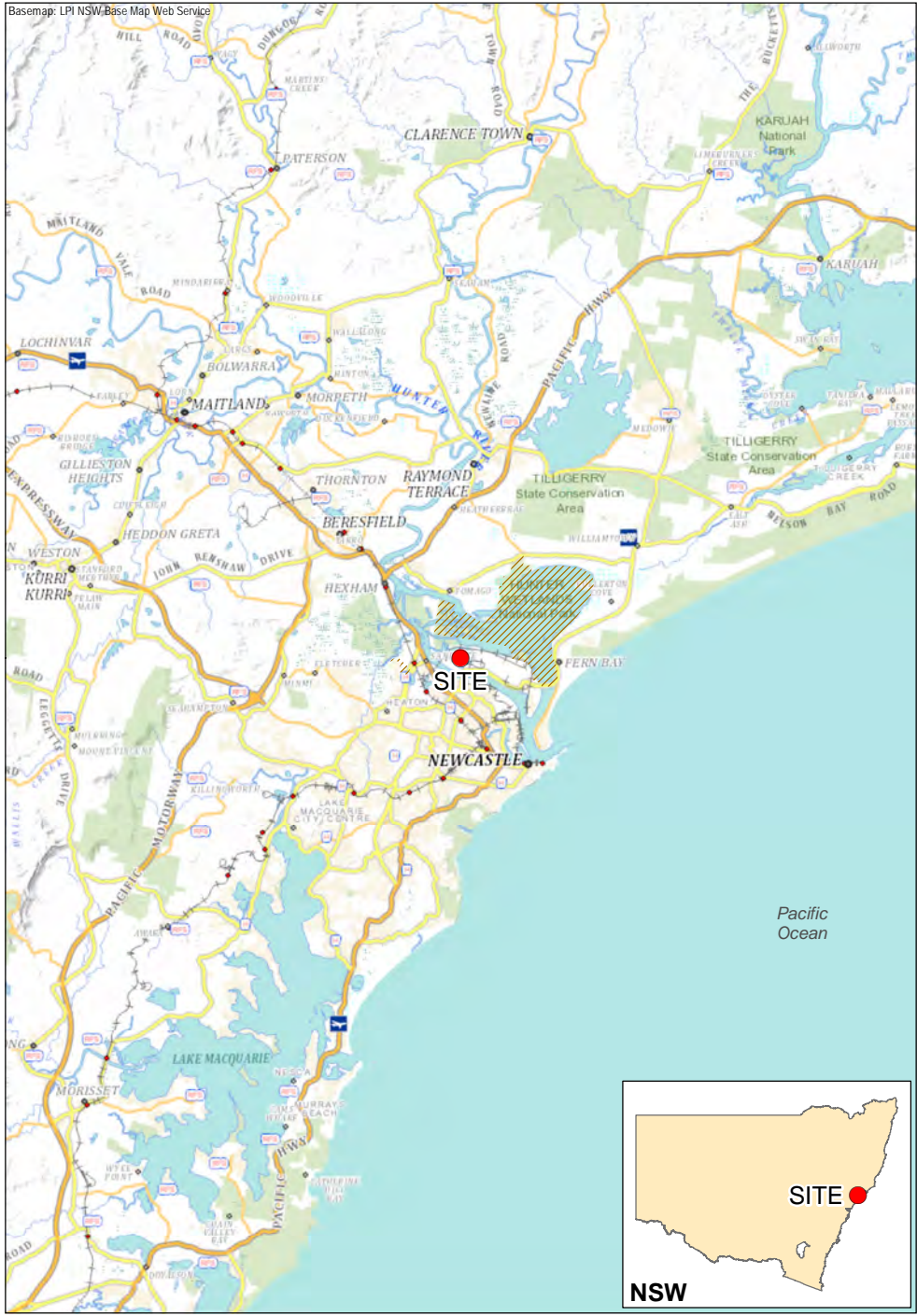
Environmental Resources Management Australia Pty Ltd (ERM) has been engaged by Hunter Development Corporation (HDC) to prepare this Review of Environmental Factors (REF) in relation to proposed closure and rehabilitation of Area 2 (K3 and K5) and the placement of Virgin Excavated Natural Material or Excavated Natural Material over a small area containing asbestos within K7 (the closure works). Area 2 and K7 are located off Cormorant Road, Kooragang Island, Newcastle NSW as illustrated in *Figure 1*.

Kooragang Island Waste Emplacement Facility (KIWEF) ceased operation in 1999 and until this time was used by Broken Hill Proprietary Company Limited (BHP) as a landfill for disposal of waste from the Mayfield steelworks and associated operations. KIWEF was subject to Environment Protection Licence (EPL) 6437 issued under the *Protection of the Environment Operations Act 1997* (PoEO Act) for the scheduled action of "Waste disposal by application to land" first issued in 1999 to BHP and subsequently transferred to Regional Land Management Corporation Pty Ltd in May 2003 and then HDC in January 2008.

HDC surrendered EPL 6437 on 8 December 2010 and the NSW Environment Protection Authority (EPA) issued conditional Surrender Notice 1111840 with 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).

The KIWEF Capping Strategy (GHD 2009) identified and described the proposed stages of closure works to be progressively completed. Due to the development of portions of the KIWEF footprint by external stakeholders, the stages of closure 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 addressed by *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act) referral 2012/6464 and a separate REF and completed in 2015;
- Area 2 - North of Rail Line ('K3' and 'K5') Closure Works the subject of a separate EPBC Act referral and this REF with works proposed to be completed by 30 June 2017; and
- Area 3 - 'K10 South' closure works addressed by EPBC Act referral 2012/6464 and a separate REF and proposed to be completed by 30 June 2017.



The works are required to satisfy HDC's obligations under the Surrender Notice and include the installation of drainage and sediment controls, capping and re-contouring of waste emplacement areas and rehabilitation using existing surface materials of approximately 36 hectares of the former KIWEF.

The application to surrender the licence was supported by the Revised Final Landform and Capping Strategy (GHD 2009) (the Capping Strategy) developed in consultation with the EPA. 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 while minimising risk to threatened fauna habitat. The EPA endorsed the Revised Final Landform and Capping Strategy (GHD, 2009) as the best balance to achieve positive environmental outcomes for the site. The endorsed approach to closure is to implement minimal change in site processes by maintaining similar site hydrology, vegetation and surface soils while further isolating potential contaminants. The isolation of contaminants is to be achieved through the reduction of surface water infiltration resulting from the installation of capping with reduced permeability and increased surface gradient.

The proposed activity does not include the development and use of the site for any purpose including waste disposal. As such this REF addresses the temporary construction impacts and ongoing potential changes to hydrology associated with the construction of a low permeability capping layer above contaminated areas, with no operational impacts likely.

1.2 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 on Area 2 and K7 of KIWEF based on a significant body of publically available information and in accordance with the principles established through previous assessments as follows:

- The site is a former licenced landfill regulated under the 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 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; and
- 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 Area 2 of KIWEF, as illustrated in *Figure 2*, and on the basis that Surrender Notice conditions and the Commonwealth Department of the Environment (DoE) required mitigation measures as provided in are implemented.

1.3

PROPONENT

The closure works area is owned by the Port of Newcastle Lessor (a NSW government entity) who has contracted HDC as an agent of the State, to complete the KIWEF remedial works in accordance with the Binding Terms of Agreement. This REF has been prepared for the remediation works to be undertaken by HDC within the KIWEF Area 2. HDC are considered to be the proponent for the completion of the Area 2 Closure works within this REF.

HDC is constituted under the Growth Centres (Development Corporations) Act 1974 and operates in accordance with its provisions. HDC is not the party responsible for the placement of waste material at KIWEF or the landowner. Instead the closure obligations of the Surrender Notice are assigned to HDC as the agent of the NSW State Government. The completion of closure obligations is consistent with the provisions of the Growth Centres (Development Corporations) Act 1974 with Section 8(1) stating:

“Subject to this Act, the Environmental Planning and Assessment Act 1979 and any other relevant Act a development corporation may, for the purposes of this Act:... (j) cause any work to be done on or in relation to any land vested in the development corporation, or any other land with the consent of the person in whom it is vested, for the purpose of rendering it fit to be used for any purpose for which it may be used under any environmental planning instrument applying to the land”.

HDC is a NSW Government agency and through the workings of the Interpretations Act 1987 Section 13A (4) and Environmental Planning & Assessment Act 1979, HDC is also considered to be a Public Authority.

At the completion of the remediation works required by the Binding Terms of Agreement and Surrender Notice, the responsibility for the ongoing management, maintenance and monitoring of the KIWEF Area 2 will revert back to the landowner, the Port of Newcastle Lessor.

Legend

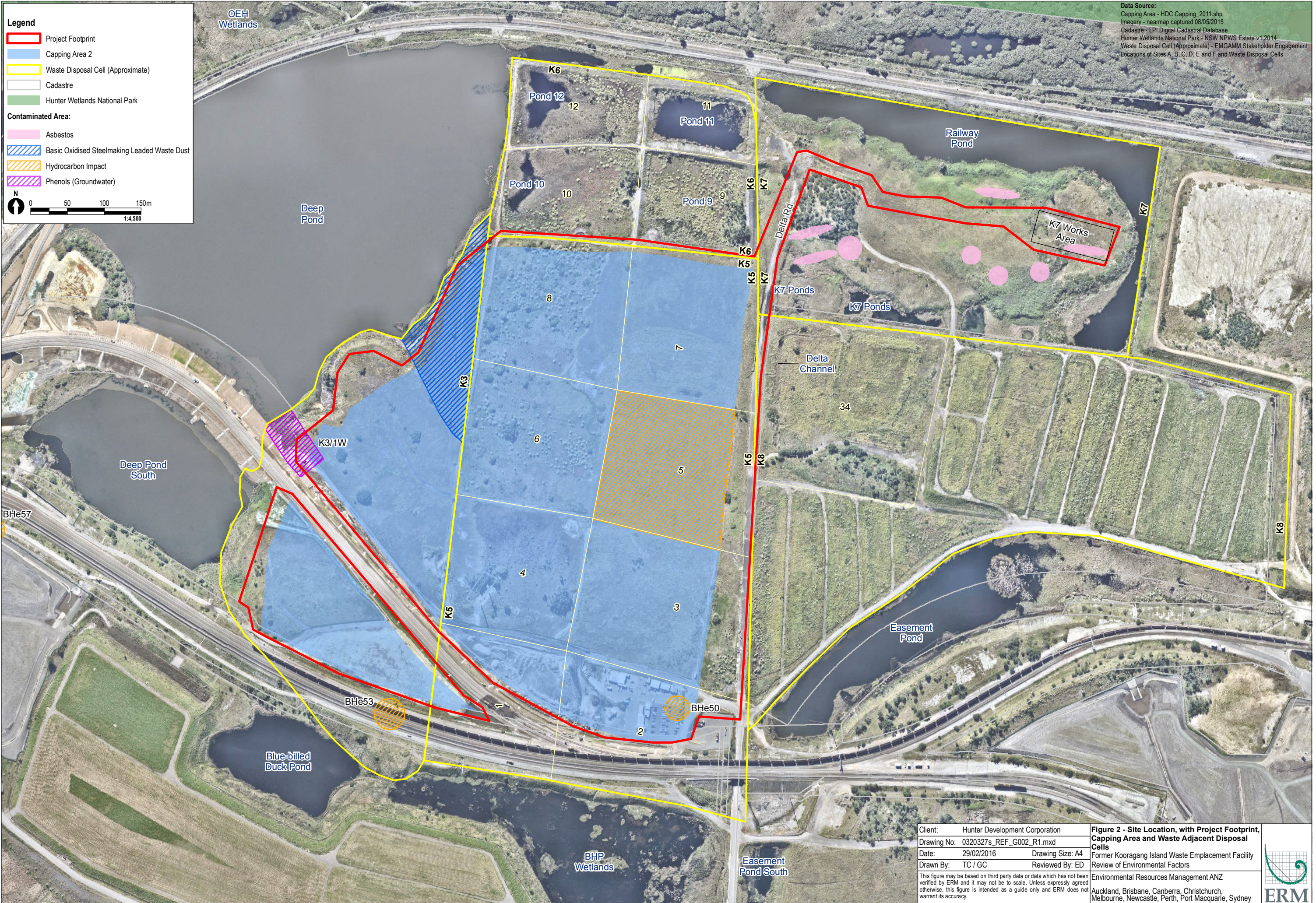
- Project Footprint
- Capping Area 2
- Waste Disposal Cell (Approximate)
- Cadastre
- Hunter Wetlands National Park

Contaminated Area:

- Asbestos
- Basic Oxidised Steelmaking Leaded Waste Dust
- Hydrocarbon Impact
- Phenols (Groundwater)


N
0 50 100 150m
1:4,500

Data Source:
 Capping Area - HDC Capping_2011.shp
 Imagery - nearmap captured 08/05/2015
 Cadastre - LPI Digital Cadastral Database
 Hunter Wetlands National Park - NSW NPWS Estate v1 2014
 Waste Disposal Cell (Approximate) - EMGAMM Stakeholder Engagement
 Locations of Sites A, B, C, D, E and F and Waste Disposal Cells



Client:	Hunter Development Corporation	Figure 2 - Site Location, with Project Footprint, Capping Area and Waste Adjacent Disposal Cells Former Kooragang Island Waste Emplacement Facility Review of Environmental Factors Environmental Resources Management ANZ Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney
Drawing No:	0320327s_REF_G002_R1.mxd	
Date:	29/02/2016	
Drawn By:	TC / GC	
		Reviewed By: ED

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The site is not currently used for any purpose beyond that of a former landfill. The site has been assessed and approved by State and Commonwealth agencies for the future potential use as a Coal Export Terminal. The proposed Closure Works are associated with the Coal Export Terminal through location only.

The Port of Newcastle Lessor Pty Ltd (PoN Lessor) is a NSW Government owned entity that owns KIWEF land, which is currently leased by the NSW Government under a 98 year lease that began in May 2014. The PoN Lessor has also entered into a Binding Terms of Agreement (BTA) with HDC, which contracts HDC to arrange the completion of the Closure Works as specified under the Surrender Notice (issued by the NSW EPA). HDC will oversee the implementation of the Closure Works to ensure compliance with any environmental management controls that are stipulated throughout the construction phase of the remediation works. After completion of the remediation works (including signoff by the NSW EPA), HDC will hand over control and any ongoing obligations attached to the site, to the PoN Lessor.

PROPOSED ACTIVITY

The proposed activity is to undertake the closure of Area 2 (K3 and K5) of KIWEF in accordance with the Surrender Notice and Capping Strategy (GHD, 2009) and the placement of additional Virgin Excavated Natural Material (VENM) or Excavated Natural Material (ENM) over a small area containing asbestos within K7.

Condition 4a of the Surrender Notice requires that the closure works be undertaken in accordance with the following documents:

- '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 Associates;
- 'K26/32 and K24/31 Ponds Action Plan- Kooragang Island Waste Emplacement Facility' dated 31 May 2011 and prepared by Golder Associates; and
- 'Materials Management Plan - Kooragang Island Waste Emplacement Facility' dated November 2012 prepared by RCA Australia.

It should be noted that, the K26/32 and K24/31 Ponds are not associated with Area 2 or K7 and as such the requirements of that report are not considered further in this REF.

2.1

CAPPING METHODOLOGY

The capping methodology is dictated by Condition 4h of the Surrender Notice, 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 be undertaken generally as follows, with required departures flagged and further discussed in the sections that follow:

- Establishment of erosion and sedimentation controls and construction of sedimentation basins as required;
- Remove any vegetation and strip the top 100 millimetres (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 100 mm 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. Any unsuitable cut material shall be stockpiled in Stage 7 area (as defined in GHD (2009) - noted to be no longer available with alternative location to be identified during the detailed design stage) and later capped;
- Place 0.5 metres (m) capping material over the regraded surface at a final minimum 1% grade. Compact the capping material to achieve a maximum permeability of $1 \times 10^{-7} \text{m/s}$. 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 100 mm 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; and
- 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.

Capping designs are to be completed to address these requirements and will consider the findings and mitigation requirements identified within this REF and the EPBC Act Referral.

Departures from the above standard approach to capping as described by the Capping Strategy are reproduced in *Table 1*.

Table 1 *Departures From Standard Capping Strategy*

Area	Recommended Strategy
K3	In areas identified as suitable Green and Golden Bell Frog (GGBF) habitat, including the area bordering the freshwater wetlands, capping will be undertaken up to within 30 m of the identified habitat area, with the exception of the area located near K3/1W (which will be capped) and then revegetated. No regrading, capping or other disturbance will be undertaken within other GGBF habitat areas.

Area	Recommended Strategy
K5 (excluding Cell 5)	To reduce the risk of migration of impacts around Cell 5, the permeability is to be reduced to 1×10^{-8} m/s for a zone (nominally 10- 20m) adjoining the Cell 5 area.
Cell 5	Minor re-contouring of the area by placing compacted Coal Washery Reject (CWR) is recommended to a minimum grade of 1% to shed surface water away from the north, west and southern boundaries of the Geo-synthetic Clay Liner (GCL) and tie into proposed surface levels of the adjoining capped areas.
K7	Placement of VENM or other material as approved in the EPL in the area where only 1.6m of fill has been placed, to provide at least 3m cover over asbestos disposal areas.

Adapted from GHD 2009

Further noted departures that may be required to fully implement the Capping Strategy in Area 2 include:

- No access to previously identified source of CWR for capping;
- Limited availability of “topsoil” requiring importation of alternative “revegetation medium” with low nutrient and low Chytrid Fungus risk;
- No access to the previously identified geotechnically unsuitable material storage area (Stage 7 area) requiring alternative disposal solutions; and
- The Post HDC Remediation Runoff Flow Paths predicted by the GHD Capping Plan may also be altered to address changes in ground surfaces caused by neighbouring site developments (including the NCIG rail flyover) and the existing site topography.

2.1.1 *Alternative Capping Source*

Where possible, CWR will be won for re-use in capping where it meets geotechnical and material properties of the materials management plan. It is likely that there will be a deficit of appropriate capping material available within Area 2. At this stage, it is unclear the source of the capping material but potential sources include:

- surplus CWR from K10 South;
- VENM/ENM from local area construction sites; or
- Commercial sources/ quarries or other appropriately licenced sources of suitable capping and/or other fill material.

Noting the requirements of previous Referral in a particular manner decision, Referral Number 2012/6464, any capping materials that are imported from outside the closure works site will be required to be sourced from an area that is demonstrated to have a low risk of containing Chytrid Fungus. Measures for determining level of risk are provided in the mitigation measures in *Section 8*.

2.1.2 *Alternative Revegetation Medium*

The existing surface soils in Area 2 are highly variable and ranges from an absence of any growth medium to fine or coarse CWR supporting extensive non-native regrowth. It is necessary to limit stripping of “topsoil” to 100 mm while ensuring a final revegetation medium of 100 mm is provided in order to address the requirements of the Surrender Notice. This will require importation of a growth medium to address the deficiency in “topsoil” expected to eventuate based on requirement to exclude unsuitable materials and the complete lack of material in some areas. The closure works therefore include the importation of a regrowth material to be sourced from an area that is demonstrated to be low in nutrients and assessed as having a low risk of containing Chytrid Fungus (to the extent possible). Suitable material is expected to include crusher dust sourced from dry stockpiles at local hard rock quarries. The crusher dust has been demonstrated to support vegetation on other sites in Newcastle, is of low nutrient value and is not sourced from areas where amphibians are prevalent. Given the dry nature of the material and the absence of amphibians, the material is unlikely to contain Chytrid Fungus spores or frogs infected with Chytrid Fungus. The crusher dust is therefore considered to be an appropriate alternative revegetation medium for the closure works.

2.1.3 *Geotechnically Unsuitable Material Management*

Experience in closure of other portions of KIWEF indicate high potential to encounter geotechnically unsuitable material that cannot be re-used in capping and that may be unsuitable as fill material. As the designated area for relocation envisaged in the Capping Strategy (Stage 7) has been used by unrelated activities, an alternative emplacement area will be identified during development of final detailed design. The area will be located to minimise risks to matters of National Environmental Significance (NES) as defined under the EPBC Act, through placement away from preferred habitat and to avoid the requirement to disturb otherwise non-impacted areas of KIWEF.

2.1.4 *Alternative Post Remediation Runoff Flow Paths*

The flow paths from the final design will be developed to reflect the natural flow paths created by the current site topography. The initial GHD capping plan identified several runoff flow paths that appear incongruent with the current landform. Additionally, adjacent developments have been constructed across the closure works area that will also greatly alter the proposed post remediation flow paths. Based on this assumption, it is proposed that the final design will be developed to direct surface water flows generally in the same direction as the existing water flow paths. Suitable surface water management controls will also be utilised to minimise impacts within sensitive environments such as erosion controls and sedimentation ponds.

2.2

OBJECTIVES OF THE PROPOSAL

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

- regrading of the site to minimum 1% grade to prevent ponding of surface waters;
- drainage improvements;
- provision of a 0.5 m thick, low permeability cap; and
- rehabilitation using existing topsoil and alternative low nutrient and Chytrid free imported growth medium.

As such, the intended outcome of the proposed activity is 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.

Given that the proposal will allow the site to rehabilitate following construction, there is not anticipated to be any ongoing loss of foraging/sheltering habitat for any fauna species, including the threatened Green and Golden Bell Frog (GGBF).

Proposed clearing will predominantly be constrained to those areas that are over 30 m from mapped GGBF breeding habitat as defined in the Capping Strategy. Where capping is required within 30 m of Deep Pond, a steep embankment is present and works will be limited to the top of this embankment with no pond fringing vegetation to be impacted. Due to these controls, no direct impacts to GGBF breeding habitat are proposed (Refer to *Section 7.2.5*).

The potential for indirect impacts to wetlands through sedimentation will be managed through the implementation of erosion and sediment control measures appropriate for sensitive environments. The provision of such controls will be included in detailed designs and illustrated on plans issued for construction purposes.

Changes in hydro-salinity are predicted to result in marginally wetter and fresher conditions in surrounding KIWEF ponds based on:

- an increase in fresher surface water runoff;
- decrease in infiltration; and
- reduced mobilisation of water within the more saline fill aquifer.

The installation of hydro-salinity monitoring devices has been undertaken and salinity levels will be monitored throughout the duration of closure works. Any identified significant changes in pond hydro-salinity, attributable to the proposed activity, would be investigated and mitigation measures explored. Based on past experience in Area 1, it is anticipated that any changes will be extremely negligible and may not be detected due to the high dilution factors involved with Deep Pond.

3 CONSIDERATION OF ALTERNATIVES

3.1 THE NEED FOR THE PROJECT

The State, as represented by HDC as the licence holder, received the EPL Surrender Notice No 1111840 from EPA dated 8 December 2010 setting out closure requirements. The work scope is based on the “Final Landform and Capping Strategy” prepared by GHD (2009) and associated documents. The EPL Surrender Notice requires all activities necessary to execute the Closure Works. In particular, Condition 4 b) requires that:

“The Capping and closure works as defined in Condition 4 a) are to be carried out in a staged manner in accordance with the following timeframes:

- *Area 1 (Area K2 and K10 North): - Capping and Closure works to be completed by 31 December 2014;*
- *Area 2 (Area K3 and K5): - Capping and Closure works to be completed by 30 June 2017; and*
- *Area 3 (K10 South): - Capping and Closure works to be completed by 30 June 2017.”*

3.2 THE ‘DO-NOTHING’ APPROACH

The “do-nothing” approach was considered for the site and in the absence of evidence of offsite contamination mobilisation likely to threaten harm to humans and the environment the do-nothing option could be considered appropriate given the absence of intended post landfill land-use and high ecological constraints on the site. The Capping Strategy (GHD (2009) has applied a “do-nothing” approach where this has been adequately demonstrated. However, in order to satisfy the Surrender Notice requirements and minimise risk of future migration of contamination the do-nothing option has been discounted in areas where the ecological impacts are able to be avoided or otherwise mitigated to an acceptable level. The proposed Capping Strategy has been endorsed as the best method of balancing contamination risks with risk of impact to ecological values of the site by the EPA.

3.3 ALTERNATIVE CAPPING DESIGN AND METHODOLOGY

Alternative bulk earthworks and capping options are limited within the KIWEF due to significant constraints associated with the existing Newcastle Coal Infrastructure Group (NCIG) rail loop, BHP emplacement cell, future use intentions of the landowner and ecological habitat. For Area 2 the alternatives are limited to alternative designs for final landform that achieve the Surrender Notice requirements while maintaining ecosystem functioning as close to its

current form as possible. The final design is to consider the availability of on-site materials for use as capping, fill and revegetation medium, while the Closure Strategy was developed considering the availability of off-site disposal options and alternative remediation technologies.

3.4

ALTERNATIVE APPROACH TO MANAGEMENT OF CONTAMINANTS

The objective of limiting potential migration of the contaminants within the landfill could be met through either excavation of contaminated material for off-site disposal or possibly through the use of alternative remediation technologies.

Off-site disposal is discounted due to the unavailability of appropriate disposal sites and this would also involve greater disturbance of the ecological values of the site.

With respect to alternative remediation technologies, it is noted that the T4 project has developed a draft Remediation Action Plan aimed at making the site suitable for the intended use of a coal export terminal and to manage the additional risks of contaminant migration presented by additional site loading. This Remediation Action Plan is not considered a viable option for the proposed activity as it increases habitat impact, is unnecessary for the protection of human and environmental health in the 'no intended post landfill land-use scenario' and is otherwise cost prohibitive in the absence of a post landfill use. The use of other remedial technologies is considered unviable due to the largely undocumented nature of the disposal practices meaning that targeting specific contaminants in specific areas in KIWEF with appropriate remedial technologies is not possible.

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 and has superseded the State Significant Site listing in the Major Project SEPP under which previous closure stages have been assessed. As the applicable environmental planning instrument the Three Ports SEPP establishes the approval pathway under NSW planning for the KIWEF site closure works.

Under 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 but under the Local Environment Plan 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*”.

ERM understands that HDC has obtained legal advice to the effect that, the closure works should meet this definition (or did so in relation to Area 1) under similar provisions of *State Environmental Planning Policy (Major Development) 2005*.

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*”.

ERM 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.

It is accepted that the proposed closure works meets the definition of remediation under *State Environmental Planning Policy 55 – Remediation of Land*, where remediation means:

- “(a) removing, dispersing, destroying, reducing, mitigating or containing the contamination of any land, or
- (b) eliminating or reducing any hazard arising from the contamination of any land (including by preventing the entry of persons or animals on the land)”.

However, it is considered more appropriate that the proposed works be considered ‘environmental management works’ since they include capping a formerly licensed landfill regulated under the PoEO Act to minimise potential future impacts of an existing development rather than actively remediating contaminated land under the CLM Act for an intended future use. On this basis, the intent of the ‘environmental management works’ provision seems more closely aligned with what is proposed than contaminated site remediation.

Remediation of land is permitted within the land use zone and as such, SEPP 55 is not relied on to make it permissible. If SEPP 55 is to be considered then the same ‘remediation works’ being the mitigation and reduction of a contamination hazard through capping are permissible without consent as ‘environmental management works’ under the Three Ports SEPP and as such under SEPP 55 would meet the definition of Category 2 remediation works not requiring development consent under the EP&A Act.

The proposed works are also subject to a referral under the EPBC Act. The referral has been made based on the known populations of listed species that inhabit the site (see *Section 4.2.1*). This referral has found that no significant impacts to Matters of National Environmental Significance (MNES) are likely. Further consideration of applicable legislation is provided in the sections that follow.

4.2 CONSIDERATION OF COMMONWEALTH LEGISLATION

4.2.1 EPBC Act

The EPBC Act is the primary piece of Commonwealth legislation relating to the environment. Under the EPBC Act any action that has, or is likely to have, a significant impact on a MNES may progress only with the approval of the Commonwealth Minister for the Environment. An action is defined as a project, development, undertaking, activity (or series of activities), or alteration to any of these.

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); and
- a water resource, in relation to coal seam gas development and large coal mining development.

It is generally the responsibility of the proponent of a proposed development, 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. It is noted that a referral can be made even where no significant impact to MNES is considered likely by the proponent, as is the case with the proposed works.

A referral to the Commonwealth Minister for the Environment has been made on the basis that while the remaining stages of the closure are expected to be able to be completed without a significant impact on MNES, a referral should be made given the history of previous EPBC Act Referrals over the site. The need for a referral is influenced by the following:

- the DoE determined that the action to undertake initial closure stages (K2 and K10) was not a controlled action if undertaken in a particular manner indicating that in the absence of strict controls it could be considered a controlled action; and
- while the same particular manner conditions can be applied to the final stages of capping, only the DoE can determine if the different location of works could still render the action a controlled activity.

4.3 *CONSIDERATION OF STATE LEGISLATION*

4.3.1 *Environmental Planning and Assessment Act, 1979*

The relevant planning legislation in New South Wales is the EP&A Act. This Act contains two Parts under which development is assessed in NSW; they are:

- Part 4 of the EP&A Act provides for the control of ‘development’ that requires development consent or is prohibited under an environmental planning instrument. Part 4 also regulates exempt and complying development, and State Significant Infrastructure (SSI) and State Significant Development (SSD); and

- where a proposal does not require development consent its environmental impacts must be addressed as an ‘activity’ under Part 5 of the Act. Generally, Part 5 is for use by government agencies acting as a determining authority, where the activity is being carried out on behalf of that determining authority. However, if the development is ‘exempt development’ the preparation of an REF is not required.

Parts 4 and Part 5 are mutually exclusive in that Part 5 only applies to ‘activities’. The term activity is defined in Part 5 to exclude development for which consent is required or development which is prohibited under Part 4.

The proposed development is considered permissible without consent under State Environmental Planning Policy (Three Ports) 2014 and as such the proposed works constitute an ‘activity’ according to the definition provided within Section 110 of the EP&A Act. Therefore, the Project requires assessment under Part 5 of the EP&A Act.

Section 111 of the EP&A Act requires the determining authority to examine and take into account to the fullest extent possible all matters affecting, or likely to affect the environment by reason of the activity. This is commonly referred to as an REF. Clause 228 of the Environmental Planning and Assessment Regulation 2000 provides a list of factors that should be considered in determining the likely impacts of activities on the natural and built environment. These are addressed in *Section 9.2*.

Section 112 of the EP&A Act outlines the requirements of the applicant if the environmental impact assessment (REF) concludes that the Project is likely to have a significant impact on the environment.

Section 5A of the EP&A Act requires that impacts of a development on threatened species, populations or ecological communities, or their habitats are considered (refer to *Section 7.2*).

4.3.2 *Threatened Species Conservation Act 1995*

The *Threatened Species Conservation Act 1995* (TSC Act) establishes mechanisms for:

- the management and protection of listed threatened species of native flora and fauna (excluding fish and marine vegetation);
- the listing of threatened species or key threatening processes;
- the development and implementation of recovery and threat abatement plans;
- the declaration of critical habitat;
- the consideration and assessment of threatened species impacts in development assessment process; and

- management and regulation of actions that may damage critical or other habitat or otherwise significantly affect threatened species, populations and ecological communities.

Developments requiring approval from a statutory authority of the New South Wales State Government are required to be assessed in accordance with the EP&A Act.

Section 5A of the *EP&A Act*, outlines seven points which must be considered in order to determine the significance of the impact of the development on the habitat of threatened species, populations and ecological communities. This assessment is commonly referred to as an 'assessment of significance'. Where the proposed development is likely to significantly affect critical habitat of a threatened species, population or ecological community, or is in critical habitat, as defined by Part 3 of the TSC Act, a species impact statement must be prepared to accompany the development application.

ERM has undertaken an assessment for the proposed works as presented in *Section 7.2* and determined that the proposed works will not significantly affect critical habitat or the lifecycle of a threatened species, population or ecological community known or expected to occur within the Proposal area of influence, therefore a species impact statement is not required.

4.3.3 *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.

4.3.4 *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 of 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:

- (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,*

is guilty of an offence.

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:

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

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

is guilty of an offence.

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; and
- the disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations.

The proposed works are not an aquifer interference activity and it is understood that the aquifer interference requirements of the WM Act are yet to commence and as such, aquifer interference approval is not deemed necessary.

4.3.5 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.

4.3.6 Protection of the Environment Operations Act 1997

The principal legislation governing waste management and landfill disposal of waste in NSW is the PoEO Act. All landfills must meet the requirements of the PoEO Act and the Regulations made under that Act. The landfill occupier must not pollute waters (in breach of Section 120 of the PoEO Act), cause air pollution (in breach of Sections 124, 125 or 126 of the PoEO Act), or emit offensive odour (in breach of Section 129 of the PoEO Act). The PoEO Act provides for an integrated system of licensing whereby a single schedule of activities requiring an Environment Protection Licence (EPL) regulates all forms of pollution.

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 HDC's obligations under this surrender notice in Area 2 (K3 and K5) and K7.

4.3.7 *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.

4.3.8 *Environmentally Hazardous Chemicals Act 1985*

KIWEF is subject to a notice under Section 35 of the *Environmentally Hazardous Chemicals Act 1985*. Notice 357 dated 1993 is described as current by the EPA. The notice relates specifically to a 41,218 square metre portion of the site. The location is provided in coordinates. The size of the area and specific reference to asbestos contamination suggest the notice relates to the rectangular area illustrated in the KIWEF Capping Strategy (GHD, 2009) within Area K7.

The Notice indicates that a portion of KIWEF described within the notice is considered reasonably expected to be contaminated with asbestos and this area is subject to the following relevant requirements:

- notify the EPA of proposed remedial works and seek approval for those works;
- obtain EPA approval to dispersing or covering the contamination, remove material, vacate the premises, disturb soil below a depth of R.L. 6.5 m AHD; and
- advise the EPA of land sale or relinquishment of occupancy.

The KIWEF Capping Strategy (GHD, 2009) identifies the EPA's intent to remove the Section 35 notice once the capping proposed in Area K7 is complete and confirmed.

4.4 STATE ENVIRONMENTAL PLANNING INSTRUMENTS

4.4.1 *State Environmental Planning Policy (Three Ports) 2014*

The site is within the application area of *State Environmental Planning Policy (Three Ports) 2014* (the 'Ports SEPP') and is zoned SP1 - Special Activities. The site is also within the Port Lease Area.

Under the Three Ports SEPP development may be carried out for the following purposes without development consent by or on behalf of a public authority such as HDC on land within the Lease Area and as such be subject to assessment under Part 5 of the EP&A Act:

- (a) environmental facilities,
- (b) environmental protection works,
- (c) community facilities.

Environmental protection works are not defined in the Three Ports SEPP but under the LEP 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*".

The Three Ports SEPP does define 'environmental management works' which means:

- "(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".

ERM 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 former landfill development and as such are also considered environmental protection works.

Section 6 (1) of the Three Ports SEPP states that subject to Section 74 (1) of the Act and this clause, in the event of an inconsistency between this Policy and another environmental planning instrument, whether made before or after the commencement of this Policy, this Policy prevails to the extent of the inconsistency.

4.4.2 *State Environmental Planning Policy No.14*

State Environmental Planning Policy 14 – ‘Coastal Wetlands’ (SEPP 14) aims to ensure coastal wetlands are preserved and protected in the environmental and economic interests of the State.

SEPP 14 Wetland No. 844, 844a and 823 are the closest to the proposed works. The northern side of Kooragang Island, the North Arm of the Hunter River and Fullerton Cove also contain SEPP 14 wetlands: 817, 819, 820, 821, 822, 846, 847, 848, and 849.

Many of these wetlands form part of the Kooragang Nature Reserve, which has been designated as a Wetland of International Importance (Ramsar wetland) because of its use by international migratory birds. No works associated with the proposal would be carried out in SEPP 14 wetlands therefore the requirements of SEPP 14 do not apply to this proposal.

4.4.3 *State Environmental Planning Policy No.55 Remediation of Land*

State Environmental Planning Policy No. 55 – Remediation of Land (SEPP 55) defines remediation as:

“(a) removing, dispersing, destroying, reducing, mitigating or containing the contamination of any land, or

(b) eliminating or reducing any hazard arising from the contamination of any land (including by preventing the entry of persons or animals on the land)”.

The closure works fall within this definition.

The object of SEPP 55 is to provide for a State wide planning approach to the remediation of contaminated land. SEPP 55 specifies the kind of remediation work that may be carried out without development consent (Category 2 remediation work) and the kind of work for which development consent is required (Category 1 remediation work). In the absence of the prevailing provisions of the Three Ports SEPP, the closure works would meet the definition of Category 1 remediation works primarily because of the classification of Kooragang Island as a coastal zone under SEPP 71 (refer to *Section 4.4.4*). However, as discussed above the proposed closure works meet the definition of Environmental Protection Works in the Three Ports SEPP and, as such, the closure works are permissible without consent.

Under Clause 14 of SEPP 55, Category 2 remediation work is remediation work that may be carried out without consent under another State Environmental Planning Policy or a regional environmental plan. On this basis the Proposal meets the definition of Category 2 remediation works.

Clause 8 (3) of SEPP 55 provides that a person may carry out a Category 2 remediation work without the consent of the consent authority.

Clause 8 (4) requires that a person who carries out a remediation work must ensure that the Council notification requirements of Clause 16, 17 and 18 are complied with in relation to the work.

4.4.4 *State Environmental Planning Policy 71*

The site is located in the Coastal Zone and therefore *State Environmental Planning Policy 71 – Coastal Protection* (SEPP 71) has been considered. The aims of SEPP 71 relate to the protection and enhancement of the coastal environment to ensure that the type, bulk, scale and size of development is appropriate for the location and protects and improves the natural scenic quality of the surrounding environment.

Clause 8 of SEPP 71 lists a number of matters to be taken into consideration by the consent authority however it is noted that Clause 7 identifies that these matters are to be considered when preparing a draft local environmental plan or when determining a development application.

As the proposal is being assessed under Part 5 of the EP&A Act, it is not a draft LEP or a DA and therefore there is no requirement to consider the matters as listed in Clause 8.

4.4.5 *State Environmental Planning Policy (State and Regional Development) 2011*

The *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP) would only apply to the Closure Works if the works are both Category 1 remediation work and are required to be carried out by a management order under the CLM Act (NSW) (Schedule I, Item 24). As the works are required under the Surrender Notice, and no management order has been issued, the SRD SEPP does not apply.

4.5 *LOCAL ENVIRONMENTAL PLANNING INSTRUMENTS*

4.5.1 *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.

4.6 *GUIDELINES*

4.6.1 *Managing Land Contamination Planning Guidelines*

The consideration of the Managing Land Contamination Planning Guidelines (Department of Urban Affairs and Planning, 1998) for all remediation work is required under SEPP 55. The guidelines establish 'best practice' methods for managing land contamination through the planning and development control process and is therefore mostly applicable to local government authorities for the preparation of plans and assessment of development applications.

Consistent with the definition of the works as environmental management or protection works the Managing Land Contamination Guidelines are not called up or referred to in the Surrender Notice.

4.6.2 *Landfill Guidelines*

The purpose of Environmental Guidelines: Solid Waste Landfills (NSW EPA, 1996) is to have a consistent and environmentally responsible approach to managing landfills across NSW. The guidelines adopt a performance based approach, rather than a prescriptive approach, to 'promote and achieve the best environmental outcomes'.

With respect to rehabilitation, the landfill must comply with the following Environmental Goals:

- 2.3.6: *Operational and post-closure procedures must ensure that the former landfill site can be used by the community for other beneficial purposes as soon as practicable after landfilling is completed.*

The proposed closure works are considered necessary to close the former licenced landfill site.

The guidelines set out possible benchmark techniques which (depending on the location of the site and the type and quantity of waste received) may be suitable for a landfill and help to achieve each of the specified environmental goals. The EPA Solid Waste Landfill Guidelines requires that former landfill facilities are capped in accordance with Benchmark 28. GHD (2009) establishes that a reduced capping sequence would be appropriate for the KIWEF due to its differentiation from a putrescible solid waste landfill based on previous risk assessments. Based on this, the general capping requirements for the site will comprise a modified Benchmark 28 of 0.5 m of CWR compacted to achieve a permeability of 1×10^{-7} m/s. The surface grade across the site will be no less than 1%. The EPA endorsed this approach in the conditions of the EPL Surrender Notice Number 1111840 (as varied 8 May 2013).

The EPA is in the process of updating the above guidelines and has issued Draft Environmental Guidelines: Solid waste landfills (Second edition, 2015) for consultation purposes. These draft guidelines replace benchmark techniques with minimum standards amongst other changes. The Draft guidelines are not considered applicable to KIWEF closure as they are not called-up or referred to in the Surrender Notice which dictates how the closure is to be undertaken.

CONSULTATION

HDC 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 Newcasktle Lessee (consisting of the Port of Newcastle Operations Pty Ltd and Port of Newcastle Investments (Property) Pty Ltd) and EPA.

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.

The water bodies at KIWEF have become habitat for many endemic and migratory species as noted by the various ecological assessments completed in relation to the site (Refer to Section 7.2.1). Consultation was undertaken with the Kooragang Bird Observers Group, the Society of Frogs and Reptiles, and the Shortland Wetlands Centre in relation to the development of the Capping Strategy and the GHD (2010) flora and fauna assessment.

HDC has also notified NSW Roads and Maritime Services (RMS) of the proposed works. RMS has included HDC on their list of stakeholders that need to be consulted regarding the proposed road upgrades that may affect access to the Site. RMS has also confirmed that the access to the site will be maintained during any road construction works, which we may continue to use as entry point for deliveries. Further consultation with RMS will be undertaken when the project construction details and dates are confirmed in order to identify the best access routes with RMS.

To aid description, KIWEF and neighbouring third party facilities are described in relation to nominal areas labelled K1 to K13 with this REF addressing Closure Works in Area 2 (K3 and K5) and a small section of K7 as presented in *Figure 2*. Waste disposal was conducted in most of these areas either by application to open ground or in numbered 'disposal ponds' that were generally delineated by bund walls comprised of slag materials. While the Capping Strategy describes these as 'ponds', for ease of description, the Referral under the EPBC Act and this REF describes them as 'cells' on the basis that incomplete or unfilled cells also contain ponds.

The site is highly disturbed given its former use as a landfill. The following site history is taken from GHD (2009). 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. Filling has had a profound impact on the morphology, hydrology, and vegetation of the island. Clearing for agriculture removed the majority of the swamp forest and rainforest vegetation on the island by 1954, and filling of land with industrial by-products resulted in substantial changes to the south-east corner of Kooragang Island by 1966.

In 1951 dredged material from Newcastle Harbour was used to initiate the filling of the tidal channels between the islands of the Hunter River. A 310 hectare (ha) parcel of land was subsequently transferred to BHP Billiton Limited in 1979; however, the site had been used for the landfilling operations since 1972. KIWEF was constructed using blast furnace rock slag and coarse CWR.

By 1989, materials deposited on the site and surrounds, included blast furnace rock slag, coarse CWR slurry, basic oxygen steelmaking slag and flue dust, asbestos, effluent treatment plant slurry, oil sludge, tarry waste and plant refuse. Landfilling between 1990 and 1993 saw the deposition of coal washery tailings, lime sludge, leaded dust, plant refuse, and waste refractory materials including shale and 'Breckett's' across the HDC site.

By 2001, the coal washery tailing cells had been capped, compacted and grassed. Despite the site maintaining an operating licence until 2010, the facility has not received any waste since ownership was transferred to the NSW Government in 2002.

The upper profile of the soils of Area 2 reflect the waste disposal operations and include areas of fine and coarse CWR, granulated slag and consolidated slag cell walls with no natural soils present.

The NCIG Environmental Assessment (Resource Strategies and NCIG 2006) describes the natural soil profile (below fill materials) generally as an upper clay layer (soft silty sandy clay), a sandy layer (loose to dense sand), a lower clay layer (stiff to very stiff sandy silty clay), soft rock layers (siltstone and mudstone) and hard rock layers (sandstone). Due to the presence of the various fill materials and the historical flow paths of the Hunter River and its tributaries, the depth of each of the soil layers varies significantly.

Department of Land and Water Conservation's Newcastle 1:100 000 Soil Landscapes Map (Matthei 1995) identify that:

- the area is described as highly disturbed due to filling at the surface and primarily consists of exposed soil or CWR, largely covered in grasses; and
- the site is underlain by Quaternary sand, silt, and clay overlying the sandstones, siltstones, claystones, coal and tuff of the Permian Tomago Coal Measures.

There have been a large number of 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.

A number of areas have been identified in previous studies as containing elevated levels of soil contamination that may pose higher risk levels, if not managed appropriately. Significantly contaminated materials have been identified at the following locations as identified in :

- Hydrocarbon impacts within Pond 5, BHe57, BHe53, BHe50, K2 and K10;
- Asbestos within K7;
- Phenols in groundwater in K3/1W; and
- Basic Oxidised Steelmaking (BOS) leached waste dust within K3 and K10.

NCIG rail construction works are considered sufficient capping for hydrocarbon impacts identified at BHe57, BHe53, BHe50 and K3/1W, capping operations were completed at Pond 5 in 2001 by BHP with K2 and K10 closure works being assessed and capped separately and assessed under a previously completed REF (ERM 2013).

It is noted that the final capping surface of Pond 5 was not constructed with a suitable fall to allow for drainage. The permeability of the cap has been accepted by the EPA however, the final landform will require reshaping as part of the Area 2 Closure Works. While contamination has been previously identified at the site, it is noted that no off-site impacts are evident, and the risk of off-site impacts has been assessed to be low (RCA Risk Assessment, 2006).

It has been reported that co-disposal of inert and hazardous waste may have taken place, and there are no accurate records of where this has occurred (GHD 2009). As a result, there is a potential for other isolated and unexpected areas of contaminated material to be present anywhere on KIWEF. The management of contaminated materials identified during closure will be dictated by the EPA approved Materials Management Plan as discussed in *Section 7.8*.

6.2 *TOPOGRAPHY*

The topography of the proposed activity area is generally flat with a series of benches formed by different filling practices. Highpoints have been created on the site by the installation of the constructed waste disposal cells (slag walls) which in places rise 9 m above the remainder of the land. The topography has also been altered by the NCIG rail spur line, fly-over and rail loop illustrated in .

6.3 *HYDROLOGY AND DRAINAGE*

KIWEF is located within the Lower Hunter Estuary of the Hunter River catchment. The site is located on Kooragang Island which divides the Hunter River into the Hunter River North Arm and Hunter River South Arm. The proposed activity is located over 500 m from the South Arm and over 1400 m from the North Arm.

The Hunter River National Park and Hunter Wetlands Ramsar site are located between the proposed activity and the Hunter River North Arm but no surface water pathway exists whereby any impact to these areas associated with the proposed activity would be likely.

6.3.1 *Groundwater*

NCIG undertook a review of the hydrogeology of the site as part of an Environmental Assessment for the New Coal Export Terminal (NCIG, 2008). The following is a summary of the findings presented in NCIG (2008). Hydrogeology at the site comprises of two aquifers (fill and estuarine) that are separated in areas by a clay aquitard. The thickness of the clay aquitard ranges from 0 m – 15 m. Despite the aquitard's low permeability, there is some vertical flow between the fill and estuarine aquifer due to thin or nonexistence of the clay or excavation of the thin clay lenses that may have occurred when waste cells were constructed.

The unconfined fill aquifer is primarily recharged by rainfall and the groundwater flow is primarily horizontal, generally flowing towards the nearest surface water body. The water table has been identified at depths between 0.4 m and 1.2 m from the surface.

The estuarine aquifer consists of sand of a moderate to high permeability. The potentiometric surface of the estuarine aquifer lies between the base of the fill aquifer and the water table, therefore allowing for the vertical flow from the fill aquifer to the estuarine aquifer.

The fill aquifer at KIWEF comprises various waste materials, which have been placed within slag bunds. The permeability of the waste materials varies from low to moderate. Groundwater flow in the fill aquifer is found generally to be dominated by two areas of recharge, evidenced by groundwater mounding as identified on the eastern portion of KIWEF. The groundwater flow from this area is radial to the surrounding surface water ponds. Groundwater flow would also be expected to be downward to the underlying aquifer.

The groundwater flow regime in the estuarine aquifer comprises a low hydraulic gradient with a groundwater divide present in a north-east – south-west direction midway through the site.

Groundwater to the north of the divide flows north towards the wetlands. Groundwater flow south of the divide would be directed towards the south-east towards the south arm of the Hunter River. It is noted that the groundwater contours developed are estimates only, and were based on a compilation of historical groundwater data and interpolation where necessary.

6.3.2

Surface Water

Surface drainage within and surrounding the proposed action location is characterised by a highly modified landform formed by landfilling over wetland, mangrove and island complexes. The topography of the proposed activity area is generally flat with a series of benches formed by different filling practices. Highpoints have been created on the Site by the installation of the constructed waste disposal cells (slag walls) which in places rise 9 m above the remainder of the land. The topography has also been altered by the NCIG rail spur line, fly-over and rail loop (referral 2006/2987).

The topography and current surface water flow of the project footprint are illustrated in *Figure 3* and are best described in relation to key features as follows:

- Raised NCIG rail flyover forms the southern boundary of the project area's northern section, with drainage directed to the east and west and then via culverts to the BHP Wetlands;
- An access road (referred to as Delta Road) running in a north-south direction forming the eastern boundary of the Area 2 Closure Works;
- A steep vegetated slag embankment rising from the western side of Delta Road to a plateau formed by the completed disposal cells 1, 3, 5 and 7;
- Flat lightly vegetated areas of cells 2, 3, 5 and 7 with less than 1% gradient and minimal off site surface water flows. The likely surface water flows in high rainfall events would be directed as illustrated in *Figure 3*;
- Lower but generally flat areas formed by incomplete filling in cells 1, 4, 6 and 8 bounded by protruding tops of slag cell walls with no surface water flows out of these cells considered possible;
- Slag cell walls slightly protruding to the north of completed Cell 7 and incomplete Cell 8 forming the northern boundary of the Area 2 Closure Works and falling away to the largely unfilled cells 9 and 10 with some surface water flows possible in high rainfall events from Cell 7 into Cell 9;
- Area K3 generally draining towards the central drainage line flowing in a north westerly direction to Deep Pond; and
- A steep embankment from the western edge of K3 to deep pond.

The southern section of the project footprint (between the NCIG rail spur and rail flyover) slopes gently towards Deep Pond in a westerly direction with raised rail embankments surrounding the Capping Area to the north, east and south.

Legend

- Project Footprint
- Capping Area 2
- Waste Disposal Cell (Approximate)
- Cadastre
- Culvert
- Surface Water Flow Direction (Approximate)
- Drainage Line Flow Direction (Approximate)

Low Point:

- May flow following high rainfall
- Unlikely to over top

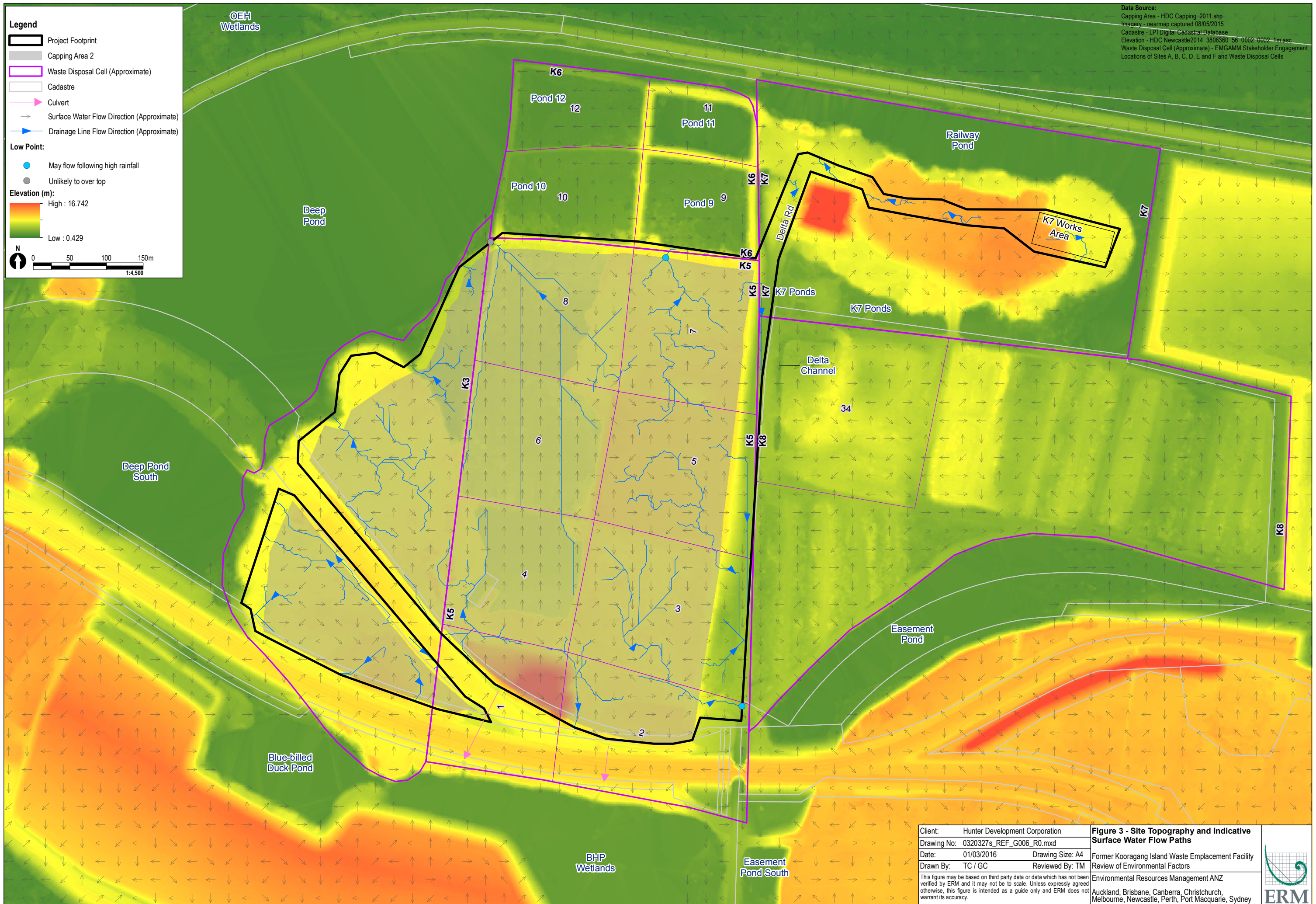
Elevation (m):

High : 16.742

Low : 0.429

Scale: 0 50 100 150m
1:4,500

Data Source:
 Capping Area - HDC Capping_2011.shp
 Imagery - nearmap captured 08/05/2015
 Cadastre - LPT Digital Cadastral Database
 Elevation - HDC Newcastle2014_3806360_56_0002_0002_1m.asc
 Waste Disposal Cell (Approximate) - EMGAMM Stakeholder Engagement
 Locations of Sites A, B, C, D, E and F and Waste Disposal Cells



Client:	Hunter Development Corporation	Figure 3 - Site Topography and Indicative Surface Water Flow Paths Former Kooragang Island Waste Emplacement Facility Review of Environmental Factors Environmental Resources Management ANZ Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney		
Drawing No:	0320327s_REF_G006_R0.mxd			
Date:	01/03/2016			Drawing Size: A4
Drawn By:	TC / GC			Reviewed By: TM
<small>This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.</small>				

Surface water drainage across the wider KIWEF area is complex and consists of a network of culverts, open drains, levees and constructed ponds that fill with surface runoff and ultimately drain to the Hunter River South Arm. The area surrounding the Area 2 Closure Works includes a number of freshwater and brackish ponds with typical flow paths identified as follows:

- ‘Deep Pond’ has recently been divided by the NCIG Rail Flyover but remains connected by culverts. Deep Pond is located immediately west of the Project footprint and collects most runoff from both the northern and southern portions of the Area 2 Closure Works. The maximum water levels of Deep Pond are established by culverts and drainage channels that direct surface water south along the rail line via K2 Basin and to the Hunter River South Arm;
- ‘Blue Billed Duck Pond’ and ‘BHP wetlands’ are separated from Area 2 by the NCIG Rail Spur. These ponds receive runoff from Area 2 via existing culverts beneath the NCIG Rail Spur and ultimately discharge into the southern portion of Deep Pond;
- ‘Easement Pond’ currently receives minimal runoff from the outer slag wall of Area K5 via Delta Road and discharges in an easterly direction via ‘Windmill Road Open Channel’ and ‘Long Pond’ to the Hunter River South Arm;
- ‘K7 Ponds’ receive minimal surface water flows from Area 2 with maximum water level established by an access road separating the K7 Ponds from Railway Pond;
- ‘Railway Pond’ located in the north east corner of KIWEF and surrounding Area K7, receives water from the neighbouring PWCS fines disposal facility, runoff from K7 and the PWCS operated rail line (Kooragang Island Branch Line), which forms its northern bank. Railway Pond discharges in a westerly direction into Deep Pond; and
- Ponds 9, 10, 11 and 12 are formed by unfilled slag walled cells. These ponds are currently not receiving significant surface water flows from Area 2, with no change proposed. Ponds 9 and 11 have no direct linkages to other ponds (although in periods of intense rainfall, Cell 7 may discharge into Pond 9), while Pond 10 and 12 maximum water levels are established by low slag walls dividing them from Deep Pond.

Currently, surface water ponds on KIWEF are provided partly by surface water runoff from rainfall and partly by discharge from horizontal flows from the aquifer within the fill layer and the estuarine aquifer below. The water quality within surface waters is therefore influenced by the contaminants within runoff and within the fill aquifer and may also be influenced by saline conditions within the estuarine aquifer.

Surface water quality sampling has been undertaken over an extended period by a number of consultants and as a result, long term monitoring data is available for all major surface water bodies within KIWEF. Mean long term analytical results prepared by SMEC (2012) show the following areas exceeding ANZECC 2000 (95% Marine and Fresh) for a number of constituents:

- Deep Pond - mean concentrations of aluminium, cadmium, copper, chromium, manganese, mercury, zinc and cyanide are above ANZECC marine criteria;
- Hunter River - mean concentrations of cadmium, chromium, copper, mercury and zinc exceed ANZECC marine criteria. Other sources may also contribute to the water quality in Hunter River;
- Blue Billed Duck Pond - mean concentrations of aluminium, cadmium, chromium, copper, mercury, nickel and zinc exceed ANZECC freshwater criteria; and
- Easement Pond - mean concentrations of aluminium, cadmium, chromium, copper, lead, mercury, nickel and zinc exceed ANZECC freshwater criteria.

Trend analysis is not available for surface water quality data however; inspection of the dataset does not indicate any clear increasing or decreasing change in water quality.

6.4

VEGETATION

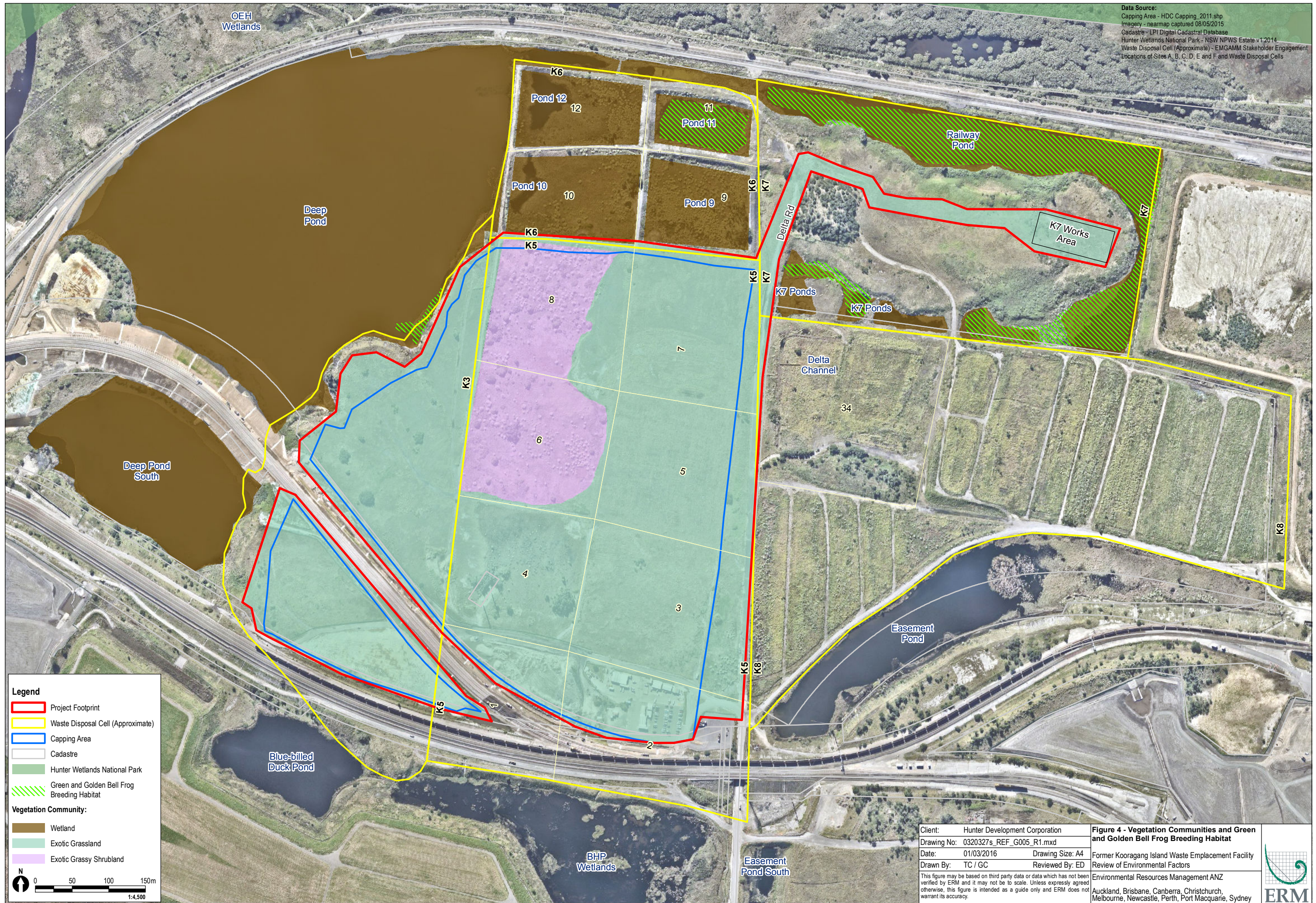
Three different vegetation communities are considered to occur within or adjacent to the Closure Work site (refer to *Figure 4*):

- exotic grassland;
- exotic shrubby grassland; and
- wetlands.

The majority of the site contains exotic grassland which has colonised the capped areas of landfill. Very few native flora species are present however the native Swamp Oak (*Casuarina glauca*) exists as isolated trees or small monospecific stands. Exotic shrubby grassland areas are likely to reflect a succession of the exotic grassland community, with a similar ground cover composition and a developing mid story of small trees and shrubs. No remnant vegetation is present on site, due to the entire site being previously cleared for landfill.

Areas of freshwater wetland exist within KIWEF, but are outside of the proposed capping area. The wetland communities have been described as there is a potential for indirect impacts to occur as a result of the proposed closure works, such as increased surface run off reduction and reduction of contaminated ground water entering the Wetlands.

Data Source:
 Capping Area - HDC Capping_2011.shp
 Imagery - nearmap captured 08/05/2015
 Cadastre - LPI Digital Cadastral Database
 Hunter Wetlands National Park - NSW NPWS Estate v1 2014
 Waste Disposal Cell (Approximate) - EMGAMM Stakeholder Engagement
 Locations of Sites A, B, C, D, E and F and Waste Disposal Cells



Legend

- Project Footprint
- Waste Disposal Cell (Approximate)
- Capping Area
- Cadastre
- Hunter Wetlands National Park
- Green and Golden Bell Frog Breeding Habitat

Vegetation Community:

- Wetland
- Exotic Grassland
- Exotic Grassy Shrubland

Scale:
 0 50 100 150m
 1:4,500

Client: Hunter Development Corporation	Figure 4 - Vegetation Communities and Green and Golden Bell Frog Breeding Habitat Former Kooragang Island Waste Emplacement Facility Review of Environmental Factors Environmental Resources Management ANZ Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney
Drawing No: 0320327s_REF_G005_R1.mxd	
Date: 01/03/2016 Drawing Size: A4	
Drawn By: TC / GC Reviewed By: ED	
<small>This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.</small>	



6.5 HERITAGE

Due to the highly disturbed nature of the Closure Works area and its former use as a landfill, it is unlikely that Aboriginal or non-Aboriginal heritage items would be present within the project footprint.

6.6 AIR QUALITY

The existing ambient air quality in the area of influence of the proposal has most recently been assessed in relation to the PWCS T4 project by Environ (2012). According to Environ existing air quality in the region is influenced by emissions from industry, domestic fuel burning and vehicle emissions. The proposal is located adjacent to the NCIG Coal terminal and the Hunter Valley Coal Chain rail network. Due to the vegetation covering of the Area 2 footprint, it is considered that there would be minimum air quality impacts originating from the existing Area 2.

6.7 ACCESS

The proposal site is accessed off Cormorant Road and Tourle Street, which are part of a regional transport corridor known as MR108, connecting Newcastle City in the south with the industrial precinct of Kooragang Island to the north, and ultimately with Port Stephens. Tourle Street Bridge crosses the Hunter River South Arm at Mayfield. Tourle Street and Cormorant Road currently provide an undivided carriageway that consists of one lane north bound and between one and two lanes southbound.

According to AECOM (2014):

“In 2012, Tourle Street typically carried 32,008 vehicles per day (both directions), with peak traffic flows occurring between about 7.00am and 8.00am and 4.00pm and 6.00pm daily. The dominant traffic direction is northbound during the morning peak and southbound during the afternoon peak”.

And

“The sections of Tourle Street and Cormorant Road subject to the proposal currently do not have sufficient capacity to accommodate existing and future demand. Between the Industrial Drive intersection and the Teal Street roundabout, this route is predominantly a two-lane, two-way road (connecting to four-lane, two-way roads at either end). Consequently, the corridor suffers from traffic congestion particularly during peak periods with traffic required to merge from two lanes to one lane when travelling in either direction”.

Construction of a road upgrade to address this insufficient capacity is proposed to commence in 2016 and take two years for the following:

- construction of a new two lane reinforced concrete bridge located immediately to the west of the existing bridge over the Hunter River;
- widening of Tourle Street and Cormorant Road to four lanes (two lanes in each direction) from about 350 m to the north of the intersection with Industrial Drive to about 200 m west of the intersection with Egret Street; and
- installation of a vertical concrete barrier within the central median along Cormorant Road.

Early works for the road upgrade have commenced and as the closure works may coincide with the full road construction the identified potential construction impacts are indicative of the potential existing access and traffic environment that will exist while closure works are being undertaken. The identified potential road construction impacts described by Parsons Brinkerhoff (2014) are as follows:

“Construction of the proposal is planned to occur over an 18-24 month period. The construction process would not require Tourle Street, the existing Tourle Street Bridge or Cormorant Road to be closed during any stage. A minimum of one lane of traffic would be maintained throughout the construction period.

Construction access

Vehicle access to and from the proposal area would mainly be via Industrial Drive and Tourle Street. Given the location of the proposal, alternative haulage and travel routes are generally not available. Construction vehicles would access the site compound by the left hand deceleration lane provided on the northbound lane of the northern approach to the existing Tourle Street Bridge.

Vehicles accessing work areas would be travelling at typically lower speeds in order to maintain a safe entrance or exit speed from worksites. This may result in delays to vehicles travelling along Tourle Street and Cormorant Road.

Access to the site compound would be undertaken in accordance with an approved Construction Traffic Management Plan (CTMP) that would be developed prior to construction commencing.

The vast majority of light vehicle movements generated by construction workers would occur outside the background peak period due to the majority of work being undertaken during standard construction hours (commencing at 7.00am and finishing at 6.00pm respectively). The existing peak periods are between 7:00am and 8:00am in the morning and 4:00pm and 6:00pm in the afternoon. As such, some overlap of the proposed light vehicle movements with the existing traffic is anticipated to occur (in particular in the morning period). This overlap could result in potential delays and increased congestion during peak times. This impact would be minimised, where possible, through programming deliveries and site movement outside of peak times.

Construction traffic volumes and road performance

Construction traffic would lead to a temporary increase in traffic along Tourle Street and Cormorant Road. The construction work required for the proposal would generate about 50 light vehicle movements to and from the site per day (generally consisting of construction staff and other incidental movements) and about 400-500 truck movements in total throughout the duration of earthworks to and from the site. It is anticipated that up to 20 heavy vehicle movements could occur per day during key construction activities. Other construction traffic generating activities would include delivery of plant, equipment and construction materials and collection and disposal of waste not appropriate for reuse on site. It is expected that the majority of construction truck movements for the proposal would be tipper trucks in the form of a truck and dog trailer or semitrailer (articulated vehicle) and would therefore be able to access the identified access points for the proposal site.

Construction vehicle movements would have the potential to impact on existing traffic flows along Tourle Street and Cormorant Road. Where practical, access tracks for construction vehicles would be constructed and haulage and movements would be maintained within the work area zone and separate from the travelling public. Lane widths on the existing roadways may require reduction to make room for a construction zone to be established and barriers to be erected. Haulage may be required across the existing roadways. Any haulage movement across or along these roads would be in accordance with an approved CTMP.

The speed limit along Tourle Street and Cormorant Road would be decreased during the construction period of the proposal. This may lead to some minor delays for vehicles travelling along these roads, which could increase overall travel times”.

7.1 POTENTIAL HYDROLOGY AND DRAINAGE CHANGES

Pond hydrology may be altered as a result of the closure works when compared to the existing conditions, as a result of a general increase in surface water discharge from capped areas; and reduced groundwater flows due to decreased infiltration through the capped area. The changes to hydrology as a result of the proposed activity are expected to be negligible in comparison to the continuing effects of direct rainfall, evaporation and unchanged interaction with aquifers. The changes to pond hydrology at the KIWEF are expected to be limited to:

- slightly altered wetting and drying regimes in ponds that will likely to be generally wetter due to an increase of surface water in-flows from the closure area via lined sediment basins; and
- water quality changes in the ponds are expected to be slightly fresher with improved general water quality, due to the reduction of leached contaminants, as a result of increased surface water in-flows and reduced infiltration via the fill aquifer to surface water bodies.

The potential for groundwater impacts associated with existing emplaced material are most recently assessed in in association with the T4 Project. In particular Douglass Partners (2013) identified that the closure works would reduce the potential for impact associated with the contaminants found within the existing landfill “through longer particle travel times and reduced mobility of existing contamination compared to the existing case”.

Consideration of the effects of changes to the hydrology on the habitat of the GGBF is provided in *Section 7.2*.

7.2 ECOLOGY

7.2.1 Background Research and Desktop Searches

The KIWEF has been assessed previously by GHD (2010) and a larger area, encompassing the site of the closure works (the proposal assessed herein), has also been assessed for T4 by Umwelt (2012). The results from these previous investigations have been reviewed and included within this assessment, in order to produce a consolidated and up to date ecological assessment. The key reports used within this assessment include:

- GHD (2010) Hunter Development Corporation – Revised Capping Strategy KIWEF Flora and Fauna Impact Assessment January 2010 Revision 3;
- Umwelt (2012) Ecological Assessment for Port Waratah Coal Services (PWCS) Proposed Terminal 4 Project, Port of Newcastle NSW; and

- Golder Associates (2011) 'Green and Golden Bell Frog Management Plan – Kooragang Island Waste Emplacement Facility Closure Works' dated 19 April 2011.

Database searches were conducted to obtain recent data on flora and fauna species, populations, communities and habitats, including those threatened, known to occur within the closure works area and the locality (defined as within 10km of the Study Area), prior to the field survey. Database searches included:

- the NSW Office of Environment and Heritage (OEH) Atlas of NSW Wildlife database (Bionet 2014); and
- the Commonwealth Department of the Environment's (DoE) online Protected Matters Search Tool (PMST) to identify species and ecological communities listed under the EPBC Act (can be found in full in *Annex A*).

7.2.2 *Field Methodology*

ERM 2015

ERM conducted a one day site survey on 10 November 2015 focusing on the proposed closure works area and immediate environs, in order to ground truth the other surveys and vegetation mapping conducted by GHD and Umwelt. This allowed any regeneration of the vegetation subsequent to those studies to be verified and any changes to fauna habitats to be documented. During the survey any incidental fauna species were recorded.

GHD 2010

GHD conducted field surveys between 25th February and 26th March 2009 of the KIWEF area. The field surveys were undertaken by eight ecologists over two nights on three separate occasions. Refer to *Table 2* for weather records and the specific dates of the GHD surveys. The survey techniques and duration of each investigation method is summarised in *Table 3*.

Table 2 *Prevailing Weather Conditions during GHD Field Surveys (2010)*

Date	Min Temp (°C)	Max Temp (°C)	Rainfall (mm)
25/02/2009	21.7	25.9	0.0
26/02/2009	21.0	23.8	0.0
11/03/2009	21.1	23.0	0.2
12/03/2009	19.0	24.6	7.6
25/03/2009	19.1	26.9	0.0
26/03/2009	17.8	26.2	0.0

Table 3 *GHD Survey Techniques and Survey Effort*

Method	Effort
<i>Green and Golden Bell Frog</i>	
Habitat Assessment including transects to assess vegetation type and condition. Habitats defined as known or potential habitat.	3 days/evenings over a 2 week period.
Tadpole surveys using standardised dip-net surveys in all waterbodies observed within the site. Included searches for basking metamorphs.	5 repeats of 5 sweeps.
Auditory survey followed by call playback	3 evenings spread over a 2 week period.
Tadpole/Fish Traps using net traps and bait. Checked periodically.	
Spotlighting Surveys, including counts of GGBF and capture-release to swab for Chytrid and measure and measurements of snout - urostyle length. Photographs were also taken to allow potential recaptures to be identified.	6-7 hrs after sunset, 3 evenings spread over a 2 week period.
<i>Water Quality</i>	
Water quality parameters were collected in each pond, including: Temperature (°C), pH, Redox, Conductivity (uS), and Dissolved Oxygen (DO).	
<i>Vegetation Mapping</i>	
Vegetation Mapping (LHCCREMS, 2003) was reviewed and ground verified during the field surveys using quadrats and transects. Focused on Endangered Ecological Communities (EECs) and Threatened Ecological Communities (TECs). Dominant species recorded with random meanders also used to pick up additional species. Vegetation map was prepared to show results.	
<i>Bats</i>	
Anabats were used to record bat calls at several locations in the Site, with the calls subsequently identified.	11 hours on 25 th and 4 hours on 26 th March 2009.
<i>Opportunistic Observations</i>	
Incidental records of all vertebrate species were collected throughout the survey period.	Six days/evenings.
1. Table 3 is compiled from data sourced from GHD 2010.	

Umwelt 2012

Umwelt conducted surveys across the T4 site over four seasons in 2010/2011 in order to account for seasonal variation and to increase detectability of different species. The surveys were conducted in a large area beyond just the KIWEF closure works area, however many of the targeted surveys for key species such as the GGBF (*Litoria aurea*) and Australasian Bittern (*Botaurus poiciloptilus*) were conducted in the Closure Works Site or adjacent to it. In total, 103 person-days or nights (of 8-12 hours each) were used to comprehensively sample the fauna assemblages of the T4 project area and surrounds. Opportunistic fauna recording was also completed during other surveys completed within the T4 project area. *Table 4* details the survey effort and timing of the Umwelt investigation.

Table 4 Umwelt Survey Timing for T4 Project Area and Surrounds

Survey Area	Season	Year	Period/Date	Length
T4 project area				
T4 Stockyard Site	Spring	2010	11, 12, 17, 22, 25, 29 & 30 November	14 person days/nights
	Summer	2010/2011	8 & 10 February	4 person days/nights
Proposed rail and utility corridor	Summer	2011	14, 15, 16, 17, 21 & 22 February	12 person days/nights
	Autumn	2011	7 & 10 March	4 person days/nights
	Summer	2012	31 January	2 person days/nights
Targeted On-site Threatened Fauna Surveys	Autumn	2010	9, 10, 15 & 16 March	8 person days/nights
	Winter	2010	6, 7 & 8 July, 18, 19 & 20 August	12 person days/nights
	Spring	2010	10, 11, 12 & 17 November	8 person days/nights
	Summer	2010/2011	8, 13, 14, 15 & 20 December, 19, 20, 24 & 27 January	18 person days/nights
Micro-bat habitat survey in mangroves	Summer	2011	15 February	2 person days/nights
	Autumn	2011	7 & 10 March	4 person days/nights
Off-site				
Off-site GGBF surveys	Summer	2011	1, 2, 3, 16 & 17 February	10 person days
	Autumn	2011	24 March	2 person days/nights
	Summer	2012	18, 19 January	3 person days/nights

Table 5 further details the Umwelt survey methods and compares the identified State Government survey requirements against the actual surveys completed.

Table 5 Umwelt Fauna Survey Methods and Effort

Survey Target	Survey Method	Survey Requirement (DEC 2004)	Survey Effort Employed for EA	Habitat Stratification Units Surveyed (number of sites)
Amphibians (including GGBF)	Nocturnal Call playback	At least one playback on each of two separate nights	20 sessions of call playback were undertaken across 7 fauna survey sites over two seasons. In addition to this, at least two sessions were undertaken at the 24 targeted GGBF sites, over at least two seasons.	Freshwater Wetland (26), Saltmarsh (1), Mangrove Forest (2) and Disturbed Land (2).
	Night watercourse search	Two hours per 200 metres of water's edge	Two nocturnal watercourse surveys, each of one person-hour on two separate nights, were undertaken at the 7 fauna survey sites over two seasons. Between two and five nocturnal watercourse surveys were undertaken at the 24 targeted GGBF sites, over three seasons.	Freshwater Wetland (31)
	Diurnal herpetological searches	One hour per stratification unit	Two diurnal herpetological surveys, each of one person-hour on two separate days, were undertaken at the 7 fauna survey sites, over two seasons.	Freshwater Wetland (1), Mangrove Forest (2), Saltmarsh (1), Planting (1) and Disturbed Land (2).
	Opportunistic observations	-	Opportunistic observations were made throughout all surveys.	All
Reptiles	Diurnal herpetological searches	30 minute search on two separate days targeting specific habitat	Two diurnal herpetological habitat searches, each of one person-hour on two separate days, were undertaken at the 7 fauna survey sites, over two seasons.	Freshwater Wetland (1), Mangrove Forest (2), Saltmarsh (1), Planting (1) and Disturbed Land (2).
	Spotlighting surveys	30 minute search on two separate nights targeting specific habitat	Two nocturnal spotlighting surveys, each of one person-hour on two separate nights, were undertaken at the 7 fauna survey sites, over two seasons.	Freshwater Wetland (1), Mangrove Forest (2), Saltmarsh (1), Planting (1) and Disturbed Land (2).
	Opportunistic observations	-	Opportunistic observations were made throughout all surveys.	All

Survey Target	Survey Method	Survey Requirement (DEC 2004)	Survey Effort Employed for EA	Habitat Stratification Units Surveyed (number of sites)
Diurnal Birds (including threatened raptors, migratory shorebirds, threatened wetland-dependent birds and threatened woodland birds)	Area search	Per stratification unit	Two diurnal bird surveys, each of one person-hour, were undertaken at the 7 fauna survey sites, over two seasons. In addition to this, bird surveys were undertaken at two sites areas considered to be 'important bird habitat' by Lindsey (2008) and Herbert (2007). Two survey periods, each comprising one person- hour, were sampled at the two locations over one season. An additional site was surveyed in the proposed rail and utility corridor on one occasion.	Freshwater Wetland (3), Mangrove Forest (2), Saltmarsh (3), Planting (1), Disturbed Land (2) and Open Water (Deep Pond) (1).
	Opportunistic observations	-	Opportunistic observations were made throughout all surveys.	All

Survey Target	Survey Method	Survey Requirement (DEC 2004)	Survey Effort Employed for EA	Habitat Stratification Units Surveyed (number of sites)
Nocturnal Birds (including threatened owls, bitterns and bush-stone curlew (<i>Burhinus grallarius</i>))	Call playback surveys	<p>Sites should be separated by 800 metres - 1km, and each site must have the playback session repeated as follows:</p> <ul style="list-style-type: none"> • at least 5 visits per site, on different nights are required for the Powerful Owl, Barking Owl and the Grass Owl; • at least 6 visits per site for the Sooty Owl, and 8 visits per site for the Masked Owl are required. <p>Sites for Bush Stone- curlew surveys should be 2-4 km apart and conducted during the breeding season.</p>	<p>20 sessions of call playback were undertaken across 7 fauna survey sites over two seasons.</p> <p>Two sessions of call playback were undertaken at the 6 targeted eastern grass owl sites, over three seasons.</p> <p>Two sessions of call playback were undertaken at the 13 targeted Australasian bittern sites, over four seasons.</p>	Freshwater Wetland (14), Mangrove Forest (2), Saltmarsh (1), Planting (1) and Disturbed Land (6)

Survey Target	Survey Method	Survey Requirement (DEC 2004)	Survey Effort Employed for EA	Habitat Stratification Units Surveyed (number of sites)
Nocturnal Birds (including threatened owls, bitterns and bush-stone curlew)	Spotlighting surveys	Spotlighting for plains wanderer and bush stone-curlew by foot or from a vehicle driven in first gear.	Two nocturnal spotlighting surveys, each of one person-hour on two separate nights, were undertaken at the 7 fauna survey sites, over two seasons. Spotlighting was undertaken in conjunction with call playback surveys at the 6 targeted eastern grass owl sites and 13 targeted Australasian bittern sites, over three and four seasons, respectively.	Freshwater Wetland (14), Mangrove Forest (2), Saltmarsh (1), Planting (1) and Disturbed Land(6).
	Day habitat searches	Search habitat for pellets, and likely hollows. Flushing of bush stone-curlews by walking through potential habitat.	Two diurnal flushing surveys were undertaken at 3 targeted eastern grass owl sites in preferred habitat within the T4 project area, over two seasons. Two diurnal flushing surveys of potential diurnal roost habitat, such as tall emergent aquatic vegetation, was undertaken across the 13 targeted Australasian bittern sites within the T4 project area, over four seasons. One flushing survey was undertaken on one occasion within the proposed rail and utility corridor.	Freshwater Wetland (14) and Disturbed Land (3).
	Opportunistic observations	-	Opportunistic observations were made throughout all surveys.	All

Survey Target	Survey Method	Survey Requirement (DEC 2004)	Survey Effort Employed for EA	Habitat Stratification Units Surveyed (number of sites)
Mammals (excluding bats)	Hair tubes	10 large and 10 small tubes in pairs for at least 4 days and 4 nights.	Hair funnel transects were placed along a 200 metre transects at the 7 fauna survey sites. Each transect comprised 20 terrestrial hair funnels. Hair funnels remained on-site for 14 days thereby resulting in 280 trap nights per fauna site.	Freshwater Wetland (1), Mangrove Forest (2), Saltmarsh (1), Planting (1) and Disturbed Land (2).
	Spotlighting surveys	2 x one hour and 1km up to 200 hectares of stratification unit, walking at approximately 1km per hour on 2 separate nights.	Two nocturnal spotlighting surveys, each of one person-hour on two separate nights, were undertaken at the 7 fauna survey sites, over two seasons.	Freshwater Wetland (1), Mangrove Forest (2), Saltmarsh (1), Planting (1) and Disturbed Land (2).
	Search for scats and signs	30 minutes searching each relevant habitat, including trees for scratch marks	Two general habitat searches, each of one person-hour on two separate days, were undertaken at the 7 fauna survey sites, over two seasons.	Freshwater Wetland (1), Mangrove Forest (2), Saltmarsh (1), Planting (1) and Disturbed Land (2).
	Opportunistic observations	-	Opportunistic observations were made throughout all surveys.	All

Survey Target	Survey Method	Survey Requirement (DEC 2004)	Survey Effort Employed for EA	Habitat Stratification Units Surveyed (number of sites)
Bats (including threatened micro-bats and the grey-headed flying-fox (<i>Pteropus poliocephalus</i>))	Ultrasonic call recording (Anabat)	Two sound activated recording devices utilised for the entire night (a minimum of four hours), starting at dusk for two nights.	Anabat surveys, on two separate nights, were undertaken at the 7 fauna survey sites, over two seasons. In addition to this, Anabat surveys were conducted over two nights at nine targeted micro-bat habitat survey sites over three seasons.	Freshwater Wetland (5), Mangrove Forest (4), Saltmarsh (2), Planting (1), Disturbed Land (5) and Open Water (Deep Pond) (1).
	Spotlighting surveys	2 x one hour spotlighting on two separate nights	Two nocturnal spotlighting surveys, each of one person-hour on two separate nights, were undertaken at the 7 fauna survey sites, over two seasons.	Freshwater Wetland (1), Mangrove Forest (2), Saltmarsh (1), Planting (1) and Disturbed Land (2).
	Stag watching	Observing potential roost hollows for 30 minutes prior to sunset and 60 minutes following sunset (recommended for gliders and possums)	Two stag watching surveys, each of one person-hour on one occasion, was undertaken at two potential mangrove micro-bat roost sites.	Mangrove Forest (2)
Bats (including threatened micro-bats and the grey-headed flying-fox)	Day habitat searches	Searches for bat excreta at or near potential habitats.	One habitat assessment was undertaken on one occasion at four potential mangrove roost sites. Dominant species cover, ground cover, presence and quantity of perch sites, litter presence, number of stags, stumps and logs were recorded.	Mangrove Forest (4)
	Opportunistic observations	-	Opportunistic observations were made throughout all surveys.	All

Table 5 has been extracted from Umwelt 2014 and adapted for the purposes of this REF.

7.2.3

Impact Assessment Methods

Likelihood of Occurrence and Impact Assessment Methods

The list of subject species for this assessment was collated from a combination of the PMST, Atlas Records, literature review and field surveys. Any entirely marine species (such as Cetaceans, Marine Fish and Pelagic Seabirds) were excluded from the subject species list given a lack of marine habitat within the closure works area. Species which may occasionally occur within the closure works area or may flyover (such as shorebirds) were included.

Based on the field surveys and desktop research, the likelihood of each listed threatened species and TEC listed under the EPBC Act, was assessed using the following definitions:

- **Known:**
 - The threatened matter has been recorded in the closure works area during recent field surveys; or
 - Database records demonstrate that the threatened matter has been known to occur in the closure works area within the last 10 year period.
- **Potential:**
 - The threatened matter's known distribution includes the closure works area, and suitable habitat is present within the closure works area; or
 - Database records demonstrate that the threatened matter has been known to occur in the closure works area, however has not been recorded within the last 10 years; or
 - The threatened matter is a wide ranging volant species which may 'fly-over' the closure works area, regardless of the habitat types present and has been recorded within 10 km of the closure works area.
- **Unlikely:**
 - The threatened matter has not been recorded within 10 km of the closure works area and suitable habitat does not occur within the closure works area; or
 - The closure works area is not within the threatened matter's known distribution; or
 - Sufficient field surveys have been conducted within the closure works area to conclude that the species is likely to be absent.

Qualitative Risk Matrix

The assessment of significance of impacts assigns a rating for the 'sensitivity' of the matter or habitat and a 'consequence' is applied as defined in *Table 6*. The product of the sensitivity and the consequence is the 'impact significance rating'. That is, Sensitivity x Consequence = Impact Significance Rating. This risk matrix is applied if a threatened matter has the potential to occur or is known to occur. If the risk to the matter is considered **low** then further assessment is **not** considered necessary. If the matter has a **medium, high** or **very high risk** then further assessment is required, including an assessment of significance.

Annex C details the risk assessment process for each of the individual species identified through the PMST, atlas records and field surveys.

Table 6

Impact Significance Ratings for Threatened Matters

		Consequence			
		Negligible ¹	Minor ²	Moderate ³	Major ⁴
Sensitivity	Ecological value not listed as threatened	Low	Low	Medium	High
	Ecological value listed as Vulnerable or Migratory	Low	Medium	Medium	High
	Ecological value listed as Endangered	Medium	High	High	Very High
	Ecological value listed as Critically Endangered	Medium	High	Very High	Very High

Consequence Definitions

¹Negligible: No impacts to an ecological community. Effect on species is within the likely normal range of variation. No removal of specific breeding habitat features.

²Minor: Indirect impacts to listed ecological community (eg changes to water quality, introduction of pathogens, introduction of invasive flora) which may affect a small proportion of the ecological community. Effects a small proportion of a population and Project-related mortality of a small number of individuals may occur, but does not substantially affect other species dependent on it, or the populations of the species itself. No removal of specific breeding habitat features.

³Moderate: Direct removal of a portion of a listed ecological community. Affects a sufficient proportion of a species population that may bring about a substantial change in abundance and/or reduction in distribution over one or more generations, but does not threaten the long term viability of that population or any population dependent on it.

⁴Major: Direct removal of a listed ecological community. Effects an entire population or species at sufficient scale to cause a substantial decline in abundance and/or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) may not return that population or species, or any population or species dependent upon it, to its former level within several generations, or when there is no possibility of recovery.

Species sensitivity definitions

Species sensitivities refer to the listing under either the EPBC Act or TSC Act. Where the species listings differ, the higher sensitivity is used.

Vegetation

Desktop review of previous work by GHD (2010) conducted within the closure works area, indicated that three different Vegetation Communities occur:

- Semi-permanent / ephemeral wetlands;
- Freshwater / brackish wetlands, and
- Cleared / disturbed grassland.

Two Endangered Ecological Communities were considered by GHD as present within KIWEF, both of which are part of the wetland complex:

- Freshwater Wetlands on Coastal Floodplains in the NSW North Coast, Sydney Basin and South, and East Corner Bioregions EEC; and
- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions.

The following sections build on the work conducted by GHD, and provide additional information based on recent field survey effort by ERM. Results reflect continuing vegetation succession within the closure works area. Refer to *Figure 4* for the distribution of the mapped vegetation described below. Umwelt has also completed habitat mapping to identify GGBF habitat, which has been replicated within *Figure 4*.

Exotic Grassland

The majority of the closure works area contains exotic grassland, which has colonised the capped areas of landfill as presented in *Photograph 1*. The dominant species include Red Natal Grass (*Melinis repens*), and the exotic forbs Fennel (*Foeniculum vulgare*), Purpletop (*Verbena bonariensis*) and Narrow-leaved Cottonbush (*Gomphocarpus fruticosus*). Very few native flora species are present and no threatened flora species are anticipated to occur or have been recorded by previous studies.



Photograph 1 *Exotic Grassland, Covering the Majority of the Closure Works Area*

Exotic Shrubby Grassland

Exotic Shrubby Grassland areas are likely to reflect a succession of the Exotic Grassland community described above, with very similar ground cover composition, refer to *Photograph 2*. The ground cover in the Exotic Shrubby Grassland also has patches of Blady Grass (*Imperata cylindrica*), which is a native coloniser of disturbed areas. Pampas Grass (*Cortaderia selloana*) is abundant and listed as a class 4 Noxious Weed.

Large shrubs and small trees are frequent, with the dominant species the naturalised Golden Wreath Wattle (*Acacia saligna*) and African Olive (*Olea europaea* subsp. *cuspidata*). Other exotic trees and shrubs include Camphor Laurel (*Cinnamomum camphora*), Castor Oil Plant (*Ricinus communis*) and Lantana (*Lantana camera*). The native species Sydney Golden Wattle (*Acacia longifolia*) and Sweet Pittosporum (*Pittosporum undulatum*) occur in low abundances and these species are both colonisers of disturbed areas, as well as a component of more established native communities.

This community occurs within Cells 6 and 8 and extends outside of the proposed closure works area into Cells 9 and 10, intergrading with wetland areas.



Photograph 2 Exotic Shrubby Grassland in Cell 8

Swamp Oak Stands

Swamp Oak (*Casuarina glauca*) are found in all of the vegetation types present within the closure works area, except within permanently inundated areas, refer to *Photograph 3*. It exists either as individual trees or as small dense stands. The ground cover is limited within the dense stands of trees and where present, it is composed of the same species present in the Exotic Grassland areas. All of the Swamp Oak present has colonised the highly modified site, and does not represent remnant vegetation.



Photograph 3 *Swamp Oak (Casuarina glauca) Stand within Exotic Grassland in the Closure Works Area.*

Wetlands

Areas of freshwater wetland exist within the closure works area. These are all outside of the proposed capping area however they have been described and assessed as there is potential for indirect impacts to occur.

Deep Pond occurs along the western edges of the proposed capping area, it is somewhat of a misnomer, with areas of shallow water extending considerable distances from the banks, especially in the north and south of the pond. A considerable portion of the pond's margins has emergent vegetation including Common Reed (*Phragmites australis*), Broadleaf Cumbungi (*Typha orientalis*), *Bolboschoenus caldwellii* and the exotic Sharp Rush (*Juncus acutus*) (refer to *Photograph 4*). One threatened species, Horned Pondweed (*Zannichellia palustris*), listed as Vulnerable under the TSC Act, was identified along the eastern margins of Deep Pond during the site inspection.

Owing to the steep banks of Deep Pond, the emergent wetland species flora rapidly transition to exotic grassland and exotic grassy shrubland communities.

Wetland areas also exist within K6 and Cells 9-12 (refer to *Photograph 5*). These include a series of semi-permeant to permeant ponds with large areas of marginal wetland vegetation with the species composition similar to Deep Pond. A small area of the saltmarsh plant Samphire (*Sarcocornia quinqueflora*) exists within the wetland, growing in an area of coal washery reject fines.



Photograph 4 **Western Edge of Deep Pond Wetland Looking Southwards.**



Photograph 5 **Cell 10 and Cell 12 Wetlands. The north eastern corner of Deep Pond is visible in the top left of the photo.**

Endangered and Threatened Ecological Communities

The likelihood of occurrence table in *Annex C*, considers the presence or absence of EECs and TECs within the closure works area. The section below discusses select communities in further detail, where attributes of the vegetation may share similarities to a listed community.

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC.

This community is associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically the community occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains; at elevations below 20 m. The communities are dominated by herbaceous plants and have very few woody species.

All of the wetland areas in the closure works area meet the community description and are therefore considered part of the EEC. It is noted that the determination for this EEC includes highly disturbed and modified landforms and therefore the disturbed nature of the wetlands in the closure works area does not preclude this listing. This community is outside of the proposed Capping Area and will not be directly impacted; however an assessment of significance will consider this EEC further owing to the potential for indirect impacts.

Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions EEC.

Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC is dominated by Swamp Oak (*Casuarina glauca*), associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains (OEH, 2015). Swamp Oak were recorded on areas of previously capped landfill waste, which is approximately 5-6 m above the water level of Deep Pond. 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 capping material and is not representative of the soil types that characterise this EEC.

This community is considered absent from the closure works area.

Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions EEC

Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions is listed as an EEC under the TSC Act 1995. An area that may be considered representative of this EEC occurs within the Wetland of K6 Cell 10 on the flat floodplain area of coal washery reject. This area has floral assemblages similar to that of Coastal Saltmarsh and the margins are dominated by Common Reed (*Phragmites australis*) with Samphire also present. It is likely that these species dominate the area due to the conditions created by very fine sediments (coal washery reject) creating anoxic growing medium and haline conditions. Haline conditions are likely to be present in this area for a number of reasons including; salts leaching from the surrounding fill, concentration of the salt due to evaporation; and due to the areas being historically part of the coastal floodplain and influenced by tidal conditions.

The area is no longer open to tidal influence due to the wetland area being within an emplacement cell and surrounded by other earthworks including a rail embankment. The community observed did not show any signs of bioturbation, and is unlikely to support the high levels of euryhaline invertebrates, typically included in Coastal Saltmarshes. It is not likely to provide important foraging resources for birds which typically prey on molluscs and polychaetes within the sediments. The scientific determination states that the community occurs in the intertidal zone on the shores of estuaries and lagoons.

This community is considered absent from the closure works area.

Subtropical and Temperate Coastal Saltmarsh TEC.

The EPBC Act also lists Subtropical and Temperate Coastal Saltmarsh as a TEC. The EPBC listing does not include Saltmarsh vegetation, which is disconnected from intertidal influence.

The community within the closure works area is permanently disconnected from tidal areas of the Hunter estuary and therefore is not considered part of the listed community, despite having species attributes similar to the listed community.

Flora

The majority of the flora recorded within the closure works area are exotic, with nine native species recorded out of the 27 species recorded during the field survey (refer to *Annex B*).

Twenty threatened flora species have been recorded within the locality (Bionet) with 12 listed in the PMST. These species are considered in *Annex C*.

One threatened flora species, Horned Pondweed was recorded within Deep Pond. The aquatic plant species behaves as an annual and dies back in the summer. At the time of the field survey (November, 2015), the plant was observed as small floating pieces which, appeared to be degenerating. Owing to the species dispersal abilities, it should be considered cosmopolitan throughout Deep Pond and may colonise other areas of Wetland during flood events.

Considerable survey effort has been employed on the Site (GHD, Umwelt and ERM) with Horned Pondweed the only threatened species recorded. Furthermore, Umwelt (2012) surveyed the larger T4 area with no additional threatened species recorded. Given the amount of field effort employed, and consideration of habitats present it is unlikely that any additional flora species are likely to occur.

Noxious Weeds

For a plant to be declared a Noxious Weed under the *Noxious Weeds Act 1993* it must be considered to pose a serious threat to humans, agriculture and/or the environment. There must also be consideration given to the feasibility of control and enforcement of those methods. Plants are declared noxious by order of the Minister for Primary Industries.

Four weeds recorded within the closure works area are listed as noxious in the Newcastle local control area. One species, Pampas Grass is listed as class 3 with the remaining four species: Bitou Bush (*Chrysanthemoides monilifera* subsp. *rotundata*), Crofton Weed (*Ageratina adenophora*) and Prickly Pear (*Opuntia stricta*) listed as Class 4. Specific controls exist for Pampas Grass and Crofton Weed and they must be prevented from growing within 10 m and 5 m, respectively, of watercourses and property boundaries.

Pampas Grass is prevalent within the closure works area, especially on the wetland margins and within Cells 6 and 8.

Crofton Weed is found in isolated patches within the closure works area in meiotic area including adjacent to wetlands and small patches with K5, Cells 6 and 8.

Bitou Bush is found throughout the closure works area, especially in the areas of Exotic Shrubby Grassland.

Prickly Pear was not prevalent and occurred sporadically across the closure works area.

Table 7 *Noxious Weed Control Classes and Controls Requirements*

Control class	Weed type	Control Requirements
Class 3	Plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.	The plant must be fully and continuously suppressed and destroyed.
Class 4	Plants that pose a potentially serious threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread

1. Table adapted from Noxious Weeds, DPI 2015

Fauna

Fauna habitat

Habitat for fauna within the closure works area can be broadly into three types; grassland, shrubby grassland and wetlands. The grassland and shrubby grassland areas provide habitat for a range of common species, especially birds such as the Golden-headed Cisticola (*Cisticola exilis*) and Fairy Martins (*Petrochelidon ariel*) which were observed foraging within the habitat. Despite the habitat being heavily disturbed, dominated by exotic flora and having no remnant vegetation, several threatened species also utilise the habitat including the Red-backed Button-quail and a number of threatened insectivorous bats.

The wetland areas adjacent to the closure works are likely to have a higher habitat value than the terrestrial areas given it supports a number of threatened bird species, EPBC listed migratory species and the Southern Myotis Bat (*Myotis macropus*). The wetlands within the closure works area are within close proximity to the Hunter Wetlands National Park and the listed Ramsar Wetland Hunter Estuary Wetlands (ID No 24) (refer to *Figure 1*). This connectivity is likely to increase the diversity and abundance of wetland species occurring within and adjacent to the closure works area. At its closest point, the Ramsar wetland occurs approximately 260 m to the north of the northern closure works area boundary.

The Hunter Estuary Wetlands Ramsar wetland is comprised of two components, Kooragang and Hunter Wetlands Centre Australia. The Kooragang component of the Hunter Estuary Wetlands Ramsar wetland (most relevant to this proposal) is located in the estuary of the Hunter River, approximately 7 km north of Newcastle on the coast of New South Wales. The Kooragang component includes Kooragang Island and Fullerton Cove, two areas that lie in the estuarine section of the Hunter River. Kooragang Island originally consisted of seven islands that were mostly separated by



narrow mangrove lined channels. Habitat types within the Reserve include mangrove forests dominated by Grey Mangrove (*Avicennia marina*), Samphire (*Sarcocornia* sp.) saltmarsh, Paperbark (*Melaleuca* sp.) and Swamp she-oak swamp (*Casuarina glauca*) forests, brackish swamps, mudflats, and sandy beaches.

The Hunter Estuary Wetlands Ramsar wetland is important as both a feeding and roosting site for a large seasonal population of shorebirds and as a waylay site for transient migrants. Over 250 species of birds have been recorded within the Ramsar wetland, including 45 species listed under international migratory conservation agreements. In addition, the Ramsar wetland provides habitat for the nationally threatened GGBF, Red Goshawk and Australasian Bittern (DoE, 2015).




















For locations of the threatened fauna within and surrounding the closure works area, refer to *Figure 5*.

. Note that a three kilometre buffer has been used in order to display the data clearly while the Likelihood of Occurrence table in *Annex C* considers species from the locality which is defined as a 10 km buffer to the closure works area.





Legend

 Project Footprint
 Project Footprint Buffer (3km)



Threatened Species:

-  *Euphrasia arguta*
-  Australasian Bittern
-  Black Bittern
-  Black-necked Stork
-  Comb-crested Jacana
-  Diamond Firetail
-  Eastern Bentwing-bat
-  Eastern Freetail-bat
-  Freckled Duck
-  Grey-headed Flying-fox
-  Little Bentwing-bat
-  Little Eagle
-  Maggie Goose
-  Pied Oystercatcher
-  Southern Myotis
-  Spotted Harrier
-  White-fronted Chat
-  Yellow-bellied Sheath-tail-bat
-  Zannichellia palustris

Migratory Species:

-  Black-tailed Godwit
-  Greater Sand-plover
-  Lesser Sand-plover
-  Providence Petrel

Threatened and Migratory Species:

-  Curlew Sandpiper
-  Eastern Curlew

Note:
Species Locations are approximate, records have been offset where more than one record occurs in the same location to ensure they are visible (excluding Curlew Sandpiper, Black-tailed Godwit and Terek Sandpiper locations).



Data Source:
Imagery - LPI WMS (SKM) captured 17/05/2014
Threatened Species - NSW Office of Environment and Heritage's Atlas of NSW
Wildlife, which holds data from a number of custodians. Data obtained 20/10/2015



Client: Hunter Development Corporation
 Drawing No: 0320327s_REF_G003_R2.mxd
 Date: 29/02/2016 Drawing Size: A3
 Drawn By: TC / GC Reviewed By: ED

Figure 5 - Threatened and Migratory Species Recorded within 3 km of the Site
 Former Kooragang Island Waste Emplacement Facility
 Review of Environmental Factors

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Environmental Resources Management ANZ
 Auckland, Brisbane, Canberra, Christchurch,
 Melbourne, Newcastle, Perth, Port Macquarie, Sydney



Amphibians

Two threatened flora species have been recorded within the locality (Bionet) with two threatened species also listed in the PMST. These species are considered in *Annex C*.

Eleven frogs have been recorded within KIWEF (GHD, 2010). The most abundant and cosmopolitan species were Striped Marsh Frog (*Limnodynastes tasmaniensis*), Eastern Dwarf Tree Frog (*Litoria fallax*) and Eastern Froglet (*Crinia signifera*). Two species were heard calling during recent surveys by ERM, the Eastern Froglet and Striped Marsh Frog.

The GGBF is listed Endangered under the TSC Act and Vulnerable under the EPBC Act. The species has been recorded both historically and recently within the KIWEF. Collaborative targeted surveys by GHD and RPS HSO recorded the species on multiple occasions including both adults and tadpoles. All of these records were outside of the proposed capping area, however several records were found in close proximity to the capping area. The highest density of records was from K6 Cell 11 (refer to *Figure 6*) with breeding also recorded in this area. Other areas in which the species was recorded include K6 Cell 10 and 12, Easement Pond, Cell 34 and the South western Corner of K7 (often referred to as K7 Ponds).

Further surveys were also completed by Umwelt within KIWEF and the surrounding area, between 2010 and 2011. The field surveys supported GHD's findings with a similar concentration of records as described with highest recorded concentrations of GGBF within K6 Cell 11.

The annual report on the 2013/2014 Field Season for GGBF on Kooragang Island (NCIG, 2015) provided information on the distribution of the species between September 2011 and March 2014. These surveys again supported the distribution of the species described above however there were notably more records in Deep Pond especially where emergent vegetation was present. The species was also detected calling in the central eastern margins of Deep Pond, indicating that potential breeding habitat is present.

Figure 6 shows the records of GGBF within the site and the surrounding area. It should be noted that several of the records are spatially suspect and include a high density of individuals within wholly terrestrial areas of the site, or within open water habitat in Deep Pond. It is likely that these results are a central point survey point, reflecting effort over a much large area, with individual records lumped together to form a single point. These records could not be interrogated further as they did not have detailed attribute data. Notwithstanding these spatially suspect records, the majority of the records are accurate and show clear habitat preferences for certain wetland habitats and ponds.

Legend

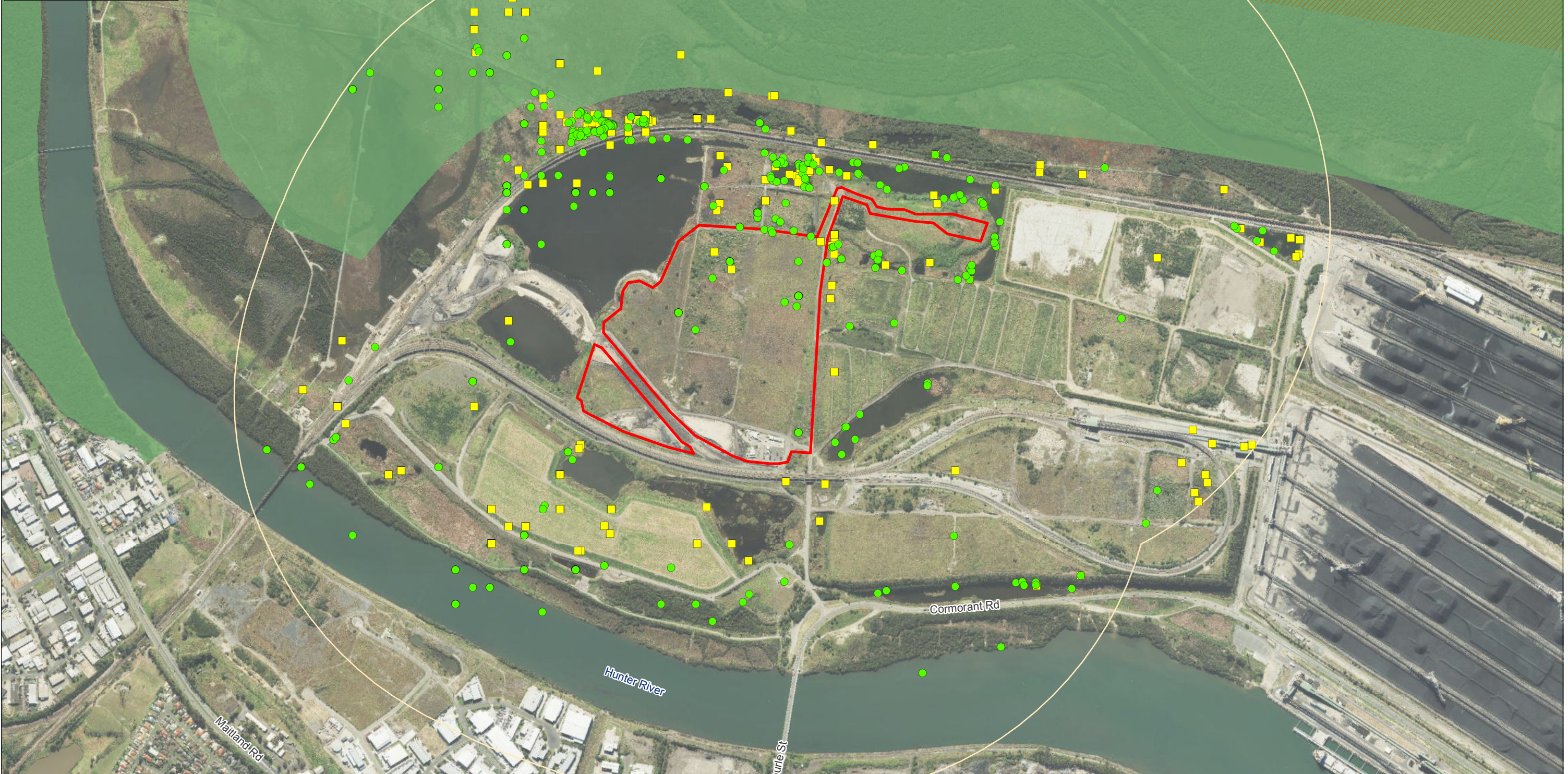
- Project Footprint
- Project Footprint Buffer (1km)
- Hunter Wetlands National Park
- Hunter Estuary Ramsar Wetland

Green and Golden Bell Frog:

- Multiple Sources
- NSW Wildlife Atlas

Scale:
 0 100 200 300m
 1:11,500

Data Source:
 Imagery - LPI WMS (SKM) captured 17/05/2014
 Hunter Wetlands National Park - NSW NPWS Estate v1 2014
 Hunter Estuary Ramsar Wetland - DoE Ramsar Wetlands of Australia
 GGBF Multiple Sources - Records are from multiple sources which were provided by HDC (2015).
 GGBF NSW Wildlife Atlas - NSW Office of Environment and Heritage's Atlas of NSW Wildlife, which holds data from a number of custodians.



Client: Hunter Development Corporation	Figure 6 - Green and Golden Bell Frog Recorded within 1 km of the Site	
Drawing No: 0320327s_REF_G004_R1.mxd	Former Kooragang Island Waste Emplacement Facility Review of Environmental Factors	
Date: 29/02/2016	Drawing Size: A4	
Drawn By: TC / GC	Reviewed By: ED	
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.		Environmental Resources Management ANZ Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

Table 8, provides an overview of the known habitat usage of site and the surrounding wetlands by the GGBF.

Table 8 *Green and Golden Bell Frog Habitat Values and Impacts*

Location	Habitat Utilisation	Impacts as a result of the Proposed Works
Deep Pond	The margins of the ponds provide foraging habitat for the species and a likely refuge during dry periods of weather. There is potential for breeding to occur with calling adults recorded, however no tadpoles or metamorphs have been detected to date. Tadpole may be compromised owing to the presence of high numbers of predatory fish including native eels and exotic Eastern Gambusia, which are known to predate on their tadpoles. A number of wetland birds are also likely to prey on the species.	No direct impacts as outside of the capping area. Negligible hydrological changes.
K6 Cell 11 Railway Pond and; Other Ponds within K7	Pond areas provide important breeding habitat for GGBF, with a high density of adults, metamorphs and tadpoles recorded. Ponds are optimal habitat with no Eastern Gambusia recorded, emergent vegetation, areas of open water and unshaded areas for basking. Surrounding wetland and terrestrial habitat provide foraging resources for the species with dense native and exotic vegetation present.	No direct impacts as outside of the capping area. Negligible hydrological changes.
K6, Cells 9,10 & 12	Mosaic of wetland and terrestrial habitats which are likely to provide drought/dry weather refuge and optimal foraging resources for the species and are within close proximity to wetland habitat and breeding habitats. There are a number of records within these areas.	No direct impacts as outside of the capping area. Negligible hydrological changes.
K5, Cells 6 & 8	These areas are highly vegetated and are likely to provide some foraging habitat for adult GGBF. They are a considerable distance from the breeding ponds and unlikely to provide habitat for metamorphs. There are a small number of records in this area. Areas of similar habitat also occur within the wider K7 area (outside of the capping area) and this habitat is not considered unique. It is not anticipated that high proportions of the population would be recorded within these areas at any given time.	Temporary clearance of all vegetation and levelling earthworks.
K3 K5: Cells 1,2,3,4,5,7	These areas are dominated by exotic grassland, without large tussock forming species or other habitat complexity which is likely to provide shelter for the species. These habitats are considered largely unsuitable for the species however individuals may occasional traverse these areas.	Temporary clearance of all vegetation and levelling earthworks.

Reptiles

No terrestrial threatened species records exist within the locality with one marine turtle species recorded. The PMST lists five marine turtle species and one terrestrial snake, the Broad-headed Snake (*Hoplocephalus bungaroides*).

GHD (2010) have recorded six reptiles within the Site including three snake species, two skinks and one turtle. No threatened reptiles have been recorded and it is considered unlikely that any threatened reptiles occur within the Site.

Fish

Fish listed on the PMST are restricted to Marine species and there is no direct connection between the Wetlands adjacent to the Site and the Hunter Estuary. No threatened freshwater fish are known from the Hunter River catchment.

Four native fish have been recorded within the Site (GHD, 2010) and one exotic species exists, Eastern Gambusia (*Gambusia holbrooki*).

Birds

ERM recorded 29 bird species during the Site visit conducted during November 2015, refer to *Annex B* for the full species list. GHD (2010) noted thirty-five bird species during field undertaken over a number of days. Neither of these surveys recorded any threatened or EPBC listed migratory birds.

Review of the Atlas of NSW Wildlife (Bionet) and collated data by Umwelt (2012) details that 12 threatened birds have been recorded within or immediately adjacent to the site, refer to *Table 9*. Of the species recorded, nine are likely to be associated with the wetland areas of the site. Species likely to utilise the terrestrial habitat areas of the site include the Red-backed Button Quail (*Turnix maculosus*), Spotted Harrier (*Circus assimilis*) and to a lesser extent the White-fronted Chat (*Epthianura albifrons*).

Table 9 *Threatened Birds Recorded within Recorded within or Immediately Adjacent to the Site*

Common Name	Scientific Name	TSC Act Status	EPBC Act Status
Magpie Goose	<i>Anseranas semipalmata</i>	V	-
Australasian Bittern	<i>Botaurus poiciloptilus</i>	E	E
Curlew Sandpiper	<i>Calidris ferruginea</i>	E	CE, Mi
Spotted Harrier	<i>Circus assimilis</i>	V	-
Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>	E	-
White-fronted Chat	<i>Epthianura albifrons</i>	V	-
Black-tailed Godwit	<i>Limosa limosa</i>	V	Mi
Eastern Curlew	<i>Numenius madagascariensis</i>		CE, Mi
Blue-billed Duck	<i>Oxyura australis</i>	V	-
Eastern Osprey	<i>Pandion cristatus</i>	V	Mi
Freckled Duck	<i>Stictonetta naevosa</i>	V	-
Red-backed Button Quail	<i>Turnix maculosus</i>	V	-

1. EPBC Act and TSC Act Status: V - Vulnerable, E - Endangered, CE Critically Endangered, Mi - Migratory (EPBC Act Only).

A total of 16 migratory species have been recorded with or adjacent to the site (refer to *Table 10*) all of which are primarily associated with the wetland areas of the site.

Table 10 *Migratory Birds Recorded within or Immediately Adjacent to the Site*

Common Name	Scientific Name	TSC Act Status	EPBC Act Status
Great Egret	<i>Ardea alba</i>		
Cattle Egret	<i>Ardea ibis</i>		
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>		
Red Knot	<i>Calidris canutus</i>		
Curlew Sandpiper	<i>Calidris ferruginea</i>	E	CE
Pectoral Sandpiper	<i>Calidris melanotos</i>		
Red-necked Stint	<i>Calidris ruficollis</i>		
Double-banded Plover	<i>Charadrius bicinctus</i>	V	
Latham's Snipe	<i>Gallinago hardwickii</i>		
Bar-tailed Godwit	<i>Limosa lapponica</i>		
Black-tailed Godwit	<i>Limosa limosa</i>	V	
Eastern Curlew	<i>Numenius madagascariensis</i>		CE
Whimbrel	<i>Numenius phaeopus</i>		
Eastern Osprey	<i>Pandion haliaetus</i>	V	
Pacific Golden Plover	<i>Pluvialis fulva</i>		
Marsh Sandpiper	<i>Tringa stagnatilis</i>		

- Note all species are listed Migratory under the EPBC Act.
- EPBC Act and TSC Act Status: V - Vulnerable, E - Endangered, CE - Critically Endangered, Mi - Migratory (EPBC Act Only).

Non-volant Mammals

Six terrestrial threatened mammals have been recorded within the locality (Bionet) with five terrestrial mammals noted on the PMST. No threatened non-volant mammals have been recorded within the Site or are expected to occur.

GHD recorded four mammals (GHD, 2010), only one of which was native, the Water Rat (*Hydromys chrysogaster*). ERM recorded one additional exotic mammal the European Hare (*Lepus europaeus*) during the recent field visit.

Bats

Ten threatened bat species have been recorded within the locality (Bionet) with two bat species noted on the PMST.

Field surveys by GHD (2010) and a collation of data from various surveys by Umwelt (2012) have detected eight threatened bat species within the Site (refer to *Table 11*). The majority of the bats were recorded by their echolocation calls, however the Southern Myotis was observed foraging over water and also roosting small number in in the Common Reed (*Phragmites australis*). No other roosting resources for Bats were noted within the site with an absence of natural or manmade structures for hollow roosting or cave roosting bats.

Table 11 *Threatened Bats Recorded within the Site*

Common Name	Scientific Name	TSC Act Status	EPBC Act Status
Grey-headed Flying-Fox	<i>Pteropus poliocephalus</i>	V	V
Yellow-bellied Sheath-tail-Bat	<i>Saccolaimus flaviventris</i>	V	-
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	V	-
Little Bentwing-Bat	<i>Miniopterus australis</i>	V	-
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	V	-
Southern Myotis	<i>Myotis macropus</i>	V	-
Greater Broad-nosed bat	<i>Scoteanax rueppellii</i>	V	-
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V	-

EPBC Act and TSC Act Status: V - Vulnerable

Exotic Fauna

Eastern Gambusia was recorded in high numbers in the shallows of Deep Pond during recent surveys by ERM and previously by GHD (2010). The species is widespread in NSW and is a pest species responsible for predating tadpoles including those of the GGBF. Predation by *Gambusia holbrooki* is listed as a Key Threatening Process on Schedule 3 of the TSC Act (1995). DPI have listed this species as a Class 1 noxious species means it is illegal to sell or possess it live.

Exotic mammals recorded during the field surveys include the House Mouse (*Mus musculus*), Black Rat (*Rattus rattus*), European Red Fox (*Vulpes vulpes*) and European Hare. Predation by the European red fox is listed as a Key Threatening Process on Schedule 3 of the TSC Act (1995).

7.2.5 *Impact Assessment*

The project includes the clearance of exotic grassland and exotic shrubby grassland. This will not directly impact any of threatened shorebirds or wetland birds, which do not typically utilise these terrestrial habitats. The clearance will remove habitat for a small number of threatened fauna species which is discussed below in greater detail. Once the closure works are complete, the area will be revegetated with native species of local provenance, which will provide similar habitat to that which currently exists, whilst reducing the dominance of exotic species.

The hydrological changes resulting from the closure works are discussed in *Section 7.1* and are considered in more detail below, with regard to the Wetland EEC and Ramsar Site.

The construction works will involve heavy machinery and increased human activity within the capping area. This will temporarily increase the amount of noise and visual disturbance in an area close to wetlands. This may disrupt shorebirds and wetland birds utilising wetland habitat adjacent to the works. This impact is temporary and it is not considered significant as there are large areas of alternative habitat within the vicinity. It is also anticipated that the birds will become habituated to the disturbance and continue foraging in the area, as demonstrated at the local analogue site of Stockton Sandspit. Additional lighting during construction works will be minimal and there is no requirement for artificial lighting during the night.

Threatened matters listed under the EPBC Act and TSC Act with the potential to be impacted as a result of the proposal are discussed below are also considered in the Assessments of Significance (*Annex D, TSC Act* and *Annex E, EPBC Act*).

EECs and TECs

One EEC is considered to occur within the site, Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC. Umwelt identify this community as "Freshwater Wetland Variant 3 - occurring in fill" the fringing vegetation of Deep Pond and the entirety of all other ponds as this community (refer to *Figure 4*). This community is outside of the proposed Capping Area and will not be directly impacted; however an assessment of significance has been conducted to consider indirect impacts such as the effect of the closure works on hydrology (refer to *Annex D*). In summary, greater surface water run-off will occur due to the reduced permeability of the capping layer. This will result in greater runoff into wetland areas including Deep Pond. Run-off will travel through a series of sediment controls which will be designed to ensure this water has a low sediment load, especially once revegetation is complete. The corresponding reduction in ground water flowing through the landfill will reduce the amount of contaminants reaching wetlands and Deep Pond. These impacts are considered of net benefit to the wetlands and threatened species, however given the large dilution factors and other complicating external factors such as precipitation and evaporation, the effects are likely to be undetectable (refer to *Section 7.2.4*). There is anticipated to be no significant impact on the Wetland EEC as a result of the proposal.

Threatened Flora

One threatened flora species, Horned Pondweed was recorded within Deep Pond. Deep Pond is a large water body and will not be directly impacted by the proposal. Any indirect impact such as changes to the hydrology is likely to be negligible due to the implementation of sediment controls and therefore there is no impact anticipated on this species.

No other threatened flora species were considered likely to occur and therefore no significant impacts are anticipated for any flora species as a result of the proposal.

Amphibians

One threatened species, the Green and Golden Bell Frog (GGBF), is known to occur within and adjacent to the site and therefore has the potential to be impacted by the proposal.

The clearance of vegetation within K5 and K3, associated with the closure works, may cause some direct impacts to GGBF. K5 Cell 6 and 8 in particular offer potential foraging habitat for the adult GGBF, occupying an area of approximately 5.2 ha. Dense vegetation is present including large tussocks of Pampas Grass in which the species may shelter. These areas are not directly adjacent to wetland habitat and it is considered unlikely that significant numbers of the local population are located within this area at any given time. Given the dense vegetation within the site there will be a limit to the effectiveness of preclearance surveys, designed to capture and relocate individuals outside of the impact area. Attendance of clearance work by ecologists and clearing at a measured rate is likely to be the most effective method of reducing clearance related mortality. Any frogs and other native fauna disturbed by the clearance can then be captured and relocated. These mitigation measures are further described in *Section 8*. Despite the preclearance and mitigation measures there is a residual risk of mortality to GGBFs as a result of the clearance works. The impact is not anticipated to be significant however, due to a small percentage of the population likely to occur within the area at any given time.

The closure works will also remove 5.2 ha of foraging habitat for the GGBF. This area is a small proportion of the total potential foraging habitat available to the population with optimal foraging habitat surrounding the wetland areas, including the K6 and K7 areas, which will not be impacted by the closure works. The amount of foraging habitat impacted by the proposal represents less than a quarter of the foraging habitat present in K6 and K7 alone.

The potential for indirect impacts to GGBF are largely limited to the potential changes to the hydrology of the area, due to the closure works and in particular the potential effects on breeding habitat. It is considered that any of these impacts will be negligible resulting in no perceptible changes in GGBF breeding habitats. Changes to hydrology of the site are discussed in *Section 7.1*, while the hydrological implications related to the GGBF are discussed below.

GHD (2009) modelled the effects of significant rainfall events on pond water levels indicating changes up to 500 mm in some ponds as a result of capping. These findings are no longer supported on the basis that maximum water levels are dictated by pond outlets based on the invert levels of weirs, culverts and overflow channels and that any short term increased water levels would dissipate rapidly. No modification is being made to physical nature of the ponds, so the maximum water levels and volumetric capacity of the ponds would not change from existing conditions. Furthermore, no significant change in minimum pond levels would occur in most of the ponds, as a result

of altered future hydrology on the basis that there will be no significant change to the overall water balance for the site.

Salinity levels within waterbodies have previously been identified as of importance to the protection of GGBF from Chytrid Fungus. Previous modelling work associated with referral number 2012/6464 for the southern portion of KIWEF closure identified that pond conditions of proximate ponds would be generally wetter and fresher.

The relationship between water quality (with a focus on salinity) and GGBF habitat can be summarised in the following ways:

- The closure works are designed to reduce contaminant loads leaving the landfill and affecting receiving waters by limiting surface water penetration into the fill aquifers. This includes mobilisation and leaching of salt content in the fill;
- The capping will increase volumes of less saline surface water runoff from capped areas, and reduce higher saline groundwater inflows into the ponds;
- Research indicates that the prevalence of Chytrid is linked to salinity and water temperature (Stockwell, *et al*, 2012) with saline water acting to limit infection, below the threshold (refer to *Table 12*) that may result in mortality;
- Further research is needed to confirm if certain heavy metals (copper and zinc) may limit the prevalence of Chytrid Fungus, (Threlfall *et al*, 2008);
- Water temperature on standing water in ponds is related to rates of solar irradiance on pond surfaces and, as such, proposed closure works would not have a significant effect on water temperature;
- The current range of salinity within and between ponds varies significantly;
- Elevated salinity in the ponds are generally attributed to concentrating effects of evaporation during dry periods;
- Saline baseflow from the fill aquifer may also influences salinity in surrounding water bodies, but to a lesser degree than the evaporation effects; and
- Peak salinity values in low elevation ponds are recorded as high as 20 000 to 35 000 $\mu\text{S}/\text{cm}$, indicating intrusion of waters from the estuarine aquifer.

Salinity level changes have the potential to impact GGBF in two main ways. These are:

- An increase in salinity in ponds above “thresholds” that would prevent GGBF tadpole and/or adult survival or habitation; and
- Reductions in salinity below a “threshold” that may provide protection against Chytrid Fungus infection or development.

SMEC (2013) reported that the independent GGBF expert, Dr Arthur White, provided guidance on these thresholds based on current GGBF research (reproduced in the *Table 12*) and using Electrical Conductivity (EC) as a measure of salinity. It should be noted that these thresholds are indicators of the suitability of ponds as different GGBF habitat and do not constitute project triggers. They have been used in the assessment process to identify the potential for significant impacts on GGBF to occur.

Table 12 *Suggested Salinity Comparison Values for KIWEF Surface Water Bodies*

No Chytrid Protection	Chytrid protection threshold ¹	GGBF tadpole health threshold ² (µS/cm)	GGBF Adult health threshold ³ (µS/cm)
0 – 1,650 µS/cm	1,650 µS/cm	2,900 µS/cm	4,100 µS/cm

1. EC below threshold presents increased risk of mortality resulting from Chytrid Fungus.
2. EC above threshold indicates unsuitability for GGBF tadpole survival.
3. EC above threshold indicates unsuitability as GGBF adult habitat.

These levels are interpreted as follows in assessing impacts of closure works:

- Salinity levels below 1,650 (µS/cm) (Chytrid risk bracket) were identified as sub-optimal GGBF condition with individual animals likely not afforded salinity-related protection from Chytrid Fungus. Chronic or long term low salinity levels below this threshold are considered to increase the risks to GGBF although it would not put individuals at immediate risk of harm in the absence of Chytrid Fungus (Stockwell, 2012);
- Salinity levels between 1,650 and 2,900 (µS/cm) are considered “optimal GGBF habitat” as this range provides Chytrid protection while also providing for tadpole survival and habitation and adult breeding;
- Salinity levels between 2,900 and 4,100 (µS/cm) are considered to be suitable for adult GGBF occupation, but would not be satisfactory for tadpole survival; and
- Salinity above 4,100 (µS/cm) is not considered to be suitable habitat for GGBF adults over extended periods. It is likely that adult GGBF would move away from ponds with salinity levels above 4,100 µS/cm rendering them unlikely to be used for breeding (and therefore egg laying, hatching and tadpole habitation).

Observed EC ranges within ponds potentially affected by changed hydrology post capping are presented in *Table 13*, the locations of the ponds are illustrated on *Figure 1* and

Table 13 *KIWEF Pond Salinity Ranges*

Surface Water Body	Historic Indicative Conductivity Range
Deep Pond	1,650 - 5,250 (prior 10 years only)
Blue Billed Duck Pond	802 - 1,822
BHP Wetlands	723 - 1,424
Railway Pond	1,850 - 3,400
Easement Pond	2,100 - 3,882
Easement Pond South	450 - 1,000
K2 Basin	950 - 3,940
Windmill Road Open Channel	3,600 - 16,500
Long Pond	2,845 - 10,565
Delta Channel	No Data
K7 Ponds	No Data
Cells 9,10,11 and 12	No Data

The results in Table 13 illustrate that there is considerable variability within and between ponds. Additionally some ponds are currently fluctuating between salinity levels providing no Chytrid protection to levels where GGBF and tadpole survival is unlikely.

Modelling of hydro-salinity changes likely to result from the capping of Area 2 has not been undertaken and is not proposed on the basis that the level of accuracy likely to be achievable is unlikely to provide confidence beyond the observation of conditions being generally wetter and fresher. Overall it is ERM’s opinion that the apparent series of divergent salinity conditions between the ponds is likely to be important through variable inter-annual wetting-drying cycles, thereby providing available aquatic habitat of suitable salinity at any time. It is likely that the maintenance of the series of ponds with variable salinity (and other water quality parameters) supports ecosystem resilience and helps sustain frog populations in relation to the set of salinity thresholds derived for GGBF ecology. The proposed activity will not reduce the variability of water quality within and between ponds despite the predicted minor move towards generally fresher conditions.

In summary, the closure works will temporarily remove an area of potential foraging habitat (5.2 ha) for adult GGBF, which may also result in some direct mortality to a small number of individuals during clearance works. The area impacted represents a small proportion of the total potential foraging habitat available to the species and due to the proposed revegetation after the works it is considered a temporary impact. Furthermore, only a small proportion of the population are likely to occur in the closure works area at any given time. Larger and more optimal foraging habitat surrounding the key wetland areas, including the K6 and K7 areas (*Figure 4*), will be retained and not impacted significantly by the action. Breeding habitat will remain unaffected by this proposal and large areas of foraging habitat will be retained. 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 any more prevalent and risking impacting the species. The Assessment of Significance provided in Annex C, concludes that the impact to this species would be **not significant**.

Reptiles

No threatened reptiles have been recorded or are expected to occur within the site, therefore no impacts are predicted.

Fish

No threatened fish have been recorded or are expected to occur within the site, therefore no impacts are predicted.

Birds

Few threatened birds have been recorded within the terrestrial areas of the site and the capping work area is not considered to contain high habitat value given the large areas of similar habitats present within the locality and the highly disturbed, largely exotic vegetation present. One species, the Red-backed Button-quail has the potential to use the terrestrial areas of the site for both foraging and breeding and has been recorded once within the site during 2008. Given the cryptic nature of this species it is difficult to assess the likely population size of this species; however it is not expected to occur in high densities. It is not anticipated that the project will have a significant effect on the species as the Capping Area is contiguous with similar habitat. The species is highly mobile and likely to be able to relocate to areas which will remain unaffected by the works. Habitat will also be re-established at the site following construction.

The majority of the threatened and migratory birds recorded within and adjacent to the site are associated with the wetland areas, especially Deep Pond. The wetland areas will not be directly impacted by the proposed works and any effects on hydrology and water quality are negligible. The construction phase of the closure works will include some noise, light and vibration disturbance from machinery which may temporarily affect some species. This is not anticipated to have significant effect on any species as acclimation to the disturbance is likely for most species and alternative habitats exist within close proximity if species experience temporary displacement.

Non-Volant Mammals

No threatened mammals have been recorded or are expected to occur within the site, therefore no impacts are predicted.

Bats

The site supports several threatened microbat bat species. The closure works will remove grassland and shrubby grassland which provides foraging habitat for the species, owing to the invertebrate populations they support. The foraging habit is not considered particularly important for the bat species, considering the large areas of a similarly disturbed nature outside of the capping area. It is anticipated that the Capping Area will not cause any decline in population size of any of the bat species given that they are highly mobile and able to forage in other adjacent habitat. Furthermore the Capping Area does not include important roosting habitat for microbats, with a lack of large trees with decorticated bark, hollow bearing trees, caves or man-made structures with crevices.

Southern Myotis are known to roost in dense vegetation and have been observed roosting in Common Reed within the site. This species is primarily associated with the wetland areas of the site and will forage over open water. Given that the wetland areas, including surrounding marginal vegetation are outside of the closure works area, no impacts are anticipated for this species.

The Grey-headed Flying-fox, in contrast to the above microbat species, is chiefly herbivorous and no suitable foraging resources exist in the site. This species is likely to fly over the site but no impacts are anticipated to the species.

Ramsar Site - Wetland Hunter Estuary Wetlands (ID No 24)

The construction phase of the closure works will include some noise, light and vibration disturbance from machinery which may affect some species such as birds, within immediate proximity of the closure works. Given that the Ramsar site is at least 260 m from any construction disturbance, the effect of the proposal would be negligible because it would be of low magnitude and limited to a small extent of the Ramsar site. This rationale is based on the local analogue of Stockton Sandspit, which provides a resting and feeding place for large aggregations of migratory wading birds, despite being within 100 m of Stockton Bridge/B63 Road, which has heavy vehicle traffic especially during peak hour periods.

Once the closure works are completed, it will result in less infiltration of rainwater into the landfill. This will in turn result in slightly higher runoff, which will drain into the surrounding small ponds. Runoff or overtopping of ponds would then drain in to the much larger Deep Pond, ultimately entering the Hunter River South Arm, which is not part of the Ramsar site. Water entering the ponds via overland flow is likely to be less saline and have fewer contaminants than water which has percolated through the landfill areas.

While potential groundwater connections between the Ramsar site and wetland areas adjacent to the Ramsar site may exist, the proposal is highly unlikely to cause any significant changes to the water quality of the Ramsar site. Modelling of contaminant migration associated with the T4 project

indicates an increased timeframe before existing contaminants within KIWEF could potentially reach the Ramsar site under a post capping scenario. The proposed action does not include any additional waste emplacement and is designed to reduce the mobilisation of contaminants within the landfill and as such impacts to the Ramsar Wetlands are likely to be beneficial through improved water quality.

Given the temporary and negligible effects of the construction activities and the negligible ongoing negative impacts associated with completion of the capping activities, there will be no significant impact on the ecological character of the Ramsar wetland, nor the species it contains, refer to *Annex E* for the Assessment of Significance.

7.3

AIR QUALITY IMPACT

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; 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 1300 m to the south west at Mangrove Road.. Dust impacts to neighbouring ponds and vegetation will require controls to be implemented.

As construction work is likely to continue for 12 months, 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.

7.4 *HERITAGE IMPACT*

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 no potential for occurrence of items of indigenous heritage. Given the past history of filling in the area, 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.

7.5 *VISUAL IMPACT*

The highly disturbed visual catchment of the closure works area is defined by a vegetated embankment along Cormorant Road to the south, the NCIG and PWCS coal loading facilities to the east, the overall KIWEF area to the north, the Steel River development to the south west, the railway corridor to the west and north and the Hunter River South Arm to the south. These areas are characterised by cleared disturbed land, industry, reclaimed agricultural land, and nature reserves. The limited visual amenity of the site has been modified by landfilling, with small areas of native vegetation remaining along the southern boundary of the property, associated with the Hunter River.

The site is not readily visible from publically accessible locations. The nearest residences are approximately 1300 m to the south west at Mangrove Road. The construction and operational visibility would be minimal due to vegetation and local topography obstructing lines of view from outside onto the site. Should views into the closure works area be available, visual impacts would still be minimal given the distance of the viewpoint, the short-term nature of works and the extensive disturbance which has taken place previously on the site. No ongoing impacts are likely as the site will be rehabilitated consistent with its existing character and at a similar elevation and gradient.

The proposed closure works are in keeping with existing environment and will incur minimal visual change in the long term. Due to the existence of heavy industries within the site's visual catchment, the proposed works will be consistent with the surrounding landscape.

7.6 *NOISE AND VIBRATION*

The existing ambient noise environment on and around Kooragang Island has most recently been summarised by EMGA Mitchell McLennan in the PWCS T4 EA (EMGAMM, 2012) and Parsons Brinkerhoff (PB) (2014) in relation to the Tourle Street Bridge duplication. According to EMGAMM (2012) the rating background level (RBL), the overall single-figure background noise level for at least 90% of the time periods over which reactions of annoyance can occur, for the nearest sensitive receiver in Sandgate is 48 dBA. PB (2014) identifies the RBL for Mayfield West as 52 dBA.

As no operation noise will result from the Proposal the Department of Environment, Climate Change and Water (DECCW - the former title of OEH) Interim Construction Noise Guideline (ICNG) 2009 applies. The guideline is specifically aimed at managing noise from construction works regulated by the EPA. The aim of the Guideline is to provide guidance on managing construction works to minimise noise (including airborne noise, ground-borne noise and blasting), with an emphasis on communication and cooperation with all involved in, or affected by, construction noise.

Best management practice would involve conducting construction activities in accordance with the ICNG to manage noise generated from construction activities.

7.6.1 *Potential Noise Impacts*

Construction works will be confined to the standard operating hours contained in the ICNG of Monday to Friday 7 am to 6 pm, Saturday 8 am to 1 pm with no work on Sundays or public holidays. In the event that works outside these standard hours are required additional noise assessments are required by the ICNG.

A detailed list of proposed construction equipment is not currently available. The ICNG identifies Noise affected sensitive receives as RBL + 10 dB. The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

It should be noted that the nearest residence is over 1300 m from the site and separated by elevated and operational rail embankments and set 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 proposed closure works 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 the noise affected level related to the works are unlikely given the type and small amount of plant, the distance to the closest residential receiver and the relatively high criteria.

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.

7.7 *TRAFFIC IMPACT*

In the event that all material is required to be imported, approximately 230,000m³ will be required to be delivered to the site. This equates to approximately 5500 truckloads over the course of the project. The works are expected to be undertaken over a 6 - 12 month timeframe. This equates to an approximate 40 deliveries per day or 80 truck movements (40 in and 40 out) or two truck movements every 10 minutes.

HDC has advised that consultation is underway with the Roads and Maritime Services (RMS) over any potential traffic restrictions or requirements that may affect the Proposal. RMS has confirmed that access to the Site will be maintained throughout the construction project.

No long term operational traffic movements will be generated by the Proposal. As such the vehicle numbers and short term nature of the works do not warrant any intersection treatments.

While existing traffic issues resulting from identified insufficient capacity may be exacerbated by the proposed activity the proposal is not expected to cause significant traffic impacts on its own.

7.8 *CONTAMINATION AND WASTE IMPACTS*

GHD (2009) identify that co-disposal of waste may have been undertaken and as a result there is a potential for other isolated areas of significantly contaminated material to be present at KIWEF. The following potential impacts are identified associated with the interaction with contaminated materials:

- identification of contaminated materials waste deemed unsuitable for on-site management and requiring off-site disposal;
- generation of odours associated with the disturbance of contaminated material; and
- mobilisation of contaminants in surface water run-off during construction.

In the event that such material is encountered it is to be managed in accordance with the Materials Management Plan (RCA Australia, 2012). This plan has been prepared in accordance with the CLM Act and has been endorsed by the EPA in the Surrender Notice. The plan has also been implemented successfully on previous stages of closure works.

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. All other wastes and contaminated materials will be managed on site in accordance with the Materials Management Plan.

Odour impacts are assessed under *Section 7.3* while water quality impacts are assessed in *Section 7.1*.

7.9 *SOCIO-ECONOMIC CONSIDERATIONS*

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.

7.10 *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:

- proposed PWCS T4 Project;
- operational NCIG coal terminal and recently constructed rail flyover;
- completed KIWEF Area 1 closure;
- upcoming KIWEF Area 3 closure works; and
- upcoming Tourle Street Bridge duplication and Egret Street upgrades.

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 identified inadequate capacity (refer to *Section 7.7*);
- dust and other air impurities contributing to existing local and regional air quality concerns during construction (refer to *Section 7.3*);
- clearing of foraging habitat for various fauna species (refer to *Section 7.2*);
- generation of waste requiring landfill disposal (refer to *Section 7.8*); and
- changes to water chemistry in water-flows to the Hunter River (refer to *Section 7.1*).

The referral is located on land forming part of the approved Port Waratah Services Terminal 4 (T4) project. No cumulative impacts with T4 exist as the Area 2 closure works are to be completed in advance of T4 construction commencing and the proposed activity has no identified ongoing detrimental impacts.

The referral area is bisected by the NCIG Newcastle Coal Infrastructure Group (NCIG) rail fly-over. The NCIG development has implemented landfill closure obligations on parts of KIWEF in the process of completing the development but the proposed closure works. 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 KIWEF Area 1 was completed in May 2015. HDC and the EPA have discussed the completion of the Area 1 closure works and the EPA has issued correspondence confirming that the works were conducted in accordance with the relevant management plans and the requirements of the KIWEF Surrender Notice. Area 1 closure had the potential to alter the local hydrology but no significant changes in pond salinity have been identified to date. The rehabilitation of Area 1 post capping will also be complete returning foraging habitat for various fauna species prior to Area 2 closure works commencing.

KIWEF Area 3 closure works is scheduled to commence in advance of Area 2 works and their construction works programs may overlap. Area 3 closure will generate similar impacts to that of Area 2 closure but have been determined as not having the potential to cause significant impacts. There is limited potential for further exacerbation of traffic impacts as the Area 3 closure does not rely on significant import of capping materials. While impacts to foraging habitat may overlap, the areas involved are similar in size to the combined size of Area 1 and Area 3 which were assessed in parallel and

found not to cause a significant impact to any fauna species. The same outcome can be inferred for the cumulative impacts of Area 2 and Area 3 closure occurring in parallel.

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 the exception of water chemistry changes, 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 coinciding with local road upgrade projects could exacerbate traffic congestion in the area and will require careful management in consultation with RMS but are not considered to represent a significant environmental impact.

MITIGATION MEASURES

Various measures to avoid or reduce impacts are currently enforced through the Surrender Notice and associated requirements to implement various plans and strategies. Of relevance to the proposed activity are:

- 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 Associates; and
- 'Materials Management Plan - Kooragang Island Waste Emplacement Facility' dated November 2012 prepared by RCA Australia.

The surrender notice also requires that the implementation of these plans and strategies to be validated through a report provided to the NSW EPA to allow the lifting of the Surrender Notice obligations. Measures of relevance to MNES protection are summarised in *Table 14*.

Table 14 Existing Environmental Management Obligations

Environmental Aspect	Specific Mitigation Measures
Competent manner	<p>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:</p> <ul style="list-style-type: none"> • The processing, handling, movement and storage of materials and substances used at the premises; and • The treatment, storage, processing, reprocessing, transport and disposal of any waste generated by the activity.
Proper and efficient operation and maintenance of plant and equipment.	<p>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:</p> <ul style="list-style-type: none"> • maintained in a proper and efficient condition; and • operated in a proper and efficient manner.
Contaminated Materials	<p>4 a) By 30 June 2017, the licensee shall complete implementation of the final landform and capping strategy as detailed in the documents titled:</p> <ul style="list-style-type: none"> • ‘Materials Management Plan – KIWEF’, dated November 2012 prepared by RCA Australia. <p>The preferred proposed landform design philosophy is for minimal engagement with the ground, balancing earthworks within each cell where possible, cover known hotspots (possible Level 3 materials) of contamination, and to keep existing materials within each cell (Section 5.3 of RCA 2012).</p> <p>The management of all material excavated during Landfill Closure Works is to be governed by a Decision Matrix. The objective of the Decision Matrix is to develop appropriate guidelines for the classification, movement and reuse of re-useable and contaminated material on site (Section 5.1 of RCA 2012).</p> <p>The priority for landfill closure is to entirely cap the site with an inert low-permeability barrier, provide drainage upgrades to prevent infiltration and to consequently reduce the risk to the environment associated with the emplaced waste (Section 5.1 of RCA 2012).</p> <p>The Materials Management Plan is to incorporate a protocol for identification of Contaminated Materials that is to include the following:</p> <ol style="list-style-type: none"> 1. The contractor will stop works if any soils are encountered which have distinguishing Level 2 or Level 3 characteristics. Such materials will be fully validated and delineated in-situ or at place of placement following excavation. Consultations will be required with third party experts and the auditor as required, and final directions have been received from the Principal. Once management of the materials is agreed then works can then continue. 2. The Contractor will contact their occupational hygienist or other appropriately qualified specialist (Contractor’s Specialist) to identify the substance.

Environmental Aspect	Specific Mitigation Measures
	<p>3. If the substance is Asbestos. Refer to the specific section of the Contract Specification dealing with the treatment of asbestos.</p> <p>4. Contaminated materials identified will be placed in accordance with the guidelines detailed in Section 3.7 of RCA 2012 (Section 5.2 of RCA 2012).</p> <p>All contaminated material encountered during the landfill closure works will be assessed and categorised. This can be achieved by imposing the common distinguishing visual and olfactory characteristics, analysis of PAH concentrations and use of instrumentation (PID) to determine the default category, as set out under Table 3 of RCA 2012 (Section 5.3 of RCA MMP).</p> <p>The minimum requirement for tracking of materials is a truck docket system that contains the following information:</p> <ul style="list-style-type: none"> • Identify the date and time of movement. • The type of materials in the truck and approximate quantity. • Identify if the material is contaminated. • Identify the material characterisation (ie, Level 1, 2 or 3). • Document any analytical testing undertaken. • Provide a co-ordinate with a GPS System (X, Y and Z co-ordinates rounded off to the nearest 5m on an ISG or MGA grid) of the source of the material and the destination of the material. <p>The above information shall be collated and presented in a manner which illustrates the quality and quantity of material movement on the site and the final placement location of all material.(Section 5.5 of RCA 2012).</p> <p>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).</p> <p>Level 2 material is designated as having restricted site use and must be placed at least 500mm below the underside of any capping undertaken as part of the landform closure works (Section 5.6.2 of RCA 2012).</p> <p>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.</p> <p>Level 3 material is designated as having restricted site use and must be placed at least 1,000mm below the underside of any capping undertaken as part of the landform closure works (Section 5.6.3 of RCA 2012).</p> <p>The use of in-situ or ex-situ treatment approach for any Fill 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 (Section 5.6.4 of RCA 2012).</p>

Environmental Aspect	Specific Mitigation Measures
	<p>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 asbestos materials and emplacing the removed material at a depth of 1m (Section 5.6.4 of RCA 2012).</p> <p>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 (Section 5.6.4 of RCA 2012).</p>
Soil and Water	<p>The licensee shall implement, maintain and operate erosion and sedimentation controls during the final capping process to ensure that there is no sedimentation of waterways (Condition 4d of the Surrender Notice).</p> <p>Section 5.1 of GGBF Management Plan requires that appropriate erosion and sediment control structures will be installed at least 30 metres upslope of known and potential GGBF habitat. These erosion and sediment control structures will be regularly inspected and maintained, particularly after significant rainfall events.</p> <p>Chapter 7 of the Final Landform and Capping Strategy requires the establishment of erosion and sedimentation controls and construction of sedimentation basins as required.</p> <p>Section 7.4 of the Final Landform and Capping Strategy Flora and Fauna Impact Assessment requires that:</p> <ul style="list-style-type: none"> • 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; and • Development of an Erosion and Sedimentation Control Plan covering the works associated with the Proposal. Erosion and sediment controls are to be installed prior to construction, and maintained throughout construction, to minimise sediment entering the adjacent waterbodies, EECs and SEPP 14 wetland areas.
Flora and Fauna	<p>By 30 June 2017, the licensee shall complete implementation of the final landform and capping strategy as detailed in the documents titled:</p> <ul style="list-style-type: none"> • HDC - Report on KIWEF - 'Revised Final Landform and Capping strategy' - August 2009 - Revision 2, prepared by GHD ("the Landfill and Capping Strategy"); • 'Green and Golden Bell Frog Management Plan - KIWEF Closure Works', dated 19 April 2011 and prepared by Golder Associates; <p>Section 5.1 of the GGBF Management Plan requires:</p> <ul style="list-style-type: none"> • The boundaries of known and potential GGBF habitat will be clearly identified on the ground and communicated to personnel undertaking site works

Environmental Aspect	Specific Mitigation Measures
	<p>as part of the site induction.</p> <ul style="list-style-type: none"> • Appropriate erosion and sediment control structures will be installed at least 30 metres upslope of known and potential GGBF habitat. These erosion and sediment control structures will be regularly inspected and maintained, particularly after significant rainfall events. • All plant entering and leaving the KIWEF site will be, disinfected via a wash bay. The location and procedures involved at this wash bay will form part of the site induction and training. Records will be kept. • The Principal and all contractors involved in activities in areas of known (mapped) habitat for the GGBF (and other amphibian species) will be trained in site hygiene management in accordance with the hygiene protocol. This will be part of the environmental induction and training. Records will be kept. • PPE in contact with soil, particularly boots, entering and leaving the site will be disinfected as a matter of routine, following the methods outlined in the Hygiene Protocol. • All disinfection processes will be monitored and controlled at the KIWEF site's entry and exit point. The location of these disinfection bays, and the obligations of disinfection, will be communicated during the site induction and training. • Any water required for dust suppression will be drawn from ponds established for the purpose. No water for dust suppression will be drawn from mapped GGBF 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 location and procedure for those dedicated dust suppression ponds will be communicated during the site induction and training. • If practicable, the capping and grading activities will be scheduled to occur outside of the core GGBF breeding period (that is, September to March), especially in areas adjacent to known and potential breeding habitat. • One week prior to works commencing in the disturbance area, a pre-works survey will be conducted by a qualified ecologist. • In the event that any GGBFs are identified in the area (during pre-clearance surveys or following commencement of construction), they will be relocated (using appropriate amphibian hygiene protocols) to known and suitable GGBF habitat areas immediately adjacent to the disturbance footprint. <p>Section 7.4 of the Final Landform and Capping Strategy calls up the mitigation measures within the GHD (2010) Flora and Fauna Impact Assessment which require:</p>

Environmental Aspect	Specific Mitigation Measures
	<ul style="list-style-type: none"> • Proposed hours of construction are maintained to restrict noise and light impacts on 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. • The site wide joint monitoring of the GGBF population should be continued seasonally, where feasible, from the next breeding season (spring 2009) to help best manage the population and determine if any adverse impacts have resulted from any works/modifications to GGBF habitat across Kooragang Island, before and after the emplacement closure works. • 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 Noxious Weeds Act 1995. • 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. • Development of an Erosion and Sedimentation Control Plan covering the works associated with the Proposal. Erosion and sediment controls are to be installed prior to construction, and maintained throughout construction, to minimise sediment entering the adjacent waterbodies, EECs and SEPP 14 wetland areas. • Bitou Bush, Crofton Weed and Pampas Grass 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.
Revegetation	<p>By 30 June 2017, the licensee shall complete implementation of the final landform and capping strategy as detailed in the documents titled:</p> <ul style="list-style-type: none"> • HDC - Report on KIWEF - 'Revised Final Landform and Capping strategy' - August 2009 - Revision 2, prepared by GHD ("the Landfill and Capping Strategy"); <p>Chapter 7 of Revised Final Landform and Capping Strategy - Topsoil 100mm thick using stockpiled surface soils or imported topsoil and revegetate the</p>

Environmental Aspect	Specific Mitigation Measures
	<p>disturbed area.</p> <p>Section 7.4 of the Final Landform and Capping Strategy Flora and Fauna Impact Assessment requires that:</p> <ul style="list-style-type: none"> • Provenance native plant stock would be used for rehabilitation of the disturbed areas to maintain the genetic integrity of the vegetation communities present on site. • Revegetation of the Proposal capped areas following soil/capping material placement should be in accordance with a Revegetation and Restoration Plan. • Restore and rehabilitate wetland communities disturbed by the Proposal in accordance with a Revegetation and Restoration Plan. <p>Section 5.3 of the GGBF Management Plan requires that:</p> <ul style="list-style-type: none"> • as part of the rehabilitation and revegetation plan for the KIWEF site, open stormwater infrastructure across the KIWEF site may be planted with species known to be favoured by GGBFs. This revegetation and rehabilitation strategy will include a 2 metre wide buffer on either side of the stormwater drains. The intention of these areas is to provide movement corridors for GGBFs across the site. • The capped areas will ideally be designed to shed water to table drains, which, in a similar manner to other stormwater infrastructure, will be vegetated with species known to be favourable to GGBFs. • 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.
Air Quality	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.
Noise	Standard noise mitigation measures contained within the ICNG are to be considered by the successful contractor undertaking the works as required.
Traffic	Consideration should be given to measures that would allow a greater proportion of materials to be delivered to site outside of peak hours which may include commencement of bulk supply of capping material in advance of full closure works program commencing and potential out of hours delivery of materials. Additional assessment of noise and lighting impacts may be required should out of hours work be proposed.

The capping of Area 1 was completed in May 2015, generally utilising the mitigation measures as described within *Table 14*. While the long-term effects of the Area 1 capping are difficult to determine after such a relatively short timeframe since completion, the mitigation measures implemented during the construction works were considered appropriate and effective in controlling the potential construction impacts. HDC and the EPA have discussed the completion of the Area 1 closure works and the EPA has indicated that the works were conducted in accordance with the relevant management plans and the requirements of the KIWEF Surrender Notice. The EPA issued a letter confirming the satisfactory completion of the Closure Works on 16 February 2016.

Based on assessments and on site experience to date the following mitigations measures are proposed to prevent significant impacts to MNES:

- works described within the REF associated with the closure of the KIWEF must only occur within the closure works area (project footprint) as illustrated on ; and must be restricted to the extent required to satisfy the Surrender Notice requirements;
- 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;
- prior to the commencement of works, GGBF breeding habitat, as identified within the closure works area must be:
 - clearly defined on construction site plans as habitat for authorised access only; and
 - protected from unauthorised access from the closure works site by sign-posting and temporary frog exclusion fencing installed outside of GGBF breeding habitat.
- temporary frog exclusion fencing must be installed to prevent movement of GGBF into the works area from likely GGBF habitat and be located to avoid additional impacts on GGBF breeding habitat;
- pre-clearance surveys for GGBF must be undertaken by a qualified ecologist in all works areas or their parts prior to commencement of physical disturbance of the site. Early works associated with the establishment of site facilities, fencing and signage should be undertaken in the presence of an Ecologist. The design of the pre-clearance survey must include active surveys aimed at maximising the capture and relocation of GGBF individuals prior to physical disturbance. Any GGBF encountered during pre-clearance surveys or during works are to be captured and relocated in accordance with the GGBF Management Plan (Golder, 2011);

- any capping materials that are imported from outside the KIWEF facility must be sourced from an area that is demonstrated to have a low risk of containing Chytrid Fungus;
- topsoil to be used for surface layers must be sourced from within KIWEF to the extent possible and will otherwise be demonstrated to be low in nutrients and assessed as having a low risk of containing Chytrid Fungus;
- design of erosion and sediment controls must be in accordance with environmental protection standards for sensitive environments, such as (but not limited to) 'Managing Urban Stormwater - Soils and Construction' (Landcom, 2004); and
- upon completion of works, the works area must be rehabilitated with local native vegetation species.

Table 15 identifies at which project stages the mitigation measures will be required to be applied or considered.

Table 15 *Proposal staging and summary of mitigation measures*

Sequence of Work Activities	Controls/Mitigation Measures
Tender and award	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 meetings should be the GGBF, hygiene protocols, installing and maintaining temporary fencing and erosion and sediment control.
Site Establishment	<ul style="list-style-type: none"> 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 Closure Works site and ensure GGBF habitat protected from unauthorised access prior to works commencing in those works areas or their parts. Conduct pre-clearance surveys by a qualified ecologist prior to works commencing in works areas or their parts. Apply erosion and sediment controls as per sensitive environments (Managing Urban Stormwater – Soils and Construction (Landcom 2004)). 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 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.

Sequence of Work Activities	Controls/Mitigation Measures
Bulk earthworks	<ul style="list-style-type: none"> • 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 nutrients and assessed as having a low risk of containing Chytrid Fungus. • 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 within each area and no transport of fill, capping or topsoil between areas is to occur. • Strip topsoil to a minimum of 100mm following material management plan decision matrix for suitability for re-use. • Topsoil to be stored separately in prepared stockpile areas as per detailed design documentation. • Stockpiles to be stored for long periods are to be wrapped, covered, re-seeded or wet to minimise dust generation. • 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. The extent of the revegetation will depend on the proposed site use (i.e. undeveloped, commercial development or habitat areas). • The use of imported topsoil is to be avoided where possible. • 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. • 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.

Sequence of Work Activities	Controls/Mitigation Measures
Construction Monitoring	<ul style="list-style-type: none"> • All personnel are to be trained in the appropriate use and disposal of spill kit materials. • Daily prestart checks on amphibian disease hygiene station functioning and supplies 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. • 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. • Reference to available PWCS/NCIG dust monitoring results to determine off site dust levels.
Defect Liability period	<ul style="list-style-type: none"> • Check and maintain the erosion and sediment controls regularly, especially after rainfall, to ensure that they remain effective including: <ul style="list-style-type: none"> ○ Collected sediment is to be removed from the controls as necessary to ensure they remain effective. ○ 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.

9.1 PROPOSAL JUSTIFICATION

In summary, the key findings of the REF are:

- the proposal provides significant long term benefits to the environment by limiting the potential for contaminated material from emplaced fill leaching into the surrounding environment;
- the hydro-salinity regime of ponds immediately down gradient of the works are predicted to generally become slightly “wetter” and less saline as a result of the closure works;
- improvements are predicted in surface water quality due to the closure works, which would enhance ecological benefits to listed protected species;
- predicted changes to hydrology would not be of a magnitude that would significantly impact Matters of National Environmental Significance as listed under the EPBC Act;
- it is highly unlikely that the proposed works would disrupt the breeding cycle of any species assessed;
- areas of appropriate foraging and breeding habitat would be retained within and adjacent to the proposal site;
- the closure works will not provide additional water pathways by which Mosquito Fish (*Gambusia holbrooki*) could migrate.

Based on the above findings the capping design is confirmed as appropriate and beneficial in:

- separating water flow pathways (surface and ground water) to optimise clean water sources for habitat ponds;
- enabling the collection and drainage of treated waters with relatively low salinity;
- having no discernible effect on hydro-salinity conditions in the majority of adjacent ponds; and
- promoting an integrated post-construction sustaining water cycle across the managed landform.

The factors listed in Clause 228(2) of the *Environmental Planning and Assessment Regulation 2000* have been considered in *Table 16* in order to summarise the likely impacts of the proposal on the natural and built environment.

Table 16 *Clause 228 Checklist*

<i>Factor</i>	<i>Nature of Impact (type; intensity; extent; duration)</i>
<p><i>a. Any environmental impact on a community?</i></p> <p>The proposed works would have an acceptable risk profile in relation to sociocultural factors such as short term effects of audible noise at nearest sensitive receivers.</p>	<p>Nil</p> <p>Negligible noise, air quality and visual impacts of a temporary nature.</p>
<p><i>b. Any transformation of a locality?</i></p> <p>The proposal involves capping and revegetation aimed at returning the site to its current vegetated state and as such will have no transformative impact on the locality.</p>	<p>Nil</p>
<p><i>c. Any environmental impact on the ecosystems of the locality?</i></p> <p>In general, improvements in water quality and extended wetting due to the closure works would provide ecological benefits. Any negative changes would not be of a magnitude that would significantly impact on flora, fauna and ecological communities. The closure works would also provide significant benefits to the environment in general by limiting the potential for contaminated material from the fill leaching into the surrounding environment.</p>	<p>Positive;</p> <p>Localised positive effects by improved water quality in the medium to long term. Short term disturbance of on-site foraging habitat.</p>
<p><i>d. Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?</i></p> <p>There would be no change in the aesthetic, recreational, scientific or other environmental quality in the locality from the proposal. The proposal will contribute to scientific information through further monitoring of GGBF populations in the locality and provide a greater understanding of the hydro-salinity regime of the site through water quality monitoring.</p>	<p>Nil</p>
<p><i>e. Any effect on 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?</i></p> <p>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.</p>	<p>Nil</p>

<i>Factor</i>	<i>Nature of Impact (type; intensity; extent; duration)</i>
<p><i>f. Any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974)?</i></p> <p>The proposal involves the clearing of previously disturbed land mapped as grassland. GHD (2010) reported that the KIWEF site is unlikely to provide important habitat for ground-dwelling or arboreal mammal species as there are no forests or hollow-bearing trees with hollows of diameter > 10 cm. Impacts to foraging habitat are noted but will be limited to the duration of construction. Following completion of capping the closure works area will be revegetated to return similar ground cover and habitat structure.</p>	<p>Positive;</p> <p>Short term, low level and localised negative impacts and long term benefits.</p>
<p><i>g. Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?</i></p> <p>Based on the EPBC Act and TSC 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.</p> <p>The proposal provides benefits to the environment by:</p> <ul style="list-style-type: none"> • limiting 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; and • areas of appropriate foraging and breeding habitat would be retained within and adjacent to the proposal site. 	<p>Positive</p> <p>Short term, low level and localised negative impacts and long term benefits.</p>
<p><i>h. Any long-term effects on the environment?</i></p> <p>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.</p>	<p>Positive</p> <p>Short term, low level and localised negative impacts and long term benefits.</p>
<p><i>i. Any degradation of the quality of the environment?</i></p> <p>The proposal is to rehabilitate a previously degraded man made 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.</p>	<p>Positive;</p> <p>Short term, low level and localised negative impacts and long term benefits.</p>
<p><i>j. Any risk to the safety of the environment?</i></p> <p>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 value of proximate water bodies has been assessed and considered minor with no significant adverse impacts. These strategies are considered to reduce the level of risk to an acceptable level. The proposed works will provide long term improvement in safety and risk associated with existing contamination.</p>	<p>Positive;</p> <p>Short term, low level and localised negative impacts and long term benefits.</p>

<i>Factor</i>	<i>Nature of Impact (type; intensity; extent; duration)</i>
<p>k. <i>Any reduction in the range of beneficial uses of the environment?</i></p> <p>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 could be considered for suitability as potential GGBF offset area subject to separate assessment and approval requirements.</p>	Nil
<p>l. <i>Any pollution of the environment?</i></p> <p>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.</p>	Positive Short term, low level and localised negative impacts and long term benefits.
<p>m. <i>Any environmental problems associated with the disposal of waste?</i></p> <p>Waste within the KIWEF has the potential to cause environmental effects and may have in the past. The low rates of waste generation associated with the works directly, together with the identified safeguards for managing the inherent site materials, will not result in significant impacts associated with the works proposal.</p>	Negative Short term, low level and localised negative impacts.
<p>n. <i>Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply?</i></p> <p>The proposal would not increase demands on resources that are, or are likely to become, in short supply.</p>	Nil
<p>o. <i>Any cumulative environmental effect with other existing or likely future activities?</i></p> <p>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.</p> <p>Cumulative traffic impacts may result from proposed closure works coinciding with the construction timeframes with the Tourle Street Bridge Duplication project and this will need to be managed.</p> <p>No loss of habitat is predicted to result from the proposal in the medium to long term (with ground disturbance in capped areas limited to about one year) and, as such, the proposal does not contribute to cumulative loss of habitat.</p>	Nil

9.2.2

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;
- transport and access;
- soils;
- noise and vibration; and

- waste.

The REF provides an assessment of many biophysical effects including those identified above. The REF demonstrates that construction of the proposed capping would not result in significant adverse environmental impacts to factors with the implementation of appropriate safeguards and mitigations. These matters will be developed into a site based environmental management plan for application to the site to manage the associated activities and their typical risks. There would be no risk of significant impacts from works activities on other biophysical matters.

9.2.3 *Socio-Economic Factors*

The potential effects of the proposal on social and cultural values and aspects that affect them were examined and identified as:

- Landscape and visual amenity; and
- Community interests.

There is no risk of significant environmental impacts associated with Hazards and Risk. Community expectations will be served by managing noise effects during closure works. This is predicted to be well within guideline levels at sensitive residential receiver locations.

The assessment presented in this REF regarding heritage, transport and amenity indicates that, provided the nominated mitigation and management measures are implemented, the proposal would have a minimal impact and acceptable risk profile in relation to socio-cultural factors. Overall, the proposal is considered to be in accordance with planning requirements.

Based on the findings of this REF, it can be concluded that the proposal is not likely to significantly impact on values of the natural or built environment (including critical habitat or threatened species, populations or ecological communities or their habitats). As such, neither an Environmental Impact Statement under the EP&A Act nor Species Impact Statement under the TSC Act are required.

Douglas Partners (2013) Assessment of Mitigation Measures for Groundwater Contamination: Proposed Terminal 4 Project Kooragang Island.

GHD (2009) Hunter Development Corporation - Report on KIWEF - Revised Final Landform and Capping Strategy - August 2009 - Revision 2.

GHD (2010) Hunter Development Corporation - Revised Capping Strategy KIWEF Flora and Fauna Impact Assessment January 2010 Revision 3.

Golder Associates (2011) 'Green and Golden Bell Frog Management Plan - Kooragang Island Waste Emplacement Facility Closure Works' dated 19 April 2011.

Herbert, C. (2007) Distribution, Abundance and Status of Birds in the Hunter Estuary, Hunter Bird Observers Club, Special Report No.4, prepared for Newcastle City Council, September 2007.

Lindsey, A. (2008) The birds of Deep Pond - Kooragang Island 1993 - 2007. The Whistler 2: 1-12.

RCA (2012) 'Materials Management Plan - Kooragang Island Waste Emplacement Facility' dated November 2012.

EMGA Mitchel McLennan (2012) T4 Project Environmental Assessment prepared for Port Waratah Coal Services Limited (Publically Available http://majorprojects.planning.nsw.gov.au/page/development-categories/transport--communications--energy---water/port---wharf-facilities/?action=view_job&job_id=4399).

ERM (2013) Former Kooragang Island Waste Emplacement Facility Landfill Closure Works: Areas K2, K10 North & K10 South Review of Environmental Factors

Department of Urban Affairs and Planning (1998) Managing Land Contamination: Planning Guidelines SEPP 55--Remediation of Land.

NCIG (2014) Annual Environmental Management Report, ENVIRON Australia.

SMEC (2012) Terminal 4 Project Surface Water Assessment (Publically Available http://majorprojects.planning.nsw.gov.au/page/development-categories/transport--communications--energy---water/port---wharf-facilities/?action=view_job&job_id=4399)

SMEC (2013) Detailed Response to SEWPaC Comments, Kooragang Island Waste Emplacement Facility - Final Report.

Umwelt (2012) Ecological Assessment for Port Waratah Coal Services (PWCS) Proposed Terminal 4 Project, Port of Newcastle NSW.

Annex A

EPBC Act Protected Matters Search Tool



EPBC Act Protected Matters Report

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

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

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 15/09/15 08:34:12

[Summary](#)

[Details](#)

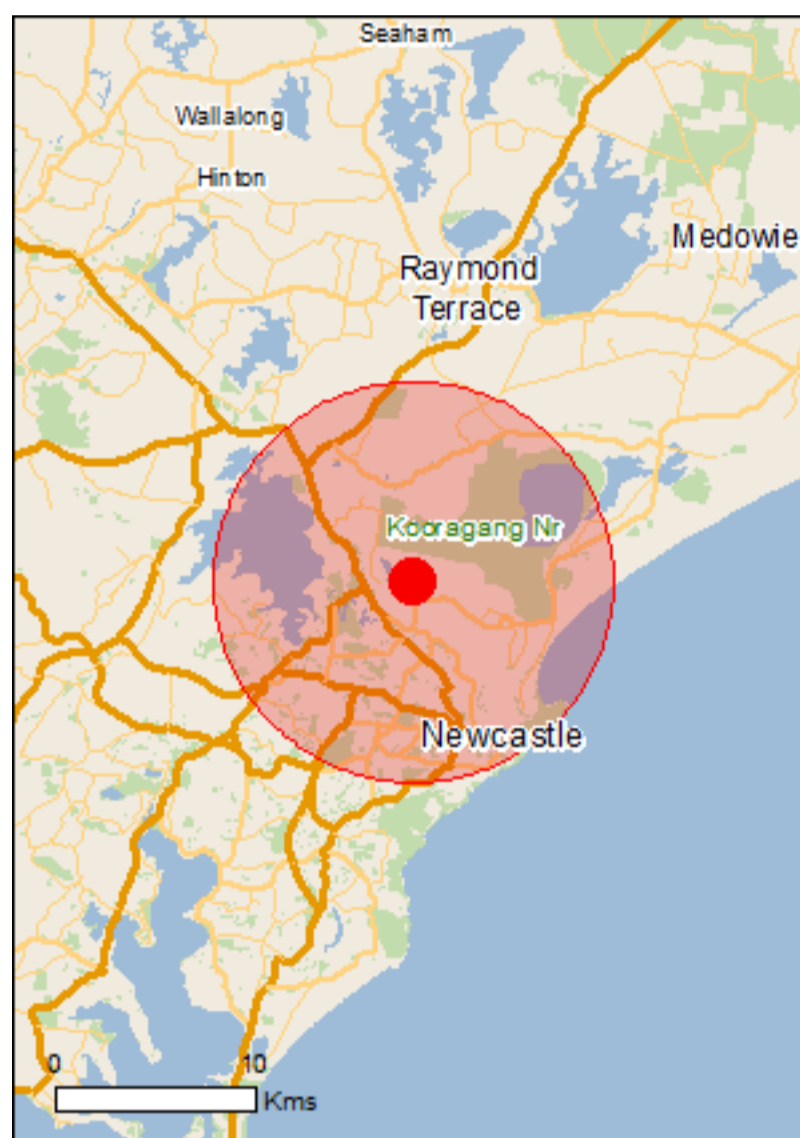
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

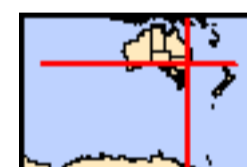
[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

[Buffer: 10.0Km](#)



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	63
Listed Migratory Species:	73

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	16
Commonwealth Heritage Places:	2
Listed Marine Species:	94
Whales and Other Cetaceans:	14
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	6
Regional Forest Agreements:	1
Invasive Species:	47
Nationally Important Wetlands:	3
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)

[\[Resource Information \]](#)

Name	Proximity
Hunter estuary wetlands	Within Ramsar site

Listed Threatened Ecological Communities

[\[Resource Information \]](#)

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

Name	Status	Type of Presence
Central Hunter Valley eucalypt forest and woodland	Critically Endangered	Community may occur within area
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community may occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area

Listed Threatened Species

[\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Roosting known to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora epomophora Southern Royal Albatross [25996]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora sanfordi Northern Royal Albatross [82331]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans exulans Tristan Albatross [82337]	Endangered	Species or species habitat may occur within area
Diomedea exulans gibsoni Gibson's Albatross [82271]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Status	Type of Presence
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew [847]	Critically Endangered	Roosting known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Phoebastria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pterodroma leucoptera leucoptera Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma neglecta neglecta Kermadec Petrel (western) [64450]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta salvini Salvin's Albatross [82343]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris impavida Campbell Albatross [82449]	Vulnerable	Species or species

Name	Status	Type of Presence
Fish		
Epinephelus daemeli Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Frogs		
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat likely to occur within area
Litoria littlejohni Littlejohn's Tree Frog, Heath Frog [64733]	Vulnerable	Species or species habitat may occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat likely to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Commersonia prostrata Dwarf Kerrawang [87152]	Endangered	Species or species habitat likely to occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area
Diuris praecox Newcastle Doubletail [55086]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus camfieldii Camfield's Stringybark [15460]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Eucalyptus parramattensis subsp. decadens Earp's Gum, Earp's Dirty Gum [56148]	Vulnerable	Species or species habitat known to occur within area
Grevillea parviflora subsp. parviflora Small-flower Grevillea [64910]	Vulnerable	Species or species habitat known to occur within area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat known to occur within area
Persicaria elatior Knotweed [5831]	Vulnerable	Species or species habitat likely to occur within area
Phaius australis Lesser Swamp-orchid [5872]	Endangered	Species or species habitat may occur within area
Pterostylis gibbosa Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat may occur within area
Rutidosis heterogama Heath Wrinklewort [13132]	Vulnerable	Species or species habitat may occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Pocket-less Brush Cherry, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat likely to occur within area
Tetratheca juncea Black-eyed Susan [21407]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Hoplocephalus bungaroides Broad-headed Snake [1182]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharias taurus (east coast population) Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Species or species habitat likely to occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within

Name	Status	Type of Presence area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Sterna albifrons Little Tern [813]		Breeding may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Dugong dugon Dugong [28]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Roosting known to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Breeding likely to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]		Roosting known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Roosting known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Roosting known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]		Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area

Name	Threatened	Type of Presence
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]		Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]		Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew [847]	Critically Endangered	Roosting known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land

[[Resource Information](#)]

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

Name

Commonwealth Land -
 Commonwealth Land - Australian & Overseas Telecommunications Corporation
 Commonwealth Land - Australian Broadcasting Corporation
 Commonwealth Land - Australian Postal Commission
 Commonwealth Land - Australian Postal Corporation
 Commonwealth Land - Australian Telecommunications Commission
 Commonwealth Land - Commonwealth Bank of Australia
 Commonwealth Land - Commonwealth Trading Bank of Australia
 Commonwealth Land - Defence Housing Authority
 Commonwealth Land - Defence Service Homes Corporation
 Commonwealth Land - Director of War Service Homes
 Commonwealth Land - Telstra Corporation Limited
 Defence - ADF CAREERS REFERENCE CENTRE
 Defence - OFFICES
 Defence - STOCKTON RIFLE RANGE
 Defence - TS TOBRUK

Commonwealth Heritage Places

[[Resource Information](#)]

Name	State	Status
Historic		
Fort Wallace	NSW	Listed place
Nobbys Lighthouse	NSW	Listed place

Listed Marine Species

[[Resource Information](#)]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Roosting known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Breeding likely to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]		Roosting known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Roosting known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Roosting known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]		Roosting known to occur within area

Name	Threatened	Type of Presence
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]		Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]		Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Roosting known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew [847]	Critically Endangered	Roosting known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Phoebastria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Breeding may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area
Fish		
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]		Species or species habitat may occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within

Name	Threatened	Type of Presence area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paegnius Rough-snout Ghost Pipefish [68425]		Species or species habitat may occur within area
Solenostomus paradoxus Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stigmatopora olivacea a pipefish [74966]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Dugong dugon Dugong [28]		Species or species habitat may occur within

Name	Threatened	Type of Presence area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [[Resource Information](#)]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Glenrock	NSW
Hexham Swamp	NSW
Hunter Wetlands	NSW
Tilligerry	NSW
Worimi	NSW
Worimi	NSW

Regional Forest Agreements	[Resource Information]
Name	State
North East NSW RFA	New South Wales

Invasive Species	[Resource Information]
Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.	

Name	Status	Type of Presence
Birds		
<i>Acridotheres tristis</i> Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
<i>Alauda arvensis</i> Skylark [656]		Species or species habitat likely to occur within area
<i>Anas platyrhynchos</i> Mallard [974]		Species or species habitat likely to occur within area
<i>Carduelis carduelis</i> European Goldfinch [403]		Species or species habitat likely to occur within area
<i>Columba livia</i> Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
<i>Lonchura punctulata</i> Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
<i>Passer domesticus</i> House Sparrow [405]		Species or species

Name	Status	Type of Presence
Passer montanus Eurasian Tree Sparrow [406]		habitat likely to occur within area Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large- leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Hexham Swamp	NSW
Kooragang Nature Reserve	NSW
Shortland Wetlands Centre	NSW

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

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

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.86886 151.73206

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Parks and Wildlife Commission NT, Northern Territory Government](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

Annex B

Field Results -ERM
November 2015

Common Name	Scientific Name	EPBC Act	TSC Act
Flora			
Sydney Golden Wattle	<i>Acacia longifolia</i>		
Golden Wreath Wattle	<i>Acacia saligna</i>		
Crofton Weed*+	<i>Ageratina adenophora</i>		
Swamp Oak	<i>Casuarina glauca</i>		
Bitou Bush*+	<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>		
Camphor Laurel*	<i>Cinnamomum camphora</i>		
Pampas Grass*+	<i>Cortaderia selloana</i>		
Fennel*	<i>Foeniculum vulgare</i>		
Cottonbush*	<i>Gomphocarpus</i> sp.		
Blady Grass	<i>Imperata cylindrica</i>		
Coastal Morning Glory*	<i>Ipomoea cairica</i>		
Lantana*	<i>Lantana camera</i>		
Red Natal Grass*	<i>Melinis repens</i>		
African Olive*	<i>Olea europaea</i> subsp. <i>cuspidata</i>		
Prickly Pear*+	<i>Opuntia stricta</i>		
Salt-water Couch	<i>Paspalum vaginatum</i>		
Fountain Grass*	<i>Pennisetum setaceum</i>		
Common Reed	<i>Phragmites australis</i>		
Sweet Pittosporum	<i>Pittosporum undulatum</i>		
Ribwort*	<i>Plantago lanceolata</i>		
Castor Oil Plant*	<i>Ricinus communis</i>		
Haresfoot Clover*	<i>Trifolium arvense</i>		
Red Clover*	<i>Trifolium pratense</i>		
Broad-leaved Cumbungi	<i>Typha orientalis</i>		
Twiggy Mullein *	<i>Verbascum virgatum</i>		
Purpletop*	<i>Verbena bonariensis</i>		
Horned Pondweed	<i>Zannichellia palustris</i>		V
Amphibians			
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>		
Fish			
Eastern Mosquito Fish*	<i>Gambusia holbrooki</i>		
Mammals			
European Hare*	<i>Lepus europaeus</i>		
Birds			
Pacific Black Duck	<i>Anas superciliosa</i>		
Australian Pipit	<i>Anthus novaeseelandiae</i>		
Cattle Egret	<i>Ardea ibis</i>		
Eastern Great Egret	<i>Ardea modesta</i>		
Swamp Harrier	<i>Circus approximans</i>		
Golden-headed Cisticola	<i>Cisticola exilis</i>		
Rock Dove*	<i>Columba livia</i>		
Black-faced Cuckoo-Shrike	<i>Coracina novaehollandiae</i>		
Australian Raven	<i>Corvus coronoides</i>		
Brown Quail	<i>Coturnix ypsilophora</i>		

Common Name	Scientific Name	EPBC Act	TSC Act
Black Swan	<i>Cygnus atratus</i>		
White-faced Heron	<i>Egretta novaehollandiae</i>		
Black-fronted Dotterel	<i>Elseyornis melanops</i>		
Australian Kestrel	<i>Falco cenchroides</i>		
Bar-Shouldered Dove	<i>Geopelia humeralis</i>		
Whistling Kite	<i>Haliastur sphenurus</i>		
Black-winged Stilt	<i>Himantopus himantopus</i>		
Welcome Swallow	<i>Hirundo neoxena</i>		
Lewin's Rail	<i>Lewinia pectoralis</i>		
Superb Fairy Wren	<i>Malurus cyaneus</i>		
Brown Songlark	<i>Megalurus cruralis</i>		
Little Grassbird	<i>Megalurus gramineus</i>		
Red-browed Finch	<i>Neochmia temporalis</i>		
Australian Pelican	<i>Pelecanus conspicillatus</i>		
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>		
Royal Spoonbill	<i>Platalea regia</i>		
Purple Swamphen	<i>Porphyrio porphyrio</i>		
Australian White Ibis	<i>Threskiornis moluccus</i>		
Silvereye	<i>Zosterops lateralis</i>		

1. TSC Act Status; V- Vulnerable
2. * Exotic Species; + Noxious Weed

Annex C

Threatened Species
Likelihood of Occurrence
Assessment

Likelihood of Occurrence Criteria

Category	Description
Known	<ul style="list-style-type: none"> the ecological community/species has been recorded in the Study Area during recent field surveys; or database records demonstrate that the ecological community/species has been known to occur in the Study Area within the last 10 year period.
Potential	<ul style="list-style-type: none"> the ecological community/species' known distribution includes the Study Area, and suitable habitat is present within the Study Area, or, database records demonstrate that the ecological community/species has been known to occur in the Study Area, however has not been recorded within the last 10 years, or the species is a wide ranging flying species which may 'fly-over' the Study Area, regardless of the habitat types present and has been recorded within 10 km of the Study Area.
Unlikely	<ul style="list-style-type: none"> the ecological community/species has not been recorded within 10 km of the Study Area and suitable habitat does not occur within the Study Area, or the Study Area is not within the TEC/species' known distribution, or sufficient field surveys have been conducted to conclude that the species is likely to be absent.

Must consider:

- Habitat quality within and adjacent to the Study Area
- Breeding habitat/resources present – assists with identification of the importance of habitat to the species
- Dispersal ability - based on known ecology - whether the species have an ability to disperse to new areas of habitat following disturbance
- Local records in similar habitat/distance/connectivity to the Study Area

Qualitative risk matrix

		Consequence			
		Negligible ¹	Minor ²	Moderate ³	Major ⁴
Sensitivity	Ecological value listed as Vulnerable or Migratory	Low	Medium	Medium	High
	Ecological value listed as Endangered	Medium	High	High	Very High
	Ecological value listed as Critically Endangered	Medium	High	Very High	Very High

Table C.1 Threatened Species Likelihood of Occurrence Assessment

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
Amphibians							
<i>Crinia tinnula</i> Wallum Froglet	V	-	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.	Unlikely. There are records of this species within the locality; however the closest record is 7 km from the Site. There is not considered to be suitable habitat within the Study Area and targeted frog surveys by GHD and Umwelt have not identified the species.	NA	NA	NA
<i>Litoria aurea</i> Green and Golden Bell Frog	E	V	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (<i>Gambusia holbrooki</i>), have a grassy area nearby and diurnal sheltering sites available. Some sites occur in highly disturbed areas (OEH 2015).	Known. This species has been recorded within and adjacent to the Closure Works area, including areas of known breeding habitat. A large number of field studies have been conducted in this area, including GHD 2010 and Umwelt 2012.	The Closure Works area contains potential terrestrial foraging habitat for this species which will be cleared, capped, and sequentially revegetated. Breeding areas (wetlands habitats) will not be directly impacted, however changes to hydrology may cause indirect impacts.	Minor	High

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Litoria littlejohni</i> Littlejohns treefrog	V	V	Occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops.	Unlikely. There are no records of this species within the locality, and the species has not been detected during field surveys.	NA	NA	NA
Reptiles							
<i>Hoplocephalus bungaroides</i> Broad-headed Snake	E	V	Largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 km of Sydney. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring (OEH, 2015)	Unlikely. Suitable habitat does not exist within the Closure Works area, and there are no records within the locality.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
Birds							
<i>Anseranas semipalmata</i> Magpie Goose	V		Typically found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges. They are often seen in trios or flocks on shallow wetlands, dry ephemeral swamps, wet grasslands and floodplains; roosts in tall vegetation. They are also often seen walking and grazing on land; feeds on grasses, bulbs and rhizomes (Higgins 1999). Breeding occurs in both summer and winter dominated rainfall areas and is strongly influenced by water level. Most breeding now occurs in monsoonal areas and is unlikely in south-eastern NSW (Higgins 1999).	Potential. This species has been recorded immediately adjacent to the Site within wetland habitat. The species may also utilise terrestrial habitats, especially adjacent to wetland areas.	The proposal will not remove habitat for this species as wetlands will not be cleared or modified. Construction disturbance may cause the species to vacate habitats adjacent to the direct impact area.	Negligible	Low
<i>Anthochaera phrygia</i> Regent Honeyeater	CE	CE	In NSW the distribution is very patchy and mainly confined to the two main breeding areas (Capertee Valley and Bundarra-Barraba regions) and surrounding fragmented woodlands. Every few years non-breeding flocks are seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests on the upper north coast.	Unlikely. There are records within the locality, however suitable habitat for the species, does not occur within the Closure Works area.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Botaurus poiciloptilus</i> Australasian Bittern	E	E	Inhabits terrestrial and estuarine wetlands. Prefers dense vegetation including sedges, rushes and reeds.	Known. There several records directly adjacent to the Closure Works area recorded by Umwelt (2012).	The proposal will not remove habitat for this species as wetlands will not be cleared or modified. There is the potential for indirect affects including changes to water quality. Construction disturbance may cause the species to vacate habitats adjacent to the direct impact area.	Minor	High.
<i>Burhinus grallarius</i> Bush Stone-curlew	E	-	Inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber. Largely nocturnal, being especially active on moonlit nights. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nest on the ground in a scrape or small bare patch. Two eggs are laid in spring and early summer (OEH 2015).	Unlikely. This species has been occasionally recorded within the locality, however as not been recorded Study Area, despite extensive surveys being conducted for T4. Habitat within the Site is suboptimal given the lack of woodland or forested areas.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Calidris ferruginea</i> Curlew Sandpiper	E	CE, Mi	Generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. Also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland (OEI 2015).	Known. This species has been recorded on the mud flats surrounding Deep Pond by Umwelt. Deep pond is directly adjacent to the Closure Works area.	The proposal will not remove habitat for this species as wetlands will not be cleared or modified. There is the potential for indirect affects including changes to water quality. Construction disturbance may cause the species to vacate habitats adjacent to the direct impact area.	Minor	High
<i>Calidris tenuirostris</i> Great Knot	V	Mi	In NSW, the species has been recorded at scattered sites along the coast, typically occurring within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons. They are also often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms. They migrate to Australia from late August to early September.	Potential. This species has been recorded, approximately 250 m from the site. The habitat within the Site is considered sub-optimal for the species given the lack of large mudflats. The wetland areas of the site may provide some foraging habitat, especially when water levels are low, exposing area of potential foraging habitat. The species may fly over the site.	The proposal will not remove habitat for this species as wetlands will not be cleared or modified. The wetland habitat is considered to be sub-optimal for this species and therefore any impacts are likely to be negligible and affecting a small number of individuals.	Negligible	Low

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Callocephalon fimbriatum</i> Gang-gang Cockatoo	V	-	In summer, the species are generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas. Favours old growth attributes for nesting and roosting (OEH, 2015)	Unlikely. The species has been recorded in the locality; however no suitable habitat exists within the Site.	NA	NA	NA
<i>Calyptorhynchus lathami</i> Glossy Black-Cockatoo	V	-	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (<i>Allocasuarina littoralis</i>) and Forest Sheoak (<i>A. torulosa</i>) are important foods. Feeds almost exclusively on the seeds of several species of she-oak (<i>Casuarina</i> and <i>Allocasuarina</i> species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites. (OEH 2015).	Unlikely. The species has been recorded in the locality; however no suitable habitat exists within the Site.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Charadrius leschenaultia</i> Greater Sand Plover	V	Mi	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. Infrequently recorded in southern NSW, more frequently from northern NSW, northwards (GHD 2010)	Unlikely. The species has been recorded within the hunter estuary, but not within the site. Habitat is not considered suitable given the lack of expansive sand or mud flats.	NA	NA	NA
<i>Charadrius mongolus</i> Lesser Sand Plover	V	Mi	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. Infrequently recorded in southern NSW, more frequently from northern NSW, northwards (GHD 2010).	Unlikely. The species has not been recorded recently within the locality, and there is a lack of large intertidal flats.	NA	NA	NA
<i>Circus assimilis</i> Spotted Harrier	V	-	Occurs in grassy open woodland including <i>Acacia</i> 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 (OEH 2015).	Known. This species has been recorded within the site, by Umwelt and also hunting over adjacent wetlands. It is likely that this species occasionally forages over the Site.	Impacts to this species will be limited to temporary loss of small areas of foraging habitat. The species is wide ranging with broad habitat requirements, with the site likely to have low importance for the species.	Negligible	Low

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Daphoenositta chrysoptera</i> Varied Sittella	V	-	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and <i>Acacia</i> woodland. Feeds on arthropods gleaned from crevices in rough or decorticated bark, dead branches, standing dead trees and small branches and twigs in the tree canopy (OEH 2015).	Unlikely. There is no suitable habitat for this species within the Study Area.	NA	NA	NA
<i>Ephippiorhynchus asiaticus</i> Black-necked Stork	E	-	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. Usually forage in water 5-30cm deep for vertebrate and invertebrate prey. Eels regularly contribute the greatest biomass to their diet, but feed on a wide variety of animals, including other fish, frogs and invertebrates (such as beetles, grasshoppers, crickets and crayfish). Build large nests high in tall trees close to water (OEH 2015).	Known. This species has been recorded from Deep Pond, adjacent to the site and also in surrounding wetlands. Judging by the few records of the species and the lack of observations during field surveys, the species may be occasionally present within or adjacent to the site. .	No direct loss of foraging habitat but potential for indirect changes to water quality. Construction disturbance may cause the species to vacate habitats adjacent to the direct impact area.	Minor	High

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Epthianura albifrons</i> White-fronted Chat	V		Typically occurs in lowlands and foothills below 1000 m above sea level. It prefers habitats near waterways and damp areas. Optimal habitat includes wetlands containing saltmarsh that are bordered by grassland or lightly timbered woodland.	Known. This species has been recorded within the Site in 2007, with additional records close to Deep Pond and in the areas adjacent to the Site.	Potential to temporarily impact foraging habitat and possible nesting habitat.	Minor	Medium
<i>Falco subniger</i> Black Falcon	V		The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. 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. The Black Falcon occurs as solitary individuals, in pairs, or in family groups of parents and offspring (OEH, 2015)	Unlikely - there are no records of the species within close to proximity to the Site, and this species is not typically recorded in coastal regions.	NA	NA	NA
<i>Glossopsitta pusilla</i> Little Lorikeet	V	-	Forages primarily in the canopy of open <i>Eucalyptus</i> forest and woodland, yet also finds food in <i>Angophora</i> , <i>Melaleuca</i> and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity.	Unlikely. Suitable habitat for this species does not occur within the site. The species has been recorded in close proximity to the Site.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Grantiella picta</i> Painted Honeyeater	V	V	Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i> . Insects and nectar from mistletoe or eucalypts are occasionally eaten. Nest from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches (OEH 2015).	Unlikely. Suitable habitat for this species does not occur within the site. The species has been recorded in close proximity to the Site.	NA	NA	NA
<i>Haematopus fuliginosus</i> Sooty Oystercatcher	V	-	Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide for foods such as limpets and mussels (OEH 2015).	Potential. There are numerous records of this species close to the site and the species has the potential to fly over the site. There is no suitable foraging habitat for the species within the site.	No direct impacts are anticipated for this species given that there are no foraging resources for this species within the Site.	Negligible	Low

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Haematopus longirostris</i> Pied Oystercatcher	E	-	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 (OEH 2015).	Potential. The species has been recorded in the adjacent Railway Pond and is regularly recorded at Stockton Sandspit. The foraging habitat within the Study Area is sub-optimal for the species however the species may occasionally occur.	Potential to temporarily impact sub-optimal foraging habitat.	Negligible	Medium
<i>Hamirostra melanosternon</i> Black-breasted Buzzard	V		Lives in a range of inland habitats, especially along timbered watercourses, which is the preferred breeding habitat. Builds a large, flat nest of sticks. Also hunts over grasslands and sparsely timbered woodlands	Unlikely. The Site does not provide suitable habitat for the species, which is typically absent from coastal area in NSW.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Hieraaetus morphnoides</i> Little Eagle	V	-	Occupies open eucalypt forest, woodland or open woodland. Sheoak or <i>Acacia</i> woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter (OEH 2015).	Potential. This species has been recorded within 1 km of the Study Area and may occasionally fly over, or foraging within the terrestrial areas of the site. The site does not contain important or unique habitat however. No breeding habitat exists.	The proposal will remove a small amount of potential foraging habitat. No breeding habitat will be impacted and the habitat within the Site is not likely to be important for the species.	Negligible	Low
<i>Irediparra gallinacea</i> Comb-crested Jacana	V	-	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 (OEH 2015).	Unlikely. This species has been recorded 1.5 km from the Study Area however it is not been recorded during any of the field surveys to date. The wetland habitat present is unlikely to be suitable for the species owing to the paucity of floating vegetation.	NA	NA	NA
<i>Ixobrychus flavicollis</i> Black Bittern	V	-	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves (OEH 2014).	Unlikely. This species is infrequently recorded within the Hunter estuary and the closest record is 1.5 km away, from 1999 (Bionet). The species has not been recorded within the Study Area despite being targeted.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Lathamus discolor</i> Swift Parrot	E	E	This species occurs 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 Swamp Mahogany (<i>Eucalyptus robusta</i>) and Spotted Gum (<i>Corymbia maculata</i>).	Unlikely. The species has not been recorded within the immediate vicinity of the Closure Works and suitable habitat does not exist within the site.	NA	NA	NA
<i>Limicola falcinellus</i> Broad-billed Sandpiper	V	Mi	This species breeds in northern Siberia before migrating southwards in winter to Australia. In NSW, the main site for the species is the Hunter River estuary, with birds occasionally reaching the Shoalhaven estuary. They favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat (OEH, 2015).	Potential. This species has not been recorded within the site but it has been recorded on Ash island and other parts of the Hunter Estuary. The foraging habitat and roosting habitat within the Site is sub-optimal, although the species has the potential to fly over.	The species is anticipated to occasionally fly over the Site or occasionally settle on the edge of wetland areas. Impacts are restricted to indirect impacts such as the noise associated with construction.	Negligible	Low

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Limosa limosa</i> Black-tailed Godwit	V	Mi	This species is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer. In NSW, it is most frequently recorded at Kooragang Island. They are usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps. They forage for insects, crustaceans, molluscs, worms, larvae, spiders, fish eggs, frog eggs and tadpoles in soft mud or shallow water. They roost on low banks of mud, sand and shell bars (OEH 2015).	Known - This species has been observed in Deep Pond, during recent field surveys. The species is likely to occasional forage within wetland areas of the site.	No direct loss of foraging habitat but potential for indirect changes to water quality. Construction disturbance may cause the species to vacate habitats adjacent to the direct impact area.	Negligible	Low

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Lophoictinia isura</i> Square-tailed Kite	V		Found in a variety of timbered habitats including dry woodlands and open forests. Preference for timbered watercourses. Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage. Appears to occupy large hunting ranges of more than 100km ² . Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs (OEH 2015).	Potential. There are numerous records of this species within the locality, and the Site may provide foraging habitat for the species.	Temporary removal of a small area of potential foraging habitat. As a wide ranging species with broad habitat preferences, impacts are likely to be negligible.	Negligible. Effect on species is within the likely normal range of variation. No removal of specific breeding habitat features.	Low
<i>Melithreptus gularis gularis</i> Black-chinned Honeyeater (eastern subsp.)	V		This species occupies mostly upper levels of drier open woodlands dominated by box and ironbark, especially Mugga Ironbark (<i>Eucalyptus sideroxylon</i>), White Box (<i>E. albens</i>), Grey Box (<i>E. microcarpa</i>), Yellow Box (<i>E. melliodora</i>) and Forest Red Gum (<i>E. tereticornis</i>). The species does not persist in remnants less than 200 ha in area. Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees (Pizzey and Knight 2003).	Unlikely. Suitable habitat does not occur within the Study Area.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Neophema pulchella</i> Turquoise Parrot	V		This species live on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. They spend most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. They nest in tree hollows, logs and posts (OEH, 2015)	Unlikely. Suitable habitat does not occur within the Study Area.	NA	NA	NA
<i>Ninox connivens</i> Barking Owl	V		Inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as Acacia and Casuarina species, or the dense clumps of canopy leaves in large Eucalypts. Nests in hollows of large, old eucalypts.	Unlikely. Suitable habitat does not occur within the Study Area.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Ninox strenua</i> Powerful Owl	V	-	Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. Requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. Breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats.	Unlikely. Suitable habitat does not occur within the Study Area.	NA	NA	NA
<i>Numenius madagascariensis</i> Eastern Curlew		C E, Mi	This species preferred foraging and roosting habitat are intertidal mudflats, particularly where mangroves are present, and saltmarsh. They occur in intertidal coastal mudflats, coastal lagoons, sandy spits (Pizzey and Knight 2003). The species does not breed in Australia.	Known. This species has been recorded several times within the Site, especially in the Deep Pond area, which is likely to provide (sub-optimal) foraging habitat for the species. The species is associated with the periphery of wetland areas, and is unlikely to utilise other area of the closure works.	The proposal will not remove habitat for this species as wetlands will not be cleared or modified. There is the potential for indirect affects including changes to water quality. Construction disturbance may cause the species to vacate habitats adjacent to the direct impact area.	Minor	High

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Oxyura australis</i> Blue-billed Duck	V	-	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. Will feed by day far from the shore, particularly if dense cover is available in the central parts of the wetland. They feed on the bottom of swamps eating seeds, buds, stems, leaves, fruit and small aquatic insects such as the larvae of midges, caddisflies and dragonflies. Blue-billed Ducks 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. (OEH 2015).	Known. This species has been recorded several times within the Site, in the Deep Pond area, which is likely to provide occasion foraging habitat for the species. The species prefers areas of open water and is unlikely to utilise other area of the site.	The proposal will not remove habitat for this species as wetlands will not be cleared or modified. There is the potential for indirect affects including changes to water quality. Construction disturbance may cause the species to vacate habitats adjacent to the direct impact area. As the habitat is only used intermittently the effect of this is anticipated to be negligible.	Negligible	Low
<i>Pandion cristatus</i> Eastern Osprey	V	Mi	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water. Breed from July to September in NSW. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea (OEH 2015).	Known. This species has been recorded flying over the site. Foraging habitat within the site is considered sub-optimal. The species is not likely to breed in the Site.	Impact to this species is likely to be negligible, as the species is likely to fly over the site and will not rely on the area for significant foraging resources.	Negligible	Low

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Petroica boodang</i> Scarlet Robin	V	-	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 regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat. (OEH 2015).	Unlikely. The species has not been recorded in close proximity to the Study Area, nor has been detected during field surveys.	NA	NA	NA
<i>Pomatostomus temporalis temporalis</i> Grey-crowned Babbler (eastern subspecies)	V		Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains (OEH, 2015). The species are poor flyers and are vulnerable to fragmentation, not able to cross large open areas.	Unlikely. The species has not been recorded in close proximity to the Study Area, nor has been detected during field surveys.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Ptilinopus magnificus</i> Wompoo Fruit-Dove	V	-	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. Most often seen in mature forests, but also found in remnant and regenerating rainforest (OEH 2015).	Unlikely. The species has not been recorded in close proximity to the Study Area, nor has been detected during field surveys.	NA	NA	NA
<i>Ptilinopus regina</i> Rose-crowned Fruit-Dove	V	-	Occurs mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. They feed entirely on fruit from vines, shrubs, large trees and palms, and are thought to be locally nomadic as they follow the ripening of fruits (OEH 2015).	Unlikely. The species has not been recorded in close proximity to the Study Area, nor has been detected during field surveys.	NA	NA	NA
<i>Ptilinopus superbus</i> Superb Fruit-dove	V	-	This species inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees (OEH, 2015)	Unlikely. The species has not been recorded in close proximity to the Study Area, nor has been detected during field surveys.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Rostratula australis</i> Australian Painted Snipe	E	E, M	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Forages nocturnally on mud-flats and in shallow water. Feeds on worms, molluscs, insects and some plant-matter. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (OEH, 2015).	Potential. The species has been recorded within 1 km of the Site, during 2012 (Bionet). Field surveys have failed to detect the species however, owing to suitable habitat existing within the Closure Works area the species is considered to have the potential to occur, perhaps intermittently.	The proposed work will temporarily remove potential sub-optimal foraging and nesting habitat in the terrestrial areas. The construction activities may also disturb the species in adjacent wetland areas, causing it to temporarily vacate foraging habitat.	Minor	High.
<i>Stagonopleura guttata</i> Diamond Firetail	V		Habitat includes a range of eucalypt dominated communities with a grassy understorey, including woodland, forest and mallee. It appears that populations are unable to persist in areas where there are no vegetated remnants larger than 200 ha.	Unlikely. This is infrequently recorded within the locality and has not been recorded during the field surveys. Habitat for this species is considered sub-optimal.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Sternula albifrons</i> Little Tern	E	Mi	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. (OEH 2015).	Likely - This species has been recorded adjacent to the Site in 2007 and the species is frequently recorded in the lower Hunter Estuary. The species is likely to fly intermittently fly over the Site and may occasionally forage within the Site, although the habitat is considered sub-optimal.	Construction activities may disturb this species, however the effects are likely to be negligible given that the species is likely to occasionally fly over the site and is does not provide important habitat for the species.	Negligible	Medium
<i>Stictonetta naevosa</i> Freckled Duck	V	-	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Generally rest in dense cover during the day, usually in deep water. Feed at dawn and dusk and at night on algae, seeds and vegetative parts of aquatic grasses and sedges and small invertebrates (OEH 2015).	Known. This species has been most recently recorded in Deep Pond in 2006. It is expected to occasionally frequent the habitat, given that more recent surveys have not observed the species.	The proposal will not remove habitat for this species as wetlands will not be cleared or modified. There is the potential for indirect affects including changes to water quality. Construction disturbance may cause the species to vacate habitats adjacent to the direct impact area. The impact on the species is considered negligible considering the occasional use of the habitats present within the site.	Negligible	Low

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Turnix maculosus</i> Red-backed Button-quail	V		This species inhabit grasslands, open and savannah woodlands with grassy ground layer, pastures and crops of warm temperate areas, typically only in regions subject to annual summer rainfall greater than 400 mm. In NSW, the species occurs in grasslands, heath and crops, preferring sites close to water, especially when breeding.	Known. This species was recorded in 2008, with grassland areas of the Site. It has not been recorded since but is a cryptic species and often had to detect.	The proposal will remove suitable habitat in which this species may reside. The terrestrial habitat for this species is considered suitable for foraging and breeding.	Minor	Medium
<i>Tyto longimembris</i> Eastern Grass Owl	V	-	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 rest by day in a 'form' - a trampled platform in a large tussock or other heavy vegetative growth. Always breeds on the ground. Nests are found in trodden grass, and often accessed by tunnels through vegetation. Breeding season is highly variable and dependent on environmental conditions, but in NSW nesting most typically occurs in autumn or winter (OEH 2015).	Potential. There are numerous records of this species within the Locality, with the closest record of the species approximately 1 km from the site dated 2013 (Bionet). Habitat within the Site may provide some value for hunting and breeding, however the species has not been recorded during field surveys to date.	Temporary removal of foraging habitat and possible breeding habitat.	Minor	Medium

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Tyto novaehollandiae</i> Masked Owl	V	-	Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting (OEH 2015).	Unlikely. Records exist within the locality; however none of these are within close proximity of the Site. Field surveys have failed to detect the species. The foraging habitat within the Site is sub-optimal and does not connect to optimal habitat, which would increase the likelihood of the species occurring.	NA	NA	NA
<i>Tyto tenebricosa</i> Sooty Owl	V	-	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosts by day in tall moist forest, in the hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals such as the Common Ringtail Possum (<i>Pseudocheirus peregrinus</i>) or Sugar Glider (<i>Petaurus breviceps</i>). Nests in very large tree-hollows (OEH 2015).	Unlikely. There is no suitable habitat for this species within the Site and the species has not been recorded within close proximity to the site.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Xenus cinereus</i> Terek Sandpiper	V	Mi	In Australia, has been recorded on coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks 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. Generally roosts communally amongst mangroves or dead trees, often with related wader species (OEH 2015).	Potential. There are historical records of this species within the Site (1988, Bionet) and more recent records in the vicinity of the Site. The species may occasionally fly over the site, although foraging habitat is considered suboptimal.	The proposal will not remove habitat for this species as wetlands will not be cleared or modified. There is the potential for indirect affects including changes to water quality. Construction disturbance may cause the species to vacate habitats adjacent to the direct impact area. The impact on the species is considered negligible considering the occasional use of the habitats present within the site.	Negligible	Low
Mammals							
<i>Cercartetus nanus</i> Eastern Pygmy-possum	V	-	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest.	Unlikely. This species has been recorded within the locality; however suitable habitat for this species is not present within the Study Area.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	V	V	This species is found in well-timbered areas containing gullies and generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. It roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (<i>Petrochelidon ariel</i>).	Unlikely. This species has been recorded in the locality at Ash Island, however there is an absence of well-timbered habitat within the Closure Works area and therefore the species is not anticipated to occur.	NA	NA	NA
<i>Dasyurus maculatus</i> Spotted-tailed Quoll	V	E	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Mostly nocturnal, although will hunt during the day; spends most of the time on the ground, although also an excellent climber and may raid possum and glider dens and prey on roosting birds.	Unlikely. This species has been recorded within the locality, however suitable habitat for this species does not exist within the Site.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Falsistrellus tasmaniensis</i> Eastern False Pipistrelle	V	-	Prefers moist habitats, with trees taller than 20m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. Hunts beetles, moths, weevils and other flying insects above or just below the tree canopy. Hibernates in winter. Females are pregnant in late spring to early summer (OEH 2015).	Known. There are records of this species within the locality (Bionet 2015) and it was recorded by GHD. The site contains poor habitat for this species containing isolated patches of small trees and no hollow bearing trees being present.	Temporary removal habitat in which the species occasionally forage within or fly over. The foraging habitat is considered of low importance to the species and therefore the impact is considered negligible. No breeding habitat will be impacted.	Negligible	Low
<i>Miniopterus australis</i> Little Bentwing-bat	V	-	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. 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. Often share roosting sites with the Eastern Bentwing-bat and, in winter, the two species may form mixed clusters. Only five nursery sites /maternity colonies are known in Australia (OEH 2015).	Known. There are records of this species within the locality (Bionet 2015) and the species was recorded by GHD using bat detectors.	There is likely to be no roosting habitat within the Site, with impacts limited to the clearance of sub-optimal foraging habitat. Given this species prefers densely vegetated habitat with canopy species present.	Negligible	Low

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Miniopterus schreibersii oceanensis</i> Eastern Bentwing-bat	V	-	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Maternity caves have very specific temperature and humidity regimes. At other times of the year, populations disperse within about 300km range of maternity caves. Cold caves are used for hibernation in southern Australia. Breeding or roosting colonies can number from 100 to 150,000 individuals. Hunt in forested areas, catching moths and other flying insects above the tree tops (OEH 2015).	Known. This species has been recorded within the Study Area (Umwelt, 2012), however the habitat present within the site is likely to be unimportant given the lack of forest.	There is likely to be no roosting habitat within the Site, with impacts limited to the clearance of sub-optimal foraging habitat, or habitat which the species may fly over.	Negligible	Low

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Mormopterus norfolkensis</i> Eastern Freetail-bat	V	-	Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures. Usually solitary but also recorded roosting communally, probably insectivorous (OEH 2015).	Known. This species has been recorded within the Study Area (Umwelt, 2012) and may forage within the site.	This species may forage within the Site, although forested areas within the locality, including mangrove forests and swamp forests are likely to provide more optimal foraging habitat. No roosting habitat exists within the Site. The species is highly mobile and unlikely to be affected by the proposal.	Negligible	Low
<i>Myotis macropus</i> Southern Myotis	V	-	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface. In NSW females have one young each year usually in November or December (OEH 2015).	Known. This species has been recorded within the site, foraging over open water and roosting in Common Reed (<i>Phragmites australis</i>) adjacent to wetland areas.	The clearance of terrestrial vegetation within the site is unlikely to provide important habitat for this species, either as foraging or roosting habitat. The wetland areas provide habitat, however they will not be directly impacted the proposal and any affect are likely to be negligible.	Negligible	Low

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Petaurus norfolcensis</i> Squirrel Glider	V	-	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 mid storey. Live in family groups of a single adult male one or more adult females and offspring. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein (OEH 2015).	Unlikely. There are records of this species within the locality (Bionet 2015), however habitat within the Study Area is unsuitable for the species	NA	NA	NA
<i>Brush-tailed Rock-wallaby</i> <i>Petrogale penicillata</i>	E	V	This species often occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Their distribution generally follows the line of the Great Dividing Range, however this has become increasingly more fragmented.	Unlikely. There are no records of this species within the locality (Bionet 2015) and the habitat within the Closure Works area is unsuitable for the species	NA	NA	

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Phascogale tapoatafa</i> Brush-tailed Phascogale	V	-	Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. Agile climber foraging preferentially in rough barked trees of 25cm DBH or greater. Feeds mostly on arthropods but will also eat other invertebrates, nectar and sometimes small vertebrates. (OEH 2015).	Unlikely There are records within the locality; however suitable habitat for the species does not exist within the Study Area.	NA	NA	NA
<i>Phascolarctos cinereus</i> Koala	V	V	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. The Area 13 Koala Plan of Management (KPOM) identifies four feed trees within the region: Forest Red Gum (<i>E.tereticornus</i>), Tallowwood (<i>E. microcorys</i>), Swamp Mahogany (<i>E. robusta</i>), and Grey Gum (<i>E. propinqua</i>) (Biolink 2008).	Unlikely. There are records within the locality, however suitable habitat for the species does not exist within the Closure Works area, Furthermore there is no connectivity between the Study Area and areas where the species has been recorded.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Potorous tridactylus tridactylus</i> Long-nosed Potoroo (SE mainland)	V	V	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. The fruit-bodies of hypogeous (underground-fruiting) fungi are a large component of the diet of the Long-nosed Potoroo. They also eat roots, tubers, insects and their larvae and other soft-bodied animals in the soil. (OEH 2015).	Unlikely. There are records of this species within the locality (Bionet 2014), however suitable habitat does not exist within the Closure Works area.	NA	NA	NA
<i>Pseudomys novaehollandiae</i> New Holland Mouse	-	V	In NSW, the New Holland Mouse is known from Royal National Park, Kangaroo Valley and from Port Stephens to Evans Head (OEH SPRAT). This species is known to inhabit open heathland, open woodland with a heathland understorey and vegetated sand dunes. Soil type may also be an important indicator of suitability of habitat, with deeper top soils and softer substrates being preferred for digging burrows.	Unlikely. There are records of this species within the locality (Bionet 2014), however the Closure Works area does not constitute preferred habitat, due to the lack of suitable vegetation and preferred habitat features.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	V	V	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 20km 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. Site fidelity to camps is high; some camps have been used for over a century. Can travel up to 50km from the camp to forage; commuting distances are more often <20km. Feed on the nectar and pollen of native trees, in particular <i>Eucalyptus</i> , <i>Melaleuca</i> and <i>Banksia</i> , and fruits of rainforest trees and vines. Also forage in cultivated gardens and fruit crops (OEH 2015).	Known. There are numerous records of this species within the locality, including records of the species flying over the subject site (GHD 2010). Despite the presence of the species, the Closure Works area does not include any habitat likely to be utilised by the species, with no foraging or roosting resources present.	The closure works will not impact the species as the species is only anticipated to fly over the Closure Works area and no habitat for the species exists, within the Closure Works area.	Negligible	Low

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Saccolaimus flaviventris</i> Yellow-bellied Sheath-tail-bat	V	-	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Breeding has been recorded from December to mid-March, when a single young is born. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn (OEH 2015).	Known. This species was recorded within the Study Area by Umwelt (2012).	Temporary removal of a small area of sub-optimal foraging habitat. No roosting habitat will be impacted.	Negligible	Low
<i>Scoteanax rueppellii</i> 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. Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3-6m. (OEH 2015).	Potential. There are records of this species within the locality (Bionet 2015) and Umwelt (2012) recorded the species adjacent to the Study Area. Habitat within the Study Area is considered sub-optimal considering the lack of forested areas.	Temporary removal of a small area of sub-optimal foraging habitat. No roosting habitat will be impacted.	Negligible	Low

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Vespadelus troughtoni</i> Eastern Cave Bat	V	-	Very little is known about the biology of this uncommon species. 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. Occasionally found along cliff-lines in wet eucalypt forest and rainforest. Little is understood of its feeding or breeding requirements or behaviour (OEH 2015).	Unlikely. There are records of this species within the locality (Bionet 2015) however the preferred habitat is lacking within the Study Area, with no cliff or cliff lines within close proximity.	NA	NA	NA
Flora							
<i>Allocasuarina defungens</i> Dwarf Heath Casuarina	E	E	Dwarf Heath Casuarina grows mainly in tall heath on sand, but can also occur on clay soils and sandstone. The species also extends onto exposed nearby-coastal hills or headlands adjacent to sandplains (OEH 2015).	Unlikely. Records do not occur within the locality (Bionet 2015). No suitable habitat within the Closure Works area.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Angophora inopina</i> Charmhaven Apple	V	V	Occurs most frequently in four main vegetation communities: (i) <i>Eucalyptus haemastoma-Corymbia gummifera-Angophora inopina</i> woodland/forest; (ii) <i>Hakea teretifolia-Banksia oblongifolia</i> wet heath; (iii) <i>Eucalyptus resinifera-Melaleuca sieberi-Angophora inopina</i> sedge woodland; (iv) <i>Eucalyptus capitellata-Corymbia gummifera-Angophora inopina</i> woodland/forest	Unlikely. Recorded within the locality, however suitable habitat and associated vegetation types do not occur within the Closure Works area. It has not been recorded during previous field surveys.	NA	NA	NA
<i>Callistemon linearifolius</i> Netted Botted Brush	V	-	This species grows in dry sclerophyll forest on the coast and adjacent ranges and flowers between spring and summer (Barker et al 1999).	Unlikely. Recorded within the locality, however suitable habitat and associated vegetation types do not occur within the Study Area. It has not been recorded during previous field surveys.	NA	NA	NA
<i>Commersonia prostrata</i> Dwarf Kerrawang	E	E	Occurs on sandy, sometimes peaty soils in a wide variety of habitats.	Unlikely. Recorded within the locality, however suitable habitat and associated vegetation types do not occur within the Closure Works area. It has not been recorded during previous field surveys.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Cynanchum Elegans</i> White-flowered Wax Plant	E	E	This species usually occurs on the edge of dry rainforest vegetation. In the Hunter Valley it is known to occur at Singleton Military Area and Kooragang Island.	Unlikely. Suitable habitat and associated vegetation types do not occur within the Closure Works area. It has not been recorded during previous field surveys. The species has been recorded close to the Study Area on Ash Island within forested areas.	NA	NA	NA
<i>Cryptostylis hunteriana</i> Leafless Tongue-orchid	V	V	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 (<i>Eucalyptus sclerophylla</i>), Silvertop Ash (<i>E. sieberi</i>), Red Bloodwood (<i>Corymbia gummifera</i>) and Black Sheoak (<i>Allocasuarina littoralis</i>); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (<i>C. subulata</i>) and the Tartan Tongue Orchid (<i>C. erecta</i>) (OEH 2015).	Unlikely. There are no records within the Locality (Bionet 2015). Not recorded within the Closure Works area and suitable woodland communities types which support this species were not recorded within the impact area.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Diuris praecox</i> Rough Doubletail	V	V	Grows on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey. Occurs in the coastal region between Ourimbah and Nelson Bay.	Unlikely. Recorded within the locality, however suitable habitat and associated vegetation types do not occur within the Closure Works area. It has not been recorded during previous field surveys.	NA	NA	NA
<i>Eucalyptus camfieldii</i> Camfield's Stringybark	V	V	Occurs in poor coastal country in shallow sandy soils overlying Hawkesbury sandstone and coastal heath mostly on exposed sandy ridges. Usually 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 species of Narrow-leaved Stringybark (<i>E. oblonga</i>), Brown Stringybark (<i>E. capitellata</i>) and Scribbly Gum (<i>E. haemastoma</i>).	Unlikely. Recorded within the locality, however suitable habitat and associated vegetation types do not occur within the Closure Works area. It has not been recorded during previous field surveys.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Eucalyptus parramattensis</i> subsp. <i>Decadens</i> Earp's Gum	V	V	The Tomago Sandbeds population is bounded by Salt Ash and Tanilba Bay in the north and Williamtown and Tomago in the south. It 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. Flowering occurs from November to January (OEH 2015)	Unlikely. Recorded within the locality, however suitable habitat and associated vegetation types do not occur within the Closure Works area. It has not been recorded during previous field surveys.	NA	NA	NA
<i>Euphrasia arguta</i>	CE	CE	Grows in grassy areas near rivers. Preliminary determination as CE following rediscovery of four populations in the Nundle area in 2008. Distribution highly restricted to rediscovered records.	Unlikely. There are no records within the Locality (Bionet 2015). Not recorded within the Closure Works area, and neither suitable nor potential habitat exists.	NA	NA	NA
<i>Grevillea parviflora</i> subsp. <i>parviflora</i> Small-flower Grevillea	V	V	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 and 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. Recorded within the locality, however suitable soil types and associated vegetation do not occur within the Closure Works area. It has not been recorded during previous field surveys.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Grevillea shiressii</i>	V	V	Known from two populations 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	Unlikely. Recorded within the locality, however habitat does not occur within the Closure Works area. It has not been recorded during previous field surveys.	NA	NA	NA
<i>Maundia triglochinoidea</i>	V	-	Grows in swamps, lagoons, dams, channels, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients. Flowering occurs during warmer months. Associated with wetland species e.g. <i>Triglochin procerum</i> . Probably wind pollinated. Diaspore is the seed and root tubers, which are probably dispersed by water. Spreads vegetatively, with tufts of leaves arising along rhizome. Populations expand following flood events and contract to more permanent wetlands in times of low rainfall (OEH 2015).	Unlikely. This species has been recorded within the locality; however all of the records are in excess of 3 km from the Study Area. The Study Area provides some suitable wetland habitat for the species however previous field survey conducted date have failed to detect this species. It is therefore considered unlikely to occur.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Melaleuca biconvexa</i> Biconvex Paperbark	V	V	Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Flowering occurs over just 3-4 weeks in September and October. Resprouts following fire (OEH 2014).	Unlikely. Recorded within the locality, however suitable habitat does not occur within the Closure Works area. It has not been recorded during previous field surveys.	NA	NA	NA
<i>Muehlenbeckia costata</i> Scrambling Lignum	V		Scrambling lignum grows in peat and coarse sandy soils typically derived from acidic volcanic outcrops or granite and at high altitudes. It is typically known to be found in open eucalypt woodland, heath and mallee.	Unlikely. Recorded within the locality, however suitable habitat does not occur within the Study Area. It has not been recorded during previous field surveys.	NA	NA	NA
<i>Persicaria elatior</i> Tall Knotweed	V	V	This species normally grows in damp locations, especially beside lakes and streams. It has occasionally been known to occur in swamp forest as well as in association with disturbance. This species is known to occur in two disjunct areas; in south-eastern NSW and northern NSW (OEH, 2015).	Unlikely. Recorded within the locality, however not within close proximity to the Closure Works area. Despite some suitable habitat existing, the species has not been detected during multiple field surveys.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Phaius australis</i> Lesser Swamp-orchid	E	E	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas.	Unlikely. Not recorded within the locality and suitable habitat does not occur within the Closure Works area. It has not been recorded during previous field surveys.	NA	NA	NA
Coastal Headland Pea <i>Pultenaea maritima</i>	V	-	This species occurs in grasslands, shrublands and heath on exposed coastal headlands.	Unlikely. Recorded within the locality, however suitable habitat does not occur within the Study Area. It has not been recorded during previous field surveys.	NA	NA	NA
<i>Rutidosia heterogama</i> Heath Wrinklewort	V	V	Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides.	Unlikely. Recorded within the locality, however suitable habitat does not occur within the Closure Works area. It has not been recorded during previous field surveys.	NA	NA	NA
<i>Streblus pendulinus</i> Siah's Backbone		E	On the Australian mainland, Siah's Backbone is found in warmer rainforests, chiefly along watercourses. The altitudinal range is from near sea level to 800 m above sea level. The species grows in well-developed rainforest, gallery forest and drier, more seasonal rainforest (ATRP 2010 as cited in DSEWPac 2013).	Unlikely. Recorded within the locality, however suitable habitat does not occur within the Closure Works area. It has not been recorded during previous field surveys.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Syzygium paniculatum</i> Magenta Lilly Pilly	E	V	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. Occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	Unlikely. Recorded within the locality, however suitable habitat does not occur within the Closure Works area. It has not been recorded during previous field surveys.	NA	NA	NA
<i>Tetratheca glandulosa</i>	V		Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone, with associated soil landscapes such as Lucas Heights, Gynea, Lambert and Falconbridge. Topographically, the plant occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Soils are generally shallow, consisting of a yellow, clayey/sandy loam. Stony lateritic fragments are also common in the soil profile on many of these ridgetops.	Unlikely. Recorded within the locality, however suitable habitat does not occur within the Study Area. It has not been recorded during previous field surveys.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
<i>Tetraloche juncea</i> <i>Black-eyed Susan</i>	V	V	This species is confined to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion. It is usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover.	Unlikely. Recorded within the locality, however suitable habitat does not occur within the Closure Works area. It has not been recorded during previous field surveys.	NA	NA	NA
<i>Zannichellia palustris</i>	E		The species is a submerged aquatic plant, and known only from the lower Hunter within NSW. It grows in fresh or slightly saline stationary or slowly flowing water. It flowers during warmer months. NSW populations behave as annuals, dying back completely every summer	Known. Species has been recorded adjacent to the Site.	The proposed works will not directly remove or modify aquatic habitats; however there are the potential for indirect impact to occur, such as alterations to water quality, run-off and sedimentation.	Minor	High

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
Endangered Ecological Communities (EECs) and Threatened Ecological Communities (TECs)							
Central Hunter Valley eucalypt forest and woodland		CE	An open forest or woodland, typically dominated by eucalypt species; it has an open to sparse mid-layer of shrubs and a ground layer of grasses, forbs and small shrubs. The canopy of the ecological community is dominated by one or more of the following four eucalypt species: Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>), Spotted Gum (<i>Corymbia maculata</i>), Slaty Gum (<i>E. dawsonii</i>) and Grey Box (<i>E. moluccana</i>).	Unlikely. The community was not recorded within the Closure Works area as the site does not offer potential given its history of modification and the landscape position which (unmodified) would provide more mesic conditions.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E		This community is associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains. Generally occur below 20 m elevation on level areas. They are dominated by herbaceous plants and have very few woody species (OEH, 2015)	Known. This community is present in various forms including small vegetation ponds and much large ponds with open water. The EEC does not exist within the proposed capping area.	This community is outside of the proposed capping area and will not be directly impacted; however there are potential indirect impacts which could occur as the works will occur adjacent to the EEC.	Negligible	Medium

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney East Corner Bioregions	E	-	Swamp Oak Floodplain Forest is a community of plants that is generally dominated by the tree/s Swamp Oak (<i>Casuarina glauca</i>) and/or Swamp Paperbark (<i>Melaleuca ericifolia</i>). The community is found in close proximity to rivers and estuaries and is generally found on soils with a saline influence. Depending on the level of salinity in the groundwater the understorey will be composed of salt tolerant grasses and herbs and in more saline areas by sedges and reeds (DECC 2007c).	Unlikely. Not recorded within the Study Area, and neither suitable nor potential habitat exists	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	E	-	A community that generally has several layers of vegetation, including trees, shrubs, groundcovers and wetland plants such as reeds and sedges. It is a community of plants that are generally found close to standing water on soils that are either waterlogged or subject to periodic flooding or inundation. It is usually an open to closed forest with a shrubby or reedy/ferny understorey. The most common trees in Swamp Sclerophyll Forest include Swamp Mahogany (<i>Eucalyptus robusta</i>), Broadleaved paperbark (<i>Melaleuca quinquenervia</i>).	Unlikely. This community was not recorded within the Site.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
River-flat Eucalypt Forest on Coastal Floodplain	E	-	Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level. The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include Forest Red Gum (<i>Eucalyptus tereticornis</i>), Cabbage Gum (<i>E. amplifolia</i>), Rough-barked Apple (<i>Angophora floribunda</i>) and Broad-leaved Apple (<i>A. subvelutina</i>) (OEH 2015).	Unlikely. Not recorded within the Study Area, and neither suitable nor potential habitat exists	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
Subtropical Coastal Floodplain Forest of the NSW North Coast Bioregion	E	-	A tall mixed forest occurring on coastal floodplains on the north coast of NSW. The most widespread and abundant dominant trees include Forest Red Gum (<i>Eucalyptus tereticornis</i>), Grey Ironbark (<i>E. siderophloia</i>), Pink Bloodwood (<i>Corymbia intermedia</i>) and, north of the Macleay floodplain, Swamp Turpentine (<i>Lophostemon suaveolens</i>). A layer of small trees may be present, including Forest Oak (<i>Allocasuarina torulosa</i>) and a range of rainforest species such as Red Ash (<i>Alphitonia excelsa</i>) and Cheese Tree (<i>Glochidion ferdinandii</i>) (DECC 2007a).	Unlikely. Not recorded within the Study Area, and neither suitable nor potential habitat exists	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	E+	CE	The ecological community occurs on coastal headlands, dunes, sea-cliffs or other places influenced by the sea. The appearance of this ecological community and its plant species can vary greatly depending on location, but it appears as a complex of rainforest and vine thickets. The vegetation generally is structurally diverse, with native trees, shrubs, vines and ground layers all potentially being present. The vegetation typically has a closed canopy (DEWHA 2009).	Unlikely. Not recorded within the Study Area, and neither suitable nor potential habitat exists.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
Lowland Rainforest of Subtropical Australia	E*	CE	Generally a moderately tall (≥ 20 m) to tall (≥ 30 m) closed forest (canopy cover $\geq 70\%$). Tree species with compound leaves are common and leaves are relatively large (notophyll to mesophyll). Typically there is a relatively low abundance of species from the genera <i>Eucalyptus</i> , <i>Melaleuca</i> and <i>Casuarina</i> . Buttresses are common as is an abundance and diversity of vines. The canopy comprises a range of tree species but in some areas a particular species may dominate e.g. palm forest, usually dominated by <i>Archontophoenix cunninghamiana</i> (Bangalow Palm) or <i>Livistona australis</i> (Cabbage Palm); and riparian areas dominated by <i>Syzygium floribundum</i> (syn. <i>Waterhousea floribunda</i>) (Weeping Satinash/Weeping Lilly Pilly).	Unlikely. Not recorded within the Study Area, and neither suitable nor potential habitat exists.	NA	NA	NA

Species Name	Species Sensitivity		Habitat Requirements	Likelihood of Occurrence	Description of Potential Impact	Consequence of impact on species	Risk Level
	TSC Act Status	EPBC Act Status					
Subtropical and Temperate Coastal Saltmarsh	E#	V	The ecological community consists of dense to patchy areas of mainly salt-tolerant vegetation (halophytes) including: grasses, herbs, sedges and shrubs that may also include bare sediment as part of the mosaic). Characteristic plant species include <i>Gahnia filum</i> , <i>G. trifida</i> , <i>Juncus kraussii</i> , <i>Samolus repens</i> , <i>Sarcocornia quinqueflora</i> , <i>Sporobolus virginicus</i> , <i>Suaeda australis</i> , <i>Tecticornia pergranulata</i> , <i>T. arbuscula</i> , <i>Triglochin striata</i> , <i>Wilsonia backousei</i> and <i>W. rotundifolia</i> . There are a number of key diagnostic characteristics for describing the Coastal Saltmarsh ecological community but principally this EEC occurs on the coastal margin, along estuaries and coastal embayments and on low wave energy coasts (TSSC 2013).	An area of habitat exists within the Wetland of K6 Cell 10, which has floral assemblages similar to that of Coastal Saltmarsh. However the community within the Site is permanently disconnected from the intertidal influence and therefore is not considered part of the listed community, despite having species attributes similar to the listed community.	NA	NA	NA
<i>Migratory Species Listed under the EPBC Act</i>							

Annex D

TSC Act Assessment Of Significance (7 Part Test)

The following assessment is based on the Assessment of Significance (known as the 'seven part test') in Section 5A of the EP&A Act. The factors within this assessment allows a determination of whether there is likely to be a significant effect on threatened species, populations or ecological communities as listed under the TSC Act, or their habitats for those species and ecological communities that have been recorded or are likely to occur in the Site.

Green and Golden Bell Frog (*Litoria aurea*) Vulnerable, EPBC Act; Endangered, TSC Act

The Green and Golden Bell Frog, has been recorded both historically and recently within KIWEF with breeding recorded in several ponds within the locality. Collaborative targeted surveys by GHD and RPS HSO recorded the species on multiple occasions including both adults and tadpoles. All of these records were outside of the proposed closure works area, however several records were found in close proximity to the capping area. The highest density of records was from K6 Cell 11 with breeding also recorded in this area. Other areas in which the species was recorded includes K6 Cell 10 and 12, Easement Pond, Cell 34 (Delta Channel) and the K7 ponds.

(a) *in the case of a threatened species, whether the action proposed 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 key breeding resources for the local population are a series of ponds providing habitat for spawning and tadpole development. The pond margins and associated wetland habitat are likely to provide key habitat for the development of metamorphs. These key areas of habitat will not be impacted by the proposal as they are outside of the development footprint.

Hydrological impacts will also be negligible considering that the capping area drains away from the known breeding areas into areas of lower habitat value such as Deep Pond. It is anticipated that there will be no significant changes to the breeding habitat as a result of this proposal and the breeding cycle of this species will not be disrupted.

(b) *in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable.

(c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(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*

Not applicable.

(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.

(d) *in relation to the habitat of a threatened species, population or ecological community:*

(i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

The closure works will temporarily remove an area of potential foraging habitat (5.2 ha) for adult Green and Golden Bell Frog. After closure works are completed the area will be revegetated, therefore the loss of habitat is considered a temporary impact.

(ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

This capping area does not provide an important linkage to other areas of habitat for the species. The majority of the capping area is open exotic grassland with a paucity of shelter, which would leave individuals open to predation and desiccation. Railways, associated embankments and roads to the south of KIWEF currently limit dispersal options within the immediate environs. Wetland areas and associated marginal vegetation to the east, north and west of the proposed closure works will not be affected and provide movement corridors for the species. No fragmentation of key areas of habitat is anticipated.

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

Proposed impact area represents a small proportion of the total potential foraging habitat available to the species. Larger more optimal foraging habitat surrounding the wetland areas, including the K6 and K7 areas, will be retained. It is likely that the temporary loss of a small proportion of foraging habitat will not cause any decline for the species and frogs will be able to utilise other areas.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

Foraging habitat that will be impacted by the proposal is not considered of high value to the species. Breeding habitat associated with K6 Cell 11 and other areas in which the species was recorded (K6 Cell 10 and 12, Easement Pond, Cell 34 (Delta Channel) and the K7 ponds) are important to the local population of the species; however these will not be impacted.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

The draft management plan for this species (2005) favours in-situ protection and management of existing habitats for the species. The proposal does not impact on important habitat for the species, with the breeding ponds not impacted directly or indirectly. Some foraging habitat will be cleared although revegetation will return the overall habitat area to its original extent.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The majority of the area to be impacted is exotic vegetation. Some small patches of native vegetation will be cleared and this constitutes a key threatening process. This is not expected to cause a significant decline on the prevalence of suitable habitat for the Green and Golden Bell Frog.

Conclusion

The closure works have avoided cells in which wetlands are present. This will minimise impacts to the species by retaining important habitat. Key impacts are limited to possible mortality of a small number of individuals during clearance of weedy terrestrial area. There are likely to be no significant impacts to this species or the population of this species.

Australasian Bittern (*Botaurus poiciloptilus*) Endangered, EPBC Act and TSC Act

This species inhabits terrestrial and estuarine wetlands, preferring dense vegetation including sedges, rushes and reeds. It is a cryptic species, occurring at low densities within the Hunter Estuary. Habitat within and adjacent to KIWEF is limited to dense areas of wetland vegetation with Common Reed and Cumbungi. The species has been recorded on four occasions during 2010 by Umwelt at Easement Pond, Railway Pond and K6 Cell 11.

(a) *in the case of a threatened species, whether the action proposed 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,*

No habitat suitable for this species will be impacted as a result of this proposal. Two individuals were recorded within K6 Cell, which may indicate a single breeding pair occurring, adjacent to the site. Breeding pairs are territorial and occupy large area, therefore it is unlikely that more than one pair occurs within close proximity to the site. In the worst case scenario the proposal may cause the pair to avoid areas of potential foraging or breeding habitat, immediately adjacent to the proposed capping area. The wetlands adjacent to the closure works area are small in size and are likely to represent a small proportion of the territory required by individual birds, therefore it is anticipated that any temporary displacement that occurs will not significantly affect breeding. The species will be able to forage or breed in alternative habitat within the locality. The species may also become habituated to the construction disturbance and persist in wetland habitats close to the works. No population effects are anticipated.

(b) *in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable.

(c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(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*

Not applicable.

(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.

(d) *in relation to the habitat of a threatened species, population or ecological community:*

(i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

This proposal will not remove habitat for this species as wetlands will not be cleared or modified. The main potential impact to this species is due to visual and noise disturbance related to the closure works. The wetlands adjacent to the closure works area are small in size and are likely to represent a small proportion of the territory required individual birds, therefore it is anticipated that any temporary displacement that occurs will not significantly affect the species. The species will be able to forage or breed in alternative habitat within the locality. The species may also become habituated to the construction disturbance and persist in wetland habitats close to the construction works.

(ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

The proposal will not remove any habitat suitable for this species and there will be no changes to the connectivity of existing habitats for the species.

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

The habitat which will be cleared is terrestrial and is unsuitable habitat for the species.

(e) *whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*

The proposal will have no direct impact on habitat for this species. Indirect impacts to the hydrology of the area are likely to be negligible and undetectable. Water quality in wetlands adjacent to the capping area may improve as a result of the reduction of leached contaminants.

(f) *whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*

There are no recovery plans currently prepared for this species.

(g) *whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

The majority of the area to be impacted is exotic vegetation. Some small patches of native vegetation will be cleared, which constitutes a key threatening process. The areas of native vegetation which require clearing to not provide habitat for the Australasian Bittern.

Conclusion

There will be no significant impact to this species, given that the habitat for this species will not be cleared or modified. Any indirect impacts as a result of the proposal are likely to be negligible.

Curlew Sandpiper (*Calidris ferruginea*) Endangered and Migratory, EPBC Act; Critically Endangered, TSC Act

This species typically forages where intertidal mudflats are present and has occasionally been recorded in Deep Pond. It is unlikely that the habitat within the closure works area is important for the species given that the area is not intertidal and that few records are present. Any impacts are therefore likely to affect a very low number of individuals. The proposal will not remove habitat for this species as wetlands will not be cleared or modified. The main potential impact to this species is due to construction disturbance related to the closure works. This is a temporary impact and considered negligible given that only a very small number of individuals will be affected. The species may also become habituated to the construction disturbance and therefore still able to utilise the sub-optimal foraging habitat present in Deep Pond.

(a) *in the case of a threatened species, whether the action proposed 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 construction works will involve heavy machinery and increased numbers of people within the capping area. This will temporarily increase the amount of noise and visual disturbance in area to the east of Deep Pond. As this disturbance is temporary, no long term impacts are anticipated and the proposal will not contribute to the risk of extinction for the population. There are also large areas of alternative habitat within the vicinity.

(b) *in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable.

(c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(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*

Not applicable.

(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.

<i>(d) in relation to the habitat of a threatened species, population or ecological community:</i>	<i>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and</i>
<p>This species is migratory, occupying a very large range and breeding in the northern hemisphere. Temporary construction disturbance may cause the species to avoid small areas of foraging habitat adjacent to the capping area, however there are other and much larger areas of intertidal foraging habitat present within the vicinity. There will be no significant changes to the habitat for this species within or adjacent to the site.</p>	
<i>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</i>	
<p>The proposal will not remove any habitat suitable for this species and there will be no changes to the connectivity of existing habitats for the species.</p>	
<i>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,</i>	
<p>The habitat which will be cleared is terrestrial and is unsuitable habitat for the species.</p>	
<i>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),</i>	<p>The proposal will have no direct impact on habitat for this species. Indirect impacts to the hydrology of the area are likely to be negligible and undetectable. Water quality in wetlands adjacent to the capping area may improve as a result of the reduction of leached contaminants.</p>
<i>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,</i>	<p>There are no recovery plans currently prepared for this species.</p>
<i>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</i>	<p>The majority of the area to be impacted is exotic vegetation. Some small patches of native vegetation will be cleared which constitutes a key threatening process. The areas of native vegetation which require clearing to not provide habitat for the Curlew Sandpiper.</p>
<i>Conclusion</i>	
<p>There will be no significant impact to this species, given that the habitat for this species will not be cleared or modified. Any indirect impacts as a result of the proposal are likely to be negligible.</p>	

Australian Painted Snipe (*Rostratula australis*) Endangered and Migratory, EPBC Act; Endangered, TSC Act.

This species is found in fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Forages nocturnally on mud-flats and in shallow water. Feeds on worms, molluscs, insects and some plant-matter. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (OEHL, 2015).

The species has been recorded within 1 km of the closure works area, during 2012 (Bionet). Field surveys have failed to detect the species however, owing to suitable habitat existing within the closure works area, the species is considered to have the potential to occur, perhaps intermittently. The most favourable habitat for the species include the wetlands and marginal vegetation surrounding the wetland areas.

The proposal will not remove habitat for this species as wetlands will not be cleared or modified. The main potential impact to this species is due to construction disturbance related to the closure works. This is a temporary impact and considered negligible given that only a very small number of individuals will be affected. The species may become habituated to the construction disturbance and therefore still able to utilise the sub-optimal foraging habitat present in Deep Pond, furthermore the species forages at night when there will be no construction activities taking place.

(a) *in the case of a threatened species, whether the action proposed 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 construction works will involve heavy machinery and increased number of people within the capping area. This will temporarily increase the amount of noise and visual disturbance in area to the east of Deep Pond. As this disturbance is temporary, no long term impacts are anticipated and the proposal will not contribute to the risk of extinction for the population. There are also areas of alternative habitat within the vicinity in which the species may be able to relocate if disturbed by the construction activities.

It is unlikely that the habitat within the closure works area is important for the species given that it has not been recorded previously and that use of the closure works area is likely to be intermittent, if at all. Any impacts are likely to affect a low number of individuals and will not have any affect at a population level.

(b) *in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable.

(c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(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*

Not applicable.

(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.

<p>(d) <i>in relation to the habitat of a threatened species, population or ecological community:</i></p>
<p>(i) <i>the extent to which habitat is likely to be removed or modified as a result of the action proposed, and</i></p>
<p>Wetland foraging habitat will not be impacted directly by the closure works. Any indirect effects to the hydrology of the wetlands are likely to be negligible and possibly beneficial, reducing the number of contaminants entering the wetlands.</p> <p>Terrestrial areas of habitat immediately adjacent to the wetlands may provide supplementary habitat for the Snipe, during diurnal resting periods. A buffer will remain surrounding the wetlands, retaining potential habitat for this species, maintaining potential shelter for this species.</p>
<p>(ii) <i>whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</i></p>
<p>The proposal will not remove any foraging habitat for this species and a buffer of connecting emergent vegetation will remain around the wetland areas. This species is also mobile and able to fly to adjacent suitable habitats.</p>
<p>(iii) <i>the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,</i></p>
<p>The habitat that will be cleared is terrestrial and is largely unsuitable habitat for the species. The habitat removed is not likely to be important for the species.</p>
<p>(e) <i>whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),</i></p>
<p>The proposal will have no direct impact on important habitat for this species. Indirect impacts to the hydrology of the area are likely to be negligible and undetectable. Water quality in wetlands adjacent to the capping area may improve as a result of the reduction of leached contaminants.</p>
<p>(f) <i>whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,</i></p>
<p>There are no recovery plans currently prepared for this species; however a targeted strategy for managing this species has been developed under the Saving Our Species program (OEH, 2015). The proposal does not include species measures to improve habitat value for the Australian Painted Snipe but will assist in meeting one of the actions proposed: <i>Undertake control of exotic weeds and invasive native plants via appropriate techniques (e.g. burning, grazing, mechanical methods)</i>. This will occur as part of the closure works in the terrestrial areas. This may have beneficial effects on the adjacent wetlands by reducing the seed input to the wetland margins from exotic plant species.</p>
<p>(g) <i>whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</i></p>
<p>The majority of the area to be impacted is exotic vegetation. Some small patches of native vegetation will be cleared which constitutes a key threatening process. The areas of native vegetation which require clearing do not provide habitat for this species however.</p>
<p><i>Conclusion</i></p>
<p>There will be no significant impact to this species, given that the habitat for this species will not be cleared or modified. Any indirect impacts as a result of the proposal are expected to be negligible.</p>

Black-necked Stork (*Ephippiorhynchus asiaticus*) Endangered, TSC Act

This species has been recorded from Deep Pond, adjacent to the closure works area and also in surrounding wetlands. Judging by the few records of the species and the lack of observations during field surveys, the species may be occasionally present within or adjacent to the closure works area as it is regularly observed in wetlands throughout the Hunter coastal region. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork (OEH, 2015).

(a) *in the case of a threatened species, whether the action proposed 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 construction works will involve heavy machinery and increased numbers of people within the capping area. This will temporarily increase the amount of noise and visual disturbance in area to the east of Deep Pond. As this disturbance is temporary, no long term impacts are anticipated and there are also large areas of alternative habitat within the vicinity. This species has not been recorded in high numbers within or adjacent to the site and therefore any indirect impact will not cause population wide effects.

(b) *in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable.

(c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(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*

Not applicable.

(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.

(d) *in relation to the habitat of a threatened species, population or ecological community:*

(i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

No wetland habitat suitable for this species will be cleared. Any indirect effects on the wetland areas are considered negligible and will not alter the habitat significantly.

(ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

This species is highly mobile exploiting sporadic and seasonal foraging resources. The clearance of a small area of terrestrial habitat will have no fragmentation affect for this species.

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

The habitat that will be cleared is terrestrial and is unsuitable habitat for the species.

(e) *whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*

The proposal will have no direct impact on habitat for this species. Indirect impacts to impact to the hydrology of the area are likely to be negligible and undetectable. Water quality in wetlands adjacent to the capping area may improve as a result of the reduction of leached contaminants.

(f) *whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*

There are no recovery plans currently prepared for this species.

(g) *whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

The majority of the area to be impacted is exotic vegetation. Some small patches of native vegetation will be cleared which constitutes a key threatening process. The areas of native vegetation which require clearing to not provide habitat for this species.

Conclusion

There will be no significant impact to this species, given that the habitat for this species will not be cleared or significantly modified. Any indirect impacts as a result of the proposal are likely to be negligible.

White-fronted Chat (*Epthianura albifrons*), Vulnerable, TSC Act

This species has been recorded within the KIWEF in 2007, with additional records close to Deep Pond and in the areas adjacent to the closure works area. The White-fronted Chat prefers habitats near waterways and damp areas. Optimal habitat includes wetlands containing saltmarsh that are bordered by grassland or lightly timbered woodland.

(a) *in the case of a threatened species, whether the action proposed 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,*

Areas of the most optimal habitat for this species will not be cleared, with the margins of the wetland areas being retained. The proposal is not anticipated to adversely affect the lifecycle of this species. Furthermore a large number of field surveys have been conducted in the last five years with no individuals of this species being detected. The closure works area is not likely to regularly support this species and therefore any impacts are not likely to have any population wide effects.

(b) *in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable.

(c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(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*

Not applicable.

(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.

(d) *in relation to the habitat of a threatened species, population or ecological community:*

(i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

No wetland habitat suitable for this species will be cleared. Any indirect effects on the wetland areas are considered negligible and will not alter the habitat significantly. Terrestrial habitat may provide sub-optimal foraging habitat for this species, however a large proportion of similar habitat within the locality will remain unaffected by the proposal.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

This species is mobile and able to utilise alternative habitats within the vicinity if it is displaced by construction disturbance. This species is able to move through open areas and connection vegetation along the margins of the wetlands will not be impacted.

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

The habitat that will be cleared is terrestrial and is composed of sub-optimal habitat for the species, with the potential to provide some foraging and shelter for the species. The more optimal foraging habitat on the wetland margins will not be impacted. The habitat within the closure works area is unlikely to be important for the species given that it has only been recorded once within the site.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

The habitat within the closure works area is not considered critical habitat and it has not been found to regularly support the species.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

There are no recovery plans currently prepared for this species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The majority of the area to be impacted is exotic vegetation. Some small patches of native vegetation will be cleared which constitutes a key threatening process. The areas of native vegetation that require clearing do not provide habitat for this species.

Conclusion

There will be no significant impact to this species, given that the most optimal areas of habitat for this species will not be cleared or significantly modified. Any indirect impacts as a result of the proposal are likely to be negligible.

Pied Oystercatcher (*Haematopus longirostris*) Endangered TSC Act

The Pied Oystercatcher 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. Nests are typically shallow scrapes in sand above the high tide mark, often amongst seaweed, shells and small stones (OEH 2015). The species has been recorded in the adjacent Railway Pond and is regularly recorded at Stockton Sandspit. The foraging habitat within the closure works area is sub-optimal for the species however the species may occasionally occur.

(a) in the case of a threatened species, whether the action proposed 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,

This species has not been recorded within the closure works area and the wetland habitat is considered sub-optimal given that it is not intertidal. The project will have no effect on the lifecycle on this species or local population, as the site does not contain important foraging or roosting habitat.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

Not applicable.

(c) <i>in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</i>	(i) <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</i>
Not applicable.	
(ii) <i>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,</i>	Not applicable.
(d) <i>in relation to the habitat of a threatened species, population or ecological community:</i>	(i) <i>the extent to which habitat is likely to be removed or modified as a result of the action proposed, and</i>
This species has the potential to fly over the closure works area or occasionally occur in the wetland margins or shallow water. The wetland habitats will not be impacted by the proposal.	
(ii) <i>whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</i>	The proposal will not remove any habitat suitable for this species and there will be no changes to the connectivity of existing habitats for the species.
(iii) <i>the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,</i>	The habitat that will be cleared is terrestrial and is unsuitable habitat for the species.
(e) <i>whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),</i>	The proposal will have no direct impact on habitat for this species. Indirect impacts to the hydrology of the area are likely to be negligible and undetectable. Water quality in wetlands adjacent to the capping area may improve as a result of the reduction of leached contaminants.
(f) <i>whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,</i>	There are no recovery plans currently prepared for this species.
(g) <i>whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</i>	The majority of the area to be impacted is exotic vegetation. Some small patches of native vegetation will be cleared which constitutes a key threatening process. The areas of native vegetation which require clearing do not provide habitat for the species.
<i>Conclusion</i>	
There will be no significant impact to this species, given that potential habitat for this species will not be cleared or modified. Any indirect impacts as a result of the proposal are likely to be negligible.	

Little Tern (*Sternula albifrons*) Endangered TSC Act

The Little Tern is almost exclusively coastal, preferring sheltered environments; however they may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records). It 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. (OEH 2015). 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. Nests are typically shallow scrapes in sand above the high tide mark, often amongst seaweed, shells and small stones (OEH 2015). The species has been recorded in the adjacent Railway Pond and is regularly recorded at Stockton Sandspit. The foraging habitat within the closure works area is sub-optimal for the species however the species may occasionally occur.

(a) *in the case of a threatened species, whether the action proposed 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,*

This species has not been recorded within the closure works area and the wetland habitat is considered sub-optimal. The project will have no effect on the lifecycle on this species or local population, as the site does not contain important foraging or roosting habitat.

(b) *in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable.

(c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(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*

Not applicable.

(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.

(d) *in relation to the habitat of a threatened species, population or ecological community:*

(i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

This species has the potential fly over the closure works area or occasionally forage within the wetland areas. The wetland habitats will not be impacted by the proposal.

(ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

The proposal will not remove any habitat suitable for this species and there will be no changes to the connectivity of existing habitats for the species.

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

The habitat that will be cleared is terrestrial and is unsuitable habitat for the species.

(e) *whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*

The proposal will have no direct impact on habitat for this species. Indirect impacts to the hydrology of the area are likely to be negligible and undetectable. Water quality in wetlands adjacent to the capping area may improve as a result of the reduction of leached contaminants.

(f) *whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*

There are no recovery plans currently prepared for this species.

(g) *whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

The majority of the area to be impacted is exotic vegetation. Some small patches of native vegetation will be cleared which constitutes a key threatening process. The areas of native vegetation which require clearing do not provide habitat for the species.

Conclusion

There will be no significant impact to this species, given that potential habitat for this species will not be cleared or modified. Any indirect impacts as a result of the proposal are likely to be negligible.

Red-backed Button Quail (*Turnix maculosus*) Vulnerable TSC Act

This species inhabits grasslands, open and savannah woodlands with grassy ground layer, pastures and crops of warm temperate areas, typically only in regions subject to annual summer rainfall greater than 400 mm. In NSW, the species occurs in grasslands, heath and crops, preferring sites close to water, especially when breeding. This species was recorded in 2008, with grassland areas of the closure works area.

(a) *in the case of a threatened species, whether the action proposed 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,*

This species has only once been recorded within the closure works area, despite numerous surveys being conducted and therefore the site unlikely to support an important resident population. The clearance of grassland habitat may impact a small number of birds however it is anticipated that species persistence in the area would continue, owing to the amount of similar habitat retained within the immediate vicinity of the site. Habitat will also be re-established at the site following construction.

Given the cryptic nature of this species it is difficult to assess the likely population size of this species; however it is not expected to occur in high densities. It is not anticipated that the project will have a significant effect on the species as the closure works area is contiguous with similar habitat.

(b) *in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable.

(c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(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*

Not applicable.

(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.

<i>(d) in relation to the habitat of a threatened species, population or ecological community:</i>
<i>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and</i>
Approximately 26 ha of exotic grassland and shrubby grassland will be removed however at least an equivalent amount will be retained adjacent to the closure works area. Further areas of similar habitat also exist in the broader locality.
<i>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</i>
The species is highly mobile and likely to be able to relocate to areas, which will remain unaffected by the works. Vegetation corridors will be maintained around the wetland margins and the proposal is not anticipated to cause any significant fragmentation effects for this species.
<i>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,</i>
The habitat that will be cleared is not anticipated to be of high importance to the species given that the species has not been recorded during the field surveys conducted over the last 5 years. Similar habitats are widespread within the locality of Kooragang island.
<i>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),</i>
The closure works area does not provide habitat that is restricted, rare or considered of critical importance to the species.
<i>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,</i>
There are no recovery plans currently prepared for this species.
<i>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</i>
The majority of the area to be impacted is exotic vegetation. Some small patches of native vegetation will be cleared which constitutes a key threatening process. The areas of native vegetation which require clearing do not provide habitat for the species.
<i>Conclusion</i>
There will be no significant impact to this species, given that large areas of similar exotic grassland habitat will be retained within the vicinity. Furthermore revegetation with native species after completion of the closure works will provide potential habitat for this species in the future.

Eastern Grass Owl (*Tyto longimembris*) Vulnerable TSC Act

This species of owl is 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 rest by day in a 'form' - a trampled platform in a large tussock or other heavy vegetative growth. This species always breeds on the ground and its nests are found in trodden grass, and often accessed by tunnels through vegetation. Breeding season is highly variable and dependent on environmental conditions, but in NSW nesting most typically occurs in autumn or winter (OEH 2015). There are numerous records of this species within the Locality, with the closest record of the species approximately 1 km from the closure works area dated 2013 (Bionet). Habitat within the closure works area may provide some value for hunting and breeding, however the species has not been recorded during field surveys to date.

<i>(a) in the case of a threatened species, whether the action proposed 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,</i>	The Eastern Grass Owl has not been recorded during the site surveys and it is possible that if the species occurs within the closure works area it is only on an intermittent basis. Removal of habitat which is occasionally used for foraging would not affect this species at population level. Breeding has not been recorded within the closure works area and the majority of grassland with the closure works area was not considered dense enough to be optimal breeding habitat for the species. Alternative habitat exists within close proximity to the Closure works and it is likely that the loss of a small area of foraging habitat would not cause and local extinction of the species.
<i>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,</i>	Not applicable.
<i>(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</i>	<i>(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</i>
Not applicable.	<i>(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,</i>
Not applicable.	<i>(d) in relation to the habitat of a threatened species, population or ecological community:</i> <i>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and</i>
Approximately 26 ha of exotic grassland will be removed. The majority of this habitat is composed of short sparse exotic grassland, which is likely to compromise sub-optimal foraging habitat. Within the 26 ha area, patches of habitat with dense tussocks of exotic grasses occur, which occupy an area of less than 5 ha. These areas are likely to provide more optimal foraging habitat and potential sub-optimal breeding habitat	<i>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</i>
The species is highly mobile and likely to be able to relocate to areas which will remain unaffected by the works. Vegetation corridors will be maintained around the wetland margins and the proposal is not anticipated to cause any significant fragmentation effects for this species.	<i>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,</i>
The habitat that will be cleared is not anticipated to be of high importance to the species given that the species has not been recorded during the field surveys conducted over the last 5 years. Similar habitats are widespread within the locality of Kooragang island.	<i>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),</i>
The closure works area does not provide habitat which is restricted, rare or considered of critical importance to the species.	

(f) *whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*

There are no recovery plans currently prepared for this species, however 'Saving our Species' (OEH, 2015) identifies an action toolbox which aims to 'Encourage landholders to enter into land management agreements that promote the protection and maintenance of tall grass and grassy tussocks in swamps, heath and sedges'. Despite the closure works removing vegetation, the majority is comprised of exotic grasses. Once closure works are completed the area will be revegetated using native species. In the longer term this is likely to provide some foraging habitat potential for the species.

(g) *whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

The majority of the area to be impacted is exotic vegetation. Some small patches of native vegetation will be cleared which constitutes a key threatening process. The areas of native vegetation which require clearing do not provide habitat for the species.

Conclusion

There will be no significant impact to this species, given that large areas of similar exotic grassland habitat will be retained within the vicinity. Furthermore revegetation with native species after completion of the closure works will provide potential habitat for this species in the future.

Horned Pondweed (*Zannichellia palustris*) Vulnerable TSC Act

The species is a submerged aquatic plant, and known only from the lower Hunter within NSW. It grows in fresh or slightly saline stationary or slowly flowing water. NSW populations behave as annuals, dying back completely every summer. This species has been recorded recently within Deep Pond and it can be considered to occur throughout the wetland. It is also possible that the species will occur in other wetland areas during optimal conditions as the species can disperse widely during flood events.

(a) *in the case of a threatened species, whether the action proposed 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 closure works will not have direct effect on the wetland areas and indirect effects such as changes to hydrology and water quality are likely to be negligible. It is anticipated that there will be no changes to this species prevalence as a result of the proposal, and there is no risk of extinction of the local population as a result of this proposal.

(b) *in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable.

(c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(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*

Not applicable.

(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.

<i>(d) in relation to the habitat of a threatened species, population or ecological community:</i>
<i>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and</i>
No habitat for this species will be removed. The changes to water quality and hydrology will be negligible and will not impact this species.
<i>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</i>
The proposal will not change the connectivity or linkages between existing wetland habitat.
<i>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,</i>
The habitat that will be cleared and modified is entirely terrestrial and therefore there will be no impact on this species.
<i>(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),</i>
Impacts will largely be restricted to terrestrial habitats which do not provide important habitat for the species.
<i>(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,</i>
There are no recovery plans currently prepared for this species.
<i>(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</i>
The proposal does not contribute to any key threatening process which is relevant to this species.
<i>Conclusion</i>
There will be no significant impact to this species, given that the wetland habitat in which it exists will not be directly impacted. Any indirect impacts are considered negligible and will not affect the species.

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, Endangered Ecological Community, TSC Act.

Areas of freshwater wetland exist within KIWEF. These are all outside of the proposed capping area however Deep Pond occurs along the western edges of the proposed capping area. The name Deep Pond is somewhat of a misnomer, with areas of shallow water extending considerable distances from the banks, especially in the north and south of the pond. Wetland areas also exist within K6 Cells 9-12, to the north of the capping area. These include a series of semi-permeant to permeant ponds with large areas of marginal wetland vegetation.

<i>(a) in the case of a threatened species, whether the action proposed 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,</i>
Not applicable.
<i>(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,</i>
Not applicable.

(c) <i>in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</i>
(i) <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</i>
The extent of the EEC will not be altered by the proposal. No clearance or modifications to the community are required.
(ii) <i>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,</i>
This community is outside of the proposed closure works area and will not be directly impacted; however some indirect changes to hydrology are anticipated. In summary greater surface run-off will occur due to the reduced permeability of the capping layer. This will result in greater runoff into wetland areas including Deep Pond. The run-off will travel through a series of sediment controls which will be designed to ensure this water has a low sediment load, especially once revegetation is complete. The corresponding reduction in ground water flowing through the landfill will reduce the amount of contaminants reaching wetlands and Deep Pond. These impacts are considered of net benefit to the Wetlands and threatened species, however given the large dilution factors and other complicating external factors such as precipitation and evaporation, the effects are likely to be undetectable. No significant changes to the EEC are likely to occur as a result of the proposal.
(d) <i>in relation to the habitat of a threatened species, population or ecological community:</i>
(i) <i>the extent to which habitat is likely to be removed or modified as a result of the action proposed, and</i>
The EEC will not be directly removed or modified as a result of the proposal.
(ii) <i>whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</i>
The proposal will not change the connectivity or linkages between existing wetland habitat.
(iii) <i>the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,</i>
The habitat that will be cleared and modified is entirely terrestrial will not affect the long-term persistence of the EECs. Appropriate sediment controls and revegetation of the area will reduce sediment input to the EECs and ensure that long-term changes do not occur. .
(e) <i>whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),</i>
No adverse effects to the EEC are anticipated, as a result of the proposal. Sediment controls will reduce sediment input to wetlands. Reduction of ground water input from the landfill areas will reduce the amount of contaminants reaching the Wetland areas
(f) <i>whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,</i>
There are no recovery plans currently prepared for this EEC.
(g) <i>whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</i>
The proposal does not contribute to any key threatening process which is relevant to this EEC.
<i>Conclusion</i>
There will be no significant impact to this EEC, given that it will not be cleared or modified by the proposal and indirect impacts are considered negligible.

Annex E

Commonwealth Significant Impact Assessment

This Annex presents the assessments of significance undertaken in accordance with the Significant Impact Guidelines 1.1 (DoE, 2015) for threatened species and ecological communities and migratory species that are known, or have potential to occur, within the Closure Works Area.

RAMSAR WETLAND

Hunter Estuary Wetland – ID No 245

The Ramsar listed Hunter Estuary Wetlands (ID No 24) occurs within close proximity of the closure works area. At its closest point the Hunter Estuary Wetland (Kooragang Component) occurs approximately 260 metres to the north of the northern boundary. The Hunter Estuary Wetlands is comprised of two components, Kooragang and Hunter Wetlands Centre Australia. The Kooragang component of the Hunter Estuary Wetlands (most relevant to this site) is located in the estuary of the Hunter River, approximately 7 km north of Newcastle on the coast of New South Wales. The Kooragang component includes Kooragang Island and Fullerton Cove, two areas that lie in the estuarine section of the Hunter River. Kooragang Island originally consisted of seven islands that were mostly separated by narrow mangrove lined channels. In the 1950s these islands were reclaimed and became "Kooragang Island". Habitat types within the Reserve include mangrove forests dominated by Grey Mangrove, Samphire saltmarsh, Paperbark and Swamp she-oak swamp forests, brackish swamps, mudflats, and sandy beaches.

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

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

areas of the wetland being destroyed or substantially modified

The proposal is limited to a discrete area, which does not include the Ramsar wetland. Therefore no areas of the Ramsar wetland will be destroyed or substantially modified by the proposal.

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

Drainage across the wider KIWEF area surrounding the proposed closure works area is complex and consists of a network of culverts, open drains, levees and constructed ponds, which fill with surface runoff and generally ultimately drain to the Hunter River South Arm. Most rainfall is expected to infiltrate, with drainage from within the closure works area directed mainly to Deep Pond with minimal drainage directed to the east and south and north, in the direction of the Ramsar wetland. Once the closure works are completed, there will be less infiltration of rainwater into the former landfilled areas. This will result in slightly higher runoff, which will drain into the surrounding small ponds and Deep Pond. The water entering the ponds via overland flow is likely to be less saline and have fewer contaminants than water that has percolated through the landfill areas. There is likely to be groundwater connection between the wetland areas adjacent to the closure works area and the Ramsar wetland. However the proposal is unlikely to cause any significant changes to the water quality of the Ramsar wetland due to the large dilution factors and distances involved. If there are any changes the water quality is likely to be improved with less contamination due to less percolation through the landfill area. In conclusion, any changes are not likely to be measurable and extremely negligible.

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

The construction phase of the closure works will include some noise, light and vibration disturbance from machinery, which may affect some species such as birds, within immediate proximity of the closure works. Given that the Ramsar wetland is at least 260 m from any construction disturbance, it is considered that the effect of the proposal will be negligible and would impact a very small portion of the Ramsar wetland, if at all. For example, Stockton Sandspit provides a resting and feeding place for large aggregations of migratory wading birds, despite being within 100 m of Stockton Bridge/B63 Road in an area that has heavy vehicle traffic, especially during peak hour periods.

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

The closure works would reduce the amount of rainfall infiltration within the landfill area. Consequently this will increase the amount of surface flow, which would not come into contact with, and be potentially impacted by the contaminants present within the mixed use landfill. This may result in a positive effect on water quality in the wetlands adjacent to the closure works. It is anticipated that this will not have detectable effect on the Ramsar wetland owing to the distances involved and the large dilution factors, nevertheless any affects are likely to be positive in terms of water quality.

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

The proposed closure works are limited to a discreet area, which does not include the Ramsar wetland, thus limiting the direct spread of any invasive species.

The closure works area and surrounding areas are dominated by weedy species including four weeds listed as noxious in the Newcastle local control area. One species, Pampas Grass is listed as Class 3 with the remaining four species; Bitou Bush, Crofton Weed and Prickly Pear listed as Class 4. Specific controls exist for Pampas Grass and Crofton Weed and they must be prevented from growing within 10 m and 5 m, respectively, of watercourses and property boundaries.

Chytrid fungus (*Batrachochytrium dendrobatidis*) has been recorded within the Kooragang Island area and is considered widespread. It has the potential to impact the threatened Green and Golden Bell Frog and is considered one of the factors contributing to the species decline.

Control measures will be implemented to reduce the spread of pathogens and weed material offsite, which will include hygiene procedures for personnel, machinery and equipment. Given that the invasive weeds and pathogens (Chytrid fungus) are already present within the wider Kooragang area it is unlikely that the proposed works will have any significant impact on the Ramsar wetlands ecological character. In addition the mitigation measures will further minimise the potential for impacts to the Ramsar wetland.

Conclusion

The proposal is restricted to a discreet area and there will be no direct impacts on the Ramsar wetland. Any indirect impacts are not likely to be measurable and are considered negligible.

ENDANGERED SPECIES

Eastern Curlew (*Numenius madagascariensis*) – Endangered and Migratory, EPBC Act

This species typically forages where intertidal mudflats are present and has occasionally been recorded in Deep Pond. It is unlikely that the habitat within the closure works area is important for the species given that it is not intertidal and that few records are present. Any impacts are therefore likely to affect a very low number of individuals. The proposal will not remove habitat for this species as wetlands will not be cleared or modified. The main potential impact to this species is due to construction disturbance related to the closure works. This is a temporary impact and considered negligible given that only a very small number of individuals will be affected. The species may also become habituated to the construction disturbance and therefore still able to utilise the sub-optimal foraging habitat present in Deep Pond.

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

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

It is unlikely that the habitat within the closure works area is important for the species given that it is not intertidal and that the species is only occasionally recorded. Any impacts are therefore likely to affect a very low number of individuals and will not have any affect at a population level.

reduce the area of occupancy of the species,

This species is migratory, occupying a very large range and breeding in the northern hemisphere. Temporary construction disturbance may cause the species to avoid small areas of sub-optimal foraging habitat, however there is other, much larger and more optimal areas of foraging habitat present within the vicinity. The area of occupancy for this species will not be significantly altered.

fragment an existing population into two or more populations,

This species is highly mobile migrating over considerable distance. The proposal will have no fragmentation effects for this species.

adversely affect habitat critical to the survival of a species,

The habitat within Deep Pond provides suboptimal foraging resources, given that it is not intertidal and few individuals have been observed occasionally utilising the habitat. The habitat within and directly adjacent to the closure works area, including Deep Pond, is not considered critical habitat.

disrupt the breeding cycle of a population,

The population of this species breeds in the northern hemisphere and therefore will not be affected by the proposal.

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

The wetland areas will not be cleared or directly modified as a result of the closure works. Indirect hydrological changes are likely to negligible to the species and possibly positive due to the reduction of contaminated groundwater flowing into the wetland areas.

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

Weed and pest management measures will be undertaken to avoid the introduction of invasive species. In consideration of the implementation of these measures, it is unlikely that the Project would result in the establishment of invasive species in potential habitat for the Eastern Curlew.

introduce disease that may cause the species to decline, or

The proposal is not expected to introduce any diseases that may cause the species to decline. All Vehicles will be required to be clean on arrival and pass through a wheel wash on entry and exiting the site and this will limit the potential spread of disease.

interfere with the recovery of the species.

The main potential impact to this species is due to construction disturbance related to the closure works. This is a temporary impact and considered negligible given that only a very small number of individuals will be affected. The species recovery is not likely to be significantly affected by the proposal.

Conclusion

There will be no significant impact to this species, given that the habitat for this species will not be cleared or modified. Any indirect impacts as a result of the proposal are expected to be negligible.

Australasian Bittern (*Botaurus poiciloptilus*) Endangered, EPBC Act and TSC Act)

This species inhabits terrestrial and estuarine wetlands, preferring dense vegetation including sedges, rushes and reeds. It is a cryptic species, occurring at low densities within the Hunter Estuary. Habitat within and adjacent to the closure works area is limited to dense areas of wetland vegetation with Common Reed and Cumbungi. The species has been recorded on four occasions during 2010 by Umwelt at Easement Pond, Railway Pond and K6 Cell 11.

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

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

The proposal is not likely to cause any mortality of the species and given the temporary nature of the construction works and their associated disturbance, no long term impacts are anticipated for the population.

reduce the area of occupancy of the species,

This proposal will not remove habitat for this species as wetlands will not be cleared or modified. The main potential impact to this species is due to visual and noise disturbance related to the closure works. The wetlands adjacent to the works area are small in size and are likely to represent a small proportion of the territory required for individual birds, therefore it is anticipated that any temporary displacement that occurs will not significantly affect the species. The species will be able to forage or breed in alternative habitat within the locality. The species may also become habituated to the construction disturbance and persist in wetland habitats close to the construction works.

fragment an existing population into two or more populations,

The proposal will not remove any habitat suitable for this species and there will be no changes to the connectivity of existing habitats for the species.

adversely affect habitat critical to the survival of a species,

The wetland areas will not be cleared or directly modified as a result of the closure works. Indirect hydrological changes are likely to be negligible to the species and possibly positive due to the reduction of contaminated groundwater flowing into the wetland areas.

disrupt the breeding cycle of a population,

K6 Cell 11. Two individuals were recorded within K6 Cell, which may indicate a single breeding pair occurring, adjacent to the closure works area. Breeding pairs are territorial and occupy a large area, therefore it is unlikely that more than one pair occurs within close proximity. In the worst case scenario the proposed works may cause the pair to avoid areas of potential foraging or breeding habitat, immediately adjacent to the proposed capping area. The wetlands adjacent to the works area are small in size and are likely to represent a small proportion of the territory required for individual birds, therefore it is anticipated that any temporary displacement that occurs will not significantly affect breeding. The species will be able to forage or breed in alternative habitat within the locality. The species may also become habituated to the construction disturbance and persist in wetland habitats close to the construction works.

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

Wetland areas will not be cleared or directly modified as a result of the closure works. Indirect hydrological changes are likely to be negligible to the species and possibly positive due to the reduction of contaminated groundwater flowing into the wetland areas. It is not anticipated that the proposal will cause any decline for the species given that no mortality is anticipated and that habitat important for the species will be retained in its entirety.

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

Weed and pest management measures will be undertaken to avoid the introduction of invasive species. In consideration of the implementation of these measures, it is unlikely that the proposal would result in the establishment of invasive species in potential habitat for the Australasian Bittern.

introduce disease that may cause the species to decline, or

The proposal is not expected to introduce any diseases that may cause the species to decline. All Vehicles will be required to be clean on arrival and pass through a wheel wash on entry and exiting the site and this will limit the potential spread of disease.

interfere with the recovery of the species.

The main potential impact to this species is due to construction disturbance related to the closure works. This is a temporary impact and considered negligible given that only a very small number of individuals will be affected and may become habituated. The species recovery is not likely to be significantly affected by the proposal.

Conclusion

There will be no significant impact to this species, given that the habitat for this species will not be cleared or modified. Any indirect impacts as a result of the proposal are likely to be negligible.

Curlew Sandpiper (*Calidris ferruginea*) Endangered and Migratory, EPBC Act; Critically Endangered, TSC Act.

This species typically forages where intertidal mudflats are present and has occasionally been recorded in Deep Pond. It is unlikely that the habitat within the closure works area is important for the species given that it is not intertidal and that few records are present. Any impacts are therefore likely to affect a very low number of individuals. The proposal will not remove habitat for this species, as wetlands will not be cleared or modified as part of the proposed activity. The main potential impact to this species is due to construction disturbance related to the closure works. This is a temporary impact and considered negligible given that only a very small number of individuals will be affected. The species may also become habituated to the construction disturbance and therefore still able to utilise the sub-optimal foraging habitat present in Deep Pond.

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

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

The construction works will involve heavy machinery and increased numbers of people within the capping area. This will temporarily increase the amount of noise and visual disturbance in area to the east of Deep Pond. As this disturbance is temporary, no long term impacts are anticipated for the population. There are also large areas of alternative habitat within the vicinity.

reduce the area of occupancy of the species,

This species is migratory, occupying a very large range and breeding in the northern hemisphere. Temporary construction disturbance may cause the species to avoid areas of foraging habitat, however, there are other and much larger areas of intertidal foraging habitat present within the vicinity. The area of occupancy for this species will not be significantly altered.

fragment an existing population into two or more populations,

This species is highly mobile migrating over considerable distance. The proposal will have no fragmentation effects for this species.

adversely affect habitat critical to the survival of a species,

The habitat within Deep Pond provides foraging resources for the species however it is not considered critical to the survival of the species given it is used on an intermittent basis and that large areas of more optimal intertidal foraging habitat are present within the Lower Hunter Estuary.

disrupt the breeding cycle of a population,

The population of this species breeds in the northern hemisphere and therefore will not be affected by the proposal.

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

Wetland Areas will not be cleared or directly modified as a result of the closure works. Indirect hydrological changes are likely to negligible to the species and possibly positive due to the reduction of contaminated ground water flowing into the wetland areas.

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

Weed and pest management measures will be undertaken to avoid the introduction of invasive species. In consideration of the implementation of these measures, it is unlikely that the proposal would result in the establishment of invasive species in potential wetland habitat.

introduce disease that may cause the species to decline, or

The proposal is not expected to introduce any diseases that may cause the species to decline. All vehicles will be required to be clean on arrival and pass through a wheel wash on entry and exiting the site and this will limit the potential spread of disease.

interfere with the recovery of the species.

The main potential impact to this species is due to construction disturbance related to the closure works. This is a temporary impact and considered negligible given that large areas of more optimal foraging habitat are present within the vicinity. The species recovery is not likely to be significantly affected by the proposal.

Conclusion

There will be no significant impact to this species, given that the habitat for this species will not be cleared or modified. Any indirect impacts as a result of the proposal are likely to be negligible.

VULNERABLE SPECIES

Green and Golden Bell Frog (*Litoria aurea*) Vulnerable, EPBC Act; Endangered, TSC Act

The Green and Golden Bell Frog, has been recorded both historically and recently within KIWEF with breeding recorded in several ponds within the locality. Collaborative targeted surveys by GHD and RPS HSO recorded the species on multiple occasions including both adults and tadpoles. All of these records were outside of the proposed capping area, however several records were found in close proximity to the capping area. The highest density of records was from K6 Cell 11 with breeding also recorded in this area. Other areas in which the species was recorded includes K6 Cell 10 and 12, Deep Pond, Easement Pond, Cell 34 (Delta Channel) and K7 Ponds as shown in *Figure 6*. Ongoing surveys by the University of Newcastle has confirmed the importance of these areas to GGBF and also recorded adults and juveniles and calling along the southern and eastern shoreline of Deep Pond. Based on these results *Figure 4* identifies areas considered likely to accommodate breeding (or attempted breeding) events.

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

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

The Green and Golden Bell Frog Population within Kooragang Island can be considered an important population and part of the Key Population in the Lower Hunter, for which there is a draft Management Plan (OEH, 2007). The proposal may directly impact a small number of individuals during clearance of terrestrial habitats, however this is not considered sufficient to cause a long term decrease in the population. After closure works are completed the area will be revegetated and therefore there will be no permanent loss of foraging habitat. Breeding habitats will remain largely unaffected by the proposal with impacts limited to negligible and imperceptible indirect impacts to hydrology.

reduce the area of occupancy of an important population,

The closure works will temporarily remove an area of foraging habitat (5.2 ha) for adult Green and Golden Bell Frog. After closure works are completed the area will be revegetated, therefore the loss of habitat is considered a temporary impact. The area impacted represents a small proportion of the total potential foraging habitat available to the population, with optimal foraging habitat surrounding the wetland areas, including the K6 and K7 areas, which will not be impacted by the location of the proposed closure works (refer to *Figure 4*). It is not anticipated that the temporary clearance of foraging habitat will significantly reduce the occupancy area for the species.

fragment an existing important population into two or more populations,

This capping area does not provide an important linkage to other areas of habitat for the species. The majority of the capping area is open exotic grassland with a paucity of shelter which would leave individuals open to predation and desiccation. Railways, associated embankments and roads to the south of KIWEF currently limit dispersal options within the area. Wetland areas and associated marginal vegetation to the east, north and east of the proposed closure works will not be affected and provide movement corridors for the species. No fragmentation of population is anticipated.

adversely affect habitat critical to the survival of a species,

habitat within the closure works area is not considered critical habitat for the species. The majority of the area is exotic grassland, which is considered low value, however 5.2 ha of exotic shrubby grassland may provide foraging habitat for adult frogs. This represents a small proportion of the total potential foraging habitat available to the species and therefore is not considered to represent critical habitat. Optimal foraging habitat exists surrounding the wetland areas, including the K6 and K7 areas, which will not be impacted by the closure works. Breeding habitat within the vicinity of the proposed works may be considered critical habitat, however this will not be impacted by the proposal.

disrupt the breeding cycle of an important population,

The key breeding resources for the local population are a series of ponds providing habitat for spawning and tadpole development. The pond margins and associated wetland habitat are likely to provide key habitat for the development of metamorphs. These key areas of habitat will not be impacted by the proposed works as they are outside of the development footprint. Hydrological impacts will also be negligible considering that the capping area drains away from the known breeding areas into areas of lower habitat value such as Deep Pond. It is anticipated that there will be no significant changes to the breeding habitat as a result of this proposal; and the breeding cycle of this species will not be disrupted.

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

The closure works will temporarily remove an area of potential foraging habitat (5.2 ha) for adult Green and Golden Bell Frog. After closure works are completed the area will be revegetated, therefore the loss of habitat is considered a temporary impact. This area impacted represents a small proportion of the total potential foraging habitat available to the species. Larger more optimal foraging habitat surrounding the wetland areas, including the K6 and K7 areas, will be retained. It is likely that the temporary loss of a small proportion of foraging habitat will not cause any decline for the species and frogs will be able to utilise other areas.

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

Weeds are prevalent with the wetlands margins and dominant within areas of terrestrial habitat, including four species of noxious weed. 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 wetland areas, especially Deep Pond which has very high numbers of Eastern Gambusia, an invasive species which predated tadpoles.

introduce disease that may cause the species to decline, or

The proposal is not expected to introduce any diseases that may cause the species to decline. Chytrid fungus has been linked to declines in the Green and Golden Bell Frog, 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. There is evidence to suggest that some salinity within Green and Golden Bell Frog habitat and breeding areas may help to prevent the prevalence 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 Green and Golden Bell Frog through reduced Chytrid fungus protection.

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 latter is likely to be the most significant driver in the species decline, especially the loss of breeding habitat. Breeding habitat will remain unaffected by this proposal and large areas of foraging habitat will be retained. 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 any more prevalent and risking impacting the species recovery.

Conclusion

The closure works have avoided cells in which wetlands are present. This will minimise impacts to the species by retaining important habitat. Key impacts are limited to possible mortality of a small number of individuals during clearance of weedy terrestrial area. There are likely to be no significant impacts to this species or the population of this species.

A.1.4

Migratory Species

Wetland Birds/Shorebirds

Common Sandpiper (<i>Actitis hypoleucos</i>)	Grey-tailed Tattler (<i>Heteroscelus brevipes</i>)
Great Egret (<i>Ardea alba</i>)	Broad-billed Sandpiper (<i>Limicola falcinellus</i>)
Cattle Egret (<i>Ardea ibis</i>)	Bar-tailed Godwit (<i>Limosa lapponica</i>)
Sharp-tailed Sandpiper (<i>Calidris acuminata</i>)	Black-tailed Godwit (<i>Limosa limosa</i>)
Red Knot (<i>Calidris canutus</i>)	Eastern Curlew (<i>Numenius madagascariensis</i>)
Curlew Sandpiper (<i>Calidris ferruginea</i>)	Whimbrel (<i>Numenius phaeopus</i>)
Pectoral Sandpiper (<i>Calidris melanotos</i>)	Ruff (<i>Philomachus pugnax</i>)
Red-necked Stint (<i>Calidris ruficollis</i>)	Pacific Golden Plover (<i>Pluvialis fulva</i>)
Great Knot (<i>Calidris tenuirostris</i>)	Grey Plover (<i>Pluvialis squatarola</i>)
Double-banded Plover (<i>Charadrius bicinctus</i>)	Marsh Sandpiper (<i>Tringa stagnatilis</i>)
Latham's Snipe (<i>Gallinago hardwickii</i>)	

The species listed above have either been recorded, or are considered to have the potential to occur, within or adjacent to the closure works area. These species are typically associated with wetland areas, including the margins and transitional habitats. They are not anticipated to occur in the landfill areas associated with the closure works, which are significantly elevated above the wetlands. For this reason there will be no direct loss of habitat for these migratory species and impacts will be restricted to indirect and temporary impacts.

Indirect impacts associated with the closure works include potential sediment runoff due to the earthworks. This will be reduced to negligible levels through sediment controls.

The construction phase of the closure works will generate noise, light and vibration disturbance from machinery. These impacts are likely to be most acute for Deep Pond while heavy machinery is operated in the K3 area and within K5 Cell 8. The noise impacts of construction works have the potential to disturb migratory birds sufficiently so that some areas of foraging habitat are avoided. This impact is most likely to affect species foraging or roosting on the shoreline in the shallow sediments or those species which utilise the areas of emergent vegetation on the eastern edge of Deep Pond. The construction activities will be temporary occurring over a period of six to eight months, and during this period there will occasions when disturbance is minimal and does not occur adjacent to the wetland areas. Works will occur during daylight hours and therefore will not affect roosting birds significantly. It is difficult to predict the degree of habitat avoidance by migratory birds however it is anticipated that it will mainly affect habitat along the eastern edges of deep pond. It is possible that species may become accustomed to the disturbance and return to the foraging site, whilst construction is continuing. For example, Stockton Sandspit within the Hunter Estuary provides a resting roosting and foraging resource for large aggregations of migratory wading birds, despite being within 100 m of Stockton Bridge/B63 Road, which has heavy vehicle traffic especially during peak hour periods.

Once the closure works are completed, it will result in less infiltration of rainwater into the landfilled area. Previous studies have shown that the water entering the ponds via overland flow is likely to be slightly less saline and have fewer contaminants than water which has percolated through the landfill areas. These changes to the water quality as a result of the proposal are considered positive in the long term with less contaminant reaching the wetlands area. The effects on salinity are likely to be negligible due to the large dilution factors involved.

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

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

Deep Pond, to the west of the proposed closure work area, is considered to contain important habitat for several migratory species as, on occasion, the habitat includes greater than 0.1% of the global population, including; Sharp-tailed Sandpiper (*Calidris acuminata*), Curlew Sandpiper (*Calidris ferruginea*); and Marsh Sandpiper (*Tringa stagnatilis*) (Herbert 2007).

Important habitat will not be substantially modified due to the proposal. Any effects to the hydrology of wetlands will be negligible and potentially improved, due to reduced leaching of contaminants from the landfill areas.

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

The proposed works are unlikely to increase the prevalence or introduce any invasive species to the habitats on which the migratory species relies. All Vehicles will be required to be clean on arrival and pass through a wheel bath on entry and exiting the site and this will limit the potential spread of weeds or pathogens. The terrestrial areas of the site are dominated by exotic weeds, however the proposed works are unlikely to increase the spread into wetland areas.

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

The only migratory species recorded in high number are the Sharp-tailed Sandpiper (*Calidris acuminata*), Curlew Sandpiper (*Calidris ferruginea*); and Marsh Sandpiper (*Tringa stagnatilis*). These species may utilise the Deep Pond shoreline to rest, forage and roost within the site. Construction impact may cause the migratory species to avoid areas of Deep Pond primarily due to the effect of noise disturbance. This is not likely to significantly disrupt the lifecycle of any of the migratory shorebirds. Deep Pond is only likely to provide habitat for large numbers of the migratory birds on an intermittent basis. During periods of high water levels the amount of exposed mud flats are minimal and increased water depth limits the area in which wading species can feed. Migratory birds are likely to be most abundant, within Deep Pond, when water levels are low which would increase the availability of shallow water for wading species and also increase the amount of exposed margins and mud flats. As the habitat is only likely to be periodically available to large numbers of migratory species, it is unlikely that it is relied upon, as it represents an unreliable foraging resource. The mudflat and shorelines of the Hunter Estuary are a much larger and more important foraging resource, with tidal movements exposing foraging habitat on a regular basis.

Conclusion

The proposal will not significantly affect wetland and shorebird migratory species, given that the wetland habitats and margins will not be removed or modified. Impacts will be limited to the temporary disturbance caused by construction activities which may cause some species to avoid wetland habitat adjacent to the construction.

Species Likely To Fly Over And Forage Within The Site

Fork-tailed Swift (*Apus pacificus*) and White-throated Needletail (*Hirundapus caudacutus*)

The Significant Impact Guidelines 1.1 (DoE 2015) requires assessment of impacts to migratory species in terms of important habitat. The Significant Impact Guidelines 1.1 defines important habitat for a migratory species as:

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

The White-throated Needletail and Fork-tailed Swift have generalist habitat requirements, occurring in a range of landscapes including disturbed areas. Both are aerial species, foraging for insects on the wing and rarely alighting whilst in Australia. The entire site has the potential to provide foraging resources given that it supports flying insects, however neither species has been recorded. As the species have generalist habitat requirements and a very wide range, habitat within the Site is not of critical importance to the species and it is never likely to contain high proportions of the species at any time.

The Ecology Study Area is not at the edge of the range of these species, and there is no evidence to suggest these species are declining in this region.

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

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

The Site does not contain important habitat for these species. Impacts to the terrestrial habitat will be temporary as it will be revegetated after closure works are completed.

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

The habitat is not considered important for the species. The terrestrial habitat is currently highly disturbed with exotic weeds dominating the vegetation. The proposed works are not likely to increase the prevalence of these weeds and all Vehicles will be required to be clean on arrival and pass through a wheel bath on entry and exiting the site and this will limit the potential spread of weeds..

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

Ecologically significant proportions of either species are not likely to occur within the site, given that they are typically dispersed over very large areas of mainland Australia.

Conclusion

These species are wide-ranging and have generalist habitat requirements. The Site is not considered to provide important habitat for these species or contain a significant proportion of the population of the species. Any impact to the species are considered temporary and negligible.

Species Likely To Fly Over And Forage Within The Site

The Eastern Osprey (*Pandion cristatus*) and the Little Tern (*Sterna albifrons*)

The Significant Impact Guidelines 1.1 (DoE 2015) requires assessment of impacts to migratory species in terms of important habitat. The Significant Impact Guidelines 1.1 defines important habitat for a migratory species as:

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

The Eastern Osprey (*Pandion haliaetus*) favours coastal areas, especially the mouths of large rivers, lagoons and lakes. The species feeds on fish over clear open water. The habitat surrounding the Site offers large areas of foraging habitat for the species and the species has been recorded flying over the site. There is potential that Deep Pond offers some potential foraging habitat for the species, however off-site wetlands and estuarine habitats in the Lower Hunter and coastal areas are considered more optimal and are of a much larger area than Deep Pond. There is an absence of tall structures within the Site which would provide potential nesting resources for the species and therefore breeding is unlikely to occur on site. The habitat within the Site is not considered important for the species; and the species have not been observed foraging within the Site. Given that only one bird has been observed flying over the site despite extensive fieldwork it is not considered that a high percentage of the population will occur within the site. The species is not at the limit of its range and can be considered cosmopolitan across the east coast.

The Little Tern has been recorded adjacent to the Site in 2007, and the species is frequently recorded in the lower Hunter Estuary. The species has the potential to intermittently fly over the Site and may occasionally forage within the Site, although the habitat is considered sub-optimal. The species has not been recorded, or is expected to occur in large number within the site. The species prefers to roost on sand dunes and the sandy beaches and are therefore unlikely to roost on the Site. The habitat within the Site is not considered important habitat for the Little Tern.

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

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

The Site does not contain important habitat for these species. There will be no direct impacts, including modification or loss of the potential foraging habitat within the Site. Any impacts to the species are likely to be limited to construction disturbance associated with the terrestrial closure works.

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

The habitat is not considered important to either species, with Deep Pond, consisting of sub-optimal foraging habitat. The proposal is not anticipated to introduce or increase the prevalence of invasive species.

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

Ecologically significant proportions of either species are not likely to occur within the site, given that only few individuals have been recorded despite significant survey effort in and around the Site.

Conclusion

Any impact to these species is considered temporary and negligible. Impacts are limited to construction disturbance in areas adjacent to areas of potential foraging habitat. A significant proportion of a local population will not be affected by the proposal.

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