

Ecological Impact Assessment

Proposed Port Kembla Bulk Liquids Terminal

TQ Reference: PJ-PK-0001-REPT-017

82015103-001/Report 002 Ver 5

Prepared for
TQ Holdings Australia Pty Ltd

4 December 2015



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Executive Summary

This ecology assessment has been undertaken on behalf of TQ Holdings Australia Pty Ltd (TQ) to determine the potential ecological impacts of the proposed Port Kembla Bulk Liquids Terminal at Lot 2 DP1125445, Lot 301 DP1148391 and Lot 11 DP1182111 in Port Kembla (the 'subject site'). The subject site is located approximately 3 km south of the Wollongong Central Business District, in the Wollongong Local Government Area (LGA).

Following a likelihood of occurrence analysis (**Appendix A**) and field assessment (see **Section 3.2**), the Green and Golden Bell Frog (*Litoria aurea*) was the only species identified to have either 'high' or 'moderate' potential to use the subject site.

A field survey of the study area undertaken on 20 May 2015 identified the site was mostly devoid of vegetation with only scattered plant species which were mostly exotic. Available faunal habitat on the site was also found to most likely be utilised by common native and exotic fauna.

A small Grey Mangrove (*Avicennia marina*) was observed within the Gurungaty waterway adjacent to the existing earthworks at Site 3. However, the proposed development at Site 3 is unlikely to have a direct impact on the Grey Mangrove observed at this site.

Mitigation measures for the project have been developed as part of this assessment to ensure the protection of Green and Golden Bell frogs and the adjacent waterways.

A Commonwealth Significant Impact Assessment found that there will be no significant impacts to Green and Golden Bell Frog from the proposal, and a Referral to the Commonwealth Government is therefore not required.

In accordance with the Secretary's Environmental Assessment Requirements (SEARs) an assessment in accordance with the Framework for Biodiversity Assessment (FBA) is in the process of being undertaken. In addition to this the SEARs have nominated Green and Golden Bell Frog as an Impact for Further Consideration (IFC) in accordance with Section 9.2 of the FBA. Consultation with the NSW Office of Environment and Heritage has specified that due to the listing of an IFC within the project, there is a requirement for an 'expert report' to determine the size of the impact on breeding, foraging and shelter habitat of the Green and Golden Bell Frog in accordance with Section 9.2.5 of the FBA. **Appendix D** of this document includes the expert report which has been issued to NSW Office of Environment and Heritage. This expert report identified that the proposal is unlikely to:

- > cause the extinction of a species or population from an IBRA (Interim Biogeographic Regionalisation for Australia) subregion (i.e. the Illawarra), or
- > significantly reduce the viability of a Green and Golden Bell Frog population.

As such the expert report recommends that Green and Golden Bell frogs be removed from the SEARs as an IFC.

The expert report also defines a 'species polygon' for Green and Golden Bell Frog for the purposes of quantifying impacts from the proposal under the greater FBA. The species polygon is 0.09 ha in area, and preliminary calculations utilising the Major Projects module of the Biobanking Credit Calculator have identified that 1 species credit will need to be obtained to meet the offset obligations of the FBA. Following confirmation from OEH that the Green and Golden Bell Frog has been eliminated as an IFC, an assessment of the impacts will proceed following the FBA and the preparation of a Biodiversity Assessment Report in accordance with the FBA will be necessary for this proposal. This process will be undertaken in parallel to the State Significant Development Approval.

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1 Introduction

1.1 Purpose of Report & Legislative Context

This Ecology Impact Assessment has been undertaken on behalf of TQ Holdings Australia Pty Ltd (TQ) to determine the potential ecological impacts of the proposed Port Kembla Bulk Liquids Terminal at Lot 2 DP1125445, Lot 301 DP1148391 and Lot 11 DP1182111 in Port Kembla. This assessment has been developed in accordance with the Secretary's Environmental Assessment Requirements (SEARs) as detailed in **Table 1-2** and in consideration of the legislative requirements outlined in **Table 1-1**.

Table 1-1 Legislative Framework & Guidelines Relevant to this Proposal

Instrument	Considerations	Context
Commonwealth		
<i>Environment Protection and Biodiversity Conservation (EPBC) Act 1999</i>	Matters of National Environmental Significance	An action will require approval from the Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance.
New South Wales		
<i>State Environmental Planning Policy (Three Ports) 2013</i>	Clause 29	Guides the preservation to the amenity of the area, including biodiversity values, through the preservation of trees and other vegetation.
<i>Threatened Species Conservation (TSC) Act 1995</i>	Schedules 1, 1A, 2 and 3	Lists threatened species, populations, ecological communities and key threatening processes to be considered under Section 5A EP&A Act.
<i>Fisheries Management Act (FM Act) 1994</i>	Schedules 4, 4A, 5 and 6	Lists threatened species, populations, ecological communities and key threatening processes.

To address the potential impacts on threatened species, populations and/or ecological communities listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act), the Secretary's Environmental Assessment Requirements (SEARs) (SSD-7264) require an assessment is undertaken in accordance with the *Framework for Biodiversity Assessment* (OEH 2014), as detailed in **Table 1-2**.

Table 1-2 Secretary's Environmental Assessment Requirements (SEARs)

Secretary's Environmental Assessment Requirement
General Requirements
Biodiversity – including: > an assessment of the potential impacts on critical habitats, threatened species (including <i>Litoria aurea</i>), populations or ecological communities and their habitats in accordance with the <i>Framework for Biodiversity Assessment</i> or relevant Office of Environment Guidelines;

1.2 Site Description

1.2.1 Study Area

The Study Area is defined as the development footprint and any additional areas that are likely to be affected by the proposal, either directly or indirectly, following DEC and DPI (2005). The study area should extend as far as is necessary to take all potential direct and indirect impacts into account.

The study area consists of three parcels of land and a berth as identified in **Figure 1-1** and includes:

- > Site 1 – Combustible and flammable bulk liquids storage and pump bay
- > Site 2 – Combustible and flammable bulk liquids and truck loading facilities
- > Site 3 – Site control room & office block, maintenance work shop and utilities
- > Berth 104 – Bulk liquids unloading (and potential loading) facilities.

The study area is highly modified and consists largely of cleared industrial land. All sites are almost completely devoid of native vegetation, with the few plants present consisting mostly of introduced pasture grasses and weeds. Site 3 also contains a large onsite stormwater detention (OSD) basin consisting of mostly introduced grasses and weeds. A smaller OSD is also present at the northern extremity of Site 1. The topography of the study area is relatively flat with a slight slope towards the adjacent waterways.

1.2.2 Locality

The TQ site is located within the Port Kembla Port precinct approximately 70 km south of Sydney and 3 km from the Wollongong City Centre in the Wollongong Local Government Area (LGA) (**Figure 1-2**). The port is connected to Wollongong via the arterial road Spring Hill Road and to Sydney via the Princes Motorway. The Port is located on a highly modified estuary at the mouth of Allan's Creek and Gurungaty Waterway, draining east to the Tasman Sea. Port Kembla consists of a number of industrial land uses with various berths for the loading and unloading of cargo ships.

The locality (within 5km of the study area) consists of predominantly cleared and/or disturbed lands largely due to industrial, commercial and residential development. The remnant Tom Thumb Lagoon is located to the north of the study area which is connected to the Gurungaty Waterway. Native vegetation mapping undertaken by National Parks and Wildlife Service (NPWS, 2002) identified that within 5 km of the site only 3.51% of the area contained native vegetation with 2.8% being highly disturbed, 0.7% being moderately disturbed and 0.01% experiencing low disturbance (**Figure 1-3**).

1.3 Proposed Development

TQ proposes to construct and operate a bulk liquids terminal with capacity of up to 288 ML of storage for combustible and flammable liquids on land situated between existing Graincorp and Port Kembla Coal Terminal operations in the Inner Harbour area of Port Kembla. The proposed development will occur on land zoned SP1 – Special Activities under *State Environmental Planning Policy (Three Ports) 2013*.



Legend

- Project Site (7.22 ha)
- Cadastre (LPI, 2015)



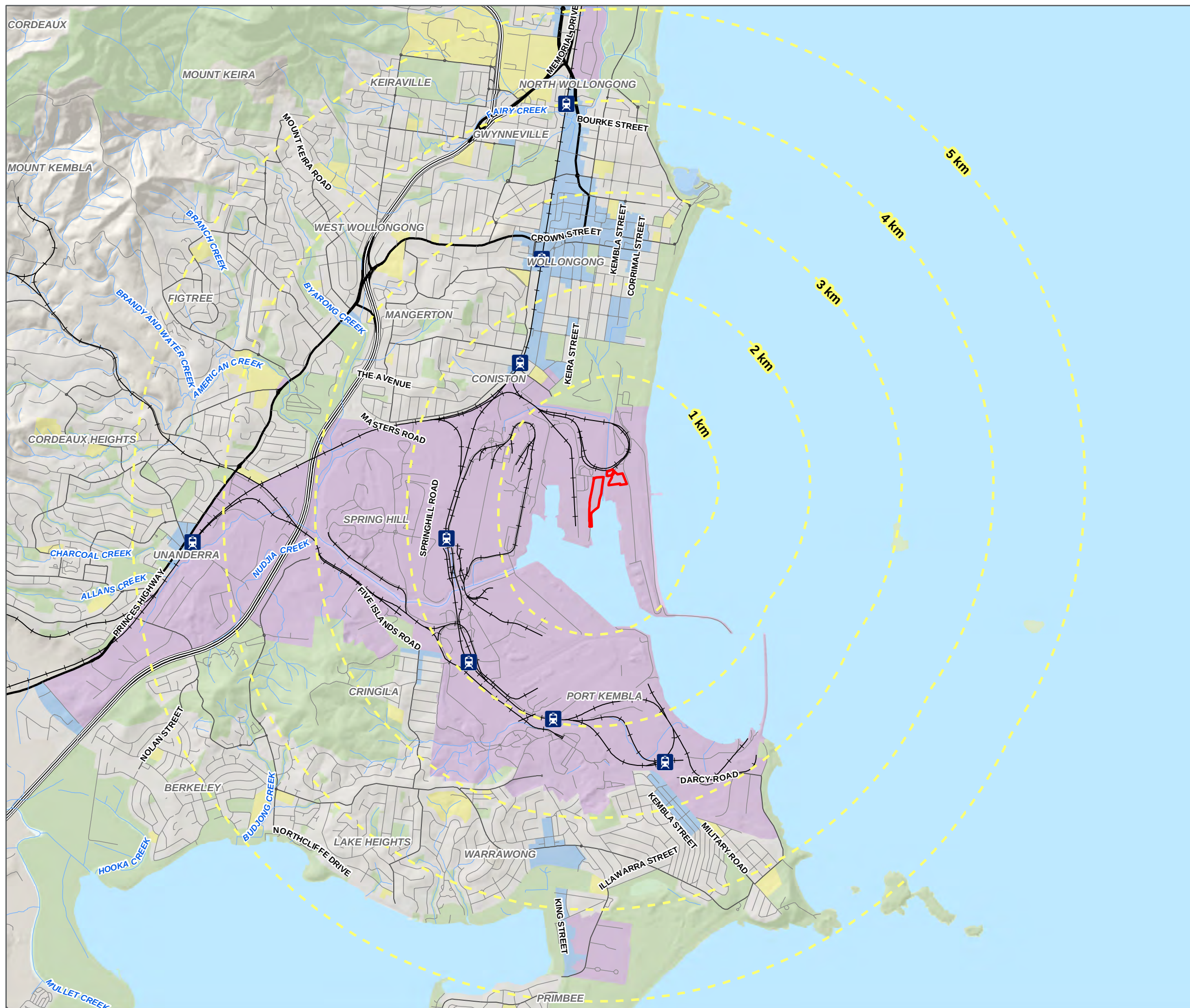
FIGURE 1-1
1:2,500 Scale at A3

Metres
0 25 50 75 100

Site Plan Ecology
PORT KEMBLA



Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2015-10-26
Coordinate System: GDA 1994 MGA Zone 56
Project: 82015103-01
Map: 82015103-GS-003-SitePlan_Ecology.mxd 06
Aerial imagery supplied by nearmap (January, 2015)



Location Plan Ecology

PORT KEMBLA

Legend

- Project Site
- Railway Stations
- Railway
- Watercourses
- Motorway
- Primary Road
- Distributor Road
- Local Road

Land Use (ABS, 2011)

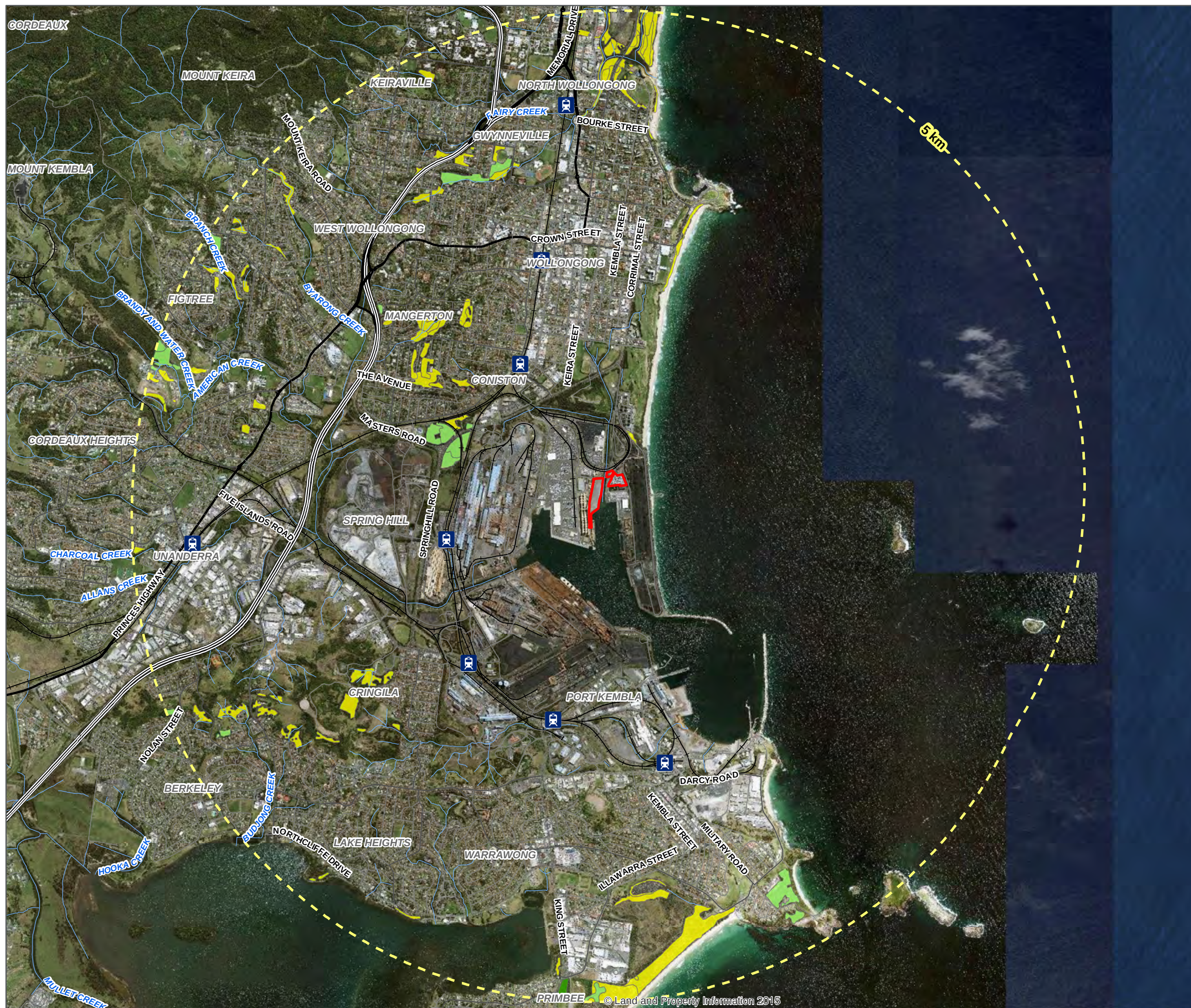
- Commercial
- Education
- Industrial
- Parkland
- Residential
- Water

FIGURE 1-2

1:40,000 Scale at A3



Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
 Date: 2015-10-26
 Coordinate System: GDA 1994 MGA Zone 56
 Project: 82015103
 Map: 82015103-GS-004-LocationPlan_Ecology.mxd 04
 All base data supplied by LPI unless otherwise stated.



Native Vegetation Condition Plan

PORT KEMBLA

Legend

- Project Site
- Railway Stations
- Motorway
- Primary Road
- Distributor Road
- Local Road
- Railway
- Watercourses

Native Vegetation Condition (NPWS, 2002)

- Low Disturbance
- Moderate Disturbance
- High Disturbance

FIGURE 1-3

1:40,000 Scale at A3



Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2015-10-26

Coordinate System: GDA 1994 MGA Zone 56

Project: 82015103-01

Map: 82015103-GS-005-NativeVegetationPlan_Ecology.mxd 04

Aerial image and all base data supplied by LPI unless otherwise stated.

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2 Methods

2.1 Literature & Database Review

A site specific literature and database review was completed prior to undertaking field survey and the preparation of this report. This included desktop analysis of aerial photography and regional scale mapping resources from the following sources:

- > NSW Planning Viewer (NSW Dept. of Planning and Environment [DPE], 2015)
- > BioNet Atlas of NSW Wildlife (NSW Office of Environment and Heritage [OEH], 2015)
- > Protected Matters Search Tool (Commonwealth Dept. of the Environment [DoE], 2015)
- > Native vegetation of the Illawarra Escarpment and Coastal Floodplain (NPWS, 2002)
- > Soil landscapes of the Wollongong-Port Hacking 1:100 000 map sheet (Hazelton and Tille, 1990)
- > SIX Maps (NSW Land and Property Information [LPI], 2015).

Previous reports relevant to the study area include:

- > Biosis (2010) Preliminary Flora and Fauna Assessment: Port Kembla Coal Terminal
- > Biosis (2013) Flora and Fauna Assessment for the Port Kembla Inner Harbour Rail Arrival Road Upgrade Prepared for Cardno on behalf of Port Kembla Coal Terminal Upgrade Project
- > Biosphere Environmental Consultants Pty Ltd (2012) Plan of Management, Green and Golden Bell Frog: National Biodiesel Site Port Kembla
- > Biosphere Environmental Consultants Pty Ltd (2015) Green and Golden Bell Frog Survey: National Terminals Port Kembla Bulk Liquids Terminal (see Appendix C)
- > Department of Environment and Conservation (NSW) (2007). Management Plan for the Green and Golden Bell Frog Key Population at Port Kembla. Department of Environment and Conservation (NSW), Sydney
- > Department of Environment and Conservation (NSW) (2008). Best practice guidelines: Green and golden bell frog habitat. Department of Environment and Conservation (NSW), Sydney
- > Gaia Research. 2008. Assessment of habitat, dispersal, corridors and management actions to conserve the Port Kembla key population of Green and Golden Bell Frog. Department of Environment and Climate Change (NSW), Sydney
- > Goldingay, R. & Lewis, B., (1999). Development of a conservation strategy for the Green and golden Bell Frog in the Illawarra Region of NSW. *Australian Zoologist*, 31, pp. 376–87
- > Goldingay, R. & Newell, D.A., (2005). Population estimation of the Green and Golden Bell Frog at Port Kembla." *Australian Zoologist*, 33, pp. 49–59
- > Leonard, G. (2011). Amphibians in exile. *Kurangabaa*, 3(2). Accessed at: <http://kurungabaa.net/2011/09/20/amphibian-exiles-in-wollongong-by-gary-leonard/>
- > Port Kembla Coal Terminal (2011). Green and Golden Bell Frog Management Plan. Prepared for Office of Environment and Heritage (OEH) Pollution Reduction Program (PRP) U4 which was attached to Port Kembla Coal Terminal's Environment Protection Licence (EPL) No. 1625
- > Pyke, G.H. & White, A. W., (1996). Habitat requirements for the Green and Golden Bell Frog *Litoria aurea* (Anura: Hylidae). *Australian Zoologist*, 30(2), pp. 224–32.

Threatened species, populations and migratory species recorded during the literature and database review were consolidated and their likelihood of occurrence was considered by:

- > review of location and date of recent (<5 years) and historical (>5-20 years) records
- > review of available habitat within the study and surrounding areas
- > review of the scientific literature pertaining to each species and population
- > applying expert knowledge of each species.

The potential for each threatened species, population and/or migratory species to occur was then considered and the necessity for targeted field surveys was determined. Following field surveys and review of available habitat within the study area, the potential for species to utilise the site and be affected directly or indirectly by the proposed action were considered as either:

- > “Recent record” = species has been recorded in the study area within the past 5 years
- > “High” = species has previously been recorded in the study area (>5 years ago) or in close proximity (for mobile species), and/or habitat is present that is likely to be utilised by a local population
- > “Moderate” = suitable habitat for a species is present onsite but no evidence of a species detected and relatively high number of recent records (5-20 years) in the locality or species is highly mobile
- > “Low” = suitable habitat for a species is present onsite but limited or highly degraded, no evidence of a species detected and relatively low number of recent records in the locality
- > “Not present” – suitable habitat for the species is not present onsite or adequate survey has determined species does not occur in the study area.

2.2 Field Survey

An initial field survey was undertaken at the study area on 20 May 2015. Weather conditions on the day were mild, with 1.5 mm of rain recorded in the 24 hours prior to the survey (**Table 2-1**). Additional surveys were undertaken targeting Green and Golden Bell Frog on 22 October 2015. Survey followed an extended period of rain in the days preceding the survey and weather on the day was initially warm, but following a southerly bluster in the early afternoon temperatures dropped to ~17°C with consistent heavy rainfall.

Table 2-1 Daily Weather Observation at Port Kembla (3 Km South)

Date	Temp (°C)		Rainfall (MM)	Max Wind	
	Min	Max		Direction	Spd (km/h)
19/05/2015	12.9	19.1	1.5 & *(0)	NNW	24
20/05/2015	12.0	22.1	0.0 & *(1.6)	NNW	26
21/10/2015	19.4	25.4	*(2.2)	NE	9
22/10/2015	17.7	20.8	*(4.8)	SSW	43

*Note: An additional rainfall data set was obtained from the nearest available BOM monitoring station located at Berkeley (Northcliff Drive) as results for October 2015 were not available for reference at Port Kembla at time of reporting. A review of results at both weather stations shows a good correlation of results due to the close proximity of each weather station to each other (approx. 2km).

Source: BOM 2015a and 2015b

2.2.2 Terrestrial Flora and Fauna Habitat Assessment

Vegetation and flora survey

Field survey involved traversing the study area recording native and exotic flora species to validate presence of any native vegetation types, and to determine condition and relative abundance of flora species. Field survey was undertaken to validate the regional vegetation mapping of NPWS (2002). No targeted threatened flora survey was undertaken as there were no threatened flora species or populations considered to have the potential to occur in the study area.

Fauna survey

Fauna survey included incidental sightings and habitat assessment, particularly for amphibian habitat due to the Key Population of Green and Golden Bell Frog known to occur across the Port Kembla area.

Field survey involved undertaking a preliminary diurnal inspection of the subject land parcels accompanied by representatives of the property owner/managers TQ Holdings (David Pincott & Matthew Price), Cardno Senior Environmental Engineer (Alex Larance), Ecoplanning Principal Ecologist (Lucas McKinnon) and Senior Ecologist (Ross Wellington, herpetological expert), NSW Ports representative (Trevor Brown) and Office of Environment & Heritage representatives (Daniel Robson and Calvin Houlison).

The subject site was physically inspected in company and the layout of the proposal identified. A reconnaissance of the adjacent sites where Green and Golden Bell Frog had been recorded previously and areas considered to have the highest potential to operate as habitat were all visited to assess the logistics of Green and Golden Bell Frog accessing, utilising and moving through the site.

Field survey was then undertaken during daylight hours in an attempt to locate any Green and Golden Bell Frog specimens in the minimal shelter habitat available for inspection. A known and accessible reference site was then inspected at South Port Kembla in an attempt to determine Green and Golden Bell Frog activity and hence validate that conditions were suitable for detecting the species and in accordance with species survey guidelines (NPWS 2003; DECC 2009). The subject site was then revisited at dusk and after dark and surveyed using headlamp and call playback at the primary potential habitats identified on the site during diurnal inspection/survey.

2.2.3 Aquatic Flora & Fauna

At each of the three sites, an inspection of the aquatic flora and fauna was conducted on foot along the shoreline. Visible aquatic flora and fauna were recorded and photos were taken using a digital camera. In-water inspection of aquatic flora and fauna was not undertaken.

2.2.4 Survey Limitations

The flora survey did not aim to provide a definitive list of the suite of flora species within the study area, nevertheless, the techniques used in this investigation are considered adequate to gather the data necessary to validate the vegetation communities and condition onsite, and detect any threatened flora with the potential to occur.

Full fauna survey following *Threatened Species Survey and Assessment Guidelines* (OEH 2015) was not undertaken as sufficient detail to determine the likelihood of occurrence of threatened and migratory species was achieved through habitat assessment and literature review.

The fauna survey aimed to determine the extent and quality of the areas that were considered to have potential Green and Golden Bell Frog habitat values. It also set out to identify the subject land and its strategic position with respect to other records of the species and potential interconnecting habitat areas. The methods and survey effort were considered adequate to determine absence at the time of survey given the extent, quality and habitat complexity evident.

A full amphibian survey following the *Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians* (DECC 2009), however, it was conceded that multiple visitations might be undertaken over extended periods and still fail to detect the species but would not completely rule out the occasional presence/occupation at some periodic/occasional frequency. An assumed presence was therefore made and an assessment and determination undertaken accordingly.

3 Results

3.1 Literature & Database Review

3.1.1 Topography, Drainage & Soils

The study area is located within a working port and is located a few metres above sea level. Each of the sites in the study area are highly modified to form flat areas which have a gradual slope towards the nearest waterway. The Gurungaty Waterway runs between the sites and is the main drainage point for the sites. The waterway is subject to tidal influences.

Due to the highly disturbed nature of the environment the soil landscape is classified as disturbed terrain (Hazelton et al, 1990). Due to the proximity of the sites to the port it is expected that the soils would be influenced by tidal flushing and would have a saline influence.

3.1.2 Terrestrial Vegetation Communities

The desktop assessment determined that there were no native vegetation communities mapped within the site.

3.1.3 Terrestrial Threatened Species, Populations & Migratory Species

A search of the relevant databases and literature identified six threatened flora species, 32 threatened fauna species (including one amphibian, one reptile, 24 birds, and six mammals), and eight migratory birds that have been recorded within the locality (a 5 km radius of the study area – see **Figure 3-2**).

The likelihood of occurrence analysis undertaken prior to field assessment identified one threatened species to have a 'high' potential to use the study area and be impacted by the proposed works (refer **Appendix A**). This species is the Green and Golden Bell Frog (*TSC* and *EPBC* Acts).

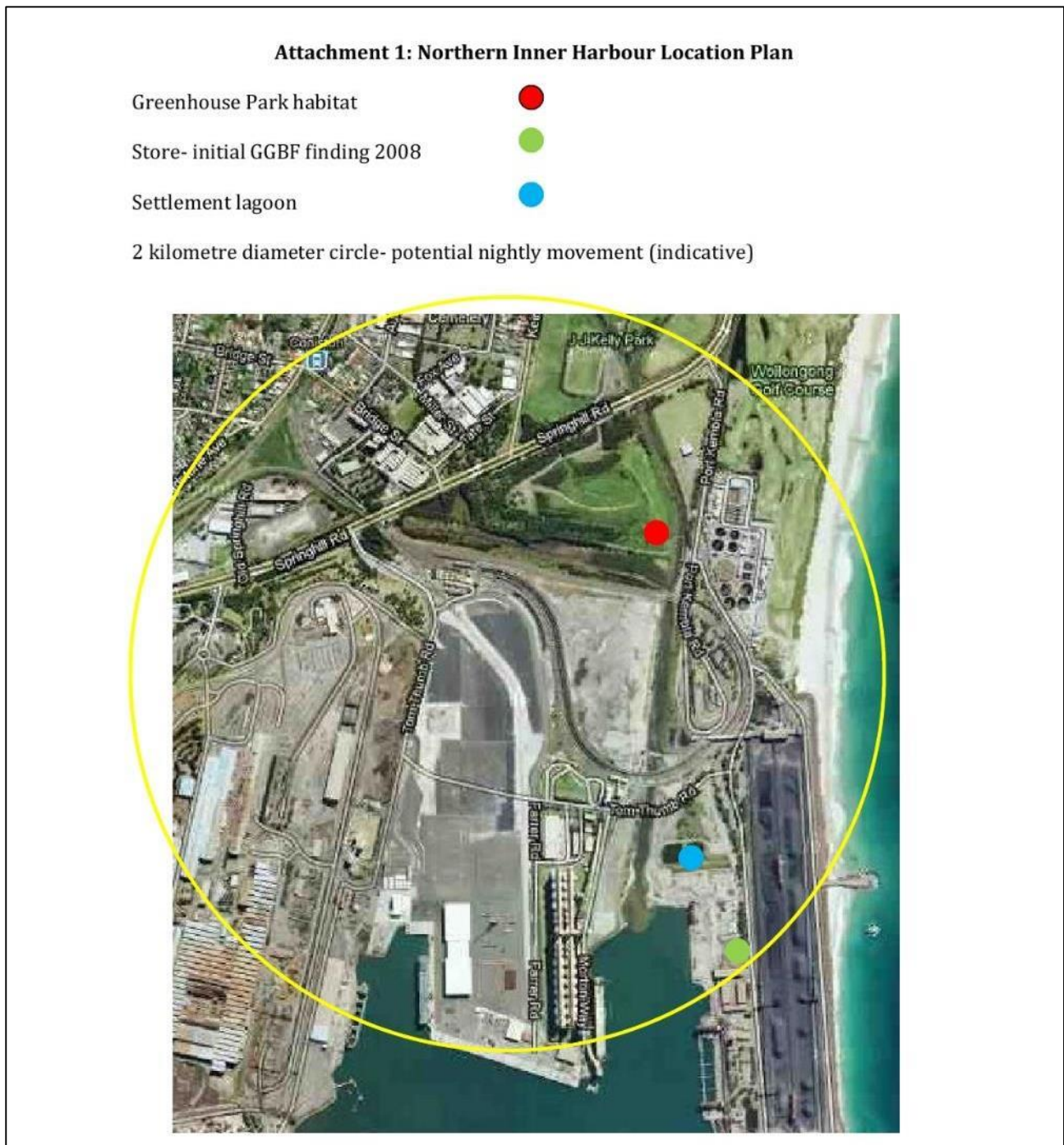
The Recovery Program that culminated in the development of the *Recovery Plan for the Green and Golden Bell Frog* in 2005 identified all the available records for the species across the species entire range, including the Port Kembla area (DEC 2005). Subsequent studies and analysis undertaken during the development of the *Green and Golden Bell Frog Port Kembla Key Population Management Plan* (DEC and DPI (2005)) identified several additional records and refined the understanding of the species local distribution in the locality in 2007 (DECC 2007).

During the implementation of the *Green and Golden Bell Frog Port Kembla Key Population Management Plan* (DEC and DPI (2005)), targeted searches and habitat assessment actioned within the plan were undertaken (Gaia Research 2008; 2009). These studies provided further point locations of occurrence and identified potential connectivity corridors and likely habitat for the species in the Port Kembla area and particularly in the north Port Kembla south Wollongong areas. Since that time a number of development related survey and assessment studies have been undertaken as well as opportunistic observations of the species in this area.

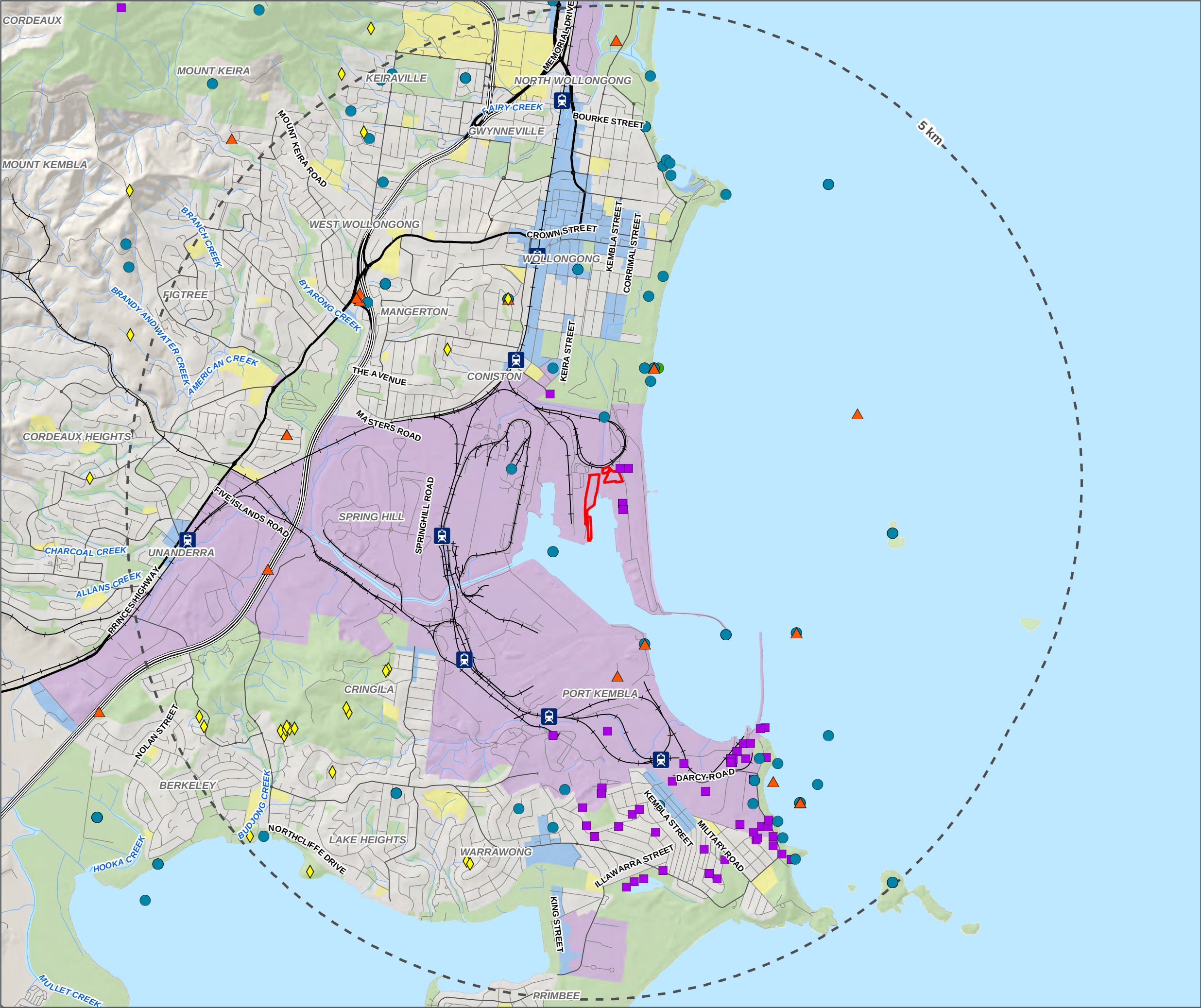
There are four main sub-populations identified of the Green and Golden Bell Frog in the Port Kembla area, with the study area being within the area identified as the North Port Kembla sub-population (DECC 2007). Recent finding of Green and Golden Bell Frogs at the Port Kembla Coal Terminal in 2008 (Gaia Research 2008) can be seen in **Figure 3-1**, and led to the development of a Green and Golden Bell Frog Management Plan (PKCT 2011), which identifies all 3 sites as within the potential nightly movement corridor. The Port Kembla Coal Terminal site is located to the south and east of the study area.

More recently, BEC (2012) developed a site specific Management Plan and undertook targeted survey which recorded five adult Green and Golden Bell Frogs in and near the frog ponds in the "Brick and Blocks Site" at on the southern side of Port Kembla harbour (BEC 2015). Targeted surveys undertaken on 11 March 2015 within the study area as part of this study did not detect this species.

Figure 3-1 Map of Recent Nearby Records of Green and Golden Bell Frog



(Source: Source: Port Kembla Coal Terminal Green and Golden Bell Frog Management Plan, 2011)



Threatened Species Records

PORT KEMBLA

Legend

- Project Site
- Flora (Bionet, 2015)
- Amphibia (Bionet, 2015)
- Aves (Bionet, 2015)
- Mammalia (Bionet, 2015)
- Reptilia (Bionet, 2015)
- Railway Stations

- Railway
- Motorway
- Primary Road
- Distributor Road
- Local Road
- Watercourses

Land Use (ABS, 2011)

- Commercial
- Education
- Industrial
- Parkland
- Residential
- Water

FIGURE 3-2

1:40,000 Scale at A3



3.2 Field Survey

3.2.1 Terrestrial Vegetation and Flora Species

Field survey validated the mapping of NPWS (2002), with no native vegetation communities recorded in the study area. Vegetation was typical of an industrial complex consisting of a number of mown lawns and complimented by some horticultural plantings (**Figure 3-3** and **Figure 3-6**).

Site 1 was almost devoid of vegetation, with only one native species recorded, *Acacia longifolia* (Coast Wattle), which appeared to be highly stressed at the time of survey (**Figure 3-4**). The remainder of the vegetation was predominantly introduced lawn and pasture grass and some self-recruited weed species including, *Cynodon dactylon* (Couch), *Chloris gayana** (Rhodes Grass), *Setaria parviflora** (Slender Pigeon Grass), *Ricinus communis** (Castor Oil Plant) and *Lagunaria patersonii** (Norfolk Island Hibiscus).

Figure 3-3 Desiccated Exotic & Introduced Grass Vegetation at Site 1



Figure 3-4 A Severely Stressed *Acacia longifolia* (Coast Wattle) Individual at Site 1



Site 2 consisted of a mostly cleared storage facility area and included a strip of mown grassed lawn along a breakwall adjoin Berth 104 (**Figure 3-5** and **Figure 3-6**). No native vegetation was recorded in this area with the lawn consisting of predominantly *Pennisetum clandestinum** (Kikuyu) and *C. gayana**, with other species recorded including, *Bidens pilosa** (Cobblers Pegs), *Chrysanthemoides monilifera** (Bitou Bush), *Foeniculum vulgare** (Fennel) and *Nephrolepis cordifolia** (Fishbone Fern). Site 3 comprised a similar species assemblage to Site 2 of introduced lawn grass and self-recruited weed species (**Figure 3-7**).

No individuals or populations of threatened flora species were recorded or expected to occur on the sites within the study area.

Figure 3-5 Mown Lawns & Cleared Storage Area (at Left) at Site 2



Figure 3-6 Breakwall at Site 2, colonised by *Nephrolepis cordifolia (Fishbone Fern) and *Bidens pilosa** (Cobblers Pegs)**



Figure 3-7 Stormwater Detention Basin at Site 3 with Sparse Grassy Groundcover



3.2.2 Terrestrial Fauna & Fauna Habitat

Table 3-1 identifies fauna habitat in the study area which was restricted mainly to open grassy areas (Site 2 and 3; **Figure 3-5**), rocky refuge areas along the breakwall (Site 2; **Figure 3-6**), some refuge areas under rubbish (Site 2; **Figure 3-8**) and two areas of standing water (Site 1 and Site 3; **Figure 3-9**, **Figure 3-10**). Fauna habitat is most likely to be utilised by common native and exotic fauna, with 12 bird and two mammal species recorded as incidental sightings during the survey period (**Table 3-2**).

Table 3-1 Key Fauna Habitat Features of Relevance to Fauna in the Study Area

Habitat features	Fauna Species				
	Microchiropteran bats	Amphibians	Reptiles	Mammals	Birds
Grassland	F	F/M	F/M	F/M	F
Stormwater detention basins	W	B	W	W	W
Rubbish and breakwall	-	F/R	F/R	-	F

Habitat usage: F = foraging; W = watering point; R = refuge/roosting; M = migration; B = breeding;

Table 3-2 Incidental Fauna Observations during Fauna Survey at the Study Area

Family name	Scientific name	Common name	Observation type
Class: Aves			
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron	O
Artamidae	<i>Cracticus torquatus</i>	Grey Butcherbird	OW
Artamidae	<i>Cracticus tibicen</i>	Australian Magpie	O
Charadriidae	<i>Vanellus miles</i>	Masked Lapwing	OW
Columbidae	<i>Columba livia</i>	Rock Dove	O
Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon	O
Corvidae	<i>Corvus coronoides</i>	Australian Raven	OW
Dicruridae	<i>Rhipidura leucophrys</i>	Willy Wagtail	OW
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel	O
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow	O/OH
Turdidae	<i>Turdus merula</i> *	Blackbird	O
Class: Mammalia			
Leporidae	<i>Oryctolagus cuniculus</i> *	European Rabbit	O
	<i>Lepus europaeus</i> *	European Hare	O

* denotes exotic/introduced species; O = Observed; W = Heard; OH = Overhead.

Figure 3-8 Potential Fauna Refuge Habitat for Reptiles and Amphibians



Figure 3-9 Potential Frog Breeding Habitat at Site 3



Figure 3-10 Concrete Water Detention Basin on Site 1, Providing Potential Breeding Habitat for Amphibians and a Watering Point for Birds, Microbats and Mammals



3.2.2.2 Threatened Species Habitat

On the basis of the studies discussed in **Section 3.1.3**, it is apparent that a small Green and Golden Bell Frog population continues to persist on the northern and southern periphery of the Port Kembla industrial area. The northern element appears to be associated with the Gurungaty Waterway and Tom Thumb Lagoon drainage and wetland area, draining south from the Wollongong CBD where sporadic occurrences have been recorded associated with elements of this drainage line within the Wollongong Golf Course and also within remnants of the Tom Thumb Lagoon wetland bordering Springhill Road. Sporadic occurrences have also been observed in the vicinity of Port Kembla Coal Terminal and inner harbour industrial and port facilities triggering rescue 'missions' and management plans to facilitate their survival (Biosphere, 2012; 2015).

The key habitat feature of importance to the Green and Golden Bell Frog in the study area is the standing water at Site 1 and Site 3 (**Figure 3-9** and **Figure 3-10**), as this may provide potential breeding habitat. These water points are immediately adjacent to a potential migration corridor along the rail line immediately north of Site 3 and the Gurungaty Waterway (**Figure 3-11** and **Figure 3-12**).

It is likely that the Green and Golden Bell Frogs are utilising the Gurungaty Waterway as a movement corridor and parts of the remnant Tom Thumb Lagoon wetland, Green House Reserve and possibly the Port Kembla Sewage Treatment works, as well as, periodically, other detention structures in the northern Port Kembla industrial/port facilities as habitat elements (**Figure 3-13**).

Figure 3-11 Rail Corridor, looking north from Site 2. Provides Potential Migration Corridor for Green and Golden Bell Frog



Figure 3-12 Gurungaty Waterway, looking south from Site 3. Temporary frog exclusion fencing can observed being erected along the waterway boundary



Figure 3-13 The Port Kembla Coal Terminal Settlement Ponds to the south of Site 1



3.2.3 Aquatic Flora & Fauna

Site 1: There was no aquatic flora or fauna observed at Site 1.

Site 2: At the northern end of Site 2 just south of the existing road bridge the intertidal area consisted of approximately 7 m of rock armouring associated with the retaining wall. Sydney rock oysters (*Saccostrea glomerata*) and periwinkles (*Bembicium auratum*) were observed to be sparsely distributed on these rocks. A bitou bush (*Chrysanthemoides monilifera*) was observed on the top of the retaining wall at the end of the retaining wall. From Site 2, a small stand of sparsely distributed Grey Mangroves (*Avicennia marina*) was observed on the eastern side of Gurungaty waterway that is likely to have recruited from the established stand of mangroves above the causeway upstream of the site (approximately 34° 26.986"E 150°53.703"S). It is noted that the Draft Wollongong City Floodplain Risk Management Plan proposes to remove this causeway which would enhance connectivity between the established stand of mangroves and the lower reaches of the Waterway (Trevor Brown, NSW Ports, pers comm 2015).

The majority of the intertidal zone at Site 2 extending from approximately 34° 26.955"E 150°53.691"S southward to approximately 34° 27.141"E 150°53.624"S consisted of a retaining wall covered with a geofabric (**Figure 3-14A**). A thin layer of green algae had established within the intertidal zone along the length of the geofabric. Scrape marks were evident on the layer of green algae indicating that it is likely grazed upon by marine fauna. No other flora or fauna species were observed to inhabit the intertidal zone along the length of the geofabric. From approximately 34° 27.141"E 150°53.624"S southward to the southern limit of the survey area approximately 34° 27.260"E 150°53.600"S the intertidal zone consisted of rock armouring associated with the retaining wall. Within the intertidal zone along this section of the retaining wall Sydney rock oysters, periwinkles and barnacles (*Austrominius modestus*) (**Figure 3-14B and C**) were observed. Debris including rope, plastic bottles, Styrofoam, branches and plastic sheeting was also observed in the higher intertidal zone among the armour rocks. Sydney rock oysters and barnacles were

observed inhabiting the intertidal zone of the wharf piles visible from the shoreline (**Figure 3-14D**). A small school of baitfish were observed near a wharf pile.

Site 3: The intertidal zone within Site 3 generally consisted of unconsolidated rock which extended shoreward to the base of the existing earthworks. There was evidence of undercutting and erosion at the base of the existing earthworks (**Figure 3-15A** and **B**). At the southern end of Site 3 an outlet pipe and associated concrete culvert was present. Along the intertidal zone within Site 3 Sydney rock oysters and periwinkles were sparsely distributed. A school of five sea mullet (*Mugil cephalus*) was observed swimming around the southern end of Site 3. A single grey mangrove (*Avicennia marina*) approximately 60 cm in height was observed to have established at the southern end of Site 3 (approximately 34° 26.938"E 150° 53.709"S) (**Figure 3-15C**). A bitou bush was observed abutting the road bridge at the southern end of Site 3 (**Figure 3-15D**).

A plan showing validated vegetation and habitat within the study area is provided in **Figure 3-16**.

Figure 3-14 Geofabric covered retaining wall (a), Sydney rock oyster (*Saccostrea glomerata*) (b), periwinkles (*Bembicium auratum*) and barnacles (*Austrominius modestus*) (c) and Sydney rock oysters and barnacles (d) recorded at Site 2



Figure 3-15 Unconsolidated rock substrata (a), undercutting and erosion of the existing earthworks (b), grey mangrove (*Avicennia marina*) (c) and bitou bush (*Chrysanthemoides monilifera*) (d) recorded at Site 3



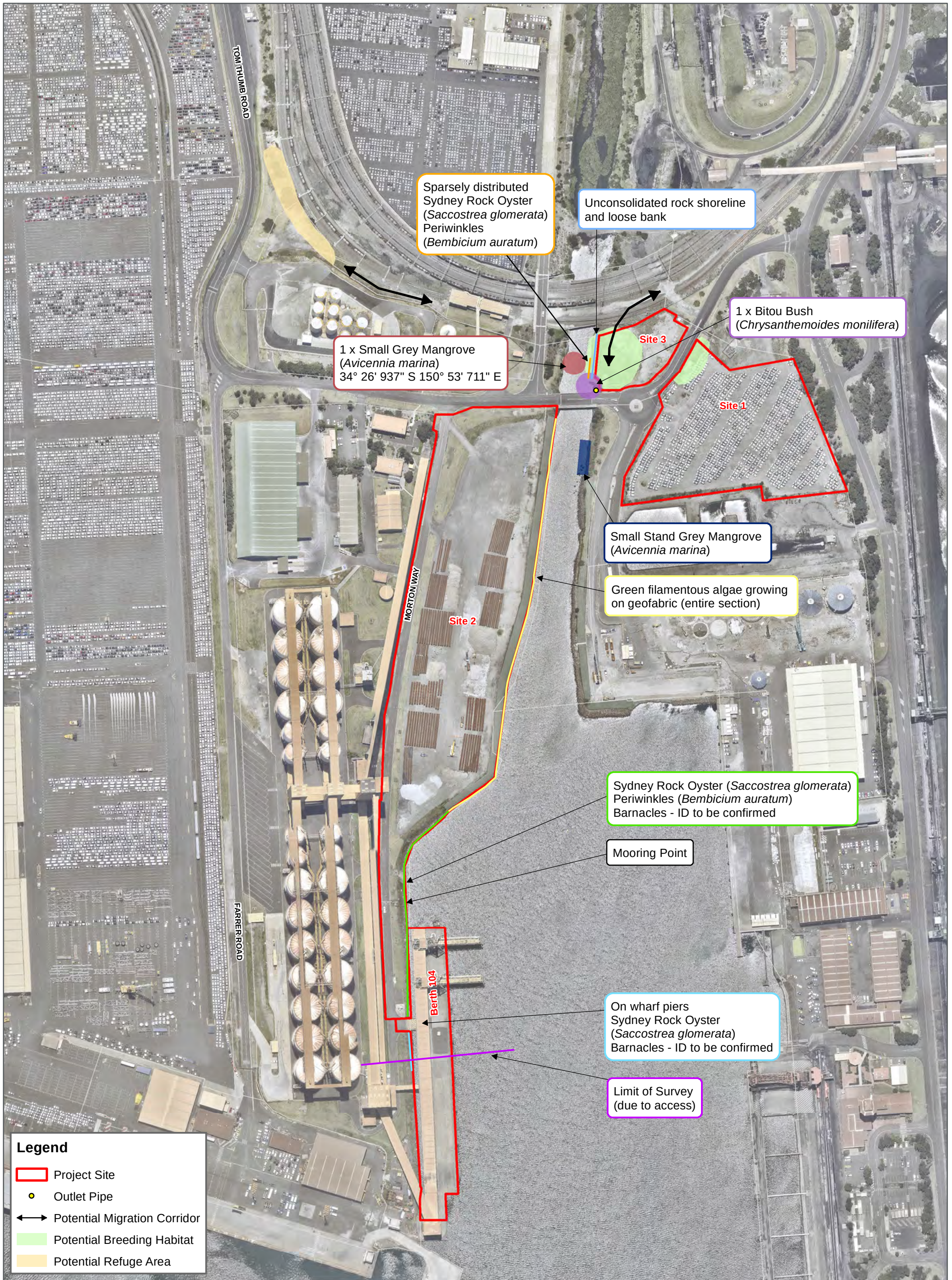


FIGURE 3-16
1:3,000 Scale at A3
Metres
0 25 50 75 100

Validated Vegetation and Habitat Plan

PORT KEMBLA



Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2015-10-26
Coordinate System: GDA 1994 MGA Zone 56
Project: 82015103-01
Map: 82015103-GS-008-ValidatedVegetationandHabitat.mxd 05
Aerial imagery supplied by nearmap (January, 2015)

4 Impact Assessment

4.1 Threatened Species, Populations, Ecological Communities & Migratory Species

4.1.1 Commonwealth and State Listings

4.1.1.1 *Terrestrial Flora & Fauna*

Impacts from the proposal are limited to potential impacts on threatened species habitat of the Green and Golden Bell Frog. This species has not been recorded in the study area although the Green and Golden Bell Frog Management Plans (PKCT 2011; BES 2012) as well as this study have identified potential habitat for this species. There is also potential habitat present in the existing artificial storm water detention area. These areas of potential habitat will be removed or modified as part of the proposed development.

Green and Golden Bell Frog is listed as 'endangered' under the *EPBC Act* and the *TSC Act*. An assessment consistent with the Significant Impact Guidelines 1.1 (DotE 2012) for a matter of National Environmental Significance listed under the *EPBC Act* is included in **Appendix B**. These impact assessments found that there will be no significant impacts to Green and Golden Bell Frog from the proposal, and a Referral to the Commonwealth Government under the *EPBC Act* is not required.

In accordance with the Secretary's Environmental Assessment Requirements (SEARs) an assessment in accordance with the *Framework for Biodiversity Assessment* (FBA) is currently being undertaken to determine biodiversity offset requirements of the project under State legislation. The SEARs have nominated Green and Golden Bell Frog as an Impact for Further Consideration (IFC) in accordance with Section 9.2 of the FBA. Consultation with the NSW Office of Environment and Heritage has specified the requirement for an 'expert report' to determine the size of the impact on breeding, foraging and shelter habitat of the Green and Golden Bell Frog in accordance with Section 9.2.5 of the FBA. An expert report (Ecoplanning, 2015) has been prepared and is provided in **Appendix D**. This report concluded that impacts from the proposal area unlikely to:

- > cause the extinction of a species or population from an IBRA (Interim Biogeographic Regionalisation for Australia) subregion (i.e. the Illawarra), or
- > significantly reduce the viability of a Green and Golden Bell Frog population

As such the expert report recommends that the Green and Golden Bell Frog be removed from the SEARs as an IFC.

The expert report also defines a 'species polygon' for Green and Golden Bell Frog for the purposes of quantifying impacts from the proposal under the greater FBA. The species polygon is 0.09 ha in area, and preliminary calculations utilising the Major Projects module of the Biobanking Credit Calculator have identified that 1 species credit will need to be obtained to meet the offset obligations of the FBA.

4.1.1.2 *Aquatic Flora & Fauna*

Under the *Fisheries Management Act 1994* (FM Act) there is a requirement to protect marine vegetation such as mangroves. A small grey mangrove was observed within Gurungaty waterway adjacent to the existing earthworks at Site 3. The proposed development at Site 3 is unlikely to have a direct impact on the grey mangrove observed at this site. Should construction activities result the need to remove or harm the existing mangrove a permit to harm marine vegetation would be required.

Grey Nurse (*Carcharias taurus*), Scolloped Hammerhead Shark (*Sphyrna lewini*), Southern Bluefin Tuna (*Thunnus maccoyii*), Black Rockcod (*Epinephelus daemeli*), Great Hammerhead Shark (*Sphyrna mokarran*), White Shark (*Carcharodon carcharias*), Dugong (*Dugong dugon*), Humpback Whale (*Megaptera novaeangliae*), Sperm Whale (*Physeter microcephalus*), Australian Fur Seal (*Arctocephalus pusillus*) and Green Turtle (*Chelonia mydas*) are marine fauna that are listed as either critically endangered, endangered or vulnerable by either the FM Act, EPBC Act or TSC Act and could inhabit the marine environment within the vicinity of the current project.

Due to the generally pelagic nature in the distribution and habitat preference of Grey Nurse, Scolloped Hammerhead Shark, Southern Bluefin Tuna, Great Hammerhead Shark, White Shark, Humpback Whale, Sperm Whale and Green Turtle these species are unlikely to be influenced by the Project. Moreover, the distribution and highly specialised dietary requirements of Dugongs suggest that only certain seagrass meadows (which were not observed within the study area) may provide suitable habitat for this species. Given this, and the fact these species are unlikely to be present within the study area it is considered that no further assessment is required for these species.

Black Rockcod is a large reef-dwelling species belonging to the grouper family. Large Black Rockcod are slow moving, territorial and curious. Juvenile black Rockcod inhabit coastal rock pools and around rocky shores in estuaries while adults are usually found in caves, gutters and rocky reefs to depth of in excess of 50 m. This species is slow growing and have a relatively long life span making them susceptible to overfishing. The species historic range likely extended from Queensland to Victoria. Within NSW the number of sites and observed individuals appears to have significantly declined. While it is acknowledged that Black Rockcod may be present within Port Kembla harbour, this species is unlikely to be affected by the proposed construction and operational phase of the proposed works. It is considered that no further assessment is required for this species.

Australian Fur Seal has been recorded within 5 km of Port Kembla. The most recent sighting was documented in 1973 (**Appendix A**). Breeding colonies of Australian Fur Seal are currently restricted to islands in the Bass Strait although historically these colonies were more widespread. Within NSW the Australian Fur Seal is reported to have bred at Seal Rocks near Port Stephens and pups have occasionally been born at Montague Island. This seal species prefers to inhabit rocky parts of islands and forages in oceanic continental shelf waters generally not deeper than 150 m. Given the distribution and habitat preference of the Australian Fur Seal Project construction or operational activities are unlikely to affect this species. It is considered that no further assessment is required for this species.

4.2 Potential Construction & Ongoing Impacts

4.2.1 Impacts during Construction

TQ construction activities may have direct impacts on the local environment. These potential impacts may include:

- > Removal of potential Green and Golden Bell Frog habitat
- > Construction activities directly damaging the mangrove present in the Gurungaty Waterway near Site 3
- > Mobilisation of sediments associated with bank stabilisation works at Site 3 decreasing water quality within Gurungaty waterway and the greater port area
- > Hydrocarbon spills from machinery involved in construction activities could enter the waterway and decrease water quality
- > Wastewater from cleaning construction equipment and plant could enter the waterway and decrease water quality; and
- > Sediment mobilised during on land construction activities could enter the waterway and decrease water quality.

5 Conclusion & Recommendations

5.1 Conclusions & Recommendations

Likelihood of occurrence analysis and field assessments identified the Green and Golden Bell Frog as the only species to have either 'high' or 'moderate' potential to use the subject site. The site was mostly devoid of vegetation with only scattered plant species which were mostly exotic and available faunal habitat on the site is most likely to be utilised by common native and exotic fauna.

A small grey mangrove was observed within the Gurungaty waterway adjacent to the existing earthworks at Site 3. However, the proposed development at Site 3 is unlikely to have a direct impact on the grey mangrove observed at this site.

The following mitigation measures will be included within the project Construction Environment Management Plan (CEMP) to ensure no adverse impacts to the Green and Golden Bell Frog or neighbouring waterways.

A Commonwealth Significant Impact Assessment for this species found that there will be no significant impacts to Green and Golden Bell Frog from the proposal, and a Referral to the Commonwealth is not required. Impacts under State legislation are currently being assessed following the FBA, as required by the SEARs. The expert report (Ecoplanning, 2015) developed in consultation with OEH (**Appendix D**) concludes that Green and Golden Bell Frogs should be removed as an IFC from the SEARS as the proposed development is unlikely to:

- > cause the extinction of a species or population from an IBRA (Interim Biogeographic Regionalisation for Australia) subregion (i.e. the Illawarra), or
- > significantly reduce the viability of a Green and Golden Bell Frog population

In accordance with the FBA, the expert report has defined a species polygon for the purposes of quantifying impacts to Green and Golden Bell Frog which equated to 0.09ha in area. Preliminary calculations utilising the Major Projects module of the Biobanking Credit Calculator have identified that 1 species credit will need to be retired to meet the offset obligations of the FBA for this species polygon. This process will be ongoing and undertaken in parallel to the State Significant Project Approval.

5.1.1 Recommendations for Mitigation of Potential during Construction Impacts

- > A frog-exclusion fence should be put in place along the fence line to the rail corridor and around the southern boundary of Site 1, limiting access for the frogs during this period. This fence should be consistent with the Green and Golden Bell Frog Best Practice Guidelines and the site Plan of Management for this species (BEC 2012). It can be attached to the existing fence lines or the proposed retaining wall and should have a lip to ensure frogs do not jump over it
- > Pre-clearance surveys are recommended consistent with the Management Plan for the site (BES 2012). The following extract is taken from the Management Plan:
 - *“Once the frog-exclusion fences have been erected it is proposed that frog clearance surveys be carried out in Area 6 at night in order to remove any Bell frogs from the site should they be present. If Bell frogs are found in Area 6 (Site 3 in the report) they will be relocated to the nearby northern Sediment Pond and released. The surveys will be carried out by a competent and qualified herpetologist (or ecologist). Only after the area 6 has been surveyed and the site is found to be clear of Bell frogs will construction work be permitted to commence. The herpetologist will issue a letter of clearance at the completion of the surveys. It is recommended that frog clearances be undertaken over two nights when survey conditions are suitable (i.e. when it is not too cold or dry)”*
- > If extended periods occur between erection of the fence and construction work further pre-clearance survey is advised to clear any stranded frogs
- > During construction activities at Site 3 construction contractors should be made aware of the position of the mangrove seedling so as to reduce the potential to cause damage

- > Sediment control devices including silt curtains should be used during bank stabilisation works at Site 3 to prevent runoff causing increased turbidity within Gurungaty waterway and the greater port area
- > Remove and dispose of bitou bushes within the construction area via methods described within the Weeds of national Significance 'Bitou bush Current management and controls options for bitou bush (*Chrysanthemoides monilifera* spp. *rotundata*) in Australia' (Winkler et al., 2008)
- > Appropriate hydrocarbon spill kits should be in the vicinity of construction activities to contain any spills. In the event that the spill kit is unable and hydrocarbons enter the waterway an absorbent boom should be available to be deployed to reduce the spread of any such spill
- > Machinery and equipment associated with construction activities should be cleaned within a designated wash down area that ensures wastewater does not enter the waterway
- > Sediment control devices such as hay bales and geofabrics should be deployed throughout the construction area in the vicinity of storm water drains to reduce mobilised sediments entering the waterway.
- > Follow the measures to be provided in the *Pollution Incident Response Management Plan* developed for the project as part of the *Construction Environment Management Plan* (CEMP)
- > Ensure training and inductions for all personnel include Green and Golden Bell Frog awareness aspects and response requirements. Green and Golden Bell Frog management and response requirements need to be outlined within the *Construction Environment Management Plan* (CEMP).

5.1.2 Impacts during Operation

TQ operational activities may have direct impacts on the local environment. These potential impacts include:

- > Potential summer Green and Golden Bell Frog vagrants moving through the site
- > Green and Golden Bell Frog are known to have utilised bunded areas as breeding habitats, particularly if water is retained within the bunds for extended periods
- > Increased risk of hydrocarbon spills from additional vehicular movements within the TQ Bulk Liquids Terminal site entering the waterway resulting in decreased water quality
- > Increase in the chance gross pollutants being introduced to the waterway via stormwater
- > Wastewater from cleaning construction equipment and plant could enter the waterway and decrease water quality
- > Increased shipping movements within the port could increase the risk of a pollution incident
- > Increased shipping movements within the port could provide a vector for the introduction of harmful aquatic organisms into Australian waters and specifically into Port Kembla.

5.1.3 Recommendations for Mitigation of Potential Impacts during Operation

- > Potential for frog migration through the site is most likely at night-time during the summer months after heavy rain. Staff and contractors should be made aware of the Green and Golden Bell Frog Management Plan prepared by BES (2012), which should be amended to reflect future operational risks and requirements prior to operations commencing
- > Bund and sump management procedures should consider the potential for Green and Golden Bell Frog breeding within bunds
- > The site manager should be made aware of any discoveries and contact an ecologist or the Wollongong Office of Environment and Heritage so that appropriate relocation of the frog/s can be undertaken if necessary

- > Ensure that appropriate hydrocarbon spill kits are placed at various locations throughout the site to contain any spills. In the event that the spill kit is unable to contain a spill and hydrocarbons enter the waterway an absorbent boom should be available to be deployed to reduce the spread of any such spill
- > Gross pollutant traps and hydrocarbon removal should be a priority for stormwater catchments which service areas accessed by tanker trucks
- > Implement a stormwater management plan that incorporates gross pollutant traps prior to waste water discharge. Employee and contractor induction should include a section dealing with the potential for gross pollutants to impact the site
- > Clean machinery and equipment associated with construction activities within a designated wash down area that ensures wastewater does not enter the waterway
- > Follow the measures to be provided in the *Pollution Incident Response Management Plan* developed for the project as part of the *Operation Environment Management Plan* (OEMP)
- > Ensure training and inductions for all personnel include Green and Golden Bell Frog awareness aspects and response requirements. Green and Golden Bell Frog management and response requirements need to be outlined within the OEMP.
- > Ensure that all vessels comply when appropriate with the International Maritime Organisation (IMO) Ballast Water Convention to reduce the potential of harmful aquatic organisms being discharged into Australian waters. The IMO Ballast Water Convention requires that all vessels must have and comply with a 'Ballast Water Management Plan'.

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Proposed Port Kembla Bulk Liquids
Terminal

APPENDIX

A

SPECIES LIKELIHOOD OF
OCCURRENCE

Methods

The potential for each threatened species, population and/or migratory species to occur was considered and the necessity for targeted field surveys was determined. Following field surveys and review of available habitat within the subject site and study area, the potential for species to utilise the site and be affected directly or indirectly by the proposed action were considered as either:

- > “Recent record” = species has been recorded in the study area within the past 5 years
- > “High” = species has previously been recorded in the study area (>5 years ago) or in close proximity (for mobile species), and/or habitat is present that is likely to be utilised by a local population
- > “Moderate” = suitable habitat for a species is present onsite but no evidence of a species detected and relatively high number of recent records (5-20 years) in the locality or species is highly mobile
- > “Low” = suitable habitat for a species is present onsite but limited or highly degraded, no evidence of a species detected and relatively low number of recent records in the locality
- > “Not present” – suitable habitat for the species is not present onsite or adequate survey has determined species does not occur in the study area.

Within the tables below:

- > “E” indicates listing as endangered
- > “P” indicates listing as protected
- > “V” indicates listing as vulnerable
- > “C” represents listing under the China – Australia Migratory Bird Agreement (CAMBA)
- > “J” represents listing under the Japan – Australia Migratory Bird Agreement (JAMBA)
- > “K” represents listing under the Republic of Korea – Australia Migratory Bird Agreement (ROKAMBA)

The species considered are listed in the table below.

Scientific Name	Common Name	Status (NSW TSC Act, 1995)	Status (EPBC Act, 1999)	Distribution	Habitat and Ecology	Number of records	Closest proximity and date	Most recent and proximity	Likelihood of occurrence
KINGDOM: Animalia; CLASS: Amphibia									
<i>Litoria aurea</i>	Green and Golden Bell Frog	E1,P	V	Formerly distributed from the NSW north coast near Brunswick Heads, southwards along the NSW coast to Victoria where it extends into east Gippsland. Records from west to Bathurst, Tumut and the ACT region. Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). There is only one known population on the NSW Southern Tablelands.	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.). Species is active by day and usually breeds in summer when conditions are warm and wet. Males call while floating in water and females produce a raft of eggs that initially float before settling to the bottom.	1311	122m (2009)	2009 (197m)	High
KINGDOM: Animalia; CLASS: Aves									
<i>Stercorarius parasiticus</i>	Arctic Jaeger	P	J,K	Trans-equatorial migrant from the arctic coasts of Eurasia and North America to the southern coastlines of Australia, Europe, South America and Africa.	Predominantly found in coastal regions and habitat but will migrate over land and sea areas.	1	1.8km (1986)	1986 (1.8km)	Not present
<i>Coracina lineata</i>	Barred Cuckoo-shrike	V,P		Coastal eastern Australia from Cape York to the Manning River in NSW. Barred Cuckoo-shrikes are generally uncommon in their range, and are rare in NSW.	Rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses. Usually seen in pairs or small flocks foraging among foliage of trees for insects and fruit. Active birds, frequently moving from tree to tree.	1	4.7km (1998)	1998 (4.7km)	Not present
<i>Thalassarche melanophris</i>	Black-browed Albatross	V,P	V	Individuals are mostly confined to subantarctic and Antarctic waters during the breeding seasons with some individuals recorded on southern mainland Australia and Tasmania in non-breeding periods.	The Black-browed Albatross begins to breed at six to 13 years of age and is capable of surviving to more than 30 years of age. The diet of the Black-browed Albatross primarily consists of a combination of fish, molluscs (mostly cephalopods) and crustaceans (mostly krill). The diet also includes other items such as carrion, jellyfish and salps that are taken less frequently. The Black-browed Albatross commonly forages with other seabirds, and often forages in association with whales, dolphins, seals and penguins.	3	2km (1977)	1998 (3.8km)	Not present
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E1,P		Widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney.	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. Build large nests high in tall trees close to water. Trees usually provide clear observation of the surroundings and are at low elevation (reflecting the floodplain habitat).	2	500m (2010)	2010 (500m)	Not present
<i>Limosa limosa</i>	Black-tailed Godwit	V,P	C,J,K	During the non-breeding period, the Black-tailed Godwit is found in all states and territories of Australia, however, it prefers coastal regions and the largest populations are found on the north coast between Darwin and Weipa. Australian populations of black-tailed Godwit likely breed in far-east Russia.	The Black-tailed Godwit does not breed in Australia. This species feeds in sea-edge flocks, and are often associated with Bar-tailed Godwits, but appear to be quite selective in feeding sites. It has been suggested that they prefer areas with certain bivalves, e.g. Siliqua and Tellina in Roebuck Bay. The greatest threat is indirect and direct habitat loss.	1	800m (1955)	1955 (800m)	Not present
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	V,P	C,J,K	The Broad-billed Sandpiper breeds in the northern hemisphere, moving south for the non-breeding season. The Broad-billed Sandpiper is a regular visitor in small numbers to NSW, in coastal areas, from Ballina, south to Shoalhaven Heads.	It occurs in sheltered parts of the coast, favouring estuarine mudflats but also occasionally occur on saltmarshes, shallow freshwater lagoons, saltworks and sewage farms, and in areas with large soft intertidal mudflats, which may have shell or sandbanks nearby. The Broad-billed Sandpiper is omnivorous, foraging on worms, including polychaetes, molluscs, crustaceans, insects, seeds and occasionally rootlets and other vegetation.	1	2.2km (1955)	1955 (2.2km)	Not present
<i>Egretta sacra</i>	Eastern Reef Egret	P	C	Coastal areas, and rarely nearby freshwater habitats	Feeds on fish and other small aquatic animals, sometimes standing quietly with wings spread to attract fish to the shade and/or reduce glare. Normally solitary, although may congregate where food is plentiful.	2	3.1km (1969)	1969 (3.1km)	Not present
<i>Petroica phoenicea</i>	Flame Robin	V,P		Endemic to south eastern Australia, and ranges from near the Queensland border to south east South Australia and also in Tasmania. In NSW, it breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands.	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The ground layer of the breeding habitat is dominated by native grasses. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgeland at high altitudes. In winter, birds migrate to drier more open habitats in the lowlands and	1	3.8km (1969)	1969 (3.8km)	Not present

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					lives in dry forests, open woodlands and in pastures and native grasslands, with or without scattered trees. Occasionally seen in heathland or other shrublands in coastal areas. Nests are often near the ground and are built in sheltered sites, such as shallow cavities in trees, stumps or banks.				
<i>Ardenna carneipes</i>	Flesh-footed Shearwater	V,P	J,K	The Flesh-footed Shearwater is a locally common visitor to waters of the continental shelf and continental slope off southern Australia (south-western Western Australia to south-eastern Queensland) and around Lord Howe Island.	The Flesh-footed Shearwater mainly occurs in the subtropics over continental shelves and slopes and occasionally inshore waters. Individuals also pass through the tropics and over deeper waters when on migration. The Flesh-footed Shearwater feeds on small fish, cephalopod molluscs (squid, cuttlefish, nautilus and argonauts), crustaceans (barnacles and shrimp), other soft-bodied invertebrates (such as Velella) and offal.	2	1.2km (1985)	1985 (1.2km)	Not present
<i>Stictonetta naevosa</i>	Freckled Duck	V,P		Found primarily in south-eastern and south-western Australia, occurring as a vagrant elsewhere. It breeds in large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system, particularly along the Paroo and Lachlan Rivers, and other rivers within the Riverina. The duck is forced to disperse during extensive inland droughts when wetlands in the Murray River basin provide important habitat. The species may also occur as far as coastal NSW and Victoria during such times.	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move to lakes, reservoirs, farm dams and sewage ponds. Nesting usually occurs between October and December and are usually located in dense vegetation at or near water level.	1	3.7km (2003)	2003 (3.7km)	Not present
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V,P,3		Distributed from southern Victoria through south- and central-eastern NSW. In NSW, the species is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the ACT. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee.	Favouring old growth attributes for nesting and roosting, during summer, it is usually found in tall mountain forests and woodlands (Higgins 1999). In winter, it may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often in urban areas. May also occur in sub-alpine Snow Gum (<i>Eucalyptus pauciflora</i>) woodland and occasionally in temperate rainforests. Tree hollows are required for breeding (Gibbons and Lindenmayer 1997).	8	2.8km (1990)	1999 (2.8km)	Not present
<i>Pterodroma leucoptera leucoptera</i>	Gould's Petrel	V,P	E	The Australian subspecies of the Gould's Petrel breeds in NSW on Cabbage Tree Island and nearby Boondelbah Island, near Port Stephens (Fullagar 1976; Priddel & Carlile 1997, 1997a), and at least one pair on Montague Island. Its distribution at sea is poorly known, it has been suggested that most individuals would occur in the Tasman Sea	Gould's Petrel is a pelagic marine species, spending much of its time foraging at sea and coming ashore only to breed. The Gould's Petrel is thought to first breed at 4–5 years old and have a generation length of 10 years. The diet of the species as a whole includes cephalopods (squid) and fish, such as Lanternfish (<i>Electrona rissoi</i>)	1	1.2km (1985)	1985 (1.2km)	Not present
<i>Thinornis rubricollis</i>	Hooded Plover	E4A,P		The Hooded Plover (eastern) is widely dispersed on or near sandy beaches in south-eastern Australia. Its range extends from about Jervis Bay in New South Wales to the western reaches of the Eyre Peninsula in South Australia, and includes Tasmania and various offshore islands	The Hooded Plover (eastern) occurs in coastal areas, on or near high energy sandy beaches. They are generally found close to shore, but may occasionally visit sites located a short distance inland (e.g. lakes near the coast). The diet of the Hooded Plover (eastern) mainly consists of marine invertebrates (e.g. polychaete worms, molluscs and crustaceans). It also feeds on insects (e.g. beetles, flies, dragonflies) and vegetable material (mostly seeds)	1	1.2km (1986)	1986 (1.2km)	Not present
<i>Puffinus assimilis</i>	Little Shearwater	V,P		Little Shearwaters have been recorded along the east coast of the Australian mainland, from the Queensland-New South Wales border through to south-east South Australia, and also in Tasmania and in waters off Tasmania's southern coast.	Little Shearwater is a marine, pelagic species, occurring in subantarctic, subtropical and occasionally tropical waters. They breed on rocky or forested islands, or on those with tussock grasslands. This species feeds on small fish, squid and crustaceans and often forages in small flocks by 'pattering' across the surface of the water, either hanging in the wind, or executing shallow dives after prey.	2	1.1km (1988)	1988 (1.1km)	Not present
<i>Sternula albifrons</i>	Little Tern	E1,P	C,J,K	The eastern breeding subpopulation of little terns are distributed along the eastern and south-eastern coast of the mainland and northern and eastern Tasmania, occasionally extending as far west as western Victoria and south-eastern South Australia	Little Terns inhabit sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets, especially those with exposed sandbanks or sand-spits, and also on exposed ocean beaches. Little Terns feed mainly on small fish (< 10 cm in length), but also eat crustaceans, insects, annelids and molluscs. Little Terns have a naturally high rate of breeding failure, with ground-nesting making the species vulnerable to a wide range of natural events that contribute to low success, such as loss of eggs and chicks through native predators, flooding of nesting sites (including high tides), and adverse weather conditions.	138	3.5km (1965)	1965 (3.5km)	Not present

Scientific Name	Common Name	Status (NSW TSC Act, 1995)	Status (EPBC Act, 1999)	Distribution	Habitat and Ecology	Number of records	Closest proximity and date	Most recent and proximity	Likelihood of occurrence
<i>Macronectes halli</i>	Northern Giant-Petrel	V,P	V	The Northern Giant Petrel breeds in the sub-Antarctic, and visits areas off the Australian mainland mainly during the winter months (May-October). Immature and some adult birds are commonly seen during this period in offshore and inshore waters from around Frenamtle (WA) to around Sydney (NSW).	The Northern Giant-Petrel becomes reproductively mature at around six years of age. However, most do not commence breeding until they have reached nine to eleven years of age. The Northern Giant-Petrel eats seal, whale, and penguin carrion, and seal placentae. It often attends and follow ships to obtain offal. It also eats substantial quantities of euphausiids (krill) and other crustaceans, cephalopods (octopus and squid), and fish	1	1.1km (2009)	2009 (1.1km)	Not present
<i>Grantiella picta</i>	Painted Honeyeater	V,P		Nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution.	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 Amyema. Nest from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.	1	2.9km (1991)	1991 (2.9km)	Not present
<i>Ninox strenua</i>	Powerful Owl	V,P,3		Endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria.	Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. Requiring large tracts of forest or woodland habitat, it can also occur in fragmented landscapes. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. By day, it roosts in dense vegetation comprising species such as <i>Syncarpia glomulifera</i> , <i>Allocasuarina littoralis</i> , <i>Acacia melanoxylon</i> , <i>Angophora floribunda</i> , <i>Exocarpus cupressiformis</i> and a number of eucalypt species. The species is linked to 50 vegetation classes. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials (Gibbons and Lindenmayer 1997).	1	2.8km (2002)	2002 (2.8km)	Not present
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	V,P		Coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Vagrants are occasionally found further south to Victoria.	Occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. Not easy to see amongst the foliage, and are more often heard than seen. Are thought to be locally nomadic as they follow the ripening of fruits. Some populations are migratory in response to food availability - numbers in north-east NSW increase during spring and summer then decline in April or May.	1	4.5km (1996)	1996 (4.5km)	Not present
<i>Ardenna tenuirostris</i>	Short-tailed Shearwater	P	J,K	The Short-tailed Shearwater breeds on Tasmania and on islands off the South Australian coast. It migrates across the Pacific Ocean to the Aleutian Islands and the Bering Strait.	Typically nests on Coastal islands. Feeds in waters of Southern Australia all the way to the Antarctic Coast. May be found over other areas during migration.	6	2km (1983)	1988 (4.1km)	Not present
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	V,P		Sooty Oystercatchers are found around the entire Australian coast, including offshore islands, being most common in Bass Strait. Small numbers of the species are evenly distributed along the NSW coast.	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. Breeds in spring and summer, almost exclusively on offshore islands, and occasionally on isolated promontories. The nest is a shallow scrape on the ground, or small mounds of pebbles, shells or seaweed when nesting among rocks.	20	600m (2001)	2009 (3.6km)	Not present
<i>Macronectes giganteus</i>	Southern Giant Petrel	E1,P	E	The Southern Giant-Petrel is marine bird that occurs in Antarctic to subtropical waters. In summer, it mainly occurs over Antarctic waters, and it is widespread south as far as the pack-ice and onto the Antarctic continent.	The young Southern Giant-Petrel disperses for several years after fledging. At six to seven years of age, it returns to its natal colony as a reproductive adult. The Southern Giant-Petrel is an opportunist scavenger and predator. In summer at least, it will scavenge primarily penguin carcasses, although it will also feed on seal and whale carrion.	4	2km (1977)	1977 (2km)	Not present
<i>Lophoictinia isura</i>	Square-tailed Kite	V,P,3		Along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems.	A variety of timbered habitats including dry woodlands and open forests. In NSW it is often associated with ridge and gully forests dominated by <i>Eucalyptus longifolia</i> , <i>Corymbia maculata</i> , <i>E. elata</i> , or <i>E. smithii</i> . Preference is for timbered watercourses. In arid regions, observations have been made in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland. Breeding is from July to February, with nest sites generally located along or near watercourses (Marchant & Higgins 1993).	1	4km (2001)	2001 (4km)	Not present
<i>Calonectris leucomelas</i>	Streaked Shearwater	P	C,J,K	Breeds on coastal islands in north east Asia (Russia, Korea, Japan and China). Migrates south in the winter to south east	Generally found above the open ocean. Breeds in large seabird colonies on offshore islands.	2	1.2km (1985)	1985 (1.2km)	Not present

Scientific Name	Common Name	Status (NSW TSC Act, 1995)	Status (EPBC Act, 1999)	Distribution	Habitat and Ecology	Number of records	Closest proximity and date	Most recent and proximity	Likelihood of occurrence
				Asia and Australia.					
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V,P		The Superb Fruit-dove occurs principally from north-eastern in Queensland to north-eastern NSW. It is much less common further south, where it is largely confined to pockets of suitable habitat as far south as Moruya.	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. Breeding takes place from September to January.	2	2km (1992)	1992 (2km)	Not present
<i>Lathamus discolor</i>	Swift Parrot	E1,P,3	E	Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes.	Migrates to the Australian south-east mainland between March and October. Favoured feed trees include winter flowering species such as Swamp Mahogany Eucalyptus robusta, Spotted Gum Corymbia maculata, Red Bloodwood C. gummifera, Mugga Ironbark E. sideroxylon, and White Box E. albens.	14	3.2km (2002)	2002 (3.2km)	Not present
<i>Diomedea exulans</i>	Wandering Albatross	E1,P	E,J	The Wandering Albatross has a circumpolar distribution. The Wandering Albatross breeds on Macquarie Island.	The Wandering Albatross is marine, pelagic and aerial. The Wandering Albatross begins breeding at around nine years of age, and adolescents visit the nesting islands from five years of age. The Wandering Albatross feeds mainly in pelagic, offshore and inshore waters. It feeds from the sea surface or just below it, or makes shallow dives from heights of 2-5 m	15	2km (1977)	1984 (4km)	Not present
<i>Tringa incana</i>	Wandering Tattler	P	J	The Wandering Tattler is a vagrant in the East Asian-Australasian Flyway and is uncommon in Australia. The Wandering Tattler has been recorded on Lord Howe and Norfolk Islands.	The Wandering Tattler is generally found on rocky coasts with reefs and platforms, points, spits, piers, offshore islands and shingle beaches or beds. It is occasionally seen on coral reefs or beaches, and tends to avoid mudflats. Wandering Tattlers feed on Polychaete worms, molluscs and crustaceans (including crabs).	1	2.6km (1992)	1992 (2.6km)	Not present
<i>Ardenna pacificus</i>	Wedge-tailed Shearwater	P	J	The Wedge-tailed Shearwater breeds on the east and west coasts of Australia and on off-shore islands. The species is common in the Indian Ocean, the Coral Sea and the Tasman Sea.	The Wedge-tailed Shearwater is a pelagic, marine bird known from tropical and subtropical waters. The species tolerates a range of surface-temperatures and salinities, but is most abundant where temperatures are greater than 21 °C and salinity is greater than 34.6 %. In Australia, Wedge-tailed Shearwaters have been observed feeding along the junction between inshore and offshore water masses.	56	2.1km (1999)	2002 (3.5km)	Not present
<i>Gygis alba</i>	White Tern	V,P		Occurs widely in tropical and subtropical seas and islands. The subspecies on Lord Howe Island is rarely seen on the mainland but occurs on Norfolk and Kermadec Islands.	Generally found over the open ocean. Nests in the high branches of trees in coastal and island forests.	1	2.6km (1967)	1967 (2.6km)	Not present
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	P	C	The White-bellied Sea-Eagle is distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. It also extends inland along some of the larger waterways, especially in eastern Australia.	The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, and the sea). Birds have been recorded in (or flying over) a variety of terrestrial habitats. The White-bellied Sea-Eagle feeds opportunistically on a variety of fish, birds, reptiles, mammals and crustaceans, and on carrion and offal	1	3.6km (2009)	2009 (3.6km)	Not present
<i>Phaethon lepturus</i>	White-tailed Tropicbird	P	C,J	In Australia, the White-tailed Tropicbird (Indian Ocean) breeds in the Cocos-Keeling Islands. At the species level, the White-tailed Tropicbird appears to be a moderately common visitor to the seas off northern Western Australia, to the west of the continental shelf.	At the species level, the White-tailed Tropicbird occupies marine habitats in tropical waters with sea-surface temperatures of more than 22°C. At the species level, the White-tailed Tropicbird does not begin to breed until at least 2 years old. The White-tailed Tropicbird (Indian Ocean) feeds on fish (mostly flying-fish) and cephalopods (squid).	3	1.2km (1984)	1985 (1.8km)	Not present
Kingdom: Plantae; Class: MAGNOLIOPSIDA									
<i>Acacia bynoeana</i>	Bynoe's Wattle	E1,P	V	Found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. The species is currently known from about 30 locations, with the size of the populations at most locations being very small (1-5 plants). It has recently been found in the Colymea and Parma Creek areas west of Nowra.	Occurs in heath or dry sclerophyll forest on sandy soils. Prefers open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple	1	2km (1986)	1986 (2km)	Not present
<i>Gossia acmenoides</i>	Gossia acmenoides population in the Sydney Basin Bioregion south of the Georges River	E2		Hawkesbury-Nepean and Southern Rivers Regions of NSW.	Found in dry rainforests.	1	4.3km (1985)	1985 (4.3km)	Not present
<i>Zieria granulata</i>	Illawarra Zieria	E1,P	E	Restricted to the Illawarra region where it is recorded from a number of sites. The species primarily occupies the coastal lowlands between Oak Flats and Toolijooa, in the local	Typical habitat is dry ridge tops and rocky outcrops on shallow volcanic soils, usually on Bumbo Latite. Less frequently found on the moist slopes of the Illawarra escarpment and in low-lying areas on	1	5km (2006)	2006 (5km)	Not present

Scientific Name	Common Name	Status (NSW TSC Act, 1995)	Status (EPBC Act, 1999)	Distribution	Habitat and Ecology	Number of records	Closest proximity and date	Most recent and proximity	Likelihood of occurrence
				government areas of Shellharbour and Kiama.	Quaternary sediments. Associated vegetation includes Bracelet Honey-myrtle Melaleuca armillaris scrub, Forest Red Gum Eucalyptus tereticornis woodland and rainforest margins, although the species has been recorded from a number of other vegetation types. Flowering occurs between early spring and summer.				
<i>Senna acclinis</i>	Rainforest Cassia	E1,P		Occurs in coastal districts and adjacent tablelands of NSW from the Illawarra in NSW to Queensland.	Grows on the margins of subtropical, littoral and dry rainforests. Often found as a gap phase shrub. Flowering occurs in spring and summer and the fruit is ripe in summer and autumn.	1	1.9km (no date)	no date (1.9km)	Not present
<i>Cynanchum elegans</i>	Whiteflowered Wax Plant	E1,P	E	Restricted to eastern NSW, from Brunswick Heads on the north coast to Gerroa in the Illawarra region, and as far west as Merriwa in the upper Hunter River valley	Usually occurs on the edge of dry rainforest vegetation. Flowers from August to May, peaking in November.	17	2.9km (2006)	2006 (2.9km)	Not present
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E1,P	V	Found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest.	On the south coast, occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast, occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	1	1.9km (no date)	no date (1.9km)	Not present
KINGDOM: Animalia; CLASS: Mammalia									
<i>Arctocephalus pusillus doriferus</i>	Australian Fur-seal	V,P		In NSW, for example, the Australian Fur-seal is reported to have bred at Seal Rocks, near Port Stephens, but no longer occurs there. Pups have been born occasionally at Montague Island, on the southern NSW coast, and many non-breeding animals are known to congregate there.	The Australian Fur-seal prefers the rocky parts of islands. On Kangaroo Island in South Australia, where New Zealand and Australian Fur-seals co-occur, the Australian Fur-seals occupy flatter, more open parts of the colony (Shaughnessy 1999). For foraging, the Australian Fur-seal prefers to utilise oceanic waters of the continental shelf and generally does not dive deeper than 150 m	3	1.2km (1973)	1973 (1.2km)	Not present
<i>Dugong dugon</i>	Dugong	E1,P		A significant proportion of the world's Dugongs are found in north Australian waters from Shark Bay, Western Australia, to Moreton Bay, Queensland. The large populations in Shark Bay, Western Australia and the Great Barrier Reef, northern Queensland were noted as one of the natural features associated with World Heritage listing of these areas. Dugongs are considered occasional visitors to NSW coastal and estuarine waters.	While Dugongs frequent coastal waters, they also use estuarine creeks and streams and have been tracked travelling within creeks upstream for several kilometres. Dugongs are also regularly observed in deeper water further offshore in areas where the continental shelf is wide, shallow and protected. Dugongs are long-lived with a low reproductive rate, long generation time, and a high investment in each offspring. Although Dugongs breed year round, they show some seasonality, with mating and calving apparently peaking in spring and summer especially in the higher latitude limits of their range. The highly specialised dietary requirements of the Dugong suggest that only certain seagrass meadows may be suitable as Dugong habitat.	1	2.6km (1960)	1960 (2.6km)	Not present
<i>Dasyurus viverrinus</i>	Eastern Quoll	E1,P		No recent sightings of this species in NSW.	Occurs in dry sclerophyll forest, scrub, heathland and cultivated land. Primarily preys on insects. Home ranges vary between sexes and are dependent on habitat quality. In fertile habitats, males often travel over a kilometre in a night, whilst females restrict their movements to a few hundred metres surrounding their dens.	1	2km (1959)	1959 (2km)	Not present
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V,P	V	Generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia.	In subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	10	2km (2006)	2010 (4.6km)	Not present
<i>Megaptera novaeangliae</i>	Humpback Whale	V,P	V	The current extent of occurrence for the Humpback Whale in Australian waters is: most of the Southern Ocean during summer; a large area of State and Commonwealth waters during migration; and unknown areas of the Great Barrier Reef complex, Queensland, and the Kimberley region, Western Australia, during breeding in winter and spring.	Humpback Whales are widely distributed along the ice-edge in their Antarctic feeding grounds, typically south of about 55° S. This distribution seems to be related to prey distribution rather than topographic features. Humpback Whales migrate to warm waters in winter and give birth to their calves near islands and atolls. Life expectancy is recorded as at least 48 years but is likely to be significantly longer as shown in other balaenopterids. Rates of natural mortality are unknown but Humpback Whale calves are particularly vulnerable to predation by killer whales and may die from natural parasitic or disease events.	2	2.7km (1997)	1997 (2.7km)	Not present
<i>Physeter macrocephalus</i>	Sperm Whale	V,P		Sperm Whales have been recorded from all Australian states. Females and young male Sperm Whales are restricted to warmer waters, generally north of approximately 45° S, while	Sperm Whales tend to inhabit offshore areas with a water depth of 600 m or more, and are uncommon in waters less than 300 m deep. Sperm Whales are seasonal breeders, but the mating season is	2	1.2km (1970)	1970 (1.2km)	Not present

Scientific Name	Common Name	Status (NSW TSC Act, 1995)	Status (EPBC Act, 1999)	Distribution	Habitat and Ecology	Number of records	Closest proximity and date	Most recent and proximity	Likelihood of occurrence
				older males travel to and from colder waters and to the edge of the Antarctic pack-ice. It is possible that Sperm Whales, in Australian waters, occur in severely fragmented populations.	prolonged, extending from late winter through to early summer. The major food for Sperm Whales comprises oceanic cephalopods, frequently taken at depth.				
KINGDOM: Animalia; CLASS: Reptilia									
Chelonia mydas	Green Turtle	V,P	V	Green Turtles nest, forage and migrate across tropical northern Australia. They usually occur between the 20°C isotherms although individuals can stray into temperate waters. No key green turtle nesting areas have been identified within NSW.	Green Turtles spend their first five to ten years drifting on ocean currents. During this pelagic (ocean-going) phase, they are often found in association with driftlines and rafts of Sargassum. Once Green Turtles reach 30 to 40 cm curved carapace length, they settle in shallow benthic foraging habitats such as tropical tidal and sub-tidal coral and rocky reef habitat or inshore seagrass beds. The shallow foraging habitat of adults contains seagrass beds or algae mats on which Green Turtles mainly feed	1	1.2km (1999)	1999 (1.2km)	Not present

Proposed Port Kembla Bulk Liquids
Terminal

APPENDIX

B

EPBC ACT MATTER OF NATIONAL
ENVIRONMENTAL SIGNIFICANCE
ASSESSMENT

Commonwealth Listings Under the EPBC Act

Green and Golden Bell frog (*Litoria aurea*) –Vulnerable Species

The Green and Golden Bell Frog's former distribution extended from the NSW north coast near Brunswick Heads south along the NSW coast to the east Gippsland area of Victoria. There are also records west to Bathurst, Tumut and the ACT region. Since 1990 there have been approximately 50 recorded locations in NSW, most being small and coastal or near coastal locations. The current locations occur over the species former range but are widely separated and isolated. Port Kembla is listed as a Key Population location with four (4) known main sub-populations (OEH 2015).

The species inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available. The Green and Golden Bell Frog is known to inhabit highly disturbed areas. The species is active by day and usually breeds in summer when conditions are warm and wet. Various wading birds and snakes are common predators of the Green and Golden Bell Frog (OEH 2015).

Impact from the proposal has been assessed following the Significant Impact Guidelines 1.1 for Matters of National Environmental Significance (DoE 2012).

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

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

An 'important population' is defined by DoE (2013) as: a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- > key source populations either for breeding or dispersal;
- > populations that are necessary for maintaining genetic diversity, and/or;
- > populations that are near the limit of the species range.

Port Kembla is known to be a 'Key Population' of Green and Golden Bell Frog (DEC 2007). The study site (referred to in report as study area) is located within the Northern Port Kembla sub-population (DEC 2007). However, the primary population of Green and Golden Bell Frog within this sub-population appears to be associated with the Gurungaty Waterway and Tom Thumb Lagoon drainage and wetland area, draining south from the Wollongong CBD, where sporadic occurrences have been recorded associated with elements of this drainage line within the Wollongong Golf Course and also within remnants of the Tom Thumb Lagoon wetland bordering Springhill Road. Sporadic occurrences have also been observed in the vicinity of the Port Kembla Coal Terminal and inner harbour industrial and port facilities triggering rescue 'missions' and management plans to facilitate their survival (Biosphere, 2012; 2015).

It is likely that the Green and Golden Bell Frog are utilising the Gurungaty Waterway as a movement corridor and parts of the remnant Tom Thumb Lagoon wetland, Green House Reserve and possibly the Port Kembla Sewage Treatment works, as well as, periodically, other detention structures in the northern Port Kembla industrial/port facilities as habitat elements.

The current proposal to redevelop the areas comprising the Biodiesel facility includes removal of two such small detention/water treatment structures that have been assessed as being potential habitat for the species although no specimens have actually been recorded utilising them. The structures have been surveyed and whilst considered unremarkable in the habitat values they may provide the species, it is impossible to rule out the possibility the species may periodically utilise them, given the unpredictable movement patterns and habitat utilisation trends often displayed by the species.

The removal of these structures is unlikely to place the Port Kembla Green and Golden Bell Frog population at risk of extinction nor even the north Port Kembla element of that population at risk.

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

No Green and Golden Bell Frog were recorded during targeted surveys at the study site. However, the site does include 2 stormwater detention basins that could be used for breeding habitat, both basins are scheduled for removal as a result of the proposal. As the basins were not occupied and they are outside of the area identified as supporting the primary population the proposal is not likely to reduce the area of occupancy of the Green and Golden Bell Frog.

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

No habitat fragmentation or disruption to the movement corridors is proposed.

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

Critical habitat is not present at the subject site, the habitat onsite is only potential habitat and used infrequently.

> *disrupt the breeding cycle of an important population*

The site is within the summertime nightly movement corridor for Green and Golden Bell Frog and as such all staff will be informed regarding identification and avoidance during site inductions and toolbox talks.

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

The site is not removing habitat considered critical to the survival of Green and Golden Bell Frog. All workers will be made aware through toolbox talks and inductions that the site is within the summertime nightly movement corridor to ensure avoidance and ongoing management of the species.

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

Not applicable.

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

Not applicable

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

The proposal will ensure staff are well informed and educated to ensure mitigation measures are in place for the protection of the species during construction and implementation phase of the proposal. As such, works will not interfere substantially with the recovery of the species.

Proposed Port Kembla Bulk Liquids
Terminal

APPENDIX

C

GREEN AND GOLDEN BELL FROG
SURVEY (BEC, 2015)



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**GREEN and GOLDEN BELL FROGS
SURVEY
NATIONAL TERMINALS
PORT KEMBLA BULK LIQUIDS TERMINAL
March 2015**

1.0 Introduction

Green and Golden Bell Frogs *Litoria aurea* were once abundant along the eastern coast of New South Wales but have undergone a significant decline here and elsewhere over the past forty years (White and Pyke 1996). They are now considered 'endangered' in New South Wales and are specifically protected by the NSW *Threatened Species Conservation Act* 1995 and the Commonwealths *Environmental Protection and Biodiversity Conservation Act* 1999.

Several populations of Green and Golden Bell frogs remain in the Illawarra area and some of these are centred around Port Kembla. Many of the areas of habitation at Port Kembla are used or disused industrial sites.

On the northern side of Port Kembla, Green and Golden Bell Frogs have been located in two main areas, namely the Port Kembla Coal Terminal and Greenhouse Park. The Port Kembla Coal Terminal has developed a Plan of Management (Biosphere 2010) that protects the frogs while still permitting the terminal to function effectively as a coal export facility. In 2012, a Plan of Management (POM:Biosphere.) was prepared for the National Terminals Site at Port Kembla.

Green and Golden Bell Frogs are a highly mobile species that are permanently resident in the north Port Kembla area and probably move in and out of the various industrial sites nearby in search of food and shelter sites.

The aims of the current surveys were to:

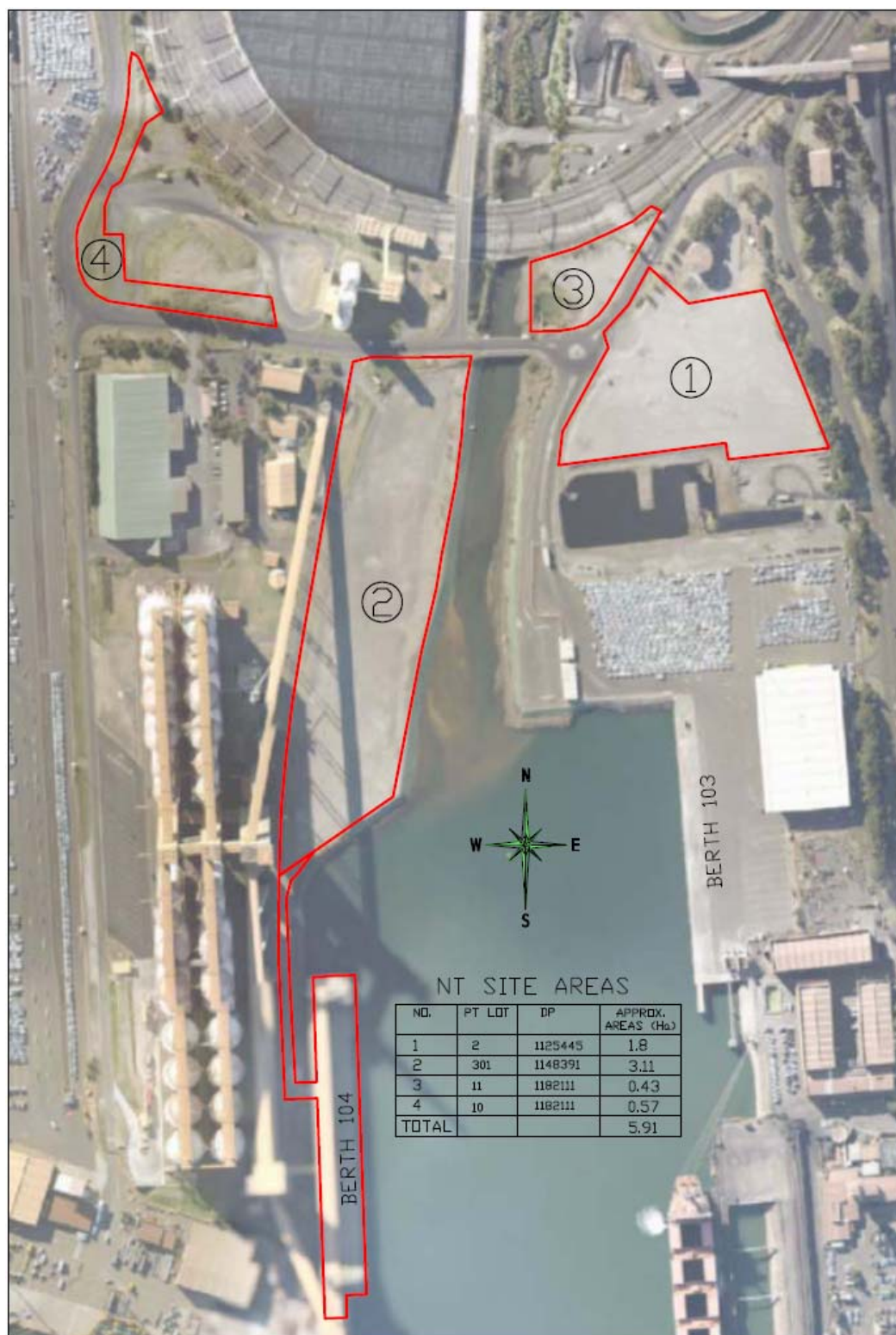
1. Determine the current presence or absence of Green and Golden Bell frogs on the National Terminal's Port Kembla Site, and
2. Recommend conservation measures that will protect the frogs during the re-development of Site Areas 1, 2, 3, and 4 as shown in Figure 1.

2.0 National Terminal's Site

The National Terminal's Site comprises four main areas (Areas 1, 2, 3 and 4: Figure 1). The Site is located on either side of the Garrangatty Waterway on the northern side of the inner harbour of Port Kembla on Tom Thumb Road. The area is an industrial site and is located on re-claimed land that has previously been levelled, compacted and sealed (Figures 2 and 3).

The area to be re-developed is Area 3: the proposed works include bulk earth works to level the site (this will include filling and covering of the existing storm water detention basin). During the construction phase of the project, the site will house temporary construction facilities in the north-east corner. The permanent development of the site will include the construction of the National Terminals office building, car park, workshop area and utilities.

Figure 1
National Terminals Site at north Port Kembla



Area 3, the northernmost site with an area of 0.38 Ha is a cleared site that abuts the Garrangatty Waterway (Figure 2).

Figure 2
Area 3 National Terminals Site



There are two storm water collection sites present on the Site, one is a small concrete-lined storm water sump in Area 1 (Figure 3), the other a large and fairly overgrown storm water detention basin and trash rack (Figure 4) in Area 3.

Figure 3
Storm Water sump in Area 1



Figure 4
Storm water detention basin in Area 3



3.0 Method

3.1 Timing of Survey

The survey for Green and Golden Bell frogs had to be carried out at a time when the frogs were active and therefore likely to be detected (if present). The survey was carried out on the 11th of March 2015. The day was fine, sunny and quite warm (21^o - 30^o) but a later thunderstorm passed through the area and light showers fell on the site just before dusk.

As a confirmation of the suitability of the survey timing, the Brick and Blocks site at Port Kembla South was also surveyed on the same night after the survey had been completed in Area 3. This site has a monitored population of Green and Golden Bell frogs and the site can be used a reference site for the National Terminals Site area because of its close proximity.

3.2 Tadpole Survey

A long-handled dip net was used to sample the water in the sump in Area 1 and the detention basin in Area 3, as these were the only observed water bodies on the Sites.

3.3 Frog Survey

After dusk, Area 3 was traversed on foot and a head-lamp search made of the grassed and vegetated areas of the site. Any frogs seen were caught (if necessary), identified and released. Imitation calls of the Green and Golden Bell frog were made several times during the survey period to try to elicit calling by any male Green and Golden Bell frogs in the area.

Area 1 was not surveyed as it is entirely covered by hard stand and apart from the stormwater basin, there is no other habitat for Green and Golden Bell frogs there.

3.4 Reference Site

The frog pond in the Brick and Block Site on Old Port Road at Port Kembla south was visited later in the evening of the 11th of March 2015. No tadpole surveys were carried out at the Brick and Block frog pond, instead a head-lamp search was carried out around the pond to determine the presence of Green and Golden Bell frogs. Imitation frog calls were also used to elicit calling by male Green and Golden Bell Frogs.

4.0 Results

4.1 Tadpole Surveys

No tadpoles were found in the sump in Area 1 or the detention basin in Area 3.

4.2 Frog Survey Area 3.

No Green and Golden Bell frogs were found in area 3. The only frog species detected was the Striped Marsh frog *Limnodynastes peronii*. Two male Striped Marsh Frogs were calling in the detention basin and one foraging male was found in the grassed areas nearby.

4.3 Frog Survey Bricks and Blocks

Five adult Green and Golden Bell frogs were found in and near the frog ponds in the Brick and Blocks Site at Port Kembla South. No calling was detected by Bell

frogs and no frogs responded to the imitation mating calls. Striped Marsh Frogs were also detected at this site, as were Eastern Dwarf Tree frogs (*Litoria fallax*).

5.0 Discussion

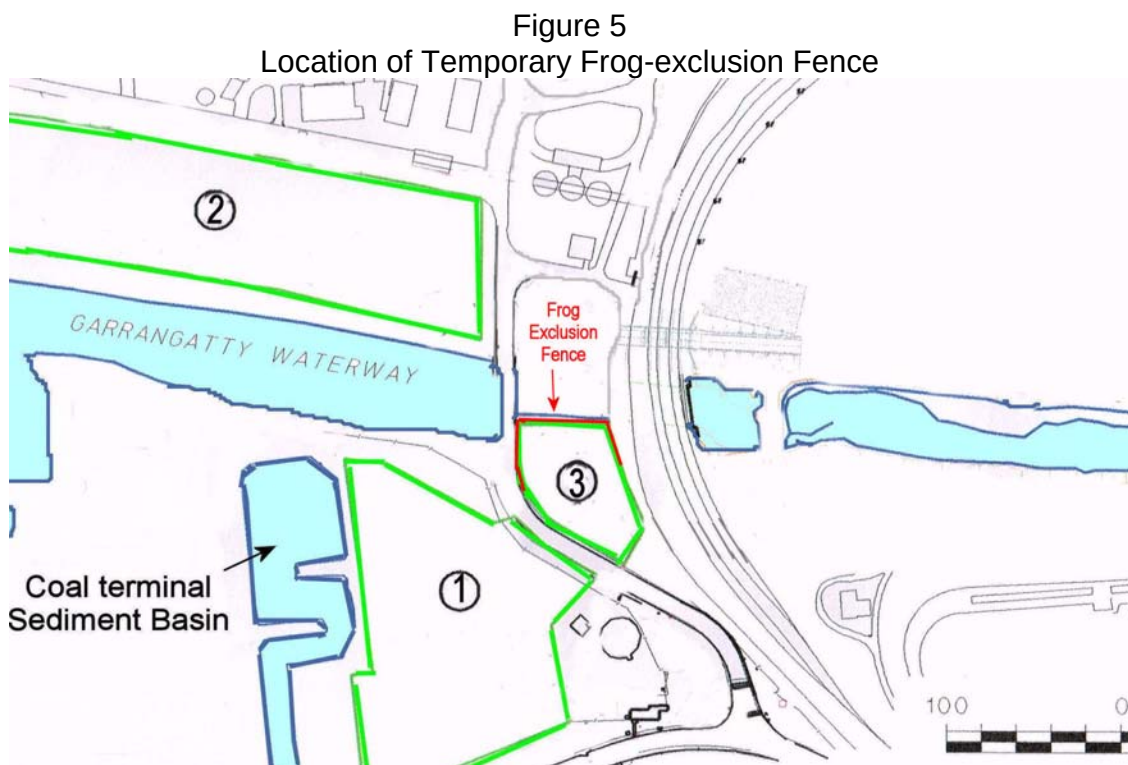
5.1 Green and Golden Bell frogs in Area 3.

No Green and Golden Bell frogs were found in Area 3 during the present survey. Their absence was not due to the prevailing weather conditions, as Bell frogs were active at the nearby Brick and Blocks site.

There is little remaining habitat for Green and Golden Bell frogs in Area 3, The detention basin offers the only shelter habitat for these frogs as well as some foraging space. This area is only likely to be visited by Bell frogs after sustained rainfall and breeding in this area is possible but unlikely.

5.2 Re-development of Area 3.

While there are no Green and Golden Bell frogs in Area 3, the re-development of this site presents no threats to the frogs. However, the advent of rain could change this situation. It is recommended that a temporary frog-exclusion fence be erected along the western and northern (part) sides of the site to prevent Bell frogs entering the site prior to any earthworks being undertaken (see Figure 5).



If there is a substantial delay between the present survey and the erection of this fence, a frog clearance survey may be required after the frog-exclusion fence has been erected. Any Bell frog caught during the frog clearance would be released into the detention pond in the Coal terminal area.

6.0 7 Part Test

As Green and Golden Bell frog habitat is present in Area 3 and that the species is known from areas within easy dispersal distance of Area 3, a Seven Part test has been conducted to assess the likely impacts of the proposed works on the Green and Golden Bell frogs and to test the efficacy of the proposed erection of the frog-exclusion fence prior to the proposed works.

6.1 Green and Golden Bell Frog

The Green and Golden Bell frog is an endangered species listed on Schedule 1 Part 1 of the *Threatened Species Conservation Act 1995*. The following sections address the requirements of the Act.

1. 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,

Bell Frogs have been recorded in the nearby Port Kembla Coal Terminal area, Greenhouse Park and JJ Kelly Park (Biosphere 2012).

Area 3 does not appear to contain breeding habitat under normal circumstances (breeding might be possible after periods of sustained summer rains). The potential breeding site in Area 3 would not be regarded as a reliable breeding site as water retention is generally quite short on the site. This pit will eventually be filled in and the site re-developed to house the National Terminals office building, car park, workshop area and utilities.

The only known breeding site at Port Kembla North is the detention basin in the Port Kembla Coal terminal and that site will not be affected by the proposal.

The proposed works will not adversely affect the life cycle of the Green and Golden Bell Frog at Port Kembla.

2. 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,

The Port Kembla Bell Frogs have not been listed as an endangered population because of the legal status already afforded to them as an endangered species.

3. *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*
 - (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.

4. *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*
 - (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*
 - (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,*

An area of low-grade foraging habitat will be lost as a result of the proposed works. These areas of low grass may be used by dispersing Bell frogs but otherwise would not be considered as habitat for the frogs. Their loss will not prevent the frogs from dispersing or prevent them from foraging along the Garrangatty Waterway.

The re-development of Area 3 is unlikely to interfere with the movements of Green and Golden Bell frogs at Port Kembla North, despite Area 3 being between the breeding pond in the Port Kembla Coal Terminal and Greenhouse Park where a Bell frog pond has been constructed. Bell frog movements between these sites are likely to be along the Garrangatty Waterway, to the wets of Area 3. The proposed works will not interfere with this movement corridor.

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

No critical habitat has been formally declared at Port Kembla, however, it is clear that critical habitat is not present in Area 3. No critical habitat will be affected.

6. whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

A Draft Recovery Plan for Green and Golden Bell frogs (DEC 2005) advocates that the best way to protect Green and Golden Bell frogs is through the protection and conservation of existing habitat areas. The loss of some foraging space as a result of the re-development of Area 3 will not result in a decrease in the population size of Green and Golden Bell Frogs at Port Kembla. The proposed re-development of Area 3 will remove a small area of potential foraging habitat but this will be insignificant compared to the total amount of habitat in the general area.

7. 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.

A recognised key threatening process is chytridiomycosis (or Frog Chytrid Disease). The works do not involve the importation of water, soil, wood chip or other materials that could harbour the chytrid spores. No special measures will be required to protect the site from chytrid.

The presence of the Plague Minnow *Gambusia holbrooki* is recognized as a key threatening process. These fish are present in Garrangatty Waterway but not in the detention basin in Area 3. Water will not be imported onto the site and the accidental importation of *Gambusia* is also very unlikely.

Another further key threatening process for habitats at Port Kembla is the loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gasses. The Bulk Liquids terminal site is on reclaimed land that is more than 5 m above current maximum high water levels and so is well above projected sea level changes for the foreseeable future.

The proposed works will not contribute significantly to the emission of greenhouse gasses and are not a threatening process.

Conclusion:

The proposed re-development of Area 3 will not result in the loss of habitat or impact directly on Green and Golden Bell frogs there. The erection of a temporary frog-exclusion fence around part of the site will prevent Green and Golden Bell frogs from being injured or killed during the works. There will be no significant impact on the frogs or their life cycle.

Overall, the proposed works will not have a significant impact on the Bell Frogs at Port Kembla.

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Dr Arthur White

31 March 2015

Proposed Port Kembla Bulk Liquids
Terminal

APPENDIX

D

EXPERT REPORT – GREEN AND
GOLDEN BELL FROG
(ECOPLANNING, 2015)



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Framework for Biodiversity Assessment: Expert Report – Green and Golden Bell Frog



**Lot 2 // DP1125445, Lot 301 // DP1148391 and
Lot 11 // DP1182111, Tom Thumb Rd, Port Kembla
Proposed Port Kembla Bulk Liquids Terminal**

Prepared for: Cardno on behalf of TQ Holdings Australia Pty Ltd

4 December 2015

PROJECT NUMBER	2015-026		
PROJECT NAME	Port Kembla Inner Harbour Green and Golden Bell Frog		
PROJECT ADDRESS	Lot 2 // DP1125445, Lot 301 // DP1148391 and Lot 11 // DP1182111, Tom Thumb Rd, Port Kembla, NSW		
PREPARED FOR	Cardno Pty Ltd on behalf of TQ Holding Australia Pty Ltd		
AUTHOR/S	Ross Wellington		
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Glossary and abbreviations

ABBR./TERM	DESCRIPTION
AHD	Australian Height Datum
BOPMP	Biodiversity Offsets Policy for Major Projects
CBD	Central Business District
CEEC	Critically endangered ecological community
DA	Development application
DEC	Department of Environment and Conservation (DEC) (now OEH)
DECC	Department of Environment and Climate Change (NSW) (now OEH)
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
FBA	Framework for Biodiversity Assessment
GGBF	Green and Golden Bell Frog
IBRA	Interim Bioregionalisation of Australia
IFC	Impact for Further Consideration
KPMP	Key Population Management Plan
LGA	Local Government Area
NPWS	National Parks and Wildlife Service (NSW)
mm/cm/m/km	millimetres/centimetres/metres/kilometres
OEH	Office of Environment and Heritage
OSD	Onsite Stormwater Detention
PK BLT	Port Kembla Bulk Liquids Terminal
PKCT	Port Kembla Coal Terminal
SSD	State Significant Development
SEARs	Secretary's Environmental Assessment Requirements
STP	Sewage Treatment Plant
SVL	Snout Vent Length
TQ	TQ Holdings Australia Pty Ltd
TEC	Threatened Ecological community, listed as vulnerable, endangered or critically endangered under either the TSC and/or EPBC Acts
TSC Act	<i>Threatened Species Conservation Act 1995</i> (NSW)
WCC	Wollongong City Council

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Executive summary

This report has been undertaken on behalf of TQ Holdings Australia Pty Ltd (TQ) to address the Secretary's Environmental Assessment Requirements (SEARs) (SSD-7264) for the proposed Port Kembla Bulk Liquids Terminal (PK BLT) at Lot 2 // DP 1125445, Lot 301 // DP 1148391 and Lot 11 // DP 1182111, Tom Thumb Rd, Port Kembla. The SEARs require that an assessment is undertaken in accordance with the Framework for Biodiversity Assessment (FBA) (OEH 2014a), as established under NSW Biodiversity Offsets Policy for Major Projects (BOPMP; OEH 2014b).

The SEARs nominate Green and Golden Bell Frog (*Litoria aurea*) as an 'impact for further consideration' (IFC), in accordance with Section 9.2 of the FBA. Consultation with the NSW Office of Environment and Heritage (OEH) has specified the requirement for an 'expert report' to:

- Identify a 'species polygon' to determine the size of any impact on breeding, foraging and shelter habitat of the Green and Golden Bell Frog in accordance with Section 9.2.5 of the FBA, and
- Eliminate the Green and Golden Bell Frog as an IFC, which requires justification that the proposal is not likely to:
 - cause the extinction of a species or population from an IBRA (Interim Biogeographic Regionalisation for Australia) subregion (i.e. the Illawarra), or
 - significantly reduce the viability of a species or population

OEH have requested that the IFC be addressed prior to proceeding with assessment of potential impacts using the FBA. This expert report outlines investigations undertaken in relation to the Green and Golden Bell Frog, a State and Commonwealth listed threatened species, scheduled under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act).

This investigation included a site inspection (including targeted surveys for the Green and Golden Bell Frog and an assessment of potential habitat both on-site and in the near locality), mapping of the potential habitats identified, and review of the current state of knowledge of the Green and Golden Bell Frog in the locality and within the broader conservation framework already established for the species.

It is apparent that knowledge gaps in our understanding preclude any categorical statements about either northern or southern population elements of the Green and Golden Bell Frog population. It is a pressing concern that the Port Kembla Green and Golden Bell Frog population appears to be continuing to wane and to improve our understanding of the Green and Golden Bell Frog in the locality will require a coordinated ongoing monitoring program that seeks out habitat areas and occurrences across all tenures.

This review has found that it is likely that the northern element of the Green and Golden Bell Frog Key Population are utilising the Gurungaty Waterway as a movement corridor and parts of the remnant Tom Thumb Lagoon wetland, Wollongong Greenhouse Reserve and possibly the Port Kembla Sewage Treatment works, as well as, periodically, other detention structures in the northern Port Kembla industrial/port facilities as habitat elements.

The current proposal to redevelop the areas comprising the PK BLT facility includes removal of two such small detention/water treatment structures that have been assessed as being potential habitat for the species, although no specimens have actually been recorded utilising them. The structures have been surveyed and whilst considered unremarkable in the habitat values, it is impossible to rule out the possibility the species may periodically utilise them, given the unpredictable movement patterns and habitat utilisation trends often displayed by the species.

The most likely beneficial measure for the local population would be to undertake some off site habitat construction/rehabilitation and/or population monitoring measures. Such efforts are likely best directed at the southern Port Kembla population element where a greater habitat mosaic persists and where concerning trends of ongoing decline in population numbers have been reported. Provision of compensatory or offset habitat in the vicinity of the proposed PK BLT facility is not considered advisable as to encourage Green and Golden Bell Frog to the subject site any more frequently than the current sporadic appearances only places these individuals in harm's way and likely increases mortality. The proposed facility is at the terminus of the Gurungaty Waterway and any useful habitat for the species is most likely to the north and outside the immediate port precinct.

It is concluded that the removal of habitat elements in the form of small detention/water treatment structures in the northern Port Kembla industrial/port facilities is unlikely to place the Port Kembla Green and Golden Bell Frog population, nor even the north Port Kembla element of that population, at risk of extinction. Consequently, in addressing Section 9.2.5 of the FBA, it is recommended that Green and Golden Bell Frog be removed from the SEARs as an IFC, as impacts that have been identified from the proposal are unlikely to:

- cause the extinction of a species or population from an IBRA (Interim Biogeographic Regionalisation for Australia) subregion (i.e. the Illawarra), or
- significantly reduce the viability of a Green and Golden Bell Frog population

This report has defined a 'species polygon' for the purposes of quantifying impacts from the proposal under the FBA. The species polygon is 0.09 ha in area, and preliminary calculations utilising the Major Projects module of the Biobanking Credit Calculator have identified that 1 species credit will need to be retired to meet the offset obligations of the FBA. Following confirmation from OEH that the Green and Golden Bell Frog has been eliminated as an IFC, an assessment of the impacts can proceed following the FBA and the preparation of a Biodiversity Assessment Report in accordance with the FBA will be necessary.

1 Introduction

1.1 Purpose of report and legislative context

This report has been undertaken on behalf of TQ Holdings Australia Pty Ltd (TQ) to address the Secretary's Environmental Assessment Requirements (SEARs) (SSD-7264) for the proposed Port Kembla Bulk Liquids Terminal at Lot 2 // DP 1125445, Lot 301 // DP 1148391 and Lot 11 // DP 1182111, Tom Thumb Rd, Port Kembla.

The SEARs require that an assessment is undertaken in accordance with the *Framework for Biodiversity Assessment* (OEH 2014a), as established under *NSW Biodiversity Offsets Policy for Major Projects* (BOPMP; OEH 2014b). This policy endeavours to standardise as well as improve biodiversity offsetting for major project approvals that qualify under the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act).

The SEARs nominate Green and Golden Bell Frog (*Litoria aurea*) as an 'impact for further consideration' (IFC), in accordance with Section 9.2 of the FBA. Consultation with the NSW Office of Environment and Heritage (OEH) (Daniel Robson, Conservation Planning Officer) has specified the requirement for an 'expert report' to:

- Identify a 'species polygon' to determine the size of any impact on breeding, foraging and shelter habitat of the Green and Golden Bell Frog in accordance with Section 9.2.5 of the FBA, and
- Eliminate the Green and Golden Bell Frog as an IFC, which requires justification that the proposal is not likely to:
 - cause the extinction of a species or population from an IBRA (Interim Biogeographic Regionalisation for Australia) subregion (i.e. the Illawarra), or
 - significantly reduce the viability of a species or population

OEH have requested that the IFC be addressed prior to proceeding with assessment of potential impacts using the FBA. This expert report outlines investigations undertaken in relation to the Green and Golden Bell Frog, which is a State and Commonwealth listed threatened species, scheduled under the *NSW Threatened Species Conservation Act 1995* (TSC Act) and Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act).

This investigation has included:

- a site inspection (including targeted surveys for the Green and Golden Bell Frog and an assessment of potential habitat both on-site and in the near locality),
- mapping of the potential habitats identified,
- reviewing the current state of knowledge of the Green and Golden Bell Frog in the locality and within the broader conservation framework already established for the species, and
- developing advice/recommendations relating to the suitability of the potential habitat identified and actions that would enhance or improve conservation outcomes for the species consistent with the recovery program framework.

Table 1.1: Legislative framework addressed in this report

INSTRUMENT	CONSIDERATIONS	CONTEXT
State (New South Wales)		
<i>Environmental Planning and Assessment (EP&A) Act 1979</i>	Part 5.1, Division 2	Environmental assessment requirements for approval of State Significant Developments; requires issue of SEARs for the proposal and include consideration of other agency/authority issues raised.
<i>Threatened Species Conservation (TSC) Act 1995</i>	Schedules 1, 1A, 2 and 3	Lists threatened species, populations, ecological communities and key threatening processes to be considered under Section 5A EP&A Act.
<i>NSW Biodiversity Offsets Policy for Major Projects (BOPMP)</i>	Developed to provide a balance between the needs of proponents, communities and the environment: • providing clear, efficient and certain guidance for stakeholders • improving outcomes for the environment and communities • providing a practical and achievable offset scheme for proponents.	The policy clarifies, standardises and improves biodiversity offsetting for major project approvals. The policy applies to state significant development and state significant infrastructure under EP&A Act.
<i>Framework for Biodiversity Assessment (FBA)</i>	The FBA sets out the process for: • assessing biodiversity impacts on a proposed development site; and • determining the biodiversity offset requirements for those impacts.	This policy is established by the BOPMP; it provides a methodology and requirements for demonstrating extent of likely biodiversity impacts and determining whether they are IFC (Impacts requiring Further Consideration.

1.2 Description of the proposal

The subject site is currently zoned IN3 - Heavy Industrial, under the Wollongong Local Environmental Plan (WLEP) (2009). It presently exists as four proximal portions along Tom Thumb Road within the Port Kembla Inner Harbour Port precinct. The proposal is to develop the facility as a bulk liquids processing, storage and export/port transfer facility along with other associated infrastructure including administration buildings and other facilities.

2 Study area, locality and IBRA sub-region

2.1 Study area

In accordance with OEH (2014a), the **study area** is defined as the development footprint and any additional areas that are likely to be affected by the proposal, either directly or indirectly. The study area extends as far as is necessary to take all potential direct and indirect impacts into account.

The study area is located within the Port Kembla port precinct approximately 70 km south of Sydney and 3 km from the Wollongong City Centre, in the Wollongong Local Government Area (LGA). The port is connected to Wollongong via the arterial road Spring Hill Road and to Sydney via the Princes Motorway. The port is located on a highly modified estuary at the mouth of Allan's Creek and Gurungaty Waterway, draining east to the Tasman Sea.

Port Kembla consists of a number of industrial land uses with various berths for the loading and unloading of cargo ships. The study area consists of three parcels of land and a berth and is approximately 7.22 ha in area, as identified in **Figure 2.1** and includes:

- Site 1 – Combustible and flammable bulk liquids storage and pump bay
- Site 2 – Combustible and flammable bulk liquids and truck loading facilities
- Site 3 – Site control room & office block, maintenance work shop and utilities
- Berth 104 – Bulk liquids unloading (and potential loading) facilities.

The study area is highly modified and consists largely of cleared industrial land. All sites are almost completely devoid of native vegetation, with the few plants present consisting mostly of introduced pasture grasses and weeds. Site 3 also contains a large onsite stormwater detention (OSD) basin consisting of mostly introduced grasses and weeds. A smaller OSD is also present at the northern extremity of Site 1. The topography of the study area is relatively flat with a slight slope towards the adjacent waterways (see **Photo 2.1** to **Photo 2.6**).

The study area has had a long history of changing land use, site modification and has been cleared and levelled with much of the surfaces as hard stand. Two small sections of the land have had previous detention/water treatment structures installed as part of broader land use planning. It is understood that these structures currently serve a stormwater drainage and water quality control function in the locality. However, these two structures do provide the potential Green and Golden Bell Frog habitat elements with respect to the currently proposed development (see **Photo 2.1** and **Photo 2.2**).

2.2 Locality

The **locality** is described as the likely extent of the *local population* within the northern Port Kembla sub-component of the Port Kembla Key Population (DECC 2007). It includes the area of the Port Kembla Inner Harbour foreshore to the south of the study area extending north to the Wollongong Golf Course (**Figure 2.2**).

This area forms the Wollongong City catchment and lies immediately to the north of Port Kembla Inner Harbour (GHD 1999; WMA Water 2013). The catchment is separated from the Tasman

Sea along its eastern boundary by a dune system. The catchment slopes to the east and south, and has a total catchment of approximately 730 ha which drains into the Port Kembla Inner Harbour via the Gurungaty Waterway. The northern boundary of the catchment is formed by Crown Street, in Wollongong's main commercial district. The catchment rises steeply in the Coniston, Mangerton and Mt St Thomas components to the west, where it reaches up to around 100 m AHD elevation.

The western part of the catchment is dissected by the South Coast railway line which obstructs flows from the west. The lower part of the catchment, between the railway line, Corrimal Street and Springhill Road, is characterised by a mixture of medium density residential, commercial and industrial land uses. The upper parts of the catchment to the north and north-east is largely residential and commercial development with the exception of the coastal area occupied by Wollongong Golf Course. In the south BlueScope steel and other industry occupies a large portion of the southern catchment around the Port Kembla Inner Harbour including the study area. The low lying area to the south and east of the Central Business District (CBD) includes the southern component of Wollongong Golf Course, JJ Kelly Park, and Wollongong Greenhouse Park.

The Wollongong City catchment area includes the suburbs of Wollongong (south of Crown Street), Coniston, and northern Port Kembla, and drains towards Wollongong Golf Course and JJ Kelly Park, ultimately discharging into Port Kembla Inner Harbour via the Gurungaty Waterway and Tom Thumb Lagoon. There have been several recorded instances of flood producing storms in the catchment, including March 1978, March 1983, December 1990, March 1995, March 2011 and February 2012.

Figure 2.3 depicts the study area in the context of a map of the locality depicting potential breeding habitat (wet areas), connectivity habitat (Gurungaty Waterway and its subsidiary drainage) and the undeveloped areas possessing features likely to operate/provide foraging and other habitat elements. All of these may contribute to the local Green and Golden Bell Frog population habitat mosaic.

2.3 Illawarra IBRA sub-region

The Interim Biogeographic Regionalisation for Australia (IBRA) system divides Australia into bioregions on the basis of their dominant landscape-scale attributes. An IBRA subregion is based on major catchment areas within the IBRA region. For the purpose of this assessment study area is found within the Sydney Basin IBRA region in the 'Illawarra' sub-region (**Figure 2.4**).



Figure 2.1: The study area, showing the proposed re-development areas and the area assessed as potential Green and Golden Bell Frog habitat.



Figure 2.2: Locality map.



Figure 2.3: Potential Green and Golden Bell Frog habitat within the locality (north Port Kembla sub-population).

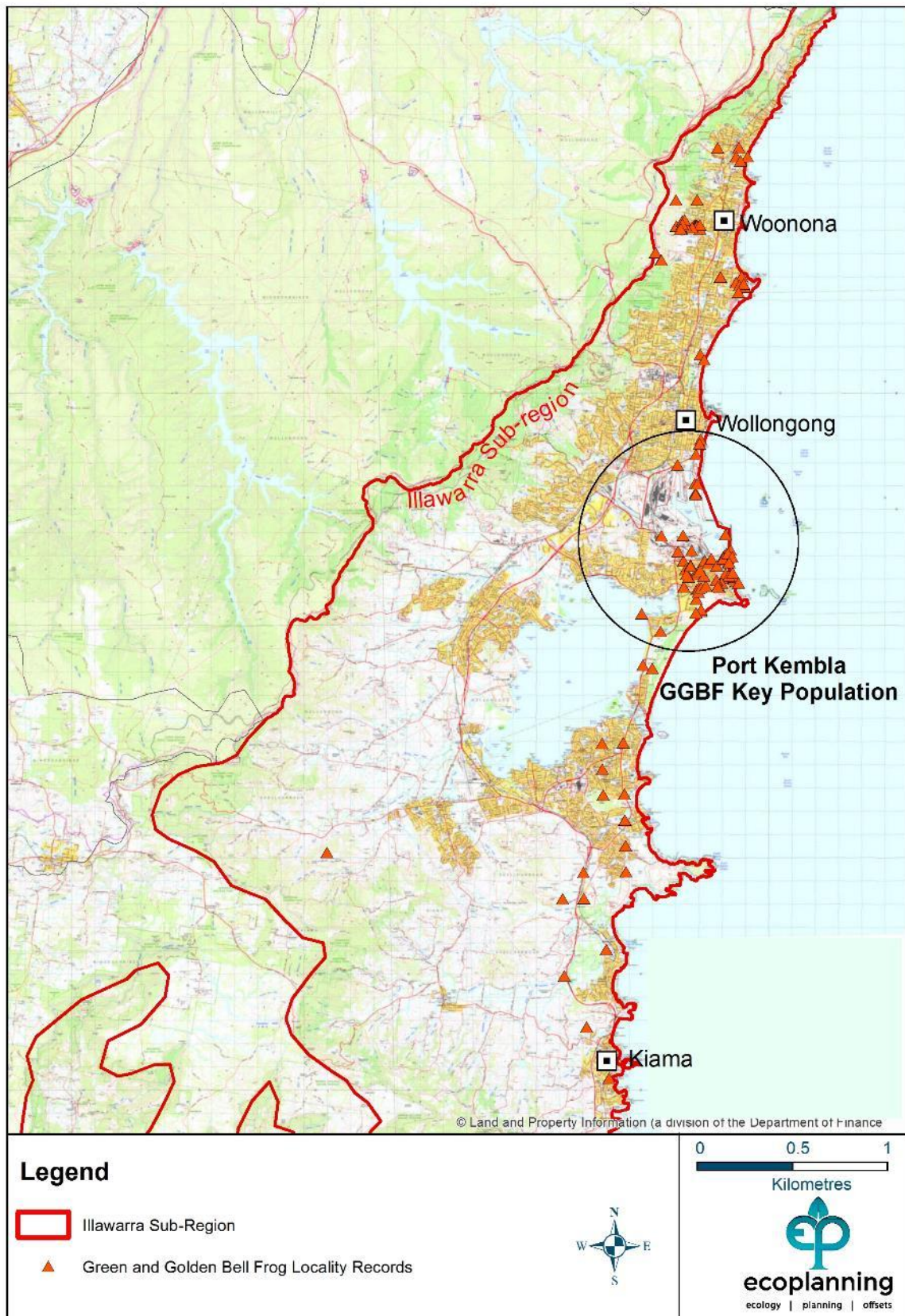


Figure 2.4: The Illawarra IBRA Sub-region as it pertains to the Port Kembla Key Population.



Photo 2.1: Stormwater detention basin on Site 1, within the study area.



Photo 2.2: Stormwater detention basin on Site 3, within the study area.



Photo 2.3: Subject site (Site 3), looking north toward rail corridor.



Photo 2.4: Subject site (Site 3), showing breeding and refuge habitat. A partially erected frog exclusion fence can be seen to the right of photo.



Photo 2.5: The rail corridor to the north of Site 3.



Photo 2.6: Large detention basin immediately to the south of the subject site (Site 1), potential breeding habitat which may encourage transitory individuals to pass through the subject site.

2.4 Status of the Green and Golden Bell Frog within the Illawarra IBRA sub-region

Green and Golden Bell Frog populations in the Illawarra have suffered some dramatic declines in the past 40 years and disappearances and these declines appear to be continuing. From its former widespread distribution it appears that only three key populations continue to persist and these are recognised within the Recovery Plan as existing within the Illawarra Region (DEC 2005).

One population is known to still occur in the Woonona area associated within the small coastal Hollymount Creek system, but this population appears to have continued to decline to a highly tenuous situation since redevelopment of the old brick works site for residential housing where they were located (**Figure 2.4**). Another key population occurs in Kiama and southern section of Shellharbour LGAs. This population is known from the Bass Point, Killalea Regional Park, Minnamurra River wetlands and Springs Creek in the Bombo area (**Figure 2.4**). These population elements appear to have also continued to decline and there have been no recent records from these fragmented localities.

The most important Illawarra population is that which occurs in the Port Kembla area (**Figure 2.4**). This population is considered to be operating more or less as a meta-population and the fragmented and isolated nature of these sub-population elements is likely more the result of persistence despite development, and other human disturbances, rather than a naturally patchy distribution.

In recognition of the importance of this population, an action in the Recovery Plan was the development of a Key Population Management Plan (KPMP) for the Port Kembla Key Population (DEC 2007). The process of developing the KPMP included a facilitated workshop with all stakeholders of the Port Kembla area and surrounds, which provided an opportunity for all participants to contribute. It included a technical presentation, input from all landowner/managers in the KPMP formulation, actions devised to establish a broader understanding of the species status at the time, actions/initiatives likely to benefit the species in the locality as well as identifying gaps in understanding/knowledge about the species in the Port Kembla area.

Important among the issues identified was the fact that the species was recognised as being distributed across many different industrial sites with varying ownerships and hence obvious access issues. This fact confounded an easy solution to establishing the species' true status, the extent of potential and utilised habitat across these lands and any understanding of patterns of habitat utilisation. Two reports were commissioned to address this gap in understanding (Gaia 2008 and 2009) and were facilitated by the major industrial land owners at Port Kembla. These reports document the areas of known and potential habitat within both the north and south Port Kembla precincts and further identify those areas likely to be contributing to ongoing connectivity between population elements.

Investigators from the University of Wollongong along with several residents have contributed to information available about habitat use and Green and Golden Bell Frog numbers on the south side of Port Kembla around Coomaditchy Lagoon, South Pond, the old MM site/Boiler's Point and Korrongulla wetland (**Figure 2.5**). Occasional occurrences of Green and Golden Bell Frog within 'tank farms' of the former Incitec/Orica site resulted in habitat ponds being constructed and periodically monitored and where the species is known to still occur. Volunteer

monitoring of these constructed ponds appears to suggest that population fluctuates in numbers but most recently has showed ongoing worrying declines (Chris Wade pers. comm.).

More recently, sporadic sightings of the Green and Golden Bell Frog in the northern Port Kembla and south Wollongong area have been recorded. These include from the Wollongong Golf course, Gurungaty Waterway, Tom Thumb Lagoon, storm water drainage/detention areas along Springhill Road and within the Port Kembla Inner Harbour precinct (**Figure 2.3**). The occurrences within the Port facilities has triggered several studies, management plans and other initiatives to protect the Green and Golden Bell Frog and further culminated in this report due to the current proposal being located within close proximity to some of the recent sightings in the Inner Harbour precinct.

The study area is located at the terminus of the Gurungaty Waterway where it enters the Port Kembla Inner Harbour. The site contains two waterbodies proposed for removal/modification as part of this major infrastructure development and thus has triggered concerns over whether the proposal is likely to place the local population at risk of extinction.

There are no recorded occurrences of the Green and Golden Bell Frog from the study area itself and a search of the site failed to detect the species. Nevertheless, the proximity of the site to recent records of the Green and Golden Bell Frog makes it difficult to rule out occasional and periodic uses of the sites wet areas which have basic habitat values that meet the definition of potential habitat for the species, although these habitat values are unremarkable (**Figure 2.6**).



Figure 2.5: Atlas records of the Port Kembla Key Population.



Figure 2.6: Study Area and records in close proximity to the site.

3 Qualifications/experience of expert

In accordance with Subsection 6.6.2 of the FBA:

'an expert report must only be prepared by a person who is accredited by the Chief Executive of OEH under section 142B(1)(b) of the TSC Act, or a person who, in the opinion of the Chief Executive of OEH possesses specialised knowledge based on training, study or experience to provide an expert opinion in relation to the biodiversity values to which an expert report relates'

Ross Wellington is considered an expert who possesses specialised knowledge based on training, study and experience to provide an expert opinion in relation to the biodiversity values to which an expert report relates. Relevant roles and project experience that demonstrate Ross's experience with respect to making an expert judgement on Green and Golden Bell Frog impact assessment and conservation through either preparation, authorship or significant input are provided in **Appendix A**.

4 Species information

4.1 Legal status

At the national level, the Green and Golden Bell Frog is listed as Vulnerable under Schedule 1 Part 2 of the EPBC Act. This Act replaced the *Endangered Species Protection Act 1992* and the adoption of the revoked Acts schedules transferred the status of the species to Vulnerable under the EPBC Act.

In NSW, the Green and Golden Bell Frog *Litoria aurea* is listed as endangered under Part 1 of Schedule 1 of the TSC Act. The species was transferred to the TSC Act Schedules from Schedule 12 of the NSW *National Parks and Wildlife Act 1974* (NPW Act), as amended by the *Endangered Fauna Interim Protection Act 1991*.

4.2 Abundance and distribution

The following comments on the overall abundance and distribution of the Green and Golden Bell Frog are drawn mainly from the Green and Golden Bell Frog Recovery Plan (DEC 2005), unless otherwise cited.

The Green and Golden Bell Frog once had an extensive distribution which ranged, not only through the coastal lowland areas of eastern NSW from approximately 50 km south of the NSW-Queensland border and extending south into northeast Victoria, but also into the more elevated southern tablelands and central slopes of Bathurst (Type Locality: Macquarie River at Bathurst – see Cogger et al., 1984). Some historic locality records from the New England, Central and Southern Tablelands need to be considered with caution due to early confusion with *L. castanea* (New England Swamp Frog) and/or *L. raniformis* (Green Swamp Frog) where they overlapped in these areas.

The northern extent of distribution has been reported from the vicinity of Brunswick Heads, the southern extent in NSW is believed to be Nadgee on the NSW-Victorian border, with the western most extent recorded from Wimbeldon south west of Bathurst. In Victoria the species is known to extend coastally west to the vicinity of Lakes Entrance.

Generally, the declines in NSW went unnoticed until the early 1980s, but had possibly begun earlier in the mid-1970s although documentary evidence is lacking. It is also likely, that as a once extremely common species, instances of observed occurrence often went unrecorded. A workshop held on the species during May 1995 resulted in the production of a 17 article special edition (monograph) of the *Australian Zoologist* (Pyke and Osborne 1996) reporting on the current state of knowledge of the Green and Golden Bell Frog. Several papers contained therein, provide specific regional overviews of the species distribution and status. This monograph was followed 10 years later by a subsequent symposium and further monographic edition of the *Australian Zoologist* (Goldingay and Osborne, 2008). This monograph contained a further species status update for the period up 2005 (Pyke and White, in Goldingay and Osborne 2008). Unfortunately, this review failed to take into account the NSW Recovery Plan (DEC 2005) for the species that was produced at about the same time and, although the monograph was actually published three years later, also failed to take into consideration 12

NSW Department of Environment and Climate Change (DECC; now OEH) endorsed, Key Population Management Plans (KPMPs) arising out of the recovery plan actions.

During preparation of the recovery plan this author also visited all known Green and Golden Bell Frog sites and, by definition, recognised 43 populations which were therein classified as ‘key’ populations, for the purposes of the recovery plan and that were known or considered likely to persist throughout the species range within NSW.

The Illawarra Region included the LGAs of Wollongong, Shellharbour and Kiama. This region is known to have had major populations within its various catchments. This included the small coastal catchments of the northern suburbs of Wollongong; the mosaic of wetlands and modified wetland remnants surrounding Port Kembla; the swampy wetland margins of Lake Illawarra and associated feeder creek catchments; coastal lagoons in the Shellharbour LGA and the river/creek systems within Kiama LGA. Pyke and White (in Pyke and Osborne 1996) and White (in Pyke and Osborne 1996) document the declines in some of these populations and, along with numerous other historical records of various herpetologists, these have assisted in piecing together the species former distribution as outlined in the species Recovery Plan (DEC, 2005).

4.3 Ecology and habitat requirements

4.3.1 Reproduction and life cycle

Breeding events and other associated reproductive behaviours have been recorded from late winter to early autumn but generally between September and February with a peak around January-February after heavy rain/storm events.

Reproductive events are however clearly influenced by the prevailing weather conditions from season to season and also appear to be influenced by geography. More southerly and higher altitude populations appear to have a narrower window of opportunity for breeding than more northerly and lower altitude populations. More northerly populations appear to more often commence breeding earlier and continue longer than southern and tableland populations which appear to have a much shorter breeding period.

Only males elicit the mating call and can be heard throughout the breeding period. Calling is mostly at night, although occasionally also by day. Individual males can sometimes also be triggered to respond to a call recording play back or call imitation. This may indicate that calls are a reflex response and may in part explain the observed coordinated choruses from around breeding habitat and with apparent chorus leaders. Calls are usually made whilst floating in water but also occasionally from positions amongst pond-side vegetation. Males appear to reach maturity at around 45-50 mm (9-12 months) and at this size begin to develop a grey to brownish yellow wash beneath the chin. This discoloration indicates the development of a vocal sac and consequently that an individual has commenced calling behaviour.

In the Green and Golden Bell Frog, amplexus is axillary with males grasping the females near the armpits rather than around the waist (which is the alternative and termed inguinal amplexus). Males develop raised “nuptial pads” on their thumbs once they reach sexual maturity. These pads are dark brown during the breeding season but become paler and much less obvious at other times. The nuptial pads assist the males to maintain their grasp on the female during amplexus and in some frog species the nuptial pads are adorned with microscopic spines and stylets to improve grip.

Amplexus occurs mainly in water or adjacent to breeding sites but has also at times been observed some distance from water. Monitoring of breeding sites during the breeding season has indicated that males are more likely to be encountered at these sites for longer periods than are females. Females have been observed to show site fidelity for shelter and foraging sites some distance from breeding sites. It would appear that various cues (call and climatic) may trigger the appearance of females at the breeding sites. It has been suggested that such females may avoid breeding sites until ready to shed so as to avoid 'forced shedding' that may result in a reduced fertilisation rate.

Observations of amplexing pairs, has provided evidence that females reach sexual maturity at two years. Females smaller than 65 mm snout vent length (SVL) are not seen in amplexus and 65mm size class, both in the wild and captivity, is not attained until the second season after metamorphosis. Anatomical or other studies may need to be undertaken to confirm this but the likelihood that females only reach reproductive maturity in their second year has implications for demonstration of recruitment success and for demonstrating second (F2) generations in monitored sites where habitat creation and enhancement measures require proof of functionality of compensatory habitat generation.

The Green and Golden Bell Frog is a highly fecund species with recorded clutch sizes ranging between approximately 2,000 to 11,500 eggs. Whilst average clutch size has also been estimated and in rounded figures of about 3,700 eggs per clutch with 3,000 to 5,000 apparently the norm.

Hatching takes place 2-5 days after oviposition/fertilisation and is affected by water temperature. Tadpole development is generally completed within 6-12 weeks although in some instances this may take 11-12 months to be completed when breeding takes place late in the season and development is not completed before temperatures fall and some tadpoles over-winter in that life stage. Metamorphosis is completed with individual froglets emerging at 24-30 mm SVL.

4.3.2 Life history and population dynamics

The Green and Golden Bell Frog has been described as a successional or colonising species and having 'weed like' life history attributes. The development of adaptations for this type of life strategy has been termed 'r' selection (Pianka, 1970; Stiling, 1999). Usually such species are generalists with tolerance for a wide range of environmental factors. They are also often associated with habitats with high variability such as fluctuating conditions and/or unpredictability in climate. Such life history strategies quite often pre-adapt a species for colonising and occupying disturbed environments.

Much of the available information on the Green and Golden Bell Frog typifies such a life strategy. However 'r' strategists also typically experience high mortality with losses independent of density and have fluctuating population size (generally below carrying capacity) but offset by high fecundity and rapid development to reproductive maturity, they are generally small and short lived. There is insufficient information available for the Green and Golden Bell Frog on some of these other 'life table' attributes to assess the species conformity as a classic 'r' strategist. However the Green and Golden Bell Frog does have high fecundity (3,000-5,000 eggs in an average clutch), develops rapidly to maturity in 1-2 years but the species is a medium to large size species by frog standards (reaches over 90 mm SVL). Information on longevity in the wild is poorly known (the species has been recorded as reaching 10-15 years of age in captivity and factors influencing population density and size are also unknown. Furthermore, 'r'

strategists are species that usually only reproduce once and normally have low competitive ability.

The available evidence on these factors for the Green and Golden Bell Frog is less certain. It has been suggested that the Green and Golden Bell Frog is displaced by other frog species or replaced in a successional sense. However, the species is known to breed more than once in captivity and in the wild. Large (>90 mm) identifiable female individuals have been observed gravid (carrying eggs or young) and to persist in the population for at least a further 3 years after breeding at that size. The species does not appear to conform, in 'r' strategist terms, with respect to longevity and nor is it a 'one off' breeder (DEC, 2005).

Information on the demographics of Green and Golden Bell Frog populations is important but will only become available through long term monitoring of populations. Only then will population viability analysis (PVA) be possible. Some populations have now been monitored over several seasons but analyses of the results of these studies are only just beginning to become available. Population size estimates for seven populations are believed to be over 1,000 individuals. How these population levels might fluctuate seasonally or be affected by climatic condition are unknown and will only be revealed by repetitive monitoring over extended periods.

Measures of mortality of the various age classes will be likely critical in determining where threatening processes are exerting most influence. Longevity in the wild is unknown and whilst individuals in captivity provide some evidence that the species is potentially long lived, this may be infrequently realised in the face of various risk factors for survival. Migratory patterns and measures of recruitment are also unknown.

4.3.3 Movement patterns and behaviour

The Green and Golden Bell Frog displays a variety of behaviours and movement patterns from population to population, site to site and even season to season within specific populations. Consequently, it is very difficult to generalise about movement patterns and other behaviours. Clearly, the species has a variety of habitat requirements and these are spatially or temporally met in different ways at different locations. Various studies have been undertaken that provide some insight into these patterns of habitat utilisation.

The species is capable of making quite large movements in a single day/night up to 1-1.5 km. Mark and recapture studies have shown tagged individuals have moved up to 3 km and revealed frogs several kilometres from the nearest breeding habitat or demonstrated significant movements within a presumed home range.

Recently, metamorphosed individuals have been observed to rapidly vacate the breeding site particularly when foraging habitat is also in the vicinity. At other sites where the breeding habitat is at some distance from the nearest habitat, suitable for adult foraging, juveniles may remain for some time. The cannibalistic nature of adults is possibly a cause of this avoidance behaviour.

There is evidence the species can show strong site fidelity with individuals returning to or remaining at an identified site. Similarities and differences in reported observations seem to suggest that the Green and Golden Bell Frog will remain at a site and show strong site fidelity provided all the required habitat attributes for its needs are present. However, where some of these requirements are not met the species will move over a wider area to satisfy those needs.

When conditions become unfavourable the species will move the required distances to find suitable habitat and when ample habitat is present those areas which have the greatest habitat complexity appear to be favoured. Long-term studies are required to confirm such trends and generalised statements about habitat utilisation.

4.3.4 Predator-prey

Green and Golden Bell Frogs have been recorded naturally feeding on a wide variety of prey items. Such prey items include many invertebrates such as insect larvae, crickets, cockroaches, dragonflies, earthworms, flies, grasshoppers, mosquito wrigglers, isopods, freshwater crayfish and slugs. In captivity the Green and Golden Bell Frog is known to feed on house crickets, fruit flies, domestic flies and maggots, mealworms, beetles, various other insect larvae, slaters, silkworms, instar plague locusts, cockroaches, water snails, spiders, earthworms, other frogs, mice and even a small tiger snake.

It has been generally known among frog keepers for many years that the Green and Golden Bell Frog is highly anurophagous (frog eating) in habit. Studies at Broughton Island, Marrickville and Crescent Head have clearly demonstrated that cannibalism and anurophagous behaviour also occurs in the wild.

In captivity the Green and Golden Bell Frog will not readily respond to stationary food items and this and various other observations have led to the general view that Green and Golden Bell Frog will eat almost anything that moves and can be accommodated. It is likely, however, that the species would show some selectivity, even if only based on a shift in size of prey item consumed dependent on relative size of the individual frog. Sub-adult Green and Golden Bell Frogs appear to hunt and feed mostly on relatively small insects, especially flying ones. Juveniles can be observed performing amazing gymnastic feats to snatch small insects in flight. Adult frogs appear to show a marked preference for larger ground dwelling insects as well as frogs.

It has also been observed that the Green and Golden Bell Frog, under some circumstances at least, will readily feed on aquatic prey including tadpoles and other aquatic organisms and therefore not necessarily restrict itself to terrestrial prey items. Recently metamorphosed individuals have also been observed to dive into shallow water to capture mosquito wrigglers.

There has also been little available information on the importance of the various known types of prey items in the natural diet of the species. This has precipitated some recent studies to quantitatively determine the proportional make up of prey items in different Green and Golden Bell Frog populations.

In captivity the Green and Golden Bell Frog consumes more during the warmer months than during cooler periods of the year. In a natural highland population it was found that Green and Golden Bell Frogs spent less time feeding during episodes of breeding and during 'brumation' (a period of aestivation or quiescence) and was more likely to be observed foraging at other times. It has also been found that newly metamorphosed and immature froglets continue to forage later in the year than did adults.

Dietary preference of tadpoles of the Green and Golden Bell Frog is understood to be mainly reliant on grazing on the algal or bacterial scum growing on submerged rocks and other substrates. More advanced tadpoles may show some preference for vegetable matter but also scavenge or even become carnivorous (opportunistically) on other aquatic organisms.

Predation on Green and Golden Bell Frog tadpoles is not often directly observed in the wild but predation on Green and Golden Bell Frog tadpoles has been observed to occur by White-faced Heron (*Ardea novaehollandiae*); Reef Egret (*Ardea sacra*); Swamp Harrier (*Circus approximans*); White Ibis (*Threskiornis aethiopica*); Long-necked Tortoise (*Chelodina longicollis*); Red-bellied Black Snake (*Pseudechis porphyriacus*); Water Beetles (Family: Dysticidae); Water Scorpion (Family: Nepidae); Dragon-fly Larvae (Order: Odonata); Plague Minnow (*Gambusia holbrooki*) and Eastern Water Skink (*Eulamprus quoyii*).

Other likely predators of Green and Golden Bell Frog tadpoles includes various introduced fish such as the Redfin Perch (*Perca fluviatilis*) and the European Carp (*Cyprinus carpio*); Native fish such as the Freshwater Eel (*Anguilla* spp.); Empire Gudgeon (*Hypseleotris compressa*); Fire-tailed Gudgeon (*H. galii*); Blue Eyes (*Pseudomugil signifier*) and other wading birds such as the Pacific Heron (*Ardea pacifica*) and Intermediate Egret (*Ardea intermedia*).

Nevertheless, there is presently little or no known information available on the extent to which any particular predator impacts on tadpoles of the Green and Golden Bell Frog. The impact such predation may have at the local population level and hence recruitment is also unknown.

Predation on adult Green and Golden Bell Frogs or at least metamorphosed frogs has been recorded for: Red-bellied Blacksnake (*Pseudechis porphyriacus*); Tiger Snake (*Notechis scutatus*); Laughing Kookaburra (*Dacelo novaeguineae*) and Sacred Kingfisher (*Todiramphus sanctus*) and the Green and Golden Bell Frog are also almost certainly preyed on by various other wading birds and other snakes such as the Green Tree Snake (*Dendrelaphis punctulatus*); Copperhead (*Austrelaps ramsayi*) and Black-bellied Swamp Snake (*Hemiaspis signata*).

These observations support the view that the Green and Golden Bell Frog is (or at least was) a significant prey item in its ecological system.

4.3.5 Habitat requirements

The Green and Golden Bell Frog is known to be associated with the following habitat types/components as outlined in the Green and Golden Bell Frog Environmental Impact Assessment Guidelines (NPWS 2003), Green and Golden Bell Frog Recovery Plan (DEC 2005) and Georges River Green and Golden Bell Frog Key Population Management Plan (DECC 2008a). Nevertheless, it is still difficult to precisely define or briefly encapsulate the full details of what constitutes the habitat requirements and/or preferences for this species. Consequently, it is more appropriate to describe the various types or habitat components known to be utilized by the species.

Breeding habitat

The suitability of habitat components for this species should always be considered in light of how a particular site will appear in the event of significant rainfall. A site when dry may appear unsuitable but this may change with moderate rains and so consideration should also be given to the species propensity to turn up to breed in ephemeral locations that are more often dry than wet. Such sites can and do include man-made structures/features such as quarries, brickpits, mining sites, sewerage treatment plants, 'bundled' or otherwise 'retained' areas, detention basins, drains, scrapes, depressions and farm dams as well as the more natural coastal or floodplain wetland features such as swamps, ponded areas of intermittent creeklines, lagoons, billabongs/ox-bows and dune swales, all of which are candidate sites for occupation and utilisation by the species. Such sites are occupied and used mainly as breeding habitat.

Foraging and shelter habitat

Foraging habitat requirements include tall, dense, grassy vegetation and tussock forming vegetation, the latter also known to be used as shelter. Other habitat components utilized by the species includes emergent aquatic vegetation which is used primarily as shelter habitat and/or as diurnal basking sites.

Over-wintering habitat

Over-wintering habitat components are another important habitat feature providing protection from disturbance during the cooler months of the year when individuals enter a period of quiescence/inactivity and become torpid. Such sites include the bases of dense vegetation tussocks, beneath rocks, timber, within logs or beneath ground debris including human refuse and building materials such as sheet iron and rubble. Various habitat components may be adjacent to one another or else may be some distance away/apart. The full range of possible habitat components used and the extent of their use by the species is still not fully understood.

The congregation of large numbers of individuals at some breeding sites followed by a dwindling in number of observed animals during non-breeding stages suggests that individuals likely move away to seek other non-breeding habitat components/requirements where these are absent or lacking in one location. Similarly, some sites may be used regularly as breeding sites only to then be vacated for lengthy periods which may be interpreted as local extinction. Only then to be re-occupied at some later date when the habitat is suitable or available when some other site is not. These sporadic uses and appearances at some sites make it difficult to judge whether the species is truly absent or the habitat unsuitable.

Movement, corridor/connectivity habitat

Movement, corridor/connectivity habitat is also an important consideration with drainage lines, rail and road easements and water supply pipeline easements providing individually and collectively potential landscape traversing pathways for population elements to interconnect.

Consequently, other 'potential' habitat attributes must be considered during any assessment of an area and not just the extent of breeding habitat. The sometimes skewed sex ratios of individuals found around breeding sites indicates there are sexual differences in the spatial and temporal use of various habitat components. Therefore, the timing of any proposed survey of, or disturbance to, potential habitat may differ significantly in the resultant detectability or direct impact on a local population of the species.

5 Assessment Methodology

5.1 Literature and database review

A site specific literature and database review was undertaken prior to undertaking field survey and the preparation of this report. This included desktop analysis of aerial photography and regional scale mapping resources from the following sources:

- NSW Planning Viewer (NSW Dept. of Planning and Environment 2015)
- BioNet Atlas of NSW Wildlife (NSW Office of Environment and Heritage 2015)
- Protected Matters Search Tool (Commonwealth Dept. of the Environment 2015)
- SIX Maps (LPI 2015)

Previous reports of most relevance to the study area include (see **References** for further relevant literature):

- Environmental Impact Assessment Guidelines for the Endangered Green and Golden Bell Frog *Litoria aurea* (NPWS 2003a)
- Recovery Plan for the Green and Golden Bell Frog *Litoria aurea* (DEC 2005)
- Key Population Management Plan for the Green and Golden Bell Frog at Port Kembla (DEC 2007)
- Assessment of Habitat, Dispersal Corridors and Management Actions to Conserve the Port Kembla Key Population of the Green and Golden Bell Frog (Gaia Research 2008)
- Assessment of Habitat, Dispersal Corridors and Management Actions to Conserve the Northern Port Kembla Key Population of the Green and Golden Bell Frog (Gaia Research 2009)
- Significant impact guidelines for the vulnerable Green and Golden Bell Frog (*Litoria aurea*) (DEWHA 2009a, b).
- Plan of Management Green and Golden Bell Frogs, Port Kembla Coal Terminal (Biosphere 2008a, b, 2010)
- Green and Golden Bell Frog Habitat Creation Report Greenhouse Park Port Kembla (Biosphere 2009)
- Plan of Management Green and Golden Bell Frogs National Biodiesel Site Port Kembla (Biosphere 2012)
- Green and Golden Bell Frog Survey PK BLT Site Port Kembla (Biosphere 2015)

Green and Golden Bell Frog records considered during the literature and database review were consolidated and the species likelihood of occurrence was considered by:

- review of location and date of recent and historical (>5-20 records)
- review of available habitat within the subject land, study area and broader locality
- review of the scientific literature pertaining to the species

- applying expert knowledge of the species ecology, distribution and habitat preferences

The potential for the species to occur was then considered and the necessity/scope for further targeted field surveys was determined. Following an initial diurnal and nocturnal field survey and an assessment of available habitat within the subject site and wider study area, the potential for the species to utilise the site and to be potentially affected directly or indirectly by the proposed action was considered.

5.2 Field survey

Initial field survey was undertaken at the study area on 20 May 2015. Weather conditions on the day were mild, with 1.5 mm of rain recorded in the 24 hours prior to the survey (**Table 2-1**). Additional surveys were undertaken targeting Green and Golden Bell Frog on 22 October 2015. Survey followed an extended period of rain in the days preceding the survey and weather on the day was initially warm, but following a southerly bluster in the early afternoon temperatures dropped to ~17°C with consistent heavy rainfall, although a relative humidity of 88-90% was recorded throughout the day and a cloud cover 8/8. (**Table 5.1**).

Table 5.1: Daily weather observation at Wollongong (8.5 km)

DATE	Temp (°C)		Rainfall (mm) ¹	Max wind	
	Min	Max		Direction	Spd (km/h)
19/05/2015	12.9	19.1	1.5 and *(0)	NNW	24
20/05/2015	12.0	22.1	0.0 & *(1.6)	NNW	26
21/10/2015	19.4	25.4	*(2.2)	NE	9
22/10/2015	17.7	20.8	*(4.8)	SSW	43

*Note: An additional rainfall data set was obtained from the nearest available BOM monitoring station located at Berkeley (Northcliffe Drive) as results for October 2015 were not available for reference at Port Kembla at time of reporting. A review of results at both weather stations shows a good correlation of results due to the close proximity of each weather station to each other (approx. 2km). Source: BOM 2015a and 2015b

5.2.1 Site inspection and assessment

Targeted field survey involved undertaking a preliminary diurnal inspection of the study area accompanied by representatives of the property owner/managers TQ Holding Australia (David Pincott & Matthew Price), Cardno Senior Environmental Engineer (Alex Larance), Ecoplanning Principal Ecologist (Lucas McKinnon) and Senior Ecologist (Ross Wellington), NSW Ports representative (Trevor Brown) and Office of Environment & Heritage representatives (Daniel Robson and Calvin Houlison).

The subject site was inspected in company and the layout of the proposal identified. A reconnaissance of the adjacent sites, sites where Green and Golden Bell Frog had been recorded previously and areas considered to have the highest potential to operate as habitat were all visited to assess the logistics of Green and Golden Bell Frog accessing, utilising and moving through the site.

Field survey was then undertaken during daylight hours in an attempt to locate any Green and Golden Bell Frog specimens in the minimal shelter habitat available for inspection. A known

and accessible reference site was then inspected at South Port Kembla in an attempt to determine Green and Golden Bell Frog activity and hence validate that conditions were suitable for detecting the species and in accordance with species survey guidelines (NPWS 2003; DEWHA 2009a, b). Dip netting was undertaken at the reference site to determine presence and identify species of any tadpoles present.

The subject site was then revisited at dusk and after dark and surveyed using headlamp and call playback at the primary potential habitats identified on the site during diurnal inspection/survey.

5.2.2 Survey limitations

The survey aimed to determine the extent and quality of the areas of each land portion that was considered to have potential Green and Golden Bell Frog habitat values. It also set out to identify the subject land and its strategic position with respect to other records of the species and potential interconnecting habitat areas. To determine presence/absence, the site was also surveyed diurnally and nocturnally using standard survey techniques for amphibians. The methods and survey effort were considered adequate to determine absence at the time of survey given the extent, quality and habitat complexity evident.

A full amphibian survey following the *Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians* (DECC 2009) was not undertaken, however, it was conceded that multiple visitations might be undertaken over extended periods and still fail to detect the species but would not completely rule out the occasional presence/occupation at some periodic/occasional frequency. An assumed presence was therefore made and an assessment and determination undertaken accordingly.

6 Survey and Assessment Results

6.1 Literature and database review

To determine a snapshot of the status of the endangered Green and Golden Bell Frog is complex and difficult to accurately determine. The entire Port Kembla locality (including both northern and southern GGBF population elements) is fragmented across various land use tenures and ownerships. Much of the land is difficult to gain access to due to industrial activities or Port operations and hence need for 'consent to enter' and associated safety/induction requirements. Therefore, whilst many of the sites are in relatively close proximity, they are unable to be monitored or surveyed simultaneously. Consequently, observations are 'piecemeal' and largely subjective and so it is not possible to be certain in drawing conclusions.

The locality is covered by a Key Population Management Plan which was directly derived from the Green and Golden Bell Frog Recovery Plan (DEC 2005). The development of the KPMP involved a consultation workshop with all stakeholders at the time including all the industrial company operators, State Government agencies, WCC and local residents/interest groups.

The lands in question included those owned/operated at the time by Cleary Brothers, Orica, Blue Scope Steel, RailCorp and other smaller operators on the southern side of the harbour. On the northern side it included Blue Scope Steel and NSW Port Authority (now NSW Ports). Orica (now IXOM) were originally licensed by NPWS/DEC to relocate Green and Golden Bell Frog within their site (when it was more inclusive of other surrounding land parcels, since then sold). Orica as part of their requirements, monitored the Green and Golden Bell Frog on their site initially on a fairly regular basis. These lands were more recently sold to IXOM and Morgan Cement and responsibility for monitoring apparently ceased at this point, however, monitoring has continued since in a somewhat ad hoc and opportunistic way by local enthusiast and former Orica employee, Chris Wade. Consequently, the best information available about trends in numbers for any of the Green and Golden Bell Frog population elements is derived from these studies. Some but not all of these private records have been able to be considered here.

Along with other threat abatement initiatives identified in the Recovery Plan and Port Kembla KPMP, surveys have been undertaken within Blue Scope Steel lands (including construction of a pond) and within Port Kembla Ports Authority land. Local land owners have also opportunistically made observations since the KPMP's preparation.

In endeavouring to compile this snapshot of Green and Golden Bell Frog status in the locality the following people/organisations were consulted in November 2015.

- Chris Wade – former Orica employee
- Gaby Kirwood (Environment Assessment Officer) – Wollongong City Council
- Lachlan Wilmott (Senior Operations Officer, Biodiversity) and James Dawson (Team Leader, Biodiversity), Paul Wearne, Jen Byrne – Office of Environment and Heritage
- Sharron Marks and Lou Gaudiosi – Local Residents, Port Kembla
- Garry Daly (Principal) – Gaia Research

As an outcome/action of the KPMP a survey and assessment of lands identified therein was undertaken by Garry Daly (Gaia Research 2008, 2009). These studies concentrated respectively on the southern and northern Port Kembla Green and Golden Bell Frog population elements. Daly also reviewed the older literature concentrating on the south Port Kembla population element that confirms that a population estimate of approximately 400 individuals has continued to decline since that time.

Anecdotal feedback from residents about the frog no longer being seen coupled with the provision of some actual monitoring data by Chris Wade suggests that the Green and Golden Bell Frog at Port Kembla has declined in recent years. With monitoring of the Orica built pond/habitat area revealing a gradual decline to about 30 detectable individuals in 2013 (Chris Wade unpublished).

Residential sites have had no Green and Golden Bell Frog recorded for several seasons (Sharron Marks, pers. comm.). Similarly, Coomaditchy Lagoon, a site monitored for many years by University of Wollongong researchers, has had no recorded Green and Golden Bell Frog for at least 5 years (Chris Wade pers. comm.). However, one recent undetermined anecdotal observation reported approximately 100 individuals. But, the exact site was not documented, and the fact that it was not known whether the individuals were all juveniles or recruited adults leaves the veracity of this observation unclear, and is still being pursued, (pers. comm., Paul Wearne, Lachlan Wilmott, Jen Byrne, James Dawson, all OEH).

Similarly, other more recent monitoring data apparently further supporting this trend may be available but was not received prior to this review (Chris Wade pers. comm.). So, whilst general trends have been towards an apparent decline, if the report of 100 individuals from another site is confirmed, it might be indicative that Green and Golden Bell Frog have gravitated to another ideal site and disappeared from more regular detection locations. This trend would be consistent with the known cyclic pattern of habitat occupation displayed by the species in other locations (see **Section 4.3**). So, the assessed decline, whilst concerning, remains to be determined as to whether reported trends in decline are real.

In the north Port Kembla area records are even more sporadic. In 2008, 15 individuals were detected over-wintering under old machinery in the 'spares yard' adjacent to the Port Kembla Coal Terminal (PKCT) (White 2008; Gaia Research 2009). Prior to this, the only confirmed then recent record was for an individual from a stormwater trash rack on Springhill Road at the outlet to stormwater discharge from Coniston in around 2000.

Following the appearance of Green and Golden Bell Frog within the Coal Loader Terminal increased interest, search effort and awareness has resulted in further observations in the Inner Harbour Precinct. Furthermore, during consultation for an assessment undertaken by the author (see ELA 2010) of a development in the north of the Gurungaty Waterway catchment near Beach Street, South Wollongong, it came to light that a number of observations of Green and Golden Bell Frog from Wollongong Golf Course had been reported to the former NSW Department of Environment, Climate Change and Water (DECCW, now OEH) (Lachlan Wilmott, Jen Byrne) and WCC personnel (Jedda Lemmon [now OEH], Gary Leonard (now Ecoplanning), Gaby Kirwood [still WCC] pers. comm.). These records do not currently appear in the Atlas of NSW Wildlife (OEH 2015b).

Further targeted surveys undertaken by Arthur White in association with development assessments in the Port Kembla industrial precinct resulting in the development of Management

Plans in the Inner Harbour precinct, has revealed Green and Golden Bell Frog records from Wollongong Greenhouse Park (Springhill Rd, South Wollongong) and culminated in establishment of habitat ponds within the Park as a strategic response from several operators within the Inner Harbour Port precinct (Biosphere, 2008a; b; 2009; 2010; 2012).

These irregular and sporadic observations provide little information about the species population size and/or conservation status, but the location of the various records does provide some clue as to how the north Port Kembla Green and Golden Bell Frog population element is operating. That is, it appears to be utilising the Gurungaty Waterway drainage line as a connective link to various fragmented areas containing habitat elements periodically occupied. These elements include water hazards within the golf course and along the watercourse itself, the Sewage Treatment Plant, fragmentary remnants of the Tom Thumb Lagoon wetland, Wollongong Greenhouse Park, the dune swale and vegetated areas along the dune system, the drainage tributaries of the Gurungaty Waterway along with the various detention and other constructed water bodies within sites of the Inner Harbour precinct (see **Figure 2.3**).

It is clear that the knowledge gaps in our understanding preclude any categorical statements about either northern or southern population elements of the Green and Golden Bell Frog population. It is a pressing concern that the Port Kembla Green and Golden Bell Frog population appears to be continuing to wane and to improve our understanding of the Green and Golden Bell Frog in the locality will require a coordinated ongoing monitoring program that seeks out habitat areas and occurrences across all tenures. Such a task is beyond the scope of this report or the proponent here.

6.2 Site survey and assessment results

6.2.1 Reference Site

Diurnal and nocturnal amphibian surveys were undertaken using standard methods revealed the presence of only a single species. The only species detected at the south Port Kembla reference site was the Brown-striped Marsh Frog (*Limnodynastes peronii*). This species was detected through dip netting for tadpoles. No individuals were heard vocalising during the survey.

6.2.2 Study area

Searches of the two detention structures and surrounds revealed no amphibians of any species. The habitat values present were unremarkable, but as noted throughout this report they cannot be ruled out as areas of potential habitat use.

7 Discussion and recommendations

The Recovery Program that culminated in the development of the Recovery Plan for the endangered Green and Golden Bell Frog in 2005 identified all the available records for the species across the species entire range, including the Port Kembla area (DEC 2005).

Subsequent studies and analysis undertaken during the development of the Port Kembla KPMP during 2007 identified several additional records and refined the understanding of the species local distribution in the locality (DECC, 2007). During the implementation of the Green and Golden Bell Frog Port Kembla KPMP targeted searches and habitat assessment actioned within the plan provided further point locations of occurrence (Gaia Research 2008; 2009) and identified potential connectivity corridors and likely habitat for the species in the Port Kembla area, particularly in the north Port Kembla south Wollongong areas.

Since that time a number of development related survey and assessment studies have been undertaken as well as opportunistic observations of the species in this area. On the basis of all these studies it is apparent that a likely small Green and Golden Bell Frog population continues to persist on the northern and southern periphery of the Port Kembla industrial area.

The northern element appears to be associated with the Gurungaty Waterway and Tom Thumb Lagoon drainage and wetland area draining to the south of the Wollongong CBD where sporadic occurrences have been recorded. Associated elements of this drainage area persist within the Wollongong golf course and also within remnants of the Tom Thumb Lagoon wetland bordering Springhill Road. Sporadic occurrences have also been observed in the vicinity of the Port Kembla coal loader and inner harbour industrial and port facilities triggering rescue 'missions' and management plans to facilitate their survival (Biosphere, 2012; 2015).

It is likely that the Green and Golden Bell Frog are utilising the Gurungaty Waterway as a movement corridor and parts of the remnant Tom Thumb Lagoon wetland, Wollongong Greenhouse Reserve and possibly the Port Kembla Sewage Treatment works, as well as, periodically, other detention structures in the northern Port Kembla industrial/port facilities as habitat elements.

The current proposal to redevelop the areas comprising the PK BLT facility includes removal of two such small detention/water treatment structures that have been assessed as being potential habitat for the species, although no specimens have actually been recorded utilising them. The structures have been surveyed and whilst considered unremarkable in the habitat values they may provide the species, it is impossible to rule out the possibility the species may periodically utilise them, given the unpredictable movement patterns and habitat utilisation trends often displayed by the species.

The most likely beneficial measure for the local population would be to undertake some off site habitat construction/rehabilitation and/or population monitoring measures. Such efforts are likely best directed at the southern Port Kembla population element where a greater habitat mosaic persists and where concerning trends of ongoing decline in population numbers have been reported (Chris Wade pers. comm.). A monitoring effort there from OEH, perhaps in concert with some survey effort in surrounding areas of the north Port Kembla area (Wollongong Greenhouse Reserve, Wollongong golf course, Port Kembla Sewage Treatment Plant and Tom

Thumb Lagoon) would likely provide an important snapshot of the current status of the species in the locality. Provision of compensatory or offset habitat in the vicinity of the proposed PK BLT facility is not considered advisable as to encourage Green and Golden Bell Frog to the subject site any more frequently than the current sporadic appearances only places these individuals in harm's way and likely increases mortality. The proposed facility is at the terminus of the Gurungaty Waterway and any useful habitat for the species is most likely to the north and outside the immediate port precinct.

Areas suitable for possible habitat construction and/or rehabilitation should be identified and assessed and where possible incorporate/link with other strategic activities and locations (e.g. Gurungaty Waterway rehabilitation, Wollongong Greenhouse Reserve, existing habitat offset ponds at the former Orica site). Rehabilitation and/or construction of Green and Golden Bell Frog habitat should be informed by referral to the Green and Golden Bell Frog Best Practice Habitat Guide (DECC 2008).

8 Conclusion

It is concluded that the removal of habitat elements in the form of small detention/water treatment structures in the northern Port Kembla industrial/port facilities is unlikely to place the Port Kembla Green and Golden Bell Frog population at risk of extinction, nor even the north Port Kembla element of that population. Consequently, in addressing Section 9.2.5 of the FBA, it is recommended that Green and Golden Bell Frog be removed from the SEARs as an IFC, as impacts that have been identified from the proposal are unlikely to:

- cause the extinction of a species or population from an IBRA (Interim Biogeographic Regionalisation for Australia) subregion (i.e. the Illawarra), or
- significantly reduce the viability of a Green and Golden Bell Frog population

The 'species polygon' for the purposes of quantifying impacts from the proposal under the FBA is provided in **Figure 2.1**. The species polygon is 0.09 ha in area, and preliminary calculations utilising the Major Projects module of the Biobanking Credit Calculator have identified that 1 species credit will need to be retired to meet the offset obligations of the FBA. Following confirmation from OEH that the Green and Golden Bell Frog has been eliminated as an IFC, an assessment of the impacts can proceed following the FBA and the preparation of a Biodiversity Assessment Report in accordance with the FBA will be necessary.

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Appendix A: Relevant experience of Ross Wellington

Ross is an ecologist/zoologist with over 30 years' experience in wildlife and environmental investigations. Since graduating with a triple major in biological sciences from Macquarie University in 1977, he has worked as a science teacher and environmental educator (NSW DET), an ecological/environmental consultant, a technical officer within the herpetology, ornithology and ichthyology departments of the Australian Museum and as a senior wildlife conservation and management officer within the NSW National Parks and Wildlife Service (NPWS) and the former NSW Department of Environment and Conservation (DEC) between 1998 and 2005.

Ross has subsequently worked as a professional ecological consultant and been engaged to undertake many herpetological projects on Australian amphibians, particularly the Green and Golden Bell Frog. During this time and in the various professional roles he has held, Ross has acquired an excellent knowledge and understanding of the ecology of NSW threatened flora and fauna, native vegetation and associated ecological and threatening processes, and has been involved in many key Government initiated broad-scale natural resource assessment projects. These have included some of the first landscape scale ecological investigations into impacts of forestry practices and bushfire on the ecology of vertebrate fauna on the far south coast of NSW. The methodologies developed during these 1980-81 studies evolved into those used for undertaking Comprehensive Regional Assessments (CRA) under the CRA/Regional Forestry Agreement (RFA) process in which he was also involved on the south coast, central coast and north coast of NSW. He was the NSW lead agency representative on National Working Groups dealing with Frog Disease and Cane Toad threats and control measures.

Ross's key area of expertise, with greatest relevance to this project and process, is that he is a recognised leading authority on herpetofauna and was employed by the NSW NPWS/DEC for over 7 years during which time one of his key roles (amongst others) was coordinating the recovery program and preparation of the National Recovery Plan for the Green and Golden Bell Frog. He also coordinated the NPWS/DEC response or provision of advice on all major developments in NSW where Green and Golden Bell Frog were implicated or potentially impacted. Other relevant matters include his possession of a diverse range of technical skills including undertaking systematic and targeted flora and fauna surveys, habitat assessments, vegetation classification and mapping, data collation and analysis as well as spatial analysis using Geographic Information Systems (GIS). He has undertaken numerous systematic and targeted amphibian and reptile surveys throughout much of NSW and interstate.

Relevant roles and project experience that demonstrate Ross's experience with respect to making an expert judgement on Green and Golden Bell Frog impact assessment and conservation through either preparation, authorship or significant input include:

- Threatened species recovery plans for:
 - Green and Golden Bell Frog
 - Broad-headed Snake
 - Blue Mountains Water Skink
 - Gould's Petrel

- *Grevillea caleyi*
- Southern Bell Frog
- Southern Brown Bandicoot
- Brush-tailed Rock-wallaby
- Yellow-bellied Glider
- Giant Burrowing Frog
- Red-crowned Toadlet
- Mount Royal NP Threatened Species Management Plan
- Morisset Forestry District Environmental Impact Statement. Supporting Document No. 7 Reptiles & Amphibians - baseline regional audit of all herpetofauna and ecological assessment and analysis of forestry practice impacts in the region demarcated by the area bounded by the Hawkesbury and Hunter Rivers.
- Herpetofauna surveys of the Ravensworth State Forest area for the proposed Mt Owen open cut coal mine. (Resource Planning Pty Ltd) studies conducted produced a baseline herpetofaunal inventory and detection of the Green and Golden Bell Frog at the site.
- Kurnell Desalination Plant – (Blue Water) Assessed the causative factors contributing to the lowering of the water table at, and adjacent to the Kurnell Desalination Plant, including the Calsill Wetland and dune system and Boral and Rocla site wetlands. This assessment also made recommendations for the rehabilitation and weed control of surrounding lands impacted by de-watering and mindful of the potential for impact on the endangered Green and Golden Bell Frog habitat adjacent.
- Green and Golden Bell Frog Recovery Program – (NSW NPWS/DECC) Coordinated the NSW Recovery Team and Recovery Program over a seven year period. This involved visiting and assessing all extant Green and Golden Bell Frog populations in NSW, chairing Recovery Team meetings comprising most of the then recognized Green and Golden Bell Frog experts. Provided input/advice or coordination of all Green and Golden Bell Frog related developments for which NSW NPWS/DECC had a statutory role during 1998 to 2004 (many high profile state significant developments (e.g. M5 East motorway, Cronulla STP upgrade and ocean outfall pipeline, Sydney 2000 Olympics, Kooragang Island Coal Loader, Mt Owen Open Cut Coalmine). Developed the NSW NPWS/DECC Green and Golden Bell Frog Threatened Species Information Profile, Green and Golden Bell Frog Environmental Impact Assessment Guidelines, State-wide DECC Frog Hygiene Protocol and Policy, the Priority Action Statement for the Green and Golden Bell Frog, among a plethora of other administrative and advisory roles and functions related to conservation, management and assessment of impacts on various wildlife. Ross played a pivotal role in integrating the Green and Golden Bell Frog Recovery Planning program with other state-wide Threat Abatement Planning programs including: Bitou TAP, Red Fox TAP, Gambusia TAP, Frog Chytrid TAP and Cane Toad TAP. Provided expert herpetological advice to and on behalf of the lead NSW Conservation agency and was NSW representative on a number of National Working Groups. Oversighted all Green and Golden Bell Frog research project licensing on behalf of NPWS/DECC.
- Green and Golden Bell Frog Key Population Management Plans – (NSW DECC). Facilitated nine stakeholder workshops in Sydney, Wollongong and the Hunter Valley to develop specific management plans for key Green and Golden Bell Frog populations. This was done as an implementation of the NSW and National Green

and Golden Bell Frog recovery plan on behalf of DECC. Part of the process was provision of a locality specific technical overview presentation for each workshop regarding the Green and Golden Bell Frog, the recovery program and local recovery issues to all stakeholder participants. The process then sought stakeholder input and produced draft and finalized/DECC endorsed KP Management Plans for - **Port Kembla**, Greenacre/Upper Cooks River, Kurnell, Lower Hunter (Kooragang/Hexham), Upper Hunter (Mt Owen, Ravensworth, Bayswater), Middle Hunter (East Maitland/Wentworth Swamp/Ellalong), Lower Cooks River (Arncliffe), Georges River and Parramatta River (Holroyd, Homebush, Camelia) Key Populations of the species. The facilitated workshop process for land owner/managers sought to raise the profile as well as strategic and specific requirements of the Green and Golden Bell Frog in each area across all land tenures and to provide an opportunity for input and hence 'ownership' by stakeholders. Also critically reviewed the other three DECC endorsed KP Management Plans for Shoalhaven Green and Golden Bell Frog populations and two other non-endorsed KP Management Plans for the Central Coast (Davistown/Avoca Lagoon) and Port Macquarie (Lake Innes/North Shore).

- M5 West Widening: Biodiversity Working Paper. (RTA). ELA undertook an ecological assessment of the proposed M5 West Widening under Part 3A of the EP&A Act for the RTA. Works included a desktop assessment, vegetation mapping, Green and Golden Bell Frog habitat assessment and flora and fauna survey over approximately 20 km of the M5 Motorway. Potential impacts of the proposal were assessed pursuant to the EP&A Act and EPBC Act. Opportunities to minimise impacts were identified and overall impacts were assessed in reference to the current motorway use and existing disturbances.
- Riverlands, near Menai NSW – (Bankstown City Council) This project involved a preliminary assessment of Green and Golden Bell Frog habitat, forming part of the assessment of a development application for a go-kart and mini golf facility.
- Botany Bay Cable Project – (Energy Australia). This project involved undertaking the terrestrial ecological assessment of the 132kVA power cable installation proposal from Bunnerong sub-transmission station in the north to the Kurnell sub-transmission station in the south. In particular this involved an assessment of the potential impacts on Eastern Suburbs Banksia Scrub declared critical habitat at Bunnerong and the Green and Golden Bell Frog, among other threatened species and endangered ecological communities, at Kurnell, as a component of a Part 3A NSW approval and its referral to the Commonwealth under EPBC Act requirements.
- Kurnell 132kVA Feeder Tower Refurbishment – (Energy Australia) Undertook ecological assessment of Energy Australia's Kurnell to Picnic Point 132 kVA feeder towers scheduled maintenance and refurbishment works. This involved assessment of risk to high quality Green and Golden Bell Frog habitat across various land tenures traversed by the feeder route on the Kurnell Peninsula. It also recommended strategies for reducing or mitigating risk factors associated with the methods to be used by Energy Australia contractors including contractor training/induction.
- Kincumber Targeted Surveys – (NSW DECC) Undertook habitat assessment for recent sighting of the Green and Golden Bell Frog at Kincumber in the intervening area between known Green and Golden Bell Frog populations at Avoca and Davistown. Provided a habitat appraisal, mapping of habitat elements present and

recommendations for enhancement and management of existing habitat in the locality. Carried out local community awareness raising consultation process and reporting/recording protocol.

- M5 East and M6 Motorway expansion proposals – (RTA) Undertook an assessment of known and potential Green and Golden Bell Frog habitat at the Marsh Street intersection and along the proposed north-south M6 route to determine potential/likely impacts of the proposed freeway construction works.
- Bayswater Power Station – (Delta Electricity) Carried out targeted habitat assessment for the Green and Golden Bell Frog with respect to proposed construction of a second electricity generation facility on the existing Bayswater buffer lands. This required a survey of potential habitat areas along existing drainage lines and surrounding water/wetland features in relation to the proposed development footprint.
- Green and Golden Bell Frog Biocertification - North West Growth Centres Riverstone Precinct – (GCC now NSW Planning) Undertook prescribed Green and Golden Bell Frog survey methodology to meet the Biocertification requirements of the Growth Centres SEPP. Provided expert advice on preferred conservation measures for the Green and Golden Bell Frog in the Riverstone precinct and beyond and consulted with DECC to achieve a parsimonious Biocertification outcome. Advised on the preferred habitat offsetting requirements for compensatory habitat and habitat creation and enhancement of features to be provided as part of the precinct development release, approach to riparian and stormwater management.
- Land and Environment Court Expert Witness – (Sutherland Shire Council - SSC) Provided expert advice and testimony to the Land and Environment Court relating to conservation and protection of Green and Golden Bell Frog habitat at Kurnell in an appeal matter Rocla V SSC and NSW Planning.
- Environmental Impact Assessment and 8 Part-test for the Green and Golden Bell Frog subdivision proposal at Tramway Road, North Avoca NSW. – (Chase Burke & Harvey Development Architects) This involved undertaking site survey and proposed mitigation measures to offset possible impacts on the Green and Golden Bell Frog, due to a subdivision and dwelling construction on allotments adjacent to the North Avoca Green and Golden Bell Frog Key Population.
- Drain Maintenance Works- approaches and methods at Davistown – (Gosford City Council) – This project involved the survey and assessment of all the drainage culverts at Davistown and their location relative to the known critical areas of habitat for the Davistown Key Population of the Green and Golden Bell Frog. It also involved identifying management and flood mitigation issues and developed recommended management practices, a works schedule and method framework integrated with the Davistown-Avoca Green and Golden Bell Frog Key Population Management Plan.
- Wonga East and Wonga West Longwall Coal Mining Proposal - Cataract Dam Special Area – (ERM for Gujarat NRE) – targeted habitat assessment for the threatened Green and Golden Bell Frog, Giant Burrowing Frog, Red-crowned Toadlet, Littlejohn's Tree Frog, Stuttering Frog, Broad-headed Snake and Rosenberg's Goanna. Carried out on ground surveys and an assessment of potential habitat for these species in critical areas proposed for undermining. This assessment was designed to assist in the refinement of the mine footprint and to avoid surface impacts on important habitat elements.

- Green and Golden Bell Frog Best Practice Habitat Guide and Identification Brochure – (NSW DECC)
 - Part 1 Brochure - Developed an effective Green and Golden Bell Frog Brochure to gain community support and assistance with a reliable identification guide and reporting protocol. Included formulating a distribution plan with the intention that the brochure be distributed to key land owners in areas in the vicinity of important/significant Green and Golden Bell Frog populations and where reliable detection is often difficult.
 - Part 2 Best Practice Guide - Researched elements of known habitat required by the Green and Golden Bell Frog throughout its distribution. This included investigation of examples of created and modified habitats that have functioned in attracting or sustaining Green and Golden Bell Frog populations. An illustrated guide was produced to advise and encourage Green and Golden Bell Frog habitat creation or enhancement/rehabilitation initiatives. The brochure was developed as a recovery plan action with the target audiences being land owner/managers with the potential to provide and enhance habitat elements in key areas.
- Reptile and Amphibian Surveys of the Narooma Forestry District – Wandella & Dampier SF detected the Giant Burrowing Frog *Heleioporus australiacus* for the first time in the gap region between Sydney basin GBF populations and the southern NSW/Vic GBF populations now considered to be separate species; also identified *Mixophyes balbus* habitat that resulted in redetection of this southern most population of the species now also considered to be a genetically distinct entity yet still to be described.
- Land and Environment Court Expert Witness – (Hawkesbury City Council) Provided expert advice and testimony to the Land and Environment Court relating to the conservation and protection of Giant Burrowing Frog, Red-crowned Toadlet and Stuttering Frog habitat in the vicinity of a proposed commercial groundwater extraction development at Mount Tootie near Bilpin, NSW.
- Launceston Airport Development – (Airservices Australia). Undertook habitat assessment and targeted surveys for Growling Grass Frog *Litoria raniformis* and developed a site management plan and monitoring program. The project revealed that a remnant population persists at Launceston Airport and its immediate downstream catchment but is absent from other nearby drainages. Fire Fighting Foam utilized during emergency drills produced residues that were implicated in the species continued survival at the location.
- Electrical Powerline Feeder Upgrade Homebush – (Ausgrid) Undertook ecological assessment of a proposed powerline feeder upgrade and joint box installation. The proposed installation site is in the vicinity of detention structures possessing habitat for the Green and Golden Bell Frog and within the vicinity and drainage of the Homebush Green and Golden Bell Frog Key Population. This project involved assessing the detailed installation process and its associated works and devising approaches, methods and induction of personnel to enable the project to proceed in a sensitive and low risk manner.
- Green and Golden Bell Frog Survey and habitat assessment - South Cecil Hills Residential Land Release Area.
- Targeted Green and Golden Bell Frog surveys at the 2KY radio station lands at Homebush in the Sydney Olympic Park precinct in relation to works proposed for

an upgrade to radio transmission facilities at the site, the species was detected during the site investigations.

- Land and Environment Court Expert Witness for Wollongong City Council – (PGH Developments Maddens Plains). Multiple threatened species impacts from proposed development including Giant Burrowing Frog, Red-crowned Toadlet, Heath Frog, Rosenberg's Goanna, Broad-headed Snake and Stuttering Frog.
- Land and Environment Court Expert Witness – (Warrigal Homes). Provided expert advice regarding the Green and Golden Bell Frog *Litoria aurea* and a presumed Endangered Ecological Community at south Wollongong. Undertook a LEC convened s34 Consultation at Wollongong City Council and successfully resolved/negotiated ecological issues from the matter.
- Emerald Hills Biocertification threatened species expert report (Green and Golden Bell Frog) in relation to a residential rezoning and Biocertification of the amended planning instrument.
- Sydney Olympic Park and radio 2BL site Green and Golden Bell Frog surveys maintenance works and development assessments.
- Green and Golden Bell Frog Management Plan South Nowra prepared for the new Masters Home Improvement Centre site as Shoalhaven City Council condition of consent.
- Coalcliff Site Biobank Offset Assessment - Targeted Threatened Species Surveys and habitat assessment – Heath Frog, Red-crowned Toadlet and Broad-headed Snake.
- NSW Frog Hygiene Protocol (NPWS/DEC) Developed the NSW Frog Hygiene Protocol delivered to the National Frog Disease Workshop (Cairns 2000). This NPWS/DEC Publication is used as a guide/policy throughout the agency as well as a required matter for licensing and other DECC/OEH coordinated activities.
- Foundation Member of the NSW Declining Frog Working Group (DFWG) Member of the NSW Declining frog working group which was initially established within the NSW NPWS/DEC/DECC to investigate frog related issues, develop policy and advise executive on general frog related conservation matters outside of its specific Threatened Species regulatory responsibilities. This group originally co-opted external frog authorities to attend internal workshops as required but the group was later to become an external group with state agency and other frog expert members now attending.
- Member of the NSW Frog and Tadpole Study Group 1992- 2002