

TNG LIMITED



TNG Limited

Darwin Refinery
Notice of Intent

October 2015

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Appendix A – Darwin Harbour Site of Conservation Significance Information Sheet

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1. Introduction

1.1 Overview

TNG Limited (TNG) submits this Notice of Intent (NOI) to the Northern Territory Environment Protection Authority (NT EPA) and Department of Lands Planning and Environment (DLPE) as formal notification of its proposal to construct and operate the Darwin Refinery (Refinery).

TNG proposes to establish the Refinery to process magnetite concentrate to produce:

- vanadium pentoxide - for use in steel, non-ferrous alloys, chemicals, catalysts and energy storage (vanadium redox batteries);
- titanium dioxide pigment - for use in paint, plastics, paper and inks; and
- pig iron - for use in steel making.

The three products will be exported through the Port of Darwin's East Arm Wharf to international customers.

The Refinery is proposed on land within Lot 1817, Hundred of Ayers, Middle Arm, Darwin, Northern Territory (NT). The site is located adjacent to the Elizabeth River and is approximately 507 ha. The Refinery and associated access roads, supporting infrastructure and services comprise a development footprint of approximately 140 ha (approximately 28% of the total Lot area).

The magnetite concentrate will be produced at TNG's proposed Mount Peake Project approximately 1,400 km south of Darwin (Figure 1-1), which is the subject of a separate environmental assessment and approvals process. The Mount Peake Project will involve the mining of a polymetallic ore body (enriched with vanadium, titanium and iron) and beneficiation of the ore to produce magnetite concentrate. The concentrate will be transported by rail from the mine site to the Refinery.

This NOI was prepared with reference to the *Draft NT EPA Guideline for the Preparation of a Notice of Intent* (May 2015) and provides a preliminary description of the Refinery Project including associated activities and services on site, the existing environment of the Project area, and potential impacts and mitigation measures.

TNG submits this NOI for the NT EPA to determine if the proposed action triggers assessment under the *Environment Assessment Act 1982*.

A referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) will be submitted to the Commonwealth Department of the Environment (DotE) to determine if the Refinery Project requires assessment under the EPBC Act.

1.2 Background

The Refinery involves downstream processing to provide added value to the magnetite concentrate produced at Mount Peake. The Refinery is dependent on the Mount Peake Project and if the mine did not proceed, the Refinery would not proceed. However, the Mount Peake Project is a project in its own right and could proceed (subject to approvals) in the event the Refinery did not proceed.



Whilst the Refinery is a project proposed by the same proponent as the Mount Peake Project, TNG requests that the Refinery proposal be assessed separately. There are a number of reasons for this including:

- to reduce the likelihood of the Refinery environmental assessment and project approvals process impacting the Mount Peake Project approval process and timing (a project in its own right independent of the Refinery); and
- the two projects are 1,400 km apart, in different biogeographical regions, and not connected to each other by ancillary infrastructure. Environmental issues relevant to the two projects will be different.

1.3 Proponent details

The proponent for the Refinery is TNG Limited. TNG is an Australian resource company focused on the exploration, evaluation and development of a multi-commodity resource portfolio in the NT and Western Australia. TNG is focused on the evaluation and development of the Mount Peake Vanadium-Titanium-Iron Project. TNG also has a broad range of exploration projects in the NT ranging from advanced projects with existing resources to greenfields exploration. Its tenements include exposure to a wide range of commodities including gold, lead, zinc, nickel and copper.

Contact details for the proponent and the consultant are contained in Table 1-1 and Table 1-2.

Table 1-1 Proponent contact details

Company	TNG Limited
ABN	12 000 817 023
Contact	Paul Burton Managing Director
Address	PO Box 1126, Subiaco, WA 6904, Australia
Phone	+61 8 9327 0900
Email	peb@tngltd.com.au

Table 1-2 Consultant contact details

Company	GHD Pty Ltd
Contact	Ian McCardle Principal Environmental Scientist
Address	999 Hay Street Perth WA 6000
Phone	+61 8 6222 8995
Email	ian.mccardle@ghd.com



LEGEND

- Major Road
- Railways

Paper Size A4
0 50 100 150 200
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 52



Darwin Refinery NOI

Job Number 61-32573
Revision A
Date 23 Oct 2015

Project Location

Figure 1-1

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2. Project Area

2.1 Project site

2.1.1 Location and tenure

The Refinery will be located on Lot 1817, Hundred of Ayers, Middle Arm Peninsula of Darwin Harbour. Access to the site is via Channel Island Road and is approximately 30 km by road from Darwin, 9 km from Palmerston and 22 km by road or rail from East Arm Wharf (Figure 2-1).

The Refinery site is located adjacent to Elizabeth River, near the Elizabeth River Bridge. High voltage power lines, the Amadeus Gas Pipeline, a water supply pipeline and Alice Springs – Darwin Railway are in close proximity to the site's southern boundary (Figure 2-2).

Lot 1817 is vacant Crown Land. The Register of Native Title Claims, Register of Indigenous Land Use agreements, Native Title Register and unregistered applications indicate that Section 1817, Hundred of Ayers was assessed under Native Title application DC96/4 Darwin Larrakia. It was determined that 'Native Title does not exist'.

Lot 1817 is separated into two main areas. The majority of the Lot is land based and adjacent to Channel Island Road, and a smaller area is located to the west and follows the coastal perimeter of Lot 1902 (Figure 2-2). Lot 1847, a utilities corridor, traverses the eastern section of Lot 1817.

Lot 1817 is approximately 507 ha of which 40 ha is mangrove forest and intertidal zone, and the balance of 467 ha is terrestrial land. Approximately 140 ha will be developed, comprising 28% of the total Lot area.

2.1.2 Land use zoning

Land use zones are specified in the *Northern Territory Planning Scheme* (DLPE 2015) (NT Planning Scheme) indicating the type of land use that is preferred in a particular location. Four land use zones apply to the Project Site:

- Zone FD (Future Development) - A majority of the land mass of Lot 1817;
- Zone CN (Conservation) – the mangrove forest and intertidal zone around the FD zone;
- Zone U (Utilities) – running through the eastern part of Lot 1817; and
- Zone M (Main Road) – the eastern part of Lot 1817 between Lot 1847 utilities corridor and Channel Island Road.

Figure 2-3 illustrates the land use zoning stipulated in the NT Planning Scheme. Application of the planning context to the Project is discussed in section 2.2.2.

Zone FD - Future Development

The Refinery and associated infrastructure is proposed to be established on the area of Lot 1817 that is zoned FD. FD is defined as:

an interim zone identifying an area that is intended for future rezoning and development in accordance with an Area Plan (where applicable) and its purpose is to: (a) limit uses and development within the zone to a level that will not prejudice the future development; and (b) provide for development in accordance with the Area Plan (where applicable) once services are (or can be) made available to the land.

Subdivision is not to prejudice the intended ultimate subdivision and future use or development of the land.

The Draft Darwin Regional Land Use Plan 2014 (NT Planning Commission 2014) identifies land on Middle Arm as an area with potential for strategic industrial development including additional deep water port development. Refer to section 2.2.2 for further discussion.

The establishment and operation of the Refinery is consistent with the Zone FD purpose and Draft Darwin Regional Land Use Plan 2014.

Zone CN – Conservation

Under the NT Planning Scheme the primary purpose of Zone CN is to conserve and protect the flora, fauna and character of natural areas. Development is to be sensitive to the natural features and habitats of the zone and be so sited and operated as to have minimal impact on the environment.

Approximately 40 ha of intertidal zone including mangroves are located within Lot 1817. No mangroves will be cleared and no direct impacts on mangroves are anticipated as part of this Project.

Zone U – Utilities

The purpose of Zone U is to ensure the use or development of land within Zone U does not prejudice the future development of the utility.

Land in Zone U may be used or developed for a utility in accordance with the requirements of the Agency or service authority responsible for the utility on the land without consent. Land in Zone U may be used or developed other than for a utility only with consent and in accordance with the requirements of the Agency or service authority responsible for the utility on the land. Under the NT Planning Scheme a utility may include trunk sewers, sewerage ponds, trunk water mains, water storage facilities, electricity transmission and substation facilities, gas pipelines and the like.

To support development of the Refinery, the utilities corridor will need to be crossed by an access road, rail line, water pipeline, gas pipeline and communications infrastructure.

Zone M - Main Road

The purpose of Zone M is to ensure that development in Zone M does not prejudice traffic safety or the amenity of the main road or the future development of a proposed main road as applicable.

Upgrade to the connection between the site and the main road will be required in Zone M as part of this Project.



2.2 Regional location context

2.2.1 Surrounding land and water uses

The land and water uses surrounding the Project site (Figure 2-1) include:

- Elizabeth River Bridge, Palmerston Boat Ramp and Palmerston to the north;
- Channel Island Road to the south;
- Railway, road and utilities corridors to the east;
- Darwin Harbour to the west; and
- Elizabeth River, Blaydin Point Ichthys onshore project and East Arm Wharf to the north-west.

The nearest emergency services are located approximately 10 km away, in Palmerston.

Darwin Harbour has a mixture of commercial shipping, military activity and recreational boating and fishing. Coastal recreational activities such as sailing and diving are also popular.

Beneficial Uses for Darwin Harbour were declared under the *Water Act 1992*. These are Aquatic Ecosystem Protection and Recreational Water Quality & Aesthetics.

Darwin Harbour is a NT Site of Conservation Significance (SOCS), and is recognised as an internationally significant site, representing one of the richest coastal environments in the Asia Pacific region in one of the world's least impacted marine regions. The Harbour is dominated by mangroves which largely remain in undisturbed condition and represent more than 5% of the NT's entire mangrove area. The mangroves support specialised fauna, including invertebrate species and mammals, bats and mangrove-endemic bird species (NRETAS 2010).

A diverse range of marine species including dugong, dolphins, marine turtles and fish occur within the Harbour. A total of 15 threatened species have been recorded, and 80 species recorded from the Darwin Harbour SOCS have been listed under international conventions or bilateral agreements protecting migratory animals (NRETAS 2010). A copy of the NT SOCS Darwin Harbour information sheet is provided in Appendix A.

2.2.2 Regional planning context

The Project site is contained within the proposed 1,000 ha Middle Arm Industrial Precinct, a Land Development Corporation initiative that provides access to industrial and commercial land under the *Land Development Corporation Act*.

The *Draft Darwin Regional Land Use Plan 2014* (NT Planning Commission 2014) identifies land on Middle Arm as an area with potential for strategic industrial development including additional deep water port development.

The Middle Arm Industrial Precinct is designed to accommodate large strategic industrial lots for downstream gas processing and gas related industry with access to an extensive corridor network to carry utilities, gas, feedstock and products. Developments (by others) will include commercial and support industry zones, planned extractive industry depot and material processing, and a rail spur line with a site to maintain and store rolling stock.

As described in section 2.1.1, land to the east of Lot 1817 is zoned Utilities, Main Roads, Proposed Main Roads and Railway. Land to the north, south and west contains intertidal areas and mangrove forests that connect the site to the Elizabeth River and Darwin Harbour, and have been zoned for Conservation (Figure 2-3).

The proposed Refinery is consistent with the industrial nature of the Middle Arm Industrial Precinct. However, under the Zone FD general industry and light industry are prohibited (although the Refinery is consistent with the purpose of Zone FD). A rezoning application may therefore be required.

Land Development Corporation has advised (pers. comm. October 2015) that a subdivision application would be submitted to separate the titles of the western section of Lot 1817 that follows the coastal perimeter of Lot 1902.

The mangroves will not be cleared for the Project, and thus the Proposal is consistent with the objective of Zone CN - Conservation.

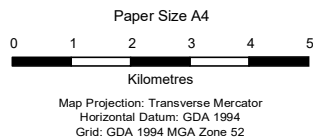
The NT Planning Scheme, Clause 6.14 relates to land subject to flooding and storm surge. The site is located in a primary and secondary storm surge area. No works are proposed in the primary and secondary storm surge areas. Infrastructure is proposed in the Extreme Storm Surge Event Area (10,000 year average recurrence interval) (refer to section 6.3 of the NOI).

The NT Planning Scheme, Clause 6.16 Excavation and Fill applies to the FD Zone – the purpose of the clause being to ensure that excavation or filling of land does not adversely affect adjacent land or water or the quality and associated riparian areas. Under this clause any proposed excavation and/or fill for the project areas is likely to require consent.

No works are proposed below the high tide level.

The NT Planning Scheme, Clause 10.2 relates to clearing of native vegetation, in this case in the Conservation Zone, and specifies all clearing of native vegetation in the Zone CN requires consent. No clearing of mangroves or intertidal vegetation in the Zone CN of the Project site is proposed.





Legend

 Project area



TNG LIMITED

Darwin Refinery NOI

Job Number 61-32573
Revision A
Date 23 Oct 2015

Project Area and Surrounds

Figure 2-1

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LEGEND

- Road
- - - Gas pipeline
- + + + Railway
- Cadastre

Paper Size A4

0 200 400 600 800

Metres

Map Projection: Transverse Mercator

Horizontal Datum: GDA 1994

Grid: GDA 1994 MGA Zone 52



Darwin Refinery NOI

Job Number 61-32573

Revision A

Date 23 Oct 2015

Project Site

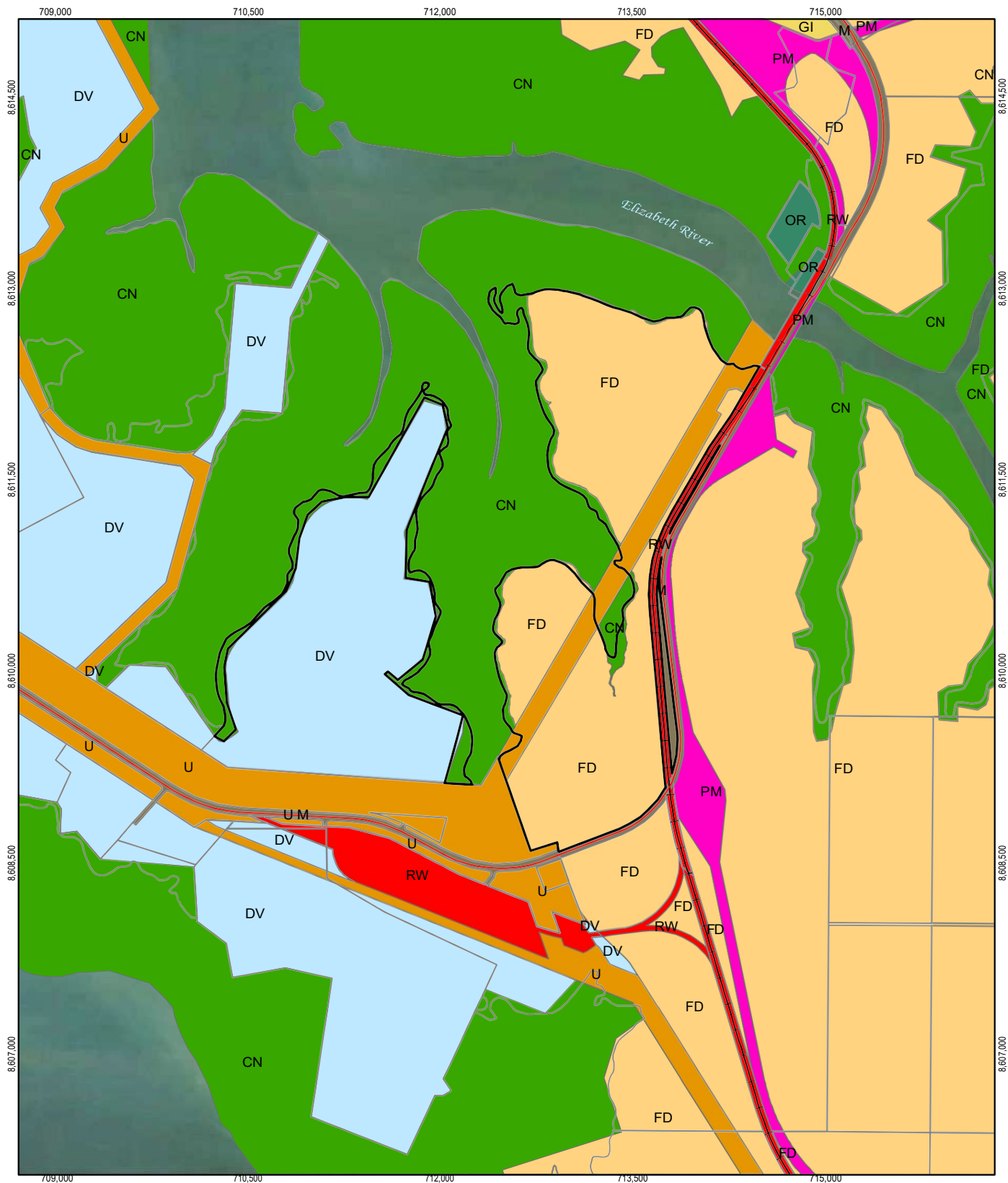
Figure 2-2

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LEGEND

Road	Town Planning Scheme	GI, General Industry	PM, Proposed Main Road
Railway	CN, Conservation	M, Main Road	RW, Railway
Project site	DV, Development	OR, Organised Recreation	U, Utilities
Cadastre	FD, Future Development		

Paper Size A4
0 0.5 1 1.5
Kilometers
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 52



Darwin Refinery NOI

Job Number 61-32573
Revision A
Date 23 Oct 2015

Land Use Zoning

Figure 2-3

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3. Key Legislation

Key legislation applicable to this Project includes:

- Commonwealth
 - *Environment Protection and Biodiversity Conservation Act 1999* – related to threatened species and migratory species and potentially approval from the Federal Minister for the Environment under this Act. A Referral under the EPBC Act will be submitted to DotE for assessment and determination.
- Northern Territory
 - *Environmental Assessment Act 1982* – a NOI is submitted to the NT EPA to determine if assessment and environmental approval is required under this Act.
 - *Planning Act 2009* – the NT Planning Scheme is applicable to the Project and the assessment and approval process for the Project applies. Approval from the NT Minister of Lands and Planning would be required.
 - *Water Act 1996* – the Project is located adjacent to the Darwin Harbour which has declared beneficial uses under the Act. The declared beneficial uses must not be impacted by the Project. No wastewater discharge is required.
 - *Waste Management and Pollution Control Act 1998* (WMPC Act) – The Project will generate waste which falls under Schedule 2 Activities of the WMPC Act. The Project will generate waste for disposal by burial (off site) (Part 1 of Schedule 2 that requires an Environment Protection Approval) or onsite (Part 2 of Schedule 2 that requires an Environment Protection Licence) prior to Project commencement.
 - *Work Health and Safety (National Uniform Legislation Act 2011* (WHS Act)) and *Work Health Safety (National Uniform Legislation) Regulations* (WHS Regulations) - related to storage of reagents at the Project site which potentially requires approval and a licence under this Act. The Refinery is likely to be classified as a Major Hazardous Facility due to onsite storage of hydrochloric acid, liquid oxygen, ammonia, liquid chlorine (and potentially other hazardous chemicals subject to further concept design) above threshold limits specified in Schedule 15 NT WHS Regulations and *Control Of Major Hazardous Facilities National Standard 1014(2002) and National Code of Practice 2016(1996)* (National Occupational Health and Safety Commission 2002) related national standards.

Activities associated with the Project are also governed by a range of other Commonwealth and NT legislation, policies and guidelines. An overview of those relevant to the proposed development is provided in Appendix B.



4. Project Description

4.1 Project extent

TNG is seeking approval for the construction and operation of the Refinery and associated activities proposed on Lot 1817.

Third parties will provide services external to the Lot boundary including concentrate transport to the Refinery, the transport of products by rail from the Refinery to East Arm Wharf, port activities including the unloading, storage, handling and export of products, port importing activities for consumables such as coke and limestone, and the transport of consumables by rail to the Refinery. Third party services will assume responsibility for environmental management measures associated with their activities covering potential impacts such as spill management, air emissions and noise emissions.

4.2 Project timing and staging

Construction of the Refinery is scheduled to commence in late 2016 with first production in late 2018, subject to statutory approvals and approval of the Mount Peake Project. The construction period is anticipated to be 24 months over both wet and dry seasons. The design life of the Refinery will be 40 years i.e. longer than the current estimated 15 year production life of the Mount Peake Project. Additional resources may be sourced from the Mount Peake area (subject to the results of further exploration drilling and economic evaluation) or from third parties.

Ultimate decommissioning of the site would be evaluated throughout the operation of the Refinery and discussed as part of ongoing licence requirements.

4.3 Processing capacity and products

The Refinery will process 894,000 tonnes per annum (tpa) of magnetite concentrate during years 1 – 4 with process capacity doubling to 1,788,000 tpa from year 5.

At full production the refinery complex will produce:

- 19,700 tpa of vanadium pentoxide (V_2O_5) flake;
- 292,000 tpa of pigment grade titanium dioxide (TiO_2); and
- 856,000 tpa of 95% pig iron ingots.

4.4 Processing

Processing involves ore preparation, followed by a pre-leach that precedes the vanadium selective *TIVAN*® leach, and a solvent extraction process.

The three products result from the vanadium precipitation process, and pig iron and titanium dioxide pigment plants. A simplified process block diagram is shown in Figure 4-1, with the key steps in the process described below. The description is based on the refinery operating at full production.

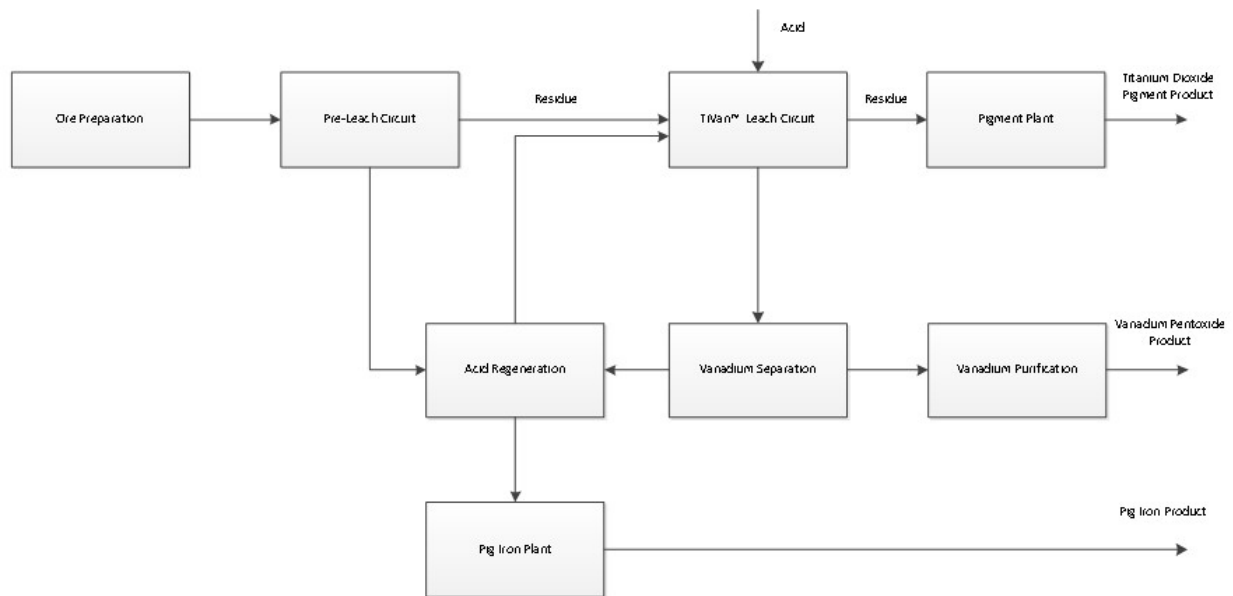


Figure 4-1 Simplified process block diagram

4.4.1 Train unloading

On average one train load of concentrate per day will be delivered to the refinery from Mount Peake. Each train will have 60 hopper wagons with a capacity of 92 tonnes of concentrate each (5,520 tonnes total). Concentrate will be unloaded via bottom discharge rail wagons over a nine hour period and conveyed to the Roaster Feed Stockpile.

4.4.2 Ore Preparation

The titanomagnetite concentrate stockpile will be housed in a shed to minimise the addition of water to the feed due to rainfall and to reduce dust generation from wind erosion.

The stockpile sits on top of a tunnel and a chute beneath the centre of the stockpile allows for the concentrate to be discharged onto a conveyor positioned inside the tunnel. The concentrate is fed to the ore-preparation process where it is treated to improve leaching in the subsequent pre-leach process.

4.4.3 Pre-Leach Circuit

The treated product from the ore-preparation process is fed to a series of agitated leach tanks which reduce the deleterious element concentration for the *TIVAN*® leach circuit.

After leaching, the slurry is transferred to a thickener to increase the solids content. The thickener overflow is sent to the regeneration plant where the solution is treated before recycling back to the pre-leach circuit. The thickener underflow is filtered and the filtrate is sent with the thickener overflow to the regeneration plant.

4.4.4 Iron reduction and pig iron production

The regeneration process generates an iron oxide powder that is further processed to create metallic iron and pig iron ingots.

A small split stream of this intermediate iron oxide product will be reduced using coke in a small multiple hearth furnace to generate metallic iron which is fed to the redox reduction tank located after the *TIVAN*® leach circuit.



The remainder of the iron oxide, generated by the regeneration process, is fed to a shaft furnace where it reacts with a reducing gas, made up of CO and H₂ produced from reforming a combination of natural gas and off gas with a catalyst. This results in Direct- Reduced Iron (DRI) as an intermediate product.

Upon exiting the shaft furnace the hot DRI is fed into an Electric Arc Furnace where the DRI melts to produce pig iron and slag. The slag is disposed of as tailings, and the molten pig iron is poured into casts and cooled to produce ingots.

4.4.5 TIVAN® leach circuit

The *TIVAN*® leach circuit extracts the vanadium from the pre-leach residue using mineral acid.

Washed pre-leach residue, as filter cake, is conveyed to the first vessel in a train of leach tanks where it is slurried with mineral acid, initiating the leaching process. The slurry flows along the leaching tank train and exits to a thickener after it has completed leaching.

The slurry is thickened to a target solids concentration for filtration. The thickener overflow, which comprises pregnant leach solution (PLS), bypasses the filter and is sent directly to the post filtration surge tank. Thickener underflow is pumped into a surge tank before filtering.

Thickened leach residue is filtered to separate the leach residue from the PLS and to wash the leach residue before it undergoes further processing to produce the titanium pigment product. The thickener underflow slurry is pumped into a pressure filter, where it is filtered and the resulting filter cake undergoes a wash cycle. The washed filter cake drops into a hopper before being fed into a flash dryer in the titanium pigment production area and the filtrate is combined with the thickener overflow in the post filtration surge tank.

The PLS is then subjected to a reduction and pH adjustment tank where the ferric ions are reduced to ferrous ions via metallic iron addition and the solution is set, using magnesium oxide, to the desired pH value for the solvent extraction circuit.

4.4.6 Solvent extraction and vanadium precipitation

The purpose of the solvent extraction is to selectively remove the vanadium from the PLS produced in the *TIVAN*® leach circuit.

Upon exiting the pH adjustment tank, the PLS solution is filtered, to remove any remaining solids. Once filtered the PLS is pumped to the Vanadium Extraction Circuit where vanadium transfers from the aqueous to the organic phase. The aqueous stream, depleted in vanadium, is then sent to the regeneration circuit for acid recovery.

From the Vanadium Extraction Circuit, the organic phase matter flows to the Organic Stripping Circuit where vanadium is stripped from the organic phase into a hydrochloric acid based strip liquor and emerges as loaded strip liquor (LSL). The stripped organic phase is cleaned and recycled through the solvent extraction circuit. The LSL is pumped to a vanadium oxidation tank and, following precipitation, the product is pumped to a product hopper. Filtered solids precipitate is conveyed to a rotary dryer to remove moisture. The resultant dried vanadium pentoxide is conveyed to a fusion furnace and flaking wheel to melt the vanadium and solidify it into flakes for packaging. Flakes will be passed through a crusher to ensure correct product size and then packaged into drums.

4.4.7 Titanium pigment plant

The purpose of the titanium pigment process is to upgrade the titanium dioxide from the leach residue, to pigment grade titanium dioxide, increasing the value of the product.

The leach residue is dried, with the dried solids fed to the chlorinator. Chlorination is carried out in a fluidised bed reactor in the presence of coke. The resulting gas stream contains titanium tetrachloride (TiCl_4), oxides of carbon and all the impurity metals from the feedstock in the form of metal chlorides. The gas stream is cooled to a level at which the other metal chlorides separate out as solids. The TiCl_4 gas is cooled further, in a secondary and tertiary condenser and condenses as crude TiCl_4 . This liquid is scrubbed to remove any remaining metal chloride impurities and, once purified, is reacted with oxygen in a burner to reform titanium dioxide and release the chlorine which is recycled back to the beginning of the reaction. The products from the burner are cooled and then filtered to recover the titanium dioxide.

The raw pigment is repulped with water and then milled. The resulting slurry is classified and any undersize titanium dioxide particles are filtered and recycled back to chlorination. Titanium dioxide particles of the correct size are subjected to a range of chemical surface treatments, followed by drying and milling.

4.5 Product handling and export

Vanadium pentoxide will be sealed in 200 L drums and exported inside sea containers. Titanium dioxide will be packaged into two tonne bulk bags. Pallets of both products will be loaded on to flat-bed wagons by forklift and railed to East Arm Wharf.

Pig iron ingots will be loaded into open rail cars by front-end loader and railed to East Arm Wharf for export as a loose bulk commodity.

The three products will be stored at the Darwin Port Corporation's nominated storage areas either in the open or within an existing shed. Product handling at the Port will be undertaken using existing facilities by the Corporation's nominated stevedores.

The Project is expected to result in one ship movement per week.

4.6 Reagents

The reagents to be used in the Refinery, and their storage threshold quantity under WHS Regulations, are listed in Table 4-1. Indicative on site storage volumes and annual consumption are included, but may vary following further design works.

4.7 Process waste streams

4.7.1 Solid wastes

The solids streams comprise pig iron slag, the iron residue, and the insoluble salts and coke rich solids from the titanium pigment plant. These streams will be pumped from their respective areas to a thickener. The thickener overflow will gravitate to the process water dam for recycling throughout the plant. The thickener underflow is dewatered on a belt filter to produce a filter cake of 85% solids. Belt filter filtrate is returned to the process water dam for recycling.

The filter cake will be stored onsite in a shed to avoid dilution from rain water. Any run-off from the filter cake will be directed to the process water dam for recycling. The filter cake will remain stockpiled for up to 1.4 days, after which drying by evaporation will allow the moisture level to reach 92% solids.



The filter cake is comprised of benign gangue minerals which are commonly used for landfill, infrastructure and road works. For the first five years of production the filter cake will be used for refinery infrastructure and roadworks.

During these initial years of production, third party concrete users will be sourced to receive the filter cake from the remainder of the refinery life. If a third party use cannot be found, the solid waste will be disposed on site.

4.7.2 Liquid wastes

The liquid streams comprise spent organic solution, titanium chloride (TiOCl_2) solution, vanadium bearing mineral oil, titanium waste solution, and titanium waste water. With the potential for hazardous waste materials to be present in all but the titanium waste water, liquid wastes will be stored in separate storage tanks, before being transferred to separate isocontainers for transportation from site by a third party for disposal at a licenced disposal facility.

4.8 Non-process waste streams

4.8.1 Waste oil and lubricants

Waste oils will be stored in bulk tanks or drums for collection and recycling. Other hydrocarbons and chemicals will be stored in sealed containers for collection, treatment and disposal. Registered waste disposal companies will be used.

4.8.2 Oily water

An oily water separator will be installed to handle water from equipment wash-down. Waste recovered from this system will be sealed in drums and removed from site for recycling or disposal.

4.8.3 Inert solid waste

Inert solid waste will be collected regularly by a waste disposal company and disposed off-site at an appropriately licenced landfill.

4.8.4 Recyclables

Recyclables will be collected and transported by a waste disposal company to an offsite recycling facility. Separate bins are planned to collect paper, plastic, aluminium and glass. Scrap metal left over from the process and maintenance will also be collected. Labelled bins will be placed alongside conventional rubbish bins at the processing plant and in the mess / office areas.

4.8.5 Sewerage

The offices, mess, administration and first aid areas will be connected to existing main sewer lines.



4.9 Fugitive dust and atmospheric emissions

4.9.1 Fugitive dust

Fugitive dust generation at the refinery will be managed through a combination of the following:

- retention of sufficient moisture in the concentrate stream to maintain the concentrate at its Dust Extinction Moisture level;
- use of water sprays or misting nozzles during stacking operations;
- water cannons on stockpiles;
- enclosed reclaim tunnels under stockpiles;
- misting sprays on reclaim feeders;
- fogging sprays at transfer points;
- physical enclosure of transfer points and operating equipment;
- vanadium precipitation, drying, fusing and packaging and titanium dioxide packaging undertaken in a shed;
- concentrate, coke, pig iron product, titanium dioxide product and filter cake stockpiles located inside multiple sheds;
- open areas not required for vehicle access or construction will be sprayed with hydromulch or sealed through the application of dust suppressant chemicals; and
- active road surfaces will be either sealed, treated with a dust suppressant chemical or sprayed with water.

4.9.2 Atmospheric emissions

The main emissions produced in the refinery are shown in Table 4-2. No detail is available at this stage regarding the level/concentration of the potential emissions. Scrubbers and treatments would be added as part of further development of the Refinery concept.

Table 4-2 Atmospheric emissions

Emission	Source
CO ₂ and H ₂ O	Pig Iron Shaft Furnace Off-gas
CO ₂ , N ₂ , O ₂ and H ₂ O	Kiln Off-gas
H ₂ O	Leach Vapour Scrubber
H ₂ O	Feed Flash Dryer Off-gas
CO ₂	Scrubbed Chlorinator Off-gas



4.10 Infrastructure and services

The refinery will need a variety of infrastructure and services, all of which are available at the site boundary, including:

- road access from the existing Channel Island Road;
- natural gas (12.7 PJpa) supplied from the Amadeus gas pipeline;
- power (approximately 82 MW) provided from the existing Channel Island and Weddell power stations via an existing power line;
- communications;
- water from the Palmerston zone pipeline; and
- a rail siding running parallel to the Adelaide-Darwin rail line.

The rail siding will be approximately 4 km long to allow for the full length of the train (1.8 km) on either side of the unloading station which will be located midway along the siding. This is required to ensure that the train will have sufficient space on the siding to unload all hopper wagons without interrupting the regular flow of traffic on the main rail.

The rail siding will be built on the Lot 1817 as close as possible to the Refinery, north of the high voltage powerline.

4.11 Site development

The north eastern section of the Project site (Lot 1817) is proposed to be developed. A preliminary concept layout of the Refinery is provided in Figure 4-2.

The development footprint (area of proposed infrastructure and immediate surrounding cleared areas) is approximately 140 ha. The area to be cleared within the footprint area is approximately 105 ha, as approximately 35 ha are already clear of vegetation (based on interpretation of satellite imagery). No mangrove areas or intertidal vegetation will be cleared. The site footprint boundary is immediately adjacent to mangroves in the northern section of the footprint.

NTG has advised (pers. comm. August 2015) that a requirement of the existing extractive licence agreements on site (held by others) would be for the site to be clean filled, levelled and compacted.





LEGEND

- Road
- Lot 1817
- - - Gas pipeline
- - - Railway
- Cadastre

Paper Size A4

0 200 400 600 800

Metres

Map Projection: Transverse Mercator

Horizontal Datum: GDA 1994

Grid: GDA 1994 MGA Zone 52



Darwin Refinery NOI

Job Number 61-32573

Revision A

Date 23 Oct 2015

Site Preliminary Concept Layout Figure 4-2

G:\61\32573\04 GIS\Maps\MXD\6132573_006_RevB_Fig4-2SitePreliminaryConceptLayout.mxd

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Earthworks for construction of infrastructure proposed for this Project include:

- concentrate and coke stockpiles and conveyor tunnels;
- Processing Plant;
- process water, raw water and cooling water ponds;
- tailings stockpile;
- workshop and stores;
- offices, administration area, including kitchen / mess-hall, emergency services;
- site for electricity sub-station;
- individual sites for potable water, raw water and fire water tanks;
- gatehouse and weighbridge;
- Oxygen Plant;
- Regeneration Plant;
- tank farm and reagent storage; and
- Car park.

The concentrate stockpile will sit over a number of prefabricated tunnels, which house the mill feed conveyor and apron feeders. The tunnels and stockpile will be built on top of the existing terrain, rather than being excavated below ground level. This design avoids potential issues with flooding during periods of torrential rainfall and prevents the accumulation of any heavier-than-air gases.

Water dams and ponds will be excavated below the prevailing ground level, followed by installation of a high-density polyethylene (HDPE) membrane (for process water only). Raised embankments will be constructed around dam and pond edges to deflect wind-borne dust and sand. Fencing will be installed for safety.

The tailings storage stockpile will be built on existing terrain, although drainage will need to be constructed around it to allow for water removal.

The offices, emergency services and gatehouse areas require a levelled site. Fit-out for these buildings include power supply, external lighting, fuel storage, potable water supply, sanitation and wastewater disposal, and a sealed bitumen area for parking including truck parking. These will be located within a security-fenced compound.

The processing plant and tank farm storage will be located on a levelled site with concrete bunds installed. The oxygen plant and acid regeneration plant will also require levelled terrain.

4.12 Water use and discharge requirements

4.12.1 Water use

Water will be required on site for processing requirements and consumption by site personnel.

Potable water for consumption is anticipated to be minimal. Make-up water is anticipated to be up to 350 MLpa (approximately 30 to 40 m³ per hour) (pers. comm. METS Engineering).

Water is proposed to be sourced from an existing potable Palmerston zone pipeline, located in close proximity to the Project site. A take-off point to the site would be required.



4.12.2 Discharge water

Liquid streams comprise spent organic solution, titanyl chloride (TiOCl_2) solution, vanadium bearing mineral oil, titanium waste solution, and titanium waste water. With the potential for hazardous waste materials to be present in all but the titanium waste water, liquid wastes will be stored in separate storage tanks, before being transferred to separate isocontainers for transportation from site by a third party for disposal. The volumes will be determined as the design of the Project progresses.

No liquid waste streams containing contaminants will be discharged from site.

4.12.3 Stormwater

Concept design of the stormwater system will be developed. It is anticipated that run-on will be diverted around the site to its current fall and run-off from the developed Refinery area will be directed to a wastewater system.

4.13 Project alternatives

Three broad options for location of the Refinery were initially considered:

- at the Mount Peake mine site;
- at a site to be determined in the Northern Territory; and
- at an offshore location.

It was always TNG's preference to establish the Refinery in the Northern Territory, however following pre-prefeasibility studies a decision was made in 2013 to pursue an offshore location due to potentially lower construction and operating costs.

Feasibility studies for the Refinery, resulting in cost optimisation and the inclusion of additional high value product streams, and discussions with the NT Government resulted in TNG again pursuing a NT based project. Three locations for siting the Refinery were identified by the Government: Lot 11482, Lot 1820 and Lot 1817 (Figure 4-3).

Lots 11482 1820 were not suitable due to their size and shape in relation to the need to accommodate a rail bottom discharge assembly for magnetite concentrate and the associated 3.8 km rail siding. It was also felt that Lot 11482 was too close to residential areas for siting of heavy industry.

Lot 1817 was considered to be the most suitable for the Refinery. The site is of sufficient size and has the necessary shape to accommodate the rail siding, which is paramount for the unloading of concentrate from Mount Peake and for railing of finished product to the Port. All of the services needed to support the Refinery (gas, water, power, road, communications, sewerage) are available and the site provides separation from residential areas.

4.14 Workforce

The construction and operational workforce is expected to peak at 500 and 100 personnel respectively.

It is expected that permanent operations staff will live in existing residential accommodation in the Darwin/Palmerston area. Construction personnel will reside in either rental properties or hotel accommodation. An option to consider existing construction camps will also be considered however it would be a service provided by a third party.



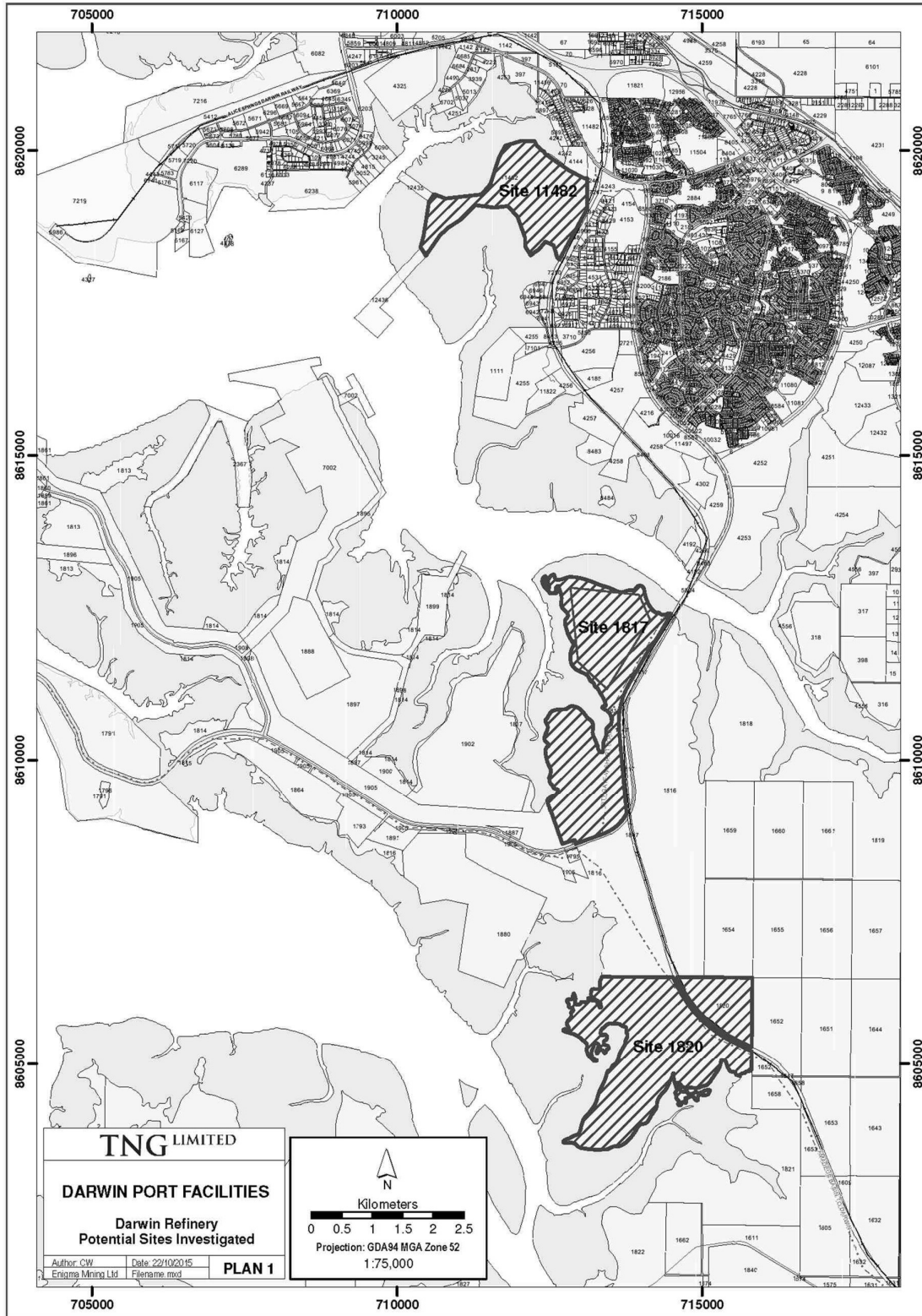


Figure 4-3 Alternative Site Locations

5. Land Use History

5.1 History

The site is currently leased from the NT government by private companies under extractive resources licence/s for quarrying activities. Strike database (NTG) indicates the following five licences / minerals applications / minerals extractive permits are or have been granted over the site (Figure 5-1):

- EMP23742;
- EMPN1136;
- MA22880;
- MA22264; and
- MA26617.



Figure 5-1 Strike Database of current site use

5.2 Previous investigations

No information on previous investigations on site is available.

Previous investigations conducted by other companies in the surrounding area include EISs by INPEX and ConocoPhillips. Where relevant, information from previous studies in the surrounding area has been referenced throughout this NOI.

6. Existing Environment

6.1 Climate

Middle Arm Peninsula is located in the wet-dry tropics and is subject to annual periods of flood and drought.

The dry season extends from approximately April to September, and displays moderate temperatures, low humidity and winds predominantly from the east.

The wet season officially begins in early October and continues with some variation through to late March / April. It is characterised by high humidity, high temperatures and heavy rainfall events with a monsoonal influence.

The hottest months are October and November, with daily temperatures of 33.3°C. The mean annual rainfall is 1,728.5 mm. Average monthly rainfalls range from 1.2 mm in June to 427.1 mm in January (Bureau of Meteorology 2015, Table 6-1).

Table 6-1 Rainfall and temperature statistics (Darwin Airport 1941-2015)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)												
Highest	940.4	1110.2	1013.6	396.2	298.9	50.6	26.6	83.8	129.8	338.7	370.8	664.5
95 th percentile	653.8	636.8	544.3	204.4	57.4	2.8	4.4	10.0	39.2	153.4	219.7	410.5
Mean	427.1	374.3	317.9	101.1	21.1	1.8	1.2	4.9	15.3	69.9	142.1	248.9
5 th percentile	211.7	159.8	129.0	15.1	0.0	0.0	0.0	0.0	0.0	5.2	57.4	106.4
Lowest	136.1	103.3	88.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	17.2	18.8
Temperature (°C)												
Highest ¹	31.8	31.4	31.9	32.7	32.0	30.6	30.6	31.4	32.6	33.3	33.3	32.6
Lowest ²	24.8	24.7	24.5	24.0	22.1	19.9	19.3	20.3	23.0	24.9	25.3	25.3

Notes: ¹ Monthly mean maximum temperature is the average of the available daily maxima for a month.

² Monthly mean minimum temperature is the average of the available minima for a month.

6.2 Topography, soils and geology

Middle Arm Peninsula is generally flat and rises to approximately 10 m AHD at its highest point. The Project area lies almost entirely within an area of lateritic plains and rises, and borders tidal flats. The predominant soil type is gravelly red and brown kandosols with minor yellow kandosols. Supratidal and intertidal hydrosol soils occur in the intertidal area covered by mangroves. The soils of the Project Area are of moderate erosion risk, due to the gentle incline and / or level areas.

Potential Acid Sulfate Soils (PASS) are naturally occurring soils, sediments or peats that contain iron sulfides which, on exposure to air, oxidise to form sulfuric acid. Production of sulfuric acid leads to the breakdown of soil structure, causing a release of acid, metals and nutrients into soil and water environments.



PASS are within soil types in low lying areas around Darwin Harbour. They are known to occur primarily in mangrove forest, melaleuca wetlands, saline flats and some coastal sand dunes. Figure 6-1 indicates PASS in the vicinity of the site is associated with mangroves, and PASS is therefore less likely to be present in the area in which the Refinery is proposed. All civil works to be undertaken for this Project will occur on land above 5 m AHD, where there is either no or low potential for the occurrence of PASS.

6.3 Natural processes

A majority of the site is cleared of vegetation and is disturbed, land. The frequency of fires on site appears to have been relatively high, likely exacerbated by the density of grassy weeds on the site.

Lot 1817 occurs within a Primary Storm surge and a Secondary Storm Surge Area (Figure 6-2). Based on interpretation of the storm surge map and concept layout, no infrastructure will be sited in the two storm surge areas, consistent with Section 6.14, clause 6 and 7 of the NT Planning Scheme (DLPE 2015). Infrastructure is sited in the Extreme Storm Surge Event (10,000 year ARI). Earthworks will be required to site infrastructure above the extreme storm surge area.

The edges of Lot 1817 that coincide with the mangrove forest areas lie within in the Primary Storm Surge Zone (1,000 year Average Recurrence Intervals) (NRETAS 2011). The section of Lot 1817 around Lot 1902 appears to be wholly in a Primary Storm Surge Area.

Land adjacent to the mangrove area appears to be located in a Secondary Storm Surge Zone (NRETAS 2011).

6.4 Surface water

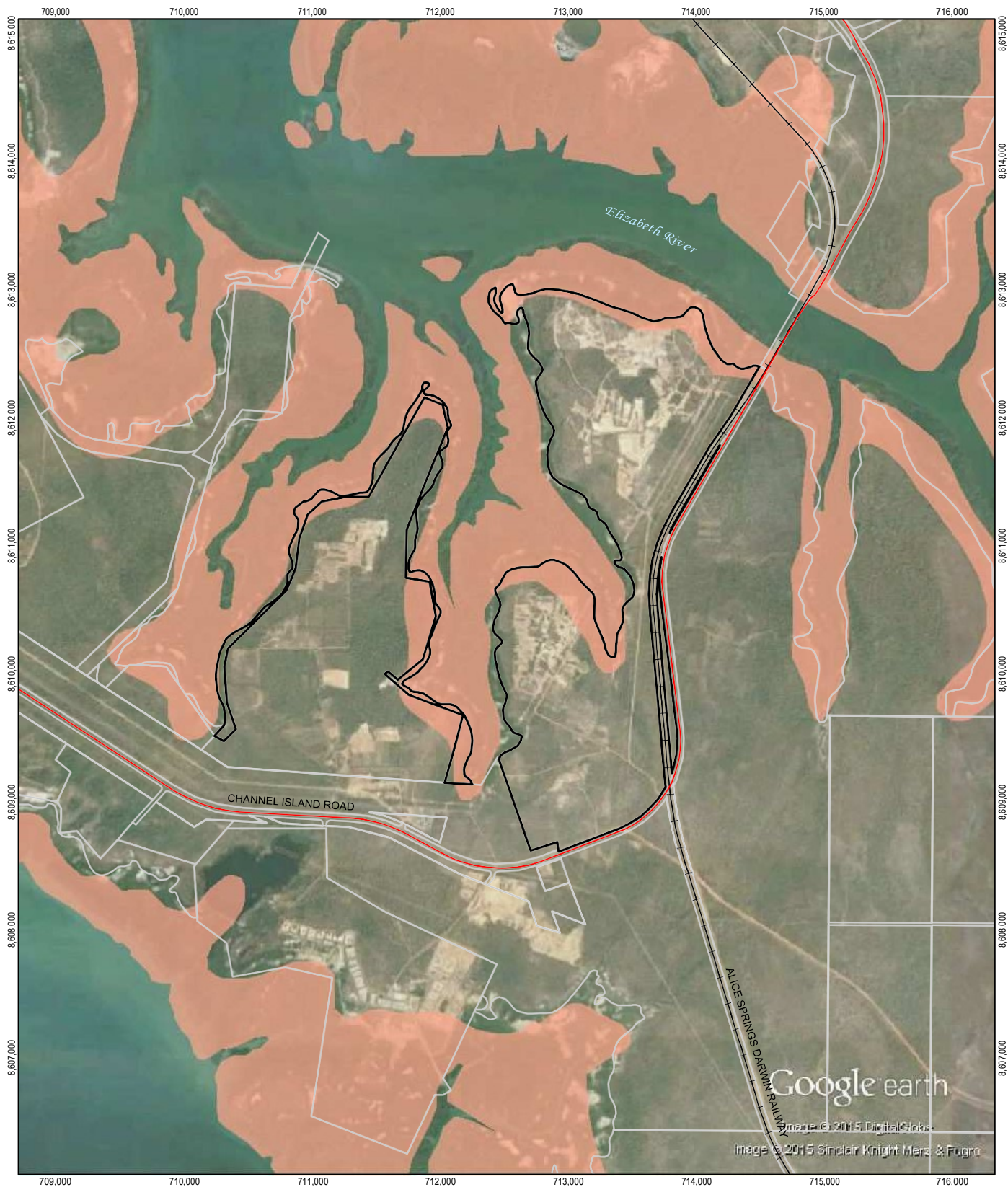
No major drainage lines, creeks, wetlands or rivers are present on site. The edges of the Lot are within intertidal areas associated with the Elizabeth River estuary, which drains into Darwin Harbour. After regular rainfall, as typically occurs in the wet season, the surface soil layer becomes saturated, and gentle, overland sheet flow occurs in some areas of Middle Arm, whilst water accumulates in other areas. Vegetation and soils distribution across the site usually gives some insight into surface water and groundwater patterns.

Darwin Harbour is classified as a slightly disturbed marine ecosystem (ANZECC / ARMCANZ 2000). During the wet season, run-off containing suspended particulate matter, inorganic and organic nutrients and a wide range of other constituents enter the harbour from the surrounding developed and undeveloped sections of the catchment area.

Hydrodynamic modelling, supported by water quality studies, indicate that significant tidal movement in the Harbour does not transport diffuse and point source nutrients out of the Harbour, but rather assists in their dispersal within the Harbour precinct (NRETAS 2010).

Water quality in Darwin Harbour is strongly influenced by tides, seasons and location within the Harbour. The marine waters around Middle Arm, in common with most other estuarine systems, are subject to significant tidal and seasonal fluctuations in salinity and temperature.





LEGEND

- Road
- Project site
- Potential acid sulfate soils
- + + Railway
- Cadastre

Paper Size A4
0 0.5 1 1.5
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 52



Darwin Refinery NOI

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Revision A
Date 23 Oct 2015

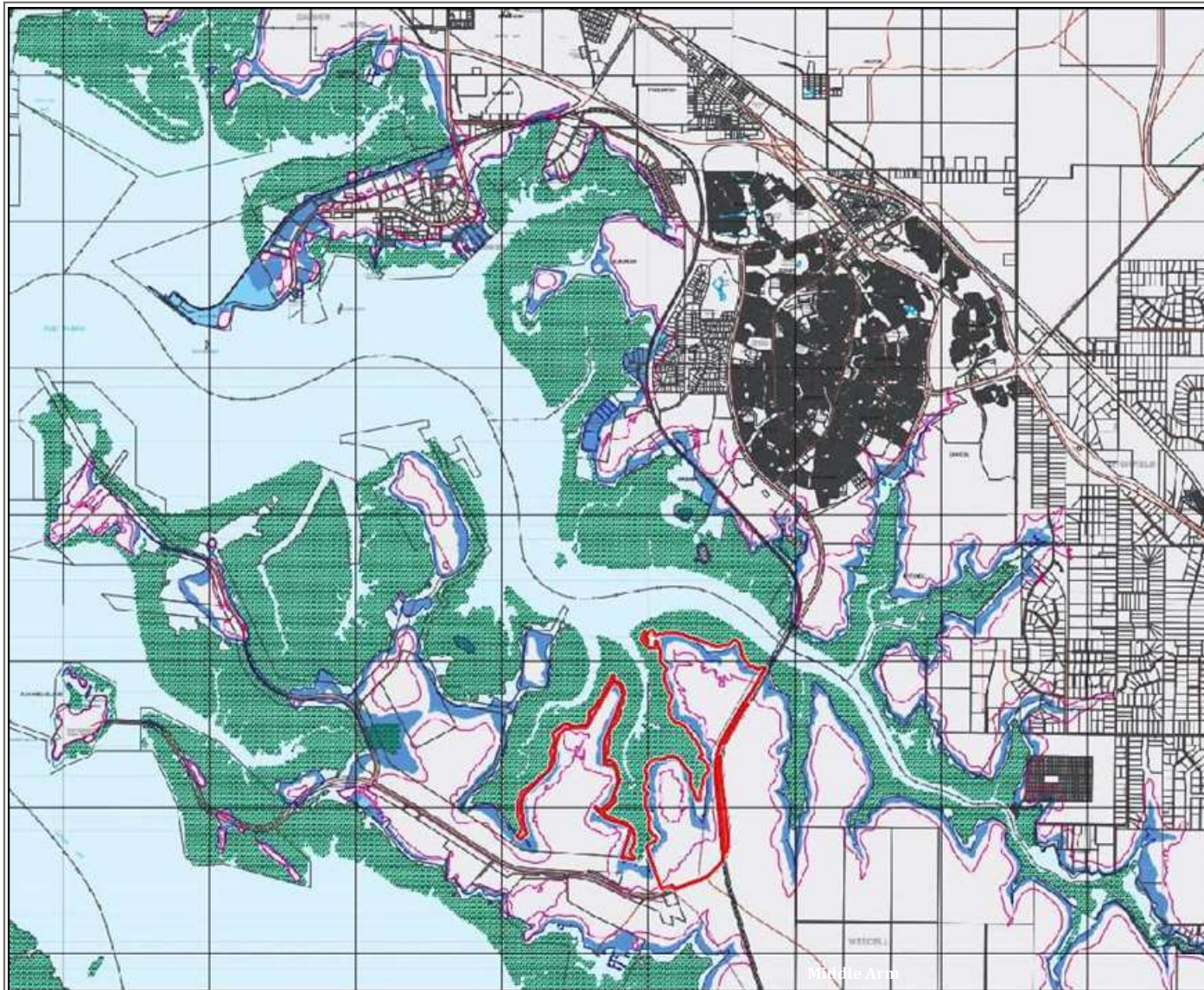
Potential Acid Sulfate Soils

Figure 6-1

G:\61132573\04 GIS\Maps\MXD\6132573_007_RevA_Fig6-1PotentialAcidSulfateSoil.mxd

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Source: PALMERSTON AREA
STORM SURGE INUNDATION
FOR 2100

(Northern Territory Government, June 2014)



GENERAL FEATURES

Local Government Area	LITCHFIELD
Property / Road Boundaries	
Suburbs / Localities	STUART PARK
Major Road	
Minor Road	
Park / Reserve	
Railway	
Gas pipeline	
Watercourse, Lake or Lagoon	
Mangroves	

Paper Size A4
0 1 2 3 4
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 52



Legend

Project area



Darwin Refinery NOI

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Revision A
Date 23 Oct 2015

Storm Surge Zones

Figure 6-2

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Data source: Water Resources NT Department of Land Resource Management; Cadastre - 20150825, Palmerston Area Storm Surge Inundation for 2100 (Nov 2014) - 20151019; Created by:rbannister

Water quality changes rapidly in accordance with the tides that carry sediment flows into and out of the mangroves (INPEX 2011). Highest salinity has been measured during September-October when values were typically 35 parts per thousand (ppt). The lowest salinity has been measured in the period January-March, coinciding with rainfall and fresh water run-off into the Harbour. Padovan (2003) concluded that the degree to which salinity was reduced is a function of location within the harbour and amount of rainfall during the monsoon period.

The Darwin Harbour Report Card 2012 indicates that water quality in Darwin Harbour and its catchment was generally good to excellent (DLRM 2012). Closer to Middle Arm Peninsula the marine water quality rating for Elizabeth River (Estuary category) was reported to be excellent. Water quality in the harbour can vary between locations according to weather, benthic habitat type and tidal state; and be influenced by activities such as dredging and construction projects.

6.5 Groundwater

The most prominent aquifer on Middle Arm occurs in the sand and gravel sediments of the Bathurst Island Group (INPEX 2011). Groundwater monitoring on Blaydin Point indicates that the groundwater salinity in the area ranges from marginally brackish to saline, and is influenced by wet season monsoon recharge.

Data logger records indicate that in 2012 groundwater elevation lows occurred during November, and increased due to the onset of the wet season; and thus increased recharge to the underlying shallow aquifer. Groundwater flow direction is radially outward from the centre of the peninsula and in the direction of the coast (URS 2012).

6.6 Land systems and land units

Land unit mapping for the Darwin area, including assessment of the vegetation, provides an overview of the expected land units in the Project Area (Table 6-2 and Table 6-3). The site falls within the Keefers Hut land system and borders the Littoral 1 land system.

Table 6-2 Keefers Hut land system

Element	Description
Land system	Keefers Hut
Map unit	Kfh
Landscape class	Lateritic plains and rise
Landscape class description	Plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils
Landform description	Dissected, gently undulating to undulating rises on deeply weathered rocks
Soil	Shallow gravelly yellow earths
Vegetation description	Mid-high open woodland of <i>Eucalyptus tetradonta</i> , <i>E. miniata</i> , <i>Corymbia foelscheana</i> , <i>E. tectifera</i> , <i>C. ferruginea</i> over <i>Heteropogon</i> spp, <i>Chrysopogon fallax</i> , <i>Sehima nervosum</i>



Table 6-3 Littoral 1 land system

Element	Description
Land system	Littoral 1
Map unit	Lit1
Landscape class	Tidal flats
Landscape class description	Tidal mudflats and coastal floodplains with channels and estuaries; subject to tidal inundation; poorly drained clays and muds
Landform description	Level tidal flats with channels and estuaries and minor dunes
Soil	Saline muds and grey cracking clays
Vegetation description	Samphire, sedgeland, or mangrove low closed forest

6.7 Vegetation

6.7.1 Overview

DLRM mapping shows the site encompassing two vegetation communities. The predominant vegetation community is mid-high open woodland of *Eucalyptus tetradonta*, *Eucalyptis miniata*, *Corymbia foelsheana*, *Eucalyptus tectifica*, *Corymbia ferruginea* over *Heteropogon spp*, *Chrysopogon fallax*, *Sehima nervosum* and borders with the samphire, sedgeland, or mangrove low closed forest community (Figure 6-3).

However, a brief site visit conducted in August 2015 confirmed that much of the proposed Project area is cleared and / or heavily degraded and frequently burnt; and a large portion of the site has been cleared for previous land uses including a quarry.

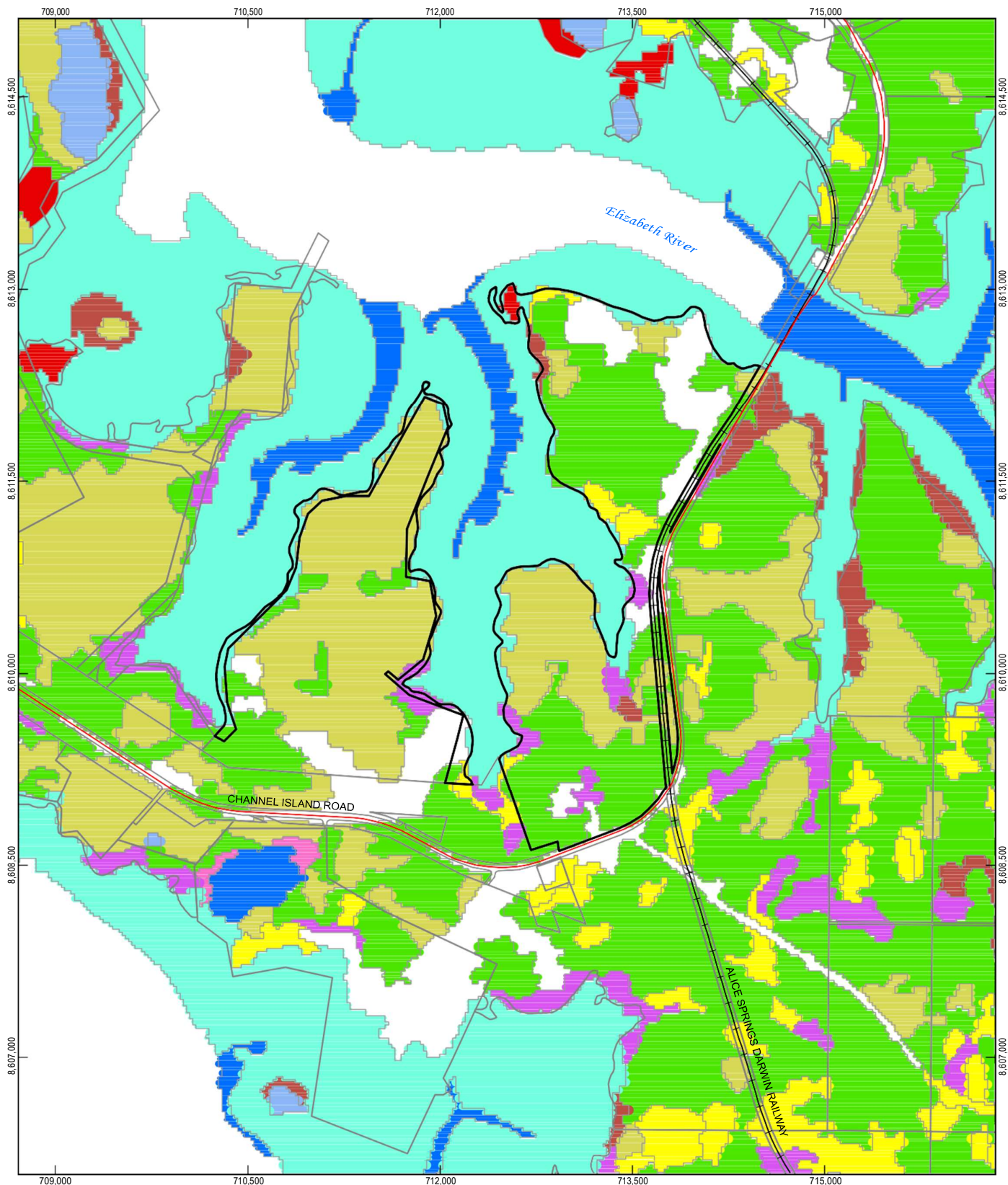
6.7.2 Listed threatened plant species and significant habitats

The EPBC Act Protected Matters Report (Appendix B) identified two EPBC listed threatened flora species as potentially occurring within 10 km of the Project Area. These are *Atalaya brevialata* and *Typhonium taylori*. It is unlikely these will occur within the Project Area as discussed in Table 6-4.

The NT Flora Atlas listed a single flora species under the *Territory Parks and Wildlife Conservation Act 2006* (TPWC Act). This species, the cycad *Cycas armstrongii*, is listed as 'vulnerable'.

The results of the EPBC Act Protected Matters Report and NT Flora Atlas reports are summarised and discussed in Table 6-4.





LEGEND

— Road	Project site	Landcover (Community Name)	Dry Rainforest	Eucalypt woodland	Riparian open forest
—+— Railway	Cadastre	Cleared land	Eucalypt open forest	Mangrove forest	Samphire
		Drainage open woodland	Eucalypt open woodland	Melaleuca swamp	Water

Paper Size A4
0 0.5 1 1.5
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 52



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Vegetation Communities

Figure 6-3

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Data source: DLRM: Cadastre, Roads, Rail; Nearmap: Imagery (4th July 2015) - 20150825. Created by:rbannister

Table 6-4 Threatened Plants Species

Species	EPBC Act	TPWC Act	Source	Most recent record (DLRM)	Likelihood of occurrence within the Project Area	Comments
PLANTS						
<i>Atalaya brevialata</i>	CR	-	PMST	-	Highly unlikely	<i>Atalaya brevialata</i> is endemic to the NT. The species is known from only five places near the Elizabeth River at Virginia and its tributary Amys Creek just to the south of Darwin. The species appears restricted to footslope sites with more open vegetation on deeper, coarser sandy soils mostly along a specific, distinct geological boundary. It grows in woodland with varying proportions of <i>Eucalyptus tectifica</i> and <i>Corymbia foelscheana</i> but also with <i>Xanthostemon paradoxus</i>, <i>Terminalia grandiflora</i> and <i>Acacia hemignosta</i> in the overstorey with open layer of perennial grasses such as <i>Eriachne avenacea</i>. Usually it occurs on sandy soils in foot slope situations, often with a surface gravel layer. Sometimes it grows in the adjoining mixed <i>Melaleuca viridiflora</i>, <i>Grevillea pteridifolia</i> and <i>Acacia leptocarpa</i> low woodland in more poorly drained situations but on slight rises.
Cycad (<i>Cycas armstrongii</i>)	-	VU	DLRM	2011	Possible	There are numerous records of cycads within 5 km of the Project Area. It occurs mainly in open grassy woodland on yellow and red earths, limited in the area by drainage. <i>Cycas armstrongii</i> is endemic to the NT and is abundant across the western Top End region, the Cobourg Peninsula and the Tiwi Islands. It is listed as Vulnerable due to its poor representation in Conservation Reserves (approximately 1%), and because its preferred habitat of deep loamy soils is favoured for agriculture, horticulture and forestry (GHD 2009). Supplementary to land clearing, the most significant threat to the population of <i>C. armstrongii</i> is fire. Adult stems suffer mortality in fires with higher than average temperatures (i.e. those fuelled by high litter loads produced by introduced grass species such as <i>Andropogon gayanus</i> (Gamba Grass) and <i>Pennisetum polystachion</i> (Mission Grass).
<i>Typhonium taylori</i>	EN	EN	PMST	-	Highly unlikely	The species occurs in seasonally saturated sandy soil in nutrient poor grass/sedgeland with occasional <i>Melaleuca viridiflora</i>. This species is endemic to the NT, and positively known only from the type locality on the edge of the Howard River floodplain. A second collection of sterile material nearby is also likely to be <i>T. taylori</i>.



6.7.3 Mangrove communities

Intertidal areas surrounding the site contain mangrove communities. These areas are zoned for Conservation under the NT Planning Scheme (DLPE 2015) and are outside the Project development footprint.

Mangroves are an important ecological component of the marine and coastal environment. They are a food resource for a range of species and their root system acts as a breeding ground and nursery for crustacean, mollusc and fish species. Their extensive root system reduces water velocity and energy causing entrapment and deposition of suspended sediments, thereby providing stability and protection of coastlines. Mangroves form as a buffer zone attenuating wave energy and current flow, and reduce erosion and storm surge damage in coastal areas.

6.8 Fauna

6.8.1 Threatened species

The EPBC Act Protected Matters Report (Appendix B) identified 31 threatened species and 49 migratory species listed under the EPBC Act within 10 km of the site (DotE 2015). Four of these threatened species (Curlew sandpiper (*Calidris ferruginea*), Eastern curlew (*Numenius madagascariensis*), Northern quoll (*Dasyurus hallucatus*) and Black-footed tree-rat (*Mesembriomys gouldii gouldii*)) have previously been recorded within 5 km of the Project Area according to a database search conducted by NT Fauna Atlas (DLRM 2015) (Figure 6-4).

An additional nine species listed as threatened under the TPWC Act have been recorded within 5 km of the Project Area (Figure 6-4). The NT Fauna Atlas has records of 50 migratory species occurring within 5 km of the Project Area.

The habitat requirements for each of these threatened species were assessed against the extent and quality of vegetation types identified in the study site. These considerations are summarised in Table 6-5. Species classified as 'data deficient', 'not evaluated' or 'near threatened' were not assessed. There are no records of any threatened species within the Project Area boundary.





LEGEND

Fauna Species - TPWC Act	Fauna Species - EPBC Act	Road	Project site
Critically Endangered	Endangered	Road	Project site
Endangered		Railway	Cadastre
Vulnerable			

Paper Size A4
0 0.5 1 1.5
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 52



Darwin Refinery NOI

Job Number 61-32573
Revision A
Date 23 Oct 2015

Threatened Fauna
Records within 5km

Figure 6-4

G:\61\32573\04 GIS\Maps\MXD\6132573_010_RevA_Fig6-4ThreatenedFauna.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

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Table 6-5 Threatened fauna

Species	EPBC Act	TPWC Act	Source	Most recent record (DLRM)	Likelihood of occurrence within the Project Area	Comments
BIRDS						
Red knot (<i>Calidris canutus</i>)	-	VU	DLRM	2005	Unlikely	There are two records of this species at the Palmerston Sewage Ponds.
Curlew sandpiper (<i>Calidris ferruginea</i>)	CR	VU	PMST / DLRM	2009	Possible	There are numerous records of this species at the Palmerston Sewage Ponds. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas and around shallow water and are known to occur around Darwin Harbour. Chatto's long term study of shorebird distribution and abundance along the entire NT coastline demonstrated significant areas for shorebirds east from Darwin to Tree Point, and on islands off Bynoe Harbour. No significant areas for shorebirds were identified within Darwin Harbour. The site is not important habitat for shorebirds.
Great knot (<i>Calidris tenuirostris</i>)	-	VU	DLRM	2003	Unlikely	There are two records of this species at the Palmerston Sewage Ponds. Suitable habitat is not likely to be present within the Project Area.
Greater sand plover (<i>Charadrius leschenaultia</i>)	-	VU	DLRM	1998	Possible	There are numerous records of this species from the Palmerston Sewage Ponds. Chatto's long term study of shorebird distribution and abundance along the entire NT coastline demonstrated significant areas for shorebirds east from Darwin to Tree Point, and on islands off Bynoe Harbour. No significant areas for shorebirds were identified within Darwin Harbour. The site is not important habitat for shorebirds.
Lesser sand plover (<i>Charadrius mongolus</i>)	-	VU	DLRM	2008	Possible	There are numerous records of this species at the Palmerston Sewage Ponds. Chatto's long term study of shorebird distribution and abundance along the entire NT coastline demonstrated significant areas for shorebirds east from Darwin to Tree Point, and on islands off Bynoe Harbour. No significant areas for shorebirds were identified within Darwin Harbour. The site is not important habitat for shorebirds.
Yellow chat (Alligator Rivers) (<i>Epthianura crocea tunneyi</i>)	EN	EN	PMST	-	Highly unlikely	There are no records within 5 km of the Project Area. Yellow chats have been reported from tall grasslands and samphire shrublands (on coastal saltpans). Most NT records are from floodplain depressions and channels, concentrating around wetter areas at the end of the dry season. Suitable habitat is not present within the Project Area.
Red goshawk (<i>Erythrotriorchis radiatus</i>)	VU	VU	PMST	-	Highly unlikely	This species inhabits coastal and subcoastal tall, open forests and woodlands, tropical savannas with tree-lined waterways and the edges of rainforests (Marchant and Higgins 1993). There are no records within 5 km of the Project Area.



Species	EPBC Act	TPWC Act	Source	Most recent record (DLRM)	Likelihood of occurrence within the Project Area	Comments
Gouldian finch (<i>Erythrura gouldiae</i>)	EN	VU	PMST	-	Highly unlikely	Suitable habitat in the form of open woodlands that are dominated by Eucalyptus trees and ground cover of Sorghum and other grasses (Tidemann <i>et al.</i> 1992) is not present within the site. There are no records within 5 km of the Project Area.
Partridge pigeon (<i>Geophaps smithii smithii</i>)	VU	VU	PMST	-	Highly unlikely	Suitable habitat in the form of open forest and woodland dominated by Darwin Stringybark <i>Eucalyptus tetrodonta</i> and Darwin Woollybutt <i>E. miniata</i> that has a structurally diverse understorey (Higgins and Davies 1996) is not present within the site. There are no records of the species within 5 km of the Project Area.
Bar-tailed godwit (<i>Limosa lapponica</i>)	-	VU	DLRM	1994	Possible	There are numerous records of this species from the Palmerston Sewage Ponds. Chatto's long term study of shorebird distribution and abundance along the entire NT coastline demonstrated significant areas for shorebirds east from Darwin to Tree Point, and on islands off Bynoe Harbour. No significant areas for shorebirds were identified within Darwin Harbour. The site cannot be defined as important habitat for shorebirds, and the development is unlikely to have an impact.
Eastern curlew (<i>Numenius madagascariensis</i>)	CR	VU	PMST / DLRM	2011	Possible	There are numerous records of this species from the Palmerston Sewage Ponds. Eastern Curlews in the NT are often solitary or in small flocks, rarely far from the coast. They are most common in mangrove areas, but will also forage on intertidal flats and saltmarshes. Suitable habitat does not occur within the Project Area.
Australian painted snipe (<i>Rostratula australis</i>)	EN	VU	PMST	-	Unlikely	Australian painted snipe occur in shallow, vegetated, freshwater swamps, claypans or inundated grassland (including temporary wetlands). They feed at the water's edge and on mudflats, taking seeds and probing for invertebrates. Suitable habitat does not occur within the Project Area and there are no records within 5 km of the Project Area.
Masked owl (northern) (<i>Tyto novaehollandiae kimberli</i>)	VU	VU	PMST	-	Highly unlikely	Suitable habitat is not present in the proposed Project Area. The masked owl (northern) usually nests in tree hollows, within patches of closed forest (Garnett and Crowley 2000). There are no records within 5 km of the Project Area.
MAMMALS						
Fawn antechinus (<i>Antechinus bellus</i>)	-	EN	DLRM	2001	Possible	Suitable habitat may be present within the Project Area. The cane toad is currently well established, occurring in most habitats within the study area. The mobile nature of this species will allow them to inhabit similar or more suitable habitat within the Darwin Harbour area.

Species	EPBC Act	TPWC Act	Source	Most recent record (DLRM)	Likelihood of occurrence within the Project Area	Comments
Blue whale (<i>Balaenoptera musculus</i>)	EN	-	PMST	-	Highly unlikely	There are no records within Darwin Harbour. In the NT, it is known from two beach-washed specimens, at Cape Hotham in 1980 (Chatto and Warnecke 2000), and at Port Essington in August 2003 (R. Chatto pers. comm.)
Brush-tailed rabbit-rat (<i>Conilurus penicillatus</i>)	VU	EN	PMST	-	Highly unlikely	There are no recent records from the Darwin area despite considerable survey effort (J.C.Z. Woinarski 2008, <i>pers. comm.</i> , cited in TSSC 2008). Suitable habitat does not occur within the Project Area.
Northern quoll (<i>Dasyurus hallucatus</i>)	EN	CR	PMST / DLRM	2001	Unlikely	There are numerous records within 5 km of the study area from 1982-2001. Rocky habitats and open eucalypt forests are the preferred habitats although a wide range of habitats are used. However, the cane toad has since become well established, occurring in most habitats within the development area. It is possible that the northern quoll previously occurred in the Project Area and has experienced localised decline following the arrival of cane toads. The mobile nature of this species will allow them to inhabit similar or more suitable habitat within the Darwin Harbour area.
Humpback whale (<i>Megaptera novaeangliae</i>)	VU	-	PMST	-	Highly unlikely	There are no records within 5 km of the Project Area. In the NT, it is known from one beach-washed specimen on the Napier Peninsula, north-eastern Arnhem Land, in 1981 (Chatto and Warnecke 2000). Recent records suggest a more regular southward migration each year around October along the western NT coast (R. Chatto pers.comm.): this has included two individuals (mother and calf) seen off Casuarina and the Perron Islands, September-October 2002 (R. Chatto pers. comm.).
Black-footed tree-rat (<i>Mesembriomys gouldii</i>)	EN	VU	PMST / DLRM	2001	Possible	There is one record of the black-footed tree rat 2 km from the Project Area from 2001. Its habitat consists of tropical woodlands and open forests in coastal areas.
Northern brush-tailed phascogale (<i>Phascogale pirata</i>)	VU	EN	PMST	-	Highly unlikely	There are no records within 5 km of the Project Area. This species is restricted to eucalypt forests in the top end of the Northern Territory (Woinarski <i>et al.</i> 2007). No suitable habitat occurs within the Project Area.
Bare-rumped sheathtail bat (<i>Saccolaimus saccolaimus nudiclunatus</i>)	CR	-	PMST	-	Highly unlikely	There is insufficient recent data to reliably calculate current extent of occurrence or area of occupancy as there are only two records in the last two decades, both from north-eastern Queensland (Coles <i>et al.</i> 1999). There are no recent records from the Top End of the Northern Territory to indicate whether the species still occurs in this region.



Species	EPBC Act	TPWC Act	Source	Most recent record (DLRM)	Likelihood of occurrence within the Project Area	Comments
Water mouse (<i>Xeromys myoides</i>)	VU	-	PMST	-	Unlikely	There are no records within 5 km of the Project Area. Suitable habitat may exist in the vicinity of the proposed Project Area in the form of mangroves, though no suitable habitat occurs within the Project Area itself. The water mouse appears to utilise both intertidal and freshwater habitats. Most records have been from mangrove forests, saltmarsh, sedgelands, clay pans and freshwater melaleuca wetlands (Magnusson <i>et al.</i> 1976; Redhead and McKean 1975; Woinarski 2000). The biggest threat to this species is habitat removal (DERM 2009).
REPTILES						
Plains death adder (<i>Acanthophis hawkei</i>)	VU	VU	PMST	-	Highly unlikely	Suitable habitat for the plains death adder consists of flat, treeless, cracking-soil riverine floodplains (Cogger 2000) which are not present in the proposed Project Area. There are no records within 5 km of the Project Area.
Loggerhead turtle (<i>Caretta caretta</i>)	EN	VU	PMST	-	Highly unlikely	This species is known to occur in Darwin Harbour. The Project Area does not include the beach areas where this species may nest.
Green turtle (<i>Chelonia mydas</i>)	VU	-	PMST	-	Highly unlikely	This species is known to occur in Darwin Harbour. The Project Area does not include the beach areas where this species may nest.
Leatherback turtle (<i>Dermochelys coriacea</i>)	EN	CR	PMST	-	Highly unlikely	This species is known to occur in Darwin Harbour. The Project Area does not include the beach areas where this species may nest.
Hawksbill turtle (<i>Eretmochelys imbricate</i>)	VU	VU	PMST	-	Highly unlikely	This species is known to occur in Darwin Harbour. The Project Area does not include the beach areas where this species may nest.
Olive Ridley turtle (<i>Lepidochelys olivacea</i>)	EN	VU	PMST	-	Highly unlikely	This species is known to occur in Darwin Harbour. The Project Area does not include the beach areas where this species may nest.
Flatback turtle (<i>Natator depressus</i>)	VU	-	PMST	-	Highly unlikely	This species is known to occur in Darwin Harbour. The Project Area does not include the beach areas where this species may nest.
Mertens' water monitor (<i>Varanus mertensi</i>)	-	VU	DLRM	2007	Unlikely	There is one record of this species within 5 km of the Project Area. The future conservation status of the monitors will be dictated by the evolutionary interaction with the cane toad, and is not expected to be affected by the proposed development. There are no fresh water sources running through the Project Area.



Species	EPBC Act	TPWC Act	Source	Most recent record (DLRM)	Likelihood of occurrence within the Project Area	Comments
Floodplain monitor (<i>Varanus panoptes</i>)	-	VU	DLRM	1996	Possible	There is one record of this species within 5 km of the Project Area. The future conservation status of the monitors will be dictated by the evolutionary interaction with the cane toad, and is not expected to be affected by the proposed development.
AMPHIBIANS						
Howard Springs toadlet (<i>Uperoleia daviesae</i>)	-	VU	DLRM	2012	Unlikely	This species has been recorded within 5 km of the Project Area, though it is highly specific to its recorded location and has not been recorded outside of its recorded location at Weddell.
SHARKS						
Great white shark (<i>Carcharodon carcharias</i>)	VU	-	PMST	-	Highly unlikely	This species has not previously been recorded in Darwin Harbour.
Northern river shark (<i>Glyphis garricki</i>)	EN	EN	PMST	-	Highly unlikely	This species is so far known to only occur in the Adelaide and Alligator River systems in the NT (Whitty <i>et al.</i> 2008).
Dwarf sawfish (<i>Pristis clavata</i>)	VU	VU	PMST	-	Possible	This species may be present in Darwin Harbour creeks, but there are no records within 5 km of the Project Area.
Freshwater sawfish (<i>Pristis pristis</i>)	VU	VU	PMST	-	Highly unlikely	In northern Australia, this species appears to be confined to freshwater drainages and the upper reaches of estuaries, occasionally being found as far as 400 km from the sea (Thornburn <i>et al.</i> 2003; Whitty <i>et al.</i> 2008).
Green sawfish (<i>Pristis zijsron</i>)	VU	VU	PMST	-	Possible	This species may be present in Darwin Harbour creeks, but there are no records within 5 km of the Project Area.
Whale shark (<i>Rhincodon typus</i>)	VU	-	PMST	-	Highly unlikely	This species may occasionally be present near Darwin Harbour but is highly unlikely to occur within the harbour itself.

Key to Table:

EX	Extinct	CR	Critically endangered	NT	Near threatened
EN	Endangered	DD	Data deficient	VU	Vulnerable

Likelihood of occurrence of fauna is assessed on a 3-tier scale:

- 1: **Possible** - suitable habitat occurs within the Project Area, and site is within species' normal range;
- 2: **Unlikely** - suitable habitat does not occur within the Project Area, or suitable habitat present but substantially modified or degraded;
- 3: **Highly unlikely** – no suitable habitat within the Project Area and site is outside species' normal range.



6.8.2 Migratory species

The EPBC Act Protected Matters Report (Appendix B) identified 49 migratory species listed under the EPBC Act as possibly occurring within 10 km of the Project Area. The NT Fauna Atlas has records of 50 migratory species occurring within 5 km of the Project Area. These species are listed in Table 6-6. Of the 50 migratory species, 12 are also threatened fauna and are discussed above in section 6.8.1 and Table 6-5.

The proposed Project Area is not a known breeding ground for any migratory species.

Table 6-6 Migratory species

Species	Source
Birds	
Common sandpiper (<i>Actitis hypoleucos</i>)	PMST / DLRM
Fork-tailed swift (<i>Apus pacificus</i>)	PMST / DLRM
Great Egret (<i>Ardea alba</i>)	PMST
Cattle Egret (<i>Ardea ibis</i>)	PMST / DLRM
Eastern Great Egret (<i>Ardea modesta</i>)	DLRM
Ruddy Turnstone (<i>Arenaria interpres</i>)	PMST / DLRM
Sharp-tailed Sandpiper (<i>Calidris acuminata</i>)	PMST / DLRM
Sanderling (<i>Calidris alba</i>)	PMST / DLRM
Baird's Sandpiper (<i>Calidris bairdii</i>)	DLRM
Red Knot (<i>Calidris canutus</i>)	PMST / DLRM
Curlew Sandpiper (<i>Calidris ferruginea</i>)	PMST / DLRM
Pectoral Sandpiper (<i>Calidris melanotos</i>)	DLRM
Little Stint (<i>Calidris minuta</i>)	DLRM
Red-necked Stint (<i>Calidris ruficollis</i>)	PMST / DLRM
Long-toed Stint (<i>Calidris subminuta</i>)	DLRM
Great Knot (<i>Calidris tenuirostris</i>)	PMST / DLRM
Little ringed plover (<i>Charadrius dubius</i>)	DLRM
Greater Sand Plover (<i>Charadrius leschenaultii</i>)	PMST / DLRM
Lesser Sand Plover (<i>Charadrius mongolus</i>)	PMST / DLRM
Oriental Plover (<i>Charadrius veredus</i>)	PMST / DLRM
White-winged Black Tern (<i>Chlidonias leucopterus</i>)	DLRM
Oriental Cuckoo (<i>Cuculus optatus</i>)	DLRM
Eastern Reef Egret (<i>Egretta sacra</i>)	DLRM
Swinhoe's Snipe (<i>Gallinago megala</i>)	PMST / DLRM
Pin-tailed Snipe (<i>Gallinago stenura</i>)	PMST / DLRM
Oriental Pratincole (<i>Glareola maldivarum</i>)	PMST / DLRM
White-bellied Sea-eagle (<i>Haliaeetus leucogaster</i>)	DLRM
Grey-tailed Tattler (<i>Heteroscelus brevipes</i>)	PMST
Barn Swallow (<i>Hirundo rustica</i>)	PMST / DLRM
Caspian tern (<i>Hydroprogne caspia</i>)	DLRM
Broad-billed Sandpiper (<i>Limicola falcinellus</i>)	DLRM
Bar-tailed Godwit (<i>Limosa lapponica</i>)	PMST / DLRM
Black-tailed Godwit (<i>Limosa limosa</i>)	PMST / DLRM
Rainbow Bee-eater (<i>Merops ornatus</i>)	PMST / DLRM
Eastern Curlew (<i>Numenius madagascariensis</i>)	PMST / DLRM



Species	Source
Little Curlew (<i>Numenius minutus</i>)	PMST / DLRM
Whimbrel (<i>Numenius phaeopus</i>)	PMST / DLRM
Osprey (<i>Pandion haliaetus</i>)	PMST / DLRM
Red-necked Phalarope (<i>Phalaropus lobatus</i>)	DLRM
Glossy ibis (<i>Plegadis falcinellus</i>)	DLRM
Pacific Golden Plover (<i>Pluvialis fulva</i>)	PMST / DLRM
Grey Plover (<i>Pluvialis squatarola</i>)	PMST / DLRM
Rufous Fantail (<i>Rhipidura rufifrons</i>)	PMST
Little Tern (<i>Sterna albifrons</i>)	PMST / DLRM
Common tern (<i>Sterna hirundo</i>)	DLRM
Grey-tailed Tattler (<i>Tringa brevipes</i>)	DLRM
Wood Sandpiper (<i>Tringa glareola</i>)	DLRM
Common greenshank (<i>Tringa nebularia</i>)	DLRM
Marsh Sandpiper (<i>Tringa stagnatilis</i>)	DLRM
Common redshank (<i>Tringa totanus</i>)	DLRM
Terek Sandpiper (<i>Xenus cinereus</i>)	PMST / DLRM
Mammals	
Blue whale (<i>Balaenoptera musculus</i>)	PMST
Bryde's Whale (<i>Balaenoptera edeni</i>)	PMST
Dugong (<i>Dugong dugon</i>)	PMST
Humpback whale (<i>Megaptera novaeangliae</i>)	PMST
Irrawaddy dolphin (<i>Orcaella brevirostris</i>)	PMST
Killer whale (<i>Orcinus orca</i>)	PMST
Indo-pacific humpback dolphin (<i>Sousa chinensis</i>)	PMST / DLRM
Spotted bottlenose dolphin (<i>Tursiops aduncus</i>) (Arafura/Timor Sea populations)	PMST
Reptiles	
Loggerhead turtle (<i>Caretta caretta</i>)	PMST
Green turtle (<i>Chelonia mydas</i>)	PMST
Estuarine Crocodile (<i>Crocodylus porosus</i>)	PMST / DLRM
Leatherback turtle (<i>Dermochelys coriacea</i>)	PMST
Hawksbill turtle (<i>Eretmochelys imbricata</i>)	PMST
Olive Ridley turtle (<i>Lepidochelys olivacea</i>)	PMST
Flatback turtle (<i>Natator depressus</i>)	PMST
Sharks and Rays	
Great white shark (<i>Carcharodon carcharias</i>)	PMST
Giant Manta Ray (<i>Manta birostris</i>)	PMST
Whale shark (<i>Rhincodon typus</i>)	PMST

6.8.3 Biting insects

Biting insects (biting midges and mosquitoes) are known to occur in pest numbers around the Top End, particularly within 2 km of the coastline and near areas where water pools. Biting insects have the potential to affect the health of workers on the Project through the transmission of mosquito-borne diseases or reactions to bites.



Peak season problems generally occur from August to November, with appreciable pest problems expected during all other months. Biting midges are generally worse around sunrise and sunset.

There are a number of marine biting midge pest species around the coast of the NT. The mangrove biting midge, *Culicoides ornatus*, causes the greatest pest problems around the NT coast and areas mostly affected are extensive coastal and tidal river mangrove areas and adjacent areas up to 2 km inland from the landward margin of mangrove areas. Middle Arm from Channel Island to Berry Springs is a local problem site (DoH 2015).

Major potential mosquito breeding areas in the Top End are tidally influenced and seasonally inundated brackish swamps or flood plains, and relatively large areas of mangroves that are poorly drained and/or only flooded by the highest tides of the year.

The Project site is adjacent to mangroves and tidal areas, therefore biting insects are likely to be present at the site.

6.9 Heritage

6.9.1 Archaeology and sacred sites

The Project Area is heavily disturbed from prior land use including quarrying and the establishment of the Middle Arm Industrial Precinct. No archaeological survey has been conducted on the site for this Project. The likelihood of finding any archaeological relics or sacred sites in the development area is low due to the site being extensively disturbed.

TNG will obtain an Aboriginal Areas Protection Authority (AAPA) Certificate prior to any works commencing. The AAPA Certificate will include information on the presence of any registered sacred site or archaeological sites within the area and any conditions of use such as restricted works areas.

6.9.2 Other heritage

No World Heritage Properties, National Heritage Places or Commonwealth Heritage Places occur within 10 km of the Project site (Appendix B).

A search of Lot 1817 Hundred of Ayers of the NT Heritage Register was conducted on the 27 September 2015. The results indicated no known heritage items or places are present on site.

Sites related to World War II activities have been recorded on Middle Arm Peninsula (Bourke & Guse 2007).

Given the site is already heavily disturbed it is unlikely there are any heritage items present.

A search of the DotE Shipwreck database was conducted 27 September 2015. An unidentified shipwreck called *Elizabeth River – unidentified wreck* (identification no. 3435) is located in Darwin Harbour immediately to the north west of the Project site at Latitude -12.53655, Longitude 130.95666. No additional detail is known.

The Catalina 1 (RAAF) flying –boat wreck is located near Blaydin Point, north west of the Project site.



6.10 Economics

The Project is the development of a Refinery for the processing of concentrate from the Mount Peake Project.

The Project will deliver significant social and economic benefits to the NT and to Australia. The Project will bring jobs and training, business opportunities, new infrastructure and advanced technology. The social and economic benefits of the Project will include:

- Regional and social infrastructure enhancement;
- Local community and Aboriginal and Torres Strait Islander development;
- Employment and training opportunities; and
- Local business growth through supply of goods and services.

The construction and operations workforces are expected to peak at 500 and 100 personnel respectively.

It is expected that permanent operations staff will live in existing accommodation in the Darwin area. Construction personnel will reside in either rental properties or hotel accommodation. An option to consider existing construction camps will also be considered.



7. Potential Impacts and Management

7.1 Overview

This section identifies the potential impacts to the environment from activities associated with construction and operation of the proposed Refinery, and the steps that will be taken to mitigate potential environmental impacts.

A desktop assessment was carried out to identify potential impacts. The management controls below are general in nature, and provide a broad approach to impact management. The impact assessment process will continue, and include an environmental impact identification (ENVID) workshop that considers both construction and operational phases of the Refinery. The ENVID will define detailed management measures to reduce the risk of potential impacts to As Low as Reasonably Possible (ALARP). The detailed impact management measures will be collated in a Construction Environmental Management Plan (CEMP) and Erosion and Sediment Control Plan (ESCP) for the Project.

7.2 Monitoring environmental performance

As part of the CEMP, a monitoring program will be developed for the Project which will aim to:

- identify environmental change, and in particular changes that have occurred as a result of the Project development;
- contribute to reviews of environmental management procedures; and
- provide data that will be used to assess adherence to and compliance with works approvals and licence conditions.

Indicators to be monitored will be determined based on the extent and nature of potential environmental impacts identified. Each of the monitoring programs will be conducted by appropriately qualified personnel in a systematic and scientifically rigorous manner.

Table 7-1 describes potential impacts to the physical environment from activities associated with construction and operation of the proposed Refinery.



Table 7-1 Potential impacts, mitigation and monitoring

Environmental Aspect / Activity	Impact Description	Mitigation Controls and Monitoring
Land use	Changes to land titles and zoning will be required for development of the Project. Subdivision will be required to remove the area of Lot 1817 Zoned CN surrounding Lot 1902 from the remainder of Lot 1817. The Project land use is consistent with zoning purposes and area plans.	Subdivision in accordance with NT Planning Regulations. Crown Lease Agreement between NTG and TNG.
Cyclones and storm surge during construction	The site is partially located in primary and secondary storm surge areas and extreme storm surge areas. Dependent upon the size and path of a storm cell such events can result in damage to the facilities and consequent pollution of surrounding and marine environment.	Hazardous materials will be stored under cover in sealed and secured containers. Storage areas covered and bunded. The available bund capacity will be equal to at least 100% of the capacity of the largest container of hazardous goods, plus 10% of the capacity of the second largest container. All buildings, storage facilities and other structures designed and constructed in compliance with the relevant Australian building codes and standards. If construction occurs in the wet season, a procedure will be developed for management of activities in cyclonic or severe storm conditions.
Cyclones and storm surge during operations	Cyclones and storm surge (or sea level rise) results in damage to the Refinery including process dam areas and reagent storage resulting in pollution of the marine environment.	Raise the ground surface level so that infrastructure is sited above/outside an extreme storm surge area level. All buildings, storage facilities and other structures will be designed and constructed in compliance with the relevant Australian building codes and standards. A management procedure will be developed for management of activities in cyclonic or severe storm conditions. Compliance with Major Hazardous Facility licence and other environment licence/s.
Water (Pollution) Storage and/or use of hazardous materials during construction and operation.	Reduction in estuarine/marine water quality as a result of leaks and spills contaminating water ways or surface run off.	No planned direct discharge of untreated liquids from the site (e.g. untreated stormwater runoff) to the marine environment. Design of stormwater drains to cater for storm events and unplanned discharge/overflow. Compliance with Major Hazardous Facility licence and



Environmental Aspect / Activity	Impact Description	Mitigation Controls and Monitoring
Water (Flooding) Operation of Refinery	Without engineering controls, the site is likely to be poorly drained and prone to localised flooding due to proximity to storm surge areas, flat grades and poorly drained soils. Groundwater rising close to the surface during the wet season would limit access to the site and damage sealed and gravelled surfaces.	environment licence/s. Design of the refinery will incorporate both surface and subsurface drainage. Design of stormwater drains will cater for storm events and unplanned discharge/overflow. The surface drainage system will be designed for a 1 in 5 year storm event and comprise unlined trapezoid open drains that will discharge to sediment ponds. A subsoil drainage system will be implemented to ensure the integrity of sealed areas and that the site is operational during the wet season. It is proposed to provide subsoil drains comprised of a geofabric lined trench and aggregate surrounding a slotted subsoil pipe installed at 20 m spacing discharging directly into the open surface drains. The open drains and subsoil drainage systems will flow into sedimentation basins 20 x 4 x 1 m deep located on either side of the Refinery. This design will need to be confirmed in detailed design. Compliance with Major Hazardous Facility licence and environment licence/s.
Soil (Pollution) Storage and use of machinery that contains hazardous materials such as petrol, oils and lubricants (POL)	Localised impact to soil and potential localised impact to surface water and/or groundwater as a result of run off/leaching of contaminated soils from the Refinery.	All spills (any uncontrolled release of hydrocarbon, chemicals, liquid waste or other hazardous substance) will be reported and cleaned up in a timely manner. Spill-response materials and equipment (including personal protective equipment and Safety Data Sheets (SDS) will be made available at all times and will be appropriate to the substances being stored on site. Contaminated soils will be contained and placed in red contamination bins with covers that will be provided onsite. These will be moved offsite and disposed of appropriately. Compliance with Major Hazardous Facility licence and environment licence/s.



Environmental Aspect / Activity	Impact Description	Mitigation Controls and Monitoring
Soil (Pollution) Ground disturbance and construction earthworks	A majority of the earthworks will be undertaken in areas that contain vegetation and soils that are unlikely to be PASS. In the event that PASS is disturbed, potential impacts include: • oxidation leading to ASS and generation of sulfuric acid; • potential acidification and heavy-metal contamination of surrounding soil, surface water and groundwater; • potential impact on growth and health of vegetation due to modified pH levels in the soil, surface water and groundwater; and • impact on the productivity of the local soils due to pH change and increased bioavailability of metals within the soil profile.	Soil tests to determine presence/absence of PASS and to ensure that compaction meet soil permeability targets for preventing groundwater intrusion and leaching of contaminants into the groundwater.
Soil (Erosion and Sedimentation) Dust and soils disturbance and relocation due to vegetation clearing, ground disturbance and construction earthworks	Short term decrease in water quality, which may or may not be localised, as a result of discharge or overflow of (potentially contaminated) sediment or soil into waterways and loss of top soil/subsoil exposure on site.	A sediment and erosion control plan will be developed and implemented for the site construction and operation by a suitably qualified practitioner. Sedimentation basins will be provided. The basins will be sized based on the International Erosion Control Association Best Practice Erosion and Sediment Control. During the construction phase silt fences and other sediment control devices will be constructed around disturbed areas during periods of wet weather. Water trucks will be used for dust suppression during the construction phase. Hose-down of hard stand areas will occur during the operational phase to avoid the potential for dust build up.
Soil (Compaction) Movement of vehicles and heavy machinery and sitting of heavy equipment at or around site.	Localised soil compaction which may result in water pooling on site after rainfall.	Design of the refinery incorporates both surface and subsurface drainage as described above. Therefore, any localised increase in surface water caused by soil compaction will be collected by a drainage system.



Environmental Aspect / Activity	Impact Description	Mitigation Controls and Monitoring
Air (Noise and Vibration) Use of heavy machinery and equipment during construction e.g. earthmovers, trucks, compactors, etc.	Short-term and localised disturbance to fauna in adjacent bushland. Short-term and localised nuisance, disturbance or health impacts to local community.	Construction activities will be managed consistent with: - AS 2436:2010, Guide to noise and vibration control on construction, maintenance and demolition sites; and - Noise guidelines for development sites in the Northern Territory (NRETAS 2011). There is, however, the potential for unexpected delays in the construction schedule to be addressed via extended work hours. As a consequence of works occurring outside of “standard” hours, Contractor requires that mitigation measures consistent with the Noise guidelines for development sites in the NT (NRETAS 2011) be implemented on Site.
Air (Emissions) Movement of an increased number of heavy vehicles on site and on un-formed roads during construction Emissions from Refinery process	Short-term and localised loss of air quality from dust generated during construction. Further work is required to understand air emissions from the Refinery process.	Where practicable, construction activities will be planned, scheduled and carried out to avoid the generation of dust. Dust-suppression techniques to protect vegetation, worker health and amenity will be implemented and may include spraying surfaces with water trucks, irrigation or stabilisation of cleared areas. On-site access roads will be mostly sealed. For unpaved road sections, the periodic application of water will be used for dust suppression. Undertake an air emissions assessment including modelling to address NT EPA and other applicable standards and identify mitigation measures and treatments that may be required.
Biodiversity (Fauna) Vegetation clearing Use of heavy machinery and equipment during construction e.g. earthmovers and trucks etc.	Localised disturbance and/or damage to native fauna in surrounding environment.	Limit vegetation clearing footprint as per project approvals.



Environmental Aspect / Activity	Impact Description	Mitigation Controls and Monitoring
Biodiversity (Flora) Vegetation clearing Use of heavy machinery and equipment during vegetation clearing e.g. earthmovers and trucks	Vegetation clearing. Localised disturbance and/or damage to native vegetation in surrounding environment Regional impacts on vegetation from the proposed development are likely to be minimal. None of the vegetation communities known from the site are listed as threatened with extinction.	Areas of vegetation to be removed will be marked to avoid clearing unintended areas. GPS equipment or flagging will be used to verify areas to be cleared. Large-scale vegetation clearing and earthworks will be planned to be undertaken in dry-season conditions where practicable. If further clearing is required during the wet-season, it will be undertaken in accordance with the mitigation measures outlined in an ESCP.
Biodiversity (Threatened Species) Disturbance of habitat areas and/or individual plants/animals during infrastructure development activities	No clearing of threatened species is proposed. The only threatened plant species that may occur, <i>Cycas armstrongii</i>, is regionally common. Its conservation status, and the local Darwin population, is unlikely to be impacted by the development. In the event threatened species were to be removed, this would result in non-compliance with threatened species legislation (Commonwealth and/or NT) or migratory species agreements.	Relocate <i>Cycas armstrongii</i> in consultation with Greening Australia and/or replant in landscaping works on site.
Pest Species (Weeds) Spread of weeds/weed seed onto and off site through movement of machinery; and delivery/removal of materials	Introduction of new weed species to the area and/or localised spread of existing weed populations to new locations.	Infestations of declared weeds will be controlled on site and along access roads to avoid contamination to vehicles and machinery during roadwork and grading activities. Machinery will be cleaned prior to entering the site. Vehicles will be inspected for weeds before entering the site. Cleared areas will be managed to control weed infestation. Any weeds will be controlled as soon as practicable. Development of a construction environmental management plan.
Pest Species (Biting Insects) Accumulation of water in open containers, and in machinery capable of holding water Water ponding in blocked culverts and drainage lines, and upstream of erosion prevention structures	Localised breeding sites created for mosquitoes and other biting insects that may carry disease, and increase in likelihood of workforce being bitten whilst on site.	Surface and subsurface drainage designed to minimise water ponding. Request Department of Health, Entomology Branch review the drainage plan and dam concepts for the site. Staff will be made aware of the risk and recommend they use personal protective equipment. Equipment and materials will be stored to minimise localised breeding sites, e.g. open containers, storage of machinery that may carry water in the Wet Season.



Environmental Aspect / Activity	Impact Description	Mitigation Controls and Monitoring
Heritage (Archaeology) and Sacred Sites Excavation, ground disturbance and other construction activities including simple access	Exposure of, or damage to Aboriginal or cultural heritage artefacts such as sacred rocks, middens, skeletal remains, World War II artefacts, etc.	An AAPA certificate will be obtained before any construction works commence. In the event that an archaeological item is located, all works will cease in that area until approval to continue is granted from the relevant authority.
Human Health and Transport Transportation of hazardous goods on public roads and increased traffic combined with existing and future traffic such as traffic to the INPEX site.	In the event of an unplanned accident or incident, transportation of hazardous chemicals via rail and road may contaminate the nearby environment and be a health risk to human and wildlife receptors.	Compliance with Major Hazardous Facility licence and environment licence/s. Third Party transport services operational requirements and procedures. Transport Management Plan
Community - Access (Security) Excavation and construction activities, stockpiles and stock storage on site, access roads and general site housekeeping	Risk of unlawful access to construction site or operating refinery which may result in safety risks to intruders and damage to site equipment.	Fencing is proposed for the entire refinery with provision of a double leaf vehicle entry gate and a pedestrian gate. It is intended to challenge vehicles at the entry to the refinery. If unauthorised to enter, a turn-around is to be provided. Signage will be provided at the intersection of the Site Access and roads to minimise the entry of unauthorised vehicles onto the site.
Community concern of a hazardous facility adjacent to Darwin Harbour	The siting of a major hazardous facility adjacent to Darwin Harbour, a marine environment of threatened species, is potentially a major concern to the community.	Development and implementation of a community consultation plan to inform the community of the Project, project controls, monitoring and corrective action in place for the Project; and to seek input on potential community concerns for further consideration. Compliance with Major Hazardous Facility licence and environment licence/s.
Waste Management	Liquid wastes generated during the refinery process will be disposed offsite at a licenced facility provided by a third party. Further work is required to understand potential impacts on solid waste for the onsite land disposal options.	A waste inventory, volumes and potential landfill concept design will be developed to gain a detailed understanding of potential waste impacts and mitigation. Compliance with Major Hazardous Facility licence and environment licence/s.



8. Matters of National Environmental Significance

8.1 Matters requiring assessment

An EPBC Act Protected Matters Report was generated on 25 August 2015 using the EPBC Protected Matters Search Tool (Appendix A). A buffer of 10 km was selected. A summary of the results is provided in Table 8-1.

Table 8-1 Summary of EPBC considerations

EPBC Act controlling provision	Description
Matters of national environmental significance	
World Heritage properties	None within 10 km of the Project site.
National Heritage places	None within 10 km of the Project site.
Wetlands of international importance	None within 10 km of the Project site.
Listed threatened species	31 (8 birds, 8 mammals, 2 plants, 7 reptiles, 6 sharks).
Listed threatened ecological communities	None within 10 km of the Project site.
Listed migratory species	49 (2 migratory marine birds, 18 migratory marine, 3 migratory terrestrial, 26 migratory wetland species).
Commonwealth marine areas	None within 10 km of the Project site.
Great Barrier Reef Marine Park	No - not within 10 km of the Project site.
Nuclear action	This Project is not a nuclear action.
A water resource, in relation to coal seam gas development and large coal mining development	Nil.
Other protected matters	
The environment of Commonwealth land	No – land owned by NT Government.
Commonwealth action	No.
Commonwealth Heritage places	None.
Listed marine species	90 within 10 km of the Project site.
Whales and other cetaceans	12 within 10 km of the Project site.
Critical habitats	None.
Commonwealth reserves - terrestrial	None.
Commonwealth reserves - marine	None.

The Project does overlap with the mapped distribution of a number of threatened species and migratory species (sections 18, 20 and 20A of the EPBC Act). Potential to impact on these matters is described in Chapter 7.



The Project is not expected to have a significant impact on a matter of national significance and is not anticipated to be “controlled action” under the EPBC Act as:

- development activities will be limited to the land based part of the site which is disturbed (from previous extractive industry activities on site);
- there will be no large scale clearing of threatened species habitat;
- there will be no clearing of mangroves or discharge of contaminated water streams off site to the marine area; and
- management measures will be implemented.

As listed threatened species are known to occur in the marine area adjacent to the Project site, the Refinery Project (the action) will be referred to DotE, shortly following submission of the NOI to the NT EPA. The Referral will be submitted to determine if the Project is a controlled action and potentially require approval from the Commonwealth Environment Minister under the EPBC Act.

If the Project is a controlled action, the bilateral assessment process would apply. No bilateral approvals process is in place for the NT.



9. Conclusion

TNG propose to construct and operate a Refinery on Lot 1817, Hundred of Ayers, Middle Arm, Darwin.

The Refinery will process concentrate (from the proposed Mount Peake Project) to produce:

- vanadium pentoxide - for use in steel, non-ferrous alloys, chemicals, catalysts and energy storage (vanadium redox batteries);
- titanium dioxide pigment - for use in paint, plastics, paper and inks; and
- pig iron - for use in steel making.

Key potential environmental impacts include:

- air emissions – generated from the refinery process;
- waste management – generated during the process and potential impacts from onsite disposal;
- human health – from transportation and onsite storage of hazardous chemicals and potential impact in the event of an incident or accident; and
- marine environment – relating to transportation and onsite storage of hazardous chemicals and the potential impact in the event of an incident or accident; and potential impacts on the marine environment from overtopping of dams on site.

Management plans and controls will be developed in accordance with regulatory requirements such as a Major Hazardous Facility licence, environmental protection approval/licence, construction environmental management plan, erosion and sediment control plan and any conditions of approval from regulatory authorities including the NT EPA, DLPE and if relevant, DotE.



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Appendices





Appendix A – Darwin Harbour Site of Conservation Significance Information Sheet



Darwin Harbour

Location and Description

Darwin Harbour is a large indented embayment with three main arms – East, Middle and West. Two major rivers, the Elizabeth and Darwin Rivers drain into the Harbour and the city of Darwin is located on the north-eastern shore. The shoreline is dominated by mangroves, which largely remain in undisturbed condition and the Site contains more than 5% of the Northern Territory's entire mangrove area. Darwin Harbour has one of the richest coastal environments anywhere in the Asia Pacific region, and occurs within one of the world's least impacted marine regions. The coastal and mangrove environments are backed by savanna woodlands and patches of monsoon rainforest.

Tenure and Land Use

The Darwin Harbour Site, especially its west and south-west portions, is predominantly vacant Crown land. The remainder is mostly freehold land associated with the cities of Darwin and Palmerston. The land uses within the Site are many and varied - the freehold portions support a mix of commercial, residential and industrial land uses. The Harbour has port facilities and supports tourism, recreation and aquaculture. Approximately 3% of the Site is managed as conservation reserves.

Significance Rating

International Significance

Ecological Values

Darwin Harbour supports a range of estuarine, freshwater and terrestrial environments including extensive areas of tidal mudflats and one of the largest and most diverse areas of mangroves in the Northern Territory. The mangroves of Darwin Harbour support a highly specialised fauna and 14 bird species that are entirely restricted to mangrove environments (e.g. Chestnut Rail, White-breasted Whistler and Mangrove Golden Whistler). The Harbour itself supports a diverse range of marine species including dugongs, dolphins, marine turtles and a large variety of fish. A total of 15 threatened species are reported from within the Site.

Management Issues

Future urban and industrial developments around Darwin Harbour represent a major management issue for this Site. The north-eastern part of Darwin Harbour catchment is already highly developed and native vegetation and tidal flats have been cleared and drained. Further major industrial developments around Middle Arm are currently



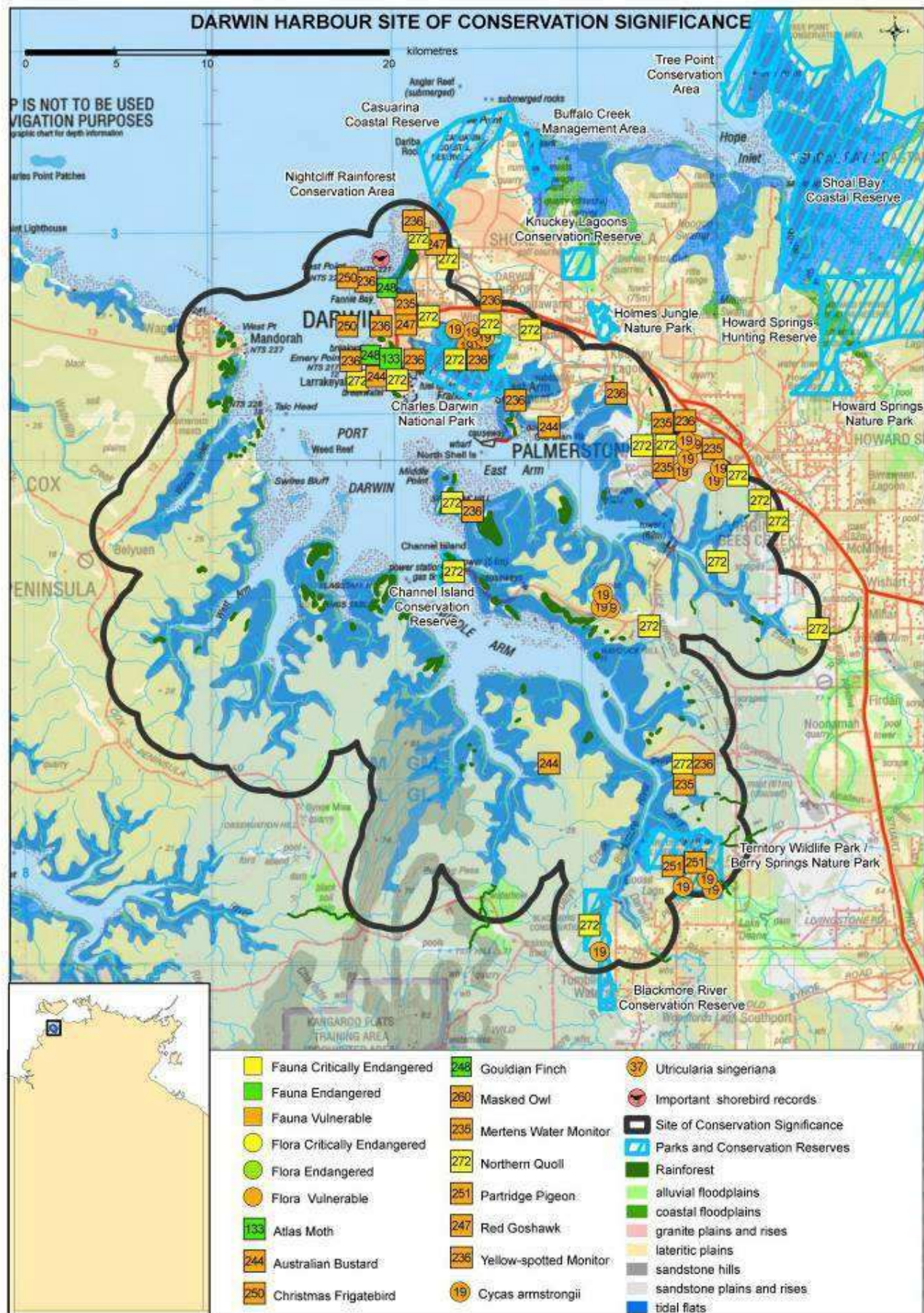
being considered. Water pollution from run-off and industry and sea-level rise will also potentially affect the Harbour environment.

Condition

In comparison with marine areas near other major cities, Darwin Harbour is in good condition. However, a range of human activities do impact on the marine and coastal environments and these are likely to intensify in future years.

Current Conservation Initiatives

A regional plan of management has been developed for Darwin Harbour and its catchment area, and priority actions are being implemented. Ecosystem monitoring and research groups have been established to direct strategic research and co-ordinate monitoring activities within the Harbour.



LOCATION	SOCS Number	6 (NT Parks and Conservation Masterplan Map Number 12)
	Latitude/Longitude	12° 34' South, 130° 52' East (at centre)
	Bioregion	Darwin Coastal (98%), Pine Creek (2%)
	Description	The site includes the tidal flats (222 km²) within the Harbour from East Point around to West Point (including the major sub-embayments of East Arm, Middle Arm, West Arm, Woods Inlet, Frances Bay and Fannie Bay) and a buffering terrestrial area (527 km²). Sub-tidal waters of the Harbour are not included in this assessment. The rivers that flow into the Harbour (including the Darwin, Blackmore and Elizabeth Rivers and Berry Creek) have small catchments and lack the large floodplains and freshwater wetlands that characterise many other coastal areas around the Top End. Much of the area behind the extensive tidal flats in this site is high ground forested with woodland rather than wetlands (Darwin Harbour Advisory Committee 2003). The extensive tidal flats associated with nearby Shoal Bay and the sand sheets of the Howard River are also recognised as sites of high conservation significance in the NT.
THREATENED SPECIES	Significance Rating	International Significance
	Threatened plants and animals (Listings at National/NT level CR - Critically Endangered, EN - Endangered, VU - Vulnerable, NT - Near Threatened, LC - Least Concern, DD - Data Deficient)	15 threatened species are reported from this site. Plants ▪ <i>Cycas armstrongii</i> (-/VU) ▪ <i>Utricularia singeriana</i> (-/VU) Vertebrates ▪ Australian Bustard <i>Ardeotis australis</i> (-/VU) ▪ Christmas Frigatebird <i>Fregata andrewsi</i> (VU/-) ▪ Gouldian Finch <i>Erythrura gouldiae</i> (EN/EN) ▪ Masked Owl <i>Tyto novaehollandiae kimberli</i> (VU/VU) ▪ Partridge Pigeon <i>Geophaps smithii</i> (VU/VU) ▪ Red Goshawk <i>Erythrorhynchus radiatus</i> (VU/VU) ▪ Northern Quoll <i>Dasyurus hallucatus</i> (EN/CR) ▪ Merten's Water Monitor <i>Varanus mertensi</i> (-/VU) ▪ Yellow-spotted Monitor <i>Varanus panoptes</i> (-/VU) ▪ Flatback Turtle <i>Natator depressus</i> (VU/DD) ▪ Green Turtle <i>Chelonia mydas</i> (VU/LC) ▪ Hawksbill Turtle <i>Eretmochelys imbricata</i> (VU/-) Invertebrates ▪ Atlas Moth <i>Attacus wardi</i> (-/EN) There are only historic records of <i>Utricularia singeriana</i> and the Atlas Moth from this site, and suitable habitat may no longer be present.
ENDEMIC SPECIES	Significance Rating	Not Significant
	Notes	Endemic to the bioregion: One vertebrate (<i>Ramphotyphlops nema</i>) and two plant species (<i>Spermacoce phalloides</i>, <i>Typhonium praetermissum</i>) recorded in this site are NT endemics and are only known from the Darwin Coastal bioregion. Endemic to the NT: 77 plant and 12 vertebrate species recorded in the site are only known from the NT. Other: 12 plant and one vertebrate species (Lewin's Rail) are only known from the site or the Darwin Coastal bioregion within the NT, but are also found in other states. There is a collection of records of vagrant bird species from Darwin Harbour/Shoal Bay that have not been recorded elsewhere in the NT.
WILDLIFE AGGREGATIONS	Significance Rating	Not Significant
	Marine turtles	Flatback, Hawksbill, and Green Turtles frequent the waters of Darwin Harbour but the lack of sandy beaches within the Harbour inhibits nesting activity.
	Seabirds	Significant aggregations of seabirds are not known from this site (Chatto 2001).
	Waterbirds	This site lacks a large area of freshwater wetland and supports relatively low numbers of waterbirds (Chatto 2006).
	Shorebirds	Although large areas of mudflats occur around Darwin Harbour during periods of low tide, high numbers of shorebirds have not been recorded. The highest count is 3000 individuals in 1994 (Chatto 2003).
	Other aggregations	None known
	Significance Rating	National Significance
WETLANDS	Ramsar criteria met	Not assessed
	DIWA criteria met	Darwin Harbour is listed as a wetland of national significance in the Directory of Important Wetlands in Australia (DIWA: NT029 Port Darwin). The site meets criteria 1, 2, 3, 4, 5, 6 and includes wetland types: A1, A2, A3, A6, A7, and A9.
	Notes	Darwin Harbour is a good example of a shallow branching embayment of the Top End Region, supporting one of the largest discrete areas of mangrove swamp in the NT (DIWA). Within the Darwin Harbour catchment there are series of ponding systems (Dambos) that may play an important role in filtering organic material before it is delivered to the harbour. Many of these are not included within the current boundary of the site (R. Wasson, Charles Darwin University, pers. comm.).

FLORA	Rivers	The Darwin, Blackmore and Elizabeth Rivers and Berry Creek flow into Darwin Harbour. All are relatively small Top End rivers.
	Significance Rating	National Significance
	Notes	Rainforest: About 1150 ha of mostly dry rainforest (or 0.4% of the NT rainforest estate) occur as small patches around the margin of the tidal flats in this site. One patch is >100 ha but most patches are small (<10 ha) (Russell-Smith 1991). Large areas of rainforest or vine-thicket habitat occur within the Harbour on peninsulas or 'hinterland islands' such as Blaydin Point, Wickham Point, Flagstaff Hill and Kings Table. Fire-sensitive vine-thicket communities have become particularly well developed in these habitats due to the protection offered by the surrounding mangroves, which unlike savannah woodlands, do not burn. Other: Mangroves fringe the whole embayment of Darwin Harbour and comprise one of the largest (~20 400 ha) and most floristically diverse (~41 species) areas of mangroves in the NT (Duke 2006). Mangrove communities within the Harbour have been identified and mapped by Brocklehurst and Edmeades (1996).
OTHER ENVIRONMENTAL VALUES		The mangroves of Darwin Harbour support a highly specialised fauna including over 306 invertebrate species and 112 species of mammals, bats and birds (Metcalfe 2007). Mangroves in north-western Australia support distinctive fauna and more mangrove-endemic bird species than any other region in the world (Noske 1996). Some of the highly specialised bird species that occur in Darwin Harbour include the Mangrove Gerygone, Mangrove Robin, Mangrove Golden Whistler and Chestnut Rail. A group of colubrid snakes including the White-bellied Mangrove Snake <i>Fordonia leucobalia</i>, are also part of the distinctive mangrove fauna found in Darwin Harbour, and compliments the wider, but poorly-known, community of sea-snakes in the area (Whiting 2003). In terms of faunal diversity, Darwin Harbour is one of the richest mangrove systems in the Indo-west Pacific region. Each of the eight different floristic assemblages defined in Darwin Harbour mangroves (Brocklehurst and Edmeades 1996) supports a distinctive faunal community. In particular, the most seaward assemblage, with <i>Sonneratia alba</i> dominant, is an exceptionally productive mangrove community with the highest primary productivity (Metcalfe 1999) and faunal diversity and abundance of any assemblage in the harbour (Metcalfe 2007). Eight sites around Darwin Harbour are listed on the Register of the National Estate for their natural values including: Berry Springs Nature Park, Darwin Foreshores, <i>Pachystoma pubescens</i> Sites 1 and 2, Channel Island Reefs, Imaluk Creek Area, Southport Area, and the Darwin Harbour Wetlands (Australian Heritage Council). 80 species recorded from this site are listed under international conventions or bilateral agreements protecting migratory animals. Dugongs are common in the Harbour (Whiting 2004). The marine areas within this site are likely to encompass other significant biodiversity values and these are currently being explored and collated in a project by the Marine Biodiversity Group of NRETAS (K. Edyvane, NRETAS, pers. comm.).
		Fire: The current fire regime in the Darwin region differs from that in other sparsely populated savanna areas of the NT and is ad hoc and closely linked to tenure (Price and Baker 2007). The frequency of late dry season fires is lower in the Darwin region than other areas (Price and Baker 2007), but exotic grasses are increasing fuel loads and the intensity of fires (Kean and Price 2003). In the period 1993-2004, 43% of the site was burnt in fewer than three years, and 24% was burnt in more than six years. Feral animals: Feral cat, dog, rat, pig and Cane Toad are present in the site. Marine pest incursions remain a concern given the proximity of Darwin Harbour to Asia (Smit 2003). Weeds: Four Weeds of National Significance (<i>Lantana camara</i>, <i>Mimosa pigra</i>, <i>Salvinia molesta</i>, <i>Parkinsonia aculeata</i>), 25 declared Category A and B weeds and 12 other undeclared but problematic environmental weeds (high priority weeds: Smith 2001) are recorded from this site. The aquatic weed <i>Cabomba caroliniana</i> is reported from Darwin River (Smith 2002). Other: The north-eastern part of Darwin Harbour catchment is highly developed and native vegetation and tidal flats have been cleared and drained. With the current rapid growth of the city of Darwin, further pressure is likely to come from future recreational, residential and industrial developments within the Harbour (Wightman 2006). Major industrial developments around Middle Arm are currently being considered. Nutrient enrichment from sewerage discharge and storm water run-off may affect mangrove communities in the Harbour (Dames and Moore 1984 in Wightman 2006). Despite having a macrotidal range of 7.8 m, the waters of Darwin Harbour are not particularly well flushed and recent research and modelling indicates that pollution may circulate within the upper reaches of the Harbour for considerable periods (Williams, 2006). Pollution and increased turbidity (e.g. from dredging) associated with future developments within the Harbour, may therefore affect water quality and the biodiversity values. The potential rise in sea level predicted in response to global climate change may affect mangrove communities in Darwin Harbour, especially in areas where coastal developments exclude the landward retreat of coastal ecosystems. Although mangroves are generally well adapted to the dynamic conditions at the land-sea interface, recovery from severe disturbance (e.g. storms, cyclones, clear-felling) may be very slow (Metcalfe, 2007). Indeed, severely damaged mangroves may take several decades to recover and such delayed recovery times increase their vulnerability to disturbance (McGuinness 1992).
MANAGEMENT ISSUES		

MANAGEMENT INFORMATION	NRM groups	Belyuen Land Management Group (Belyuen), Larrakia Rangers (Darwin) (Northern Land Council 2006).
	Protected areas	Blackmore River Conservation Reserve (4 km ² / 0.6% of site), Channel Island Conservation Reserve (1 km ² / 0.1% of site), Charles Darwin National Park (10 km ² / 1% of site), Territory Wildlife Park/Berry Springs Nature Park (11 km ² / 1% of site).
	Current management plans	Site-specific plans: Charles Darwin National Park Plan of Management (PWCNT undated); Darwin Harbour Regional Plan of Management (Darwin Harbour Advisory Committee 2003). National recovery plans for threatened species: marine turtles (Environment Australia 2003); Northern Quoll (Hill and Ward in prep.); Partridge Pigeon and Masked Owl (Woinarski 2004a), Gouldian Finch (O'Malley 2006); Red Goshawk (Baker-Gabb in prep.). Other management plans: Australian Weeds Strategy (NRMCC 2007); Threat Abatement Plan for Predation by Feral Cats (Environment Australia, 1999); Threat Abatement Plan for Predation, habitat degradation, competition and disease transmission by feral pigs (DEH 2005); FIREPLAN: Fire management for the savanna community (Russell-Smith <i>et al.</i> in prep.).
	Monitoring programs and research projects	Fire in the tropical savannas is mapped continuously under the North Australia Fire Information Project http://www.firenorth.org.au/nafi/app/init.jsp Numerous programs and sites exist for monitoring water quality and ecological condition within the Darwin Harbour catchment area and a summary of them is reported by the Darwin Harbour Advisory Committee (2005). Fauna and vegetation are monitored at permanent sites in NT parks within the Darwin region including the Territory Wildlife Park and Charles Darwin National Park (Calnan <i>et al.</i> 2008). Populations of the rare ground orchid <i>Nervilia peltata</i> (D. Liddle, NRETAS unpubl.) and <i>Cycas armstrongii</i> (Liddle 2004) are monitored under different fire regimes at permanent plots in Charles Darwin National Park. There is an ongoing program of monitoring and removal of Saltwater Crocodiles from within Darwin Harbour and Shoal Bay (Nichols and Letnic in press). Dolphins are surveyed monthly along transects within Darwin Harbour and Shoal Bay (C. Palmer, NRETAS unpubl.). Research on the biodiversity of mangrove habitats in Darwin Harbour involving surveys of vertebrate and invertebrate fauna in disturbed and undisturbed mangroves was conducted from 1999-2002 (Metcalf 2007). The methodology developed has since been applied for mangrove monitoring purposes. A two year study of primary productivity within the eight different mangrove assemblages was conducted at eight sites in the three arms of Darwin Harbour from 1997-1999 (Metcalf 1999). Monitoring of mangrove productivity was continued for a 3 rd year by DIPE. Recommended methodology for monitoring of flora and soils in mangrove habitats of Darwin Harbour was developed by DIPE (Moritz-Zimmern <i>et al.</i> 2002), developed further in a research framework (Comley 2002) and later applied at the Darwin LNG plant (McHugh 2004). Commercial mangrove monitoring programs for aquaculture developments in Darwin Harbour including Wild River and Tiger International subsequently adopted this monitoring methodology for impact assessment purposes. Research on the distribution and role of Dambo wetland systems in the Darwin Harbour catchment (R. Wasson, Charles Darwin University, pers. comm.). Research on the use of mangrove habitats by fish in Darwin Harbour was conducted from 1998 to 2001 including development of a trophic model for the harbour (Martin 2004). As part of the Environmental Management Plan for the Darwin LNG Plant, Conoco Phillips established in 2002 a mangrove monitoring program at Wickham Point with matched control sites in Darwin Harbour. The monitoring program has provided over 6 years of valuable baseline data on mangrove flora and invertebrate fauna (URS 2003; Metcalf 2005; 2006).
KEY REFERENCES	Management recommendations	Continue to implement the Darwin Harbour Regional Plan of Management (NRETA 2005). Develop a fire management strategy for the Darwin region that identifies clear objectives, roles and responsibilities (Price and Baker 2007). Prevent the spread of exotic grasses, especially mission grasses and gamba grass, into new areas in the Darwin region and reduce populations in areas with high conservation value or where fires threaten properties (Kean and Price 2003). Assess the data for Darwin Harbour against Ramsar criteria and consider listing as a wetland of international significance (S. Blanch, Environment Centre NT, pers. comm.). Consider expanding the boundary of the site to the catchment boundary to incorporate Dambo wetland systems (R. Wasson, Charles Darwin University, pers. comm.).
	Papers and reports	Darwin Harbour Advisory Committee (2003). <i>Darwin Harbour Regional Plan of Management</i> . Department of Infrastructure, Planning and Environment, Darwin. Darwin Harbour Advisory Committee (2005). <i>A Review of Environmental Monitoring of the Darwin Harbour Region and Recommendations for Integrated Monitoring</i> . Darwin Harbour Advisory Committee, Darwin. DIWA (A Directory of Important Wetlands in Australia). <i>Australian Wetlands Database</i> . Department of Environment, Water, Heritage & the Arts, Canberra ACT (accessed November 2007). Metcalf, K. (2007). <i>The biological diversity, recovery from disturbance and rehabilitation of mangroves in Darwin Harbour</i> . PhD thesis. Charles Darwin University, Darwin.
	Contributors	Kristin Metcalf, Consultant Environmental Scientist, Darwin

Appendix B - Legislative Framework

Commonwealth Legislation

Environment Protection and Biodiversity Conservation Act 1999

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), any development requires assessment if it has the potential to significantly impact one or more of nine Matters of National Environmental Significance (MNES). The MNES include:

1. World Heritage properties;
2. National Heritage places;
3. Wetlands of international importance (listed under the Ramsar Convention);
4. Listed threatened species and ecological communities;
5. Migratory species protected under international agreements;
6. Commonwealth marine areas;
7. The Great Barrier Reef Marine Park;
8. Nuclear actions (including uranium mines); and
9. A water resource, in relation to coal seam gas development and large coal mining development.

The environment under the EPBC Act includes:

- ecosystems and their constituents;
- natural and physical resources;
- qualities and characteristics of locations, places and areas;
- heritage values of places; and
- social, economic and cultural aspects.

The EPBC Protected Matters Search Tool was used to generate the EPBC Act Protected Matters Report. The Report indicated that there are 31 threatened species and 49 migratory species within 10 km of the proposed Refinery (DotE 2015). The Project is not anticipated to impact on MNES.

The Project is not anticipated to be a “controlled action” under the EPBC Act. As listed threatened species are known to occur in the marine area adjacent to the Project site, an EPBC Referral will be submitted to DotE in October 2015, shortly following submission of this NOI to the NT EPA, for assessment and determination.

If the Project is a controlled action, the bilateral assessment process would apply. No bilateral approvals process is in place for the NT.

National Environment Protection Measures (Implementation) Act 1998

Under the *National Environment Protection Measures (Implementation) Act 1998*, the National Environmental Protection Council (NEPC) was established to set national environmental goals and standards for Australia through the development of National Environment Protection



Measures (NEPMs). The NEPC is part of the Environment Protection and Heritage Council (EPHC).

Section 14(1) of the NEPC Act prescribes that NEPMs may relate to any one or more of the following:

- ambient air quality;
- ambient marine, estuarine and fresh water quality;
- the protection of amenity in relation to noise;
- general guidelines for the assessment of site contamination;
- environmental impacts associated with hazardous wastes; and
- the re-use and recycling of used materials.

Mitigation and management measures were developed in accordance with Section 14(1) of the Act.

National Strategy for Ecologically Sustainable Development

The goal of the National Strategy for Ecological Sustainable Development (ESD) is to develop in a way that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. This strategy is being implemented in the NT, under the *Northern Territory Environment Protection Authority Act 2012* (NT EPA Act 2012). Under this Act the NT EPA is required to:

- promote ESD; and
- protect the environment, having regard for the need to enable ESD.

Under the NT EPA Act (2012), ESD means using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life now and in the future can be increased.

Northern Territory Legislation

Northern Territory Environmental Protection Authority Act 2012

The *Northern Territory Environment Protection Authority Act 2012* commenced on 1 January 2013. The Act establishes the new Northern Territory Environment Protection Authority (NT EPA) as an independent regulatory authority and makes consequential amendments to the *Waste Management and Pollution Control Act 1998* and the *Environmental Assessment Act 1982*.

Amendments to the *Waste Management and Pollution Control Act* identify the NT EPA as the entity responsible for administration of the regulatory functions of that Act.

Amendments to the *Environmental Assessment Act 1982* identify the NT EPA as the entity responsible for administration of the assessment functions and impose additional transparency and reporting responsibilities on the Environment Minister and the responsible Minister for specific projects.



The Environmental Assessment Act 1982 and Environmental Assessment Administrative Procedures Act 1984

The Environmental Assessment Act 1982 and the Environmental Assessment Administrative Procedures Act 1984 ensure each matter affecting the environment is fully examined and taken into account in, and in relation to:

- formulation of proposals;
- carrying out of works and other projects;
- negotiation, operation and enforcement of agreements and arrangements (including agreements and arrangements with authorities of the commonwealth, the states and other territories);
- making of, or the participation in the making of, decisions and recommendations; and
- incurring of expenditure.

This NOI was prepared in accordance with the Guidelines for a Notice of Intent (NOI) (NT EPA). The NT EPA will determine whether the proposal is likely to have a significant impact on the environment following submission of the NOI. If the impact is likely to be significant, a Public Environment Report or Environmental Impact Statement will be required under the Act.

Northern Territory Aboriginal Sacred Sites Act 1989

The *Northern Territory Aboriginal Sacred Sites Act 1989* is administered by the Aboriginal Areas Protection Authority (AAPA). The Act provides for the location, recognition, description and protection of sites sacred under Aboriginal tradition. All sacred sites (even if not registered) are protected under the Act and it is an offence to enter or carry out work on a sacred site without permission or a certificate issued by the AAPA. The certificate sets out conditions under which the work may be carried out.

Heritage Act 2011

The *Heritage Act 2011* commenced on 1 October 2012. It replaced the Heritage Conservation Act, which had been in operation since 1991.

This Act applies to the Project. Chapter two of the Act allows for the establishment of the Northern Territory Heritage Register. Members of the community can nominate areas, places, sites, buildings, shipwrecks and heritage objects to the register. If the Minister agrees that these features are of special significance to the heritage of the Northern Territory, the place is added to the register. The place will then be protected from accidental and deliberate damage or harm. The Act allows for processes to approve works and maintenance for a heritage place. There are no nominated or declared heritage places in the Project Area.

Sections 17 and 18 of the new Act declare all Aboriginal and Macassan archaeological places and objects heritage places, providing the same level of protection as places on the Heritage Register. Part 3.2 of the HA allows for applications to work on heritage places, including work on, or salvage of, Aboriginal archaeological sites. In practice, permits to salvage Aboriginal Archaeological places will be issued under conditions which include the approval of the appropriate Traditional Owner or Site Custodian for a site. Permits under the new Act will also require reasonable study of each site disturbed, and appropriate curation of any artefacts salvaged. This will normally mean repatriation of artefacts to the appropriate Traditional Owners of an area.



The *Heritage Act 2011* includes a provision for the declaration of classes of places or objects that are known to be of significance in the NT but where not all locations are currently mapped and recorded.

Planning Act 2009

The *Planning Act 2009* applies to the Project. The Project site is zoned FD – Future Development under the Act. The Planning Act 2009 defines "development" as an activity that involves carrying out works on land, including clearing of native vegetation. "Works" is defined as any activity on land other than mining or agriculture, resulting in a physical change to the land or a part of the land.

The planning scheme requires native vegetation to be cleared in accordance with the Land Clearing Guidelines 2010 (DoR 2010).

A Development Permit and an Environment Protection Licence may be required under the Planning Act.

Water Act 1992

The *Water Act 1992* covers allocation, use, control, protection and management of Northern Territory water resources.

Pollution under the Act includes directly or indirectly altering the physical, thermal, chemical, biological or radioactive properties of the water so as to render it less fit for a prescribed beneficial use for which it is or may reasonably be used, or to cause a condition which is hazardous or potentially hazardous to:

- public health, safety or welfare;
- animals, birds, fish or aquatic life or other organisms; and
- plants.

Waste Management and Pollution Control Act 1998

The purpose of the *Waste Management and Pollution Control Act 1998* is to protect the environment through objectives and approvals, encouraging effective and responsible waste management and reduction and response to pollution. This Act facilitates the implementation of national environment protection measures made under the *National Environment Protection Council (Northern Territory) Act 1999*, and incorporates environmental compliance plans and audits.

Section 14 of the Act establishes a process for notifying the NT EPA (the administering agency for the Act) about incidents causing, or threatening to cause pollution. Schedule 2 of the Act requires environment protection/licensing for certain activities.

Waste Management and Pollution Control (Administration) Regulations 2012

These regulations deal with administrative issues such as fees for licensing and approvals and payment of "on the spot fines".

Works Health and Safety Act 2011

Work Health and Safety (National Uniform Legislation Act 2011 (WHS Act)) and *Work Health Safety (National Uniform Legislation) Regulations (WHS Regulations)* relate to storage of reagents at the Project site which potentially requires approval and a licence under this Act. The Refinery is likely to be classified as a Major Hazardous Facility due to onsite storage of



Hydrochloric acid, liquid oxygen, ammonia, liquid chlorine (and potentially other hazardous chemicals subject to further concept design) above threshold limits specified in Schedule 15 NT WHS Regulations and *Control Of Major Hazardous Facilities National Standard 1014(2002) and National Code of Practice 2016(1996)* (National Occupational Health and Safety Commission 2002) related national standards.

All Northern Territory sites that are determined as MHF's are required to hold a licence under the WHS Act and must comply with stringent requirements, including preparation of a safety case, to ensure they are operated safely.

Other Legislation

Other legislation that may be applicable to the Project includes:

- *Territory Parks and Wildlife Conservation Act 2006;*
- *Soil Conservation and Land Utilisation Act 2001;*
- *Weeds Management Act 2001;*
- *Bushfires Act 2009;*
- *Fire and Emergency Act 2012;* and
- *Traffic Act 1987.*



Appendix C – EPBC Act Protected Matters Report





EPBC Act Protected Matters Report

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

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

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

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[Summary](#)

[Details](#)

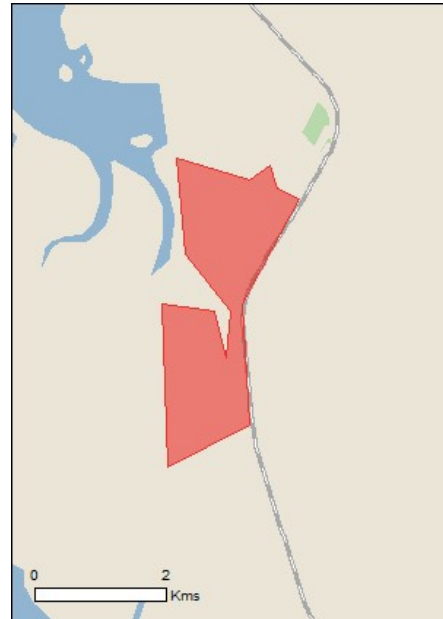
[Matters of NES](#)

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

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

Buffer: 10.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	31
Listed Migratory Species:	49

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	6
Commonwealth Heritage Places:	None
Listed Marine Species:	90
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	31
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
Epthianura crocea tunneyi Yellow Chat (Alligator Rivers) [67089]	Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat known to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat known to occur within area
Geophaps smithii smithii Partridge Pigeon (eastern) [64441]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew [847]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Conilurus penicillatus Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat may occur within area
Dasyurus hallucatus Northern Quoll [331]	Endangered	Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Mesembriomys gouldii gouldii Black-footed Tree-rat (Kimberley and mainland Northern Territory), Djintamoonga [87618]	Endangered	Species or species habitat known to occur within area
Phascogale pirata Northern Brush-tailed Phascogale [82954]	Vulnerable	Species or species habitat likely to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tail Bat [66889]	Critically Endangered	Species or species habitat likely to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Atalaya brevialata [86125]	Critically Endangered	Species or species habitat known to occur within area
Typhonium taylori a herb [65904]	Endangered	Species or species habitat likely to occur within area
Reptiles		
Acanthophis hawkei Plains Death Adder [83821]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis Largetooth Sawfish, Freshwater Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish	Vulnerable	Species or species

Name	Status	Type of Presence
[68442]		habitat known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Sterna albifrons		
Little Tern [813]		Species or species habitat may occur within area
Migratory Marine Species		
Balaenoptera edeni		
Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat may occur within area
Carcharodon carcharias		
Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Crocodylus porosus		
Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Dugong dugon		
Dugong [28]		Species or species habitat known to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Lepidochelys olivacea		
Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Manta birostris		
Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Foraging, feeding or related behaviour known to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area
Calidris alba Sanderling [875]		Foraging, feeding or related behaviour known to occur within area
Calidris canutus Red Knot, Knot [855]		Foraging, feeding or related behaviour known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
Calidris ruficollis Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area
Calidris tenuirostris Great Knot [862]		Foraging, feeding or related behaviour likely to occur within area

[Charadrius leschenaultii](#)

Greater Sand Plover, Large Sand Plover [877]

Foraging, feeding or related behaviour known to occur within area

[Charadrius mongolus](#)

Lesser Sand Plover, Mongolian Plover [879]

Foraging, feeding or related behaviour known to occur within area

[Charadrius veredus](#)

Oriental Plover, Oriental Dotterel [882]

Foraging, feeding or related behaviour may occur within area

[Gallinago megala](#)

Swinhoe's Snipe [864]

Foraging, feeding or related behaviour likely to occur within area

[Gallinago stenura](#)

Pin-tailed Snipe [841]

Foraging, feeding or related behaviour likely to occur within area

[Glareola maldivarum](#)

Oriental Pratincole [840]

Foraging, feeding or related behaviour may occur within area

[Heteroscelus brevipes](#)

Grey-tailed Tattler [59311]

Foraging, feeding or related behaviour known to occur within area

[Limosa lapponica](#)

Bar-tailed Godwit [844]

Species or species habitat known to occur within area

[Limosa limosa](#)

Black-tailed Godwit [845]

Foraging, feeding or related behaviour likely to occur within area

[Numenius madagascariensis](#)

Eastern Curlew [847]

Critically Endangered

Foraging, feeding or related behaviour known to occur within area

[Numenius minutus](#)

Little Curlew, Little Whimbrel [848]

Foraging, feeding or related behaviour likely to occur within area

[Numenius phaeopus](#)

Whimbrel [849]

Foraging, feeding or related behaviour known to occur within area

[Pandion haliaetus](#)

Osprey [952]

Breeding known to occur within area

[Pluvialis fulva](#)

Pacific Golden Plover [25545]

Foraging, feeding or related behaviour known to occur within area

[Pluvialis squatarola](#)

Grey Plover [865]

Foraging, feeding or related behaviour known to occur within area

[Xenus cinereus](#)

Terek Sandpiper [59300]

Foraging, feeding or related behaviour known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

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

Name
Commonwealth Land -
Commonwealth Land - Australian Government Solicitor
Commonwealth Land - Director of Property Services Defence Estate
Defence - KOWANDI NORTH COMMUNICATION STATION
Defence - KOWANDI SOUTH REPEATING STATION
Defence - ROBERTSON BARRACKS (Waler Barracks)

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Foraging, feeding or related behaviour known to occur within area
Anseranas semipalmata		
Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area
Calidris alba		
Sanderling [875]		Foraging, feeding or related behaviour known to occur within area
Calidris canutus		
Red Knot, Knot [855]		Foraging, feeding or related behaviour known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
Calidris ruficollis		
Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area
Calidris tenuirostris		
Great Knot [862]		Foraging, feeding or related behaviour likely to occur within area
Charadrius leschenaultii		
Greater Sand Plover, Large Sand Plover [877]		Foraging, feeding or related behaviour known

Name	Threatened	Type of Presence to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]		Foraging, feeding or related behaviour known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Foraging, feeding or related behaviour may occur within area
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Foraging, feeding or related behaviour may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Foraging, feeding or related behaviour known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Foraging, feeding or related behaviour likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew [847]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area
Numenius phaeopus Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area
Pluvialis squatarola Grey Plover [865]		Foraging, feeding or related behaviour known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Xenus cinereus Terek Sandpiper [59300]		Foraging, feeding or related behaviour known to occur within area
Fish		
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys haematopterus Reef-top Pipefish [66201]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribbioned Pipehorse, Ribbioned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
Hippichthys parvicarinatus Short-keel Pipefish, Short-keeled Pipefish [66230]		Species or species habitat

Name	Threatened	Type of Presence
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paegnius Rough-snout Ghost Pipefish [68425]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within

Name	Threatened	Type of Presence area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773]		Species or species habitat may occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis atriceps Black-headed Seasnake [1101]		Species or species habitat may occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis inornatus Plain Seasnake [1107]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Hydrophis pacificus Large-headed Seasnake, Pacific Seasnake [1112]		Species or species habitat

Name	Threatened	Type of Presence
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Parahydrophis mertoni Northern Mangrove Seasnake [1090]		Species or species habitat may occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information
Name	Status	Type of Presence
Mammals		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
		may occur within area

Extra Information

State and Territory Reserves [\[Resource Information \]](#)

Name	State
Channel Island	NT

Invasive Species [\[Resource Information \]](#)

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

Name	Status	Type of Presence
Birds		

Acridotheres tristis Common Myna, Indian Myna [387]	Species or species habitat likely to occur within area
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Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]	Species or species habitat likely to occur within area
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Passer domesticus House Sparrow [405]	Species or species habitat likely to occur within area
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Passer montanus Eurasian Tree Sparrow [406]	Species or species habitat likely to occur within area
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Sturnus vulgaris Common Starling [389]	Species or species habitat likely to occur within area
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Frogs

Rhinella marina Cane Toad [83218]	Species or species habitat likely to occur within area
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Mammals

Bos taurus Domestic Cattle [16]	Species or species habitat likely to occur within area
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Bubalus bubalis Water Buffalo, Swamp Buffalo [1]	Species or species habitat likely to occur within area
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Canis lupus familiaris Domestic Dog [82654]	Species or species habitat likely to occur within area
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Name	Status	Type of Presence
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Plants		
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area
Annona glabra Pond Apple, Pond-apple Tree, Alligator Apple, Bullock's Heart, Cherimoya, Monkey Apple, Bobwood, Corkwood [6311]		Species or species habitat may occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, BlackBuffel-grass [20213]		Species or species habitat may occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Hymenachne amplexicaulis Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		Species or species habitat likely to occur within area
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Mimosa pigra Mimosa, Giant Mimosa, Giant Sensitive Plant, Thorny Sensitive Plant, Black Mimosa, Catclaw Mimosa, Bashful Plant [11223]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Pennisetum polystachyon Mission Grass, Perennial Mission Grass, Missiongrass, Feathery Pennisetum, Feather		Species or species habitat likely to occur

Name	Status	Type of Presence
Pennisetum, Thin Napier Grass, West Indian Pennisetum, Blue Buffel Grass [21194] Salvinia molesta		within area
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area

Reptiles

Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Lepidodactylus lugubris Mourning Gecko [1712]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Nationally Important Wetlands		<u>[Resource Information]</u>
Name		State
Port Darwin		NT

Caveat

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-12.544758 130.974203,-12.558628 130.966383,-12.574639 130.967527,-12.580317 130.956369,-12.558628 130.955511,-12.559559
130.962663,-12.565889 130.964189,-12.559652 130.964952,-12.552112 130.958658,-12.539266 130.957514,-12.542152 130.967432,-12.54029
130.970293,-12.543362 130.971246,-12.544735 130.974084,-12.544758 130.974155,-12.544758 130.974155,-12.544758 130.974203

Acknowledgements

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- [Department of Environment, Climate Change and Water, New South Wales](#)
- [Department of Sustainability and Environment, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment and Natural Resources, South Australia](#)
- [Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [Environmental and Resource Management, Queensland](#)
- [Department of Environment and Conservation, Western Australia](#)
- [Department of the Environment, Climate Change, Energy and Water](#)
- [Birds Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Museum Victoria](#)
- [Australian Museum](#)
- [SA Museum](#)
- [Queensland Museum](#)
- [Online Zoological Collections of Australian Museums](#)
- [Queensland Herbarium](#)
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- [Australian National Herbarium, Atherton and Canberra](#)
- [University of New England](#)
- [Ocean Biogeographic Information System](#)
- [Australian Government, Department of Defence](#)
- [State Forests of NSW](#)
- [Geoscience Australia](#)
- [CSIRO](#)
- Other groups and individuals

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

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

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