Port Kembla Gas Terminal

Volume 1

Environmental Impact Statement

November 2018

GHD

AIE
Powering Australian Industry

Declaration

This environmental impact statement for the Port Kembla Gas Terminal has been prepared in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* and submitted under section 5.15 of the *Environmental Planning and Assessment Act 1979*.

Development application	**Project**	Port Kembla Gas Terminal		
	Proponent	Australian Industrial Energy		
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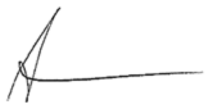
Declaration	The environmental impact statement has been prepared in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*. The environmental impact statement contains all available information that is relevant to the environmental assessment of the development, activity or infrastructure to which the statement relates. The information contained in the environmental impact statement is neither false nor misleading.			
	Signature			
	Name	Karl Rosen	Craig Dengate	Michael Goodall
	Date	5/11/2018	5/11/2018	5/11/2018

Executive summary

Introduction

Australian Industrial Energy (AIE) proposes to develop the Port Kembla Gas Terminal (the project). The project involves the development of a liquefied natural gas (LNG) import terminal at Port Kembla, south of Wollongong in NSW. The project will be the first of its kind in NSW and provide a simple, flexible solution to the state's gas supply challenges.

LNG will be sourced from worldwide suppliers and transported by LNG carriers to the Port Kembla Gas Terminal. The LNG will then be re-gasified for input into the NSW gas transmission network. At present it is envisaged that an LNG shipment will be required every two to three weeks to provide for an annual supply of up to 100 petajoules of gas per year which represents more than 70% of the State's gas needs. Supply could be increased further to around 140 to 150 petajoules per year through a slight increase in LNG delivery schedules and pipeline upgrades. In addition, the storage capacity of the Floating Storage and Regasification Unit (FSRU) equates to about 4 petajoules of gas, or around 10 to 12 days of natural gas storage for the whole of NSW in case of interstate supply disruption.

The proponent

AIE was formed in 2017 by a consortium of Australian and international companies with extensive global expertise and experience in the energy sector. The consortium consists of:

- ***Squadron Energy*** — a privately owned energy company forming part of the Minderoo Group, with a record of world class natural resource projects across Australia.
- ***Marubeni Corporation*** — a major Japanese trading and investment business with significant energy sector expertise and interests in over 25 countries including LNG import terminals, gas pipelines and power plant.
- ***JERA Co., Inc.*** — established in April 2015 as part of a comprehensive alliance between TEPCO Fuel & Power, Incorporated (a wholly owned subsidiary of Tokyo Electric Power Company Holdings, Incorporated) and Chubu Electric Power Co., Incorporated. JERA Co., Inc. is the largest buyer of LNG in the world (about 10 to 15% of the global market), operates eight import terminals, is an equity owner in four Australian LNG export projects, and operates a fleet of LNG transport ships and approximately 70GW of power generation.

Need for project

The NSW Gas Plan notes more than a million NSW households use gas for everyday uses like cooking or heating and around 33,000 NSW businesses and 500 heavy industrial operations rely heavily on natural gas for their operations. These businesses are estimated to support over 300,000 jobs across NSW. In addition, over 10% of NSW's current electricity generation capacity is gas powered, with a number of proposed expansions already well advanced in the planning process.

NSW currently imports more than 95% of the natural gas it uses, with the majority of supplies coming as interstate supplies from Victoria and South Australia. In recent years, gas supplies to the Australia east coast market have tightened, resulting in increased prices for both industrial and domestic users. Several recent economic studies, including from the Australian Energy Market Operator (AEMO) and EnergyQuest have predicted significant future gas shortfalls for NSW by 2022.

The project provides an immediate solution to address predicted gas shortages and will be of considerable economic benefit to both the Illawarra region and NSW. The project will introduce a new source of competitively priced gas to the market, helping to put downward pressure on prices and improving overall gas security for NSW.

In August 2018, the project was declared Critical State Significant Infrastructure, and thus essential to NSW on social, environmental and/or economic grounds, in accordance with section 5.13 of the *Environmental Planning and Assessment Act 1979* and Schedule 5 of the State Environmental Planning Policy (State and Regional Development) 2011

Site setting

The project is located at Port Kembla within the Illawarra region of NSW, about 80 kilometres south of Sydney. Port Kembla is characterised by the existing import and export terminal and multiple other business, cargo, logistics, bulk goods and heavy industrial facilities in the vicinity.

Port Kembla was first established in 1883 to facilitate the export of coal. Since then it has had a continuous history as a working port, with the establishment of Port Kembla's Outer Harbour more than a century ago. The port is now divided into an Inner Harbour and Outer Harbour, including a deep-water shipping channel to facilitate the arrival and departure of large carriers and cargo ships. The facilities currently include 18 import and export berths and six major independently operated terminals.

Port Kembla operates 24 hours per day 7 days per week and is a key infrastructure asset for NSW and an economic driver for the Illawarra region.

The project will be predominantly located within land zoned for dedicated port and industrial uses. Berth and wharf facilities and the FSRU would be situated at Berth 101 within the Inner Harbour, while the gas pipeline would extend around the periphery of port operations from Berth 101 to a tie-in point at Cringila.

Berth 101 currently forms part of the Port Kembla Coal Terminal site and was most recently utilised as an off-loading wharf for materials handling equipment. The berth does not currently have any regular use with the majority of coal exports operating out of Berth 102 located to the north of Berth 101.

The Cringila gas transfer station owned and operated by Jemena provides a connection to the NSW Eastern Gas Pipeline (EGP). The EGP is a 797 kilometre long gas pipeline with a nameplate capacity in excess of 350 terajoules per day. The pipeline supplies gas to major gas markets in Victoria, Wollongong and Sydney as well as regional NSW and the ACT.

Project Description

The Port Kembla Gas Terminal consists of four key components:

- LNG carrier vessels — there are hundreds of these in operation worldwide transporting LNG from production facilities all around the world to demand centres
- Floating Storage and Regasification Unit (FSRU) — a cape-class ocean-going vessel which would be moored at Berth 101 in Port Kembla
- Berth and wharf facilities – including landside offloading facilities to transfer natural gas from the FSRU into a natural gas pipeline located on shore
- Gas pipeline – a Class 900 carbon steel high-pressure pipeline connection from the berth to the existing gas transmission network at Cringila.

An overview of the proposed layout for the project is shown on Figure E1.

Paper Size ISO A4

0 50 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Australian Industrial Energy
Port Kembla Gas Terminal

Project No.	21-27477
Revision No.	A
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Project layout

Figure E-1

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

The FSRU is a double-hulled vessel of approximately 300 metres in length and 50 metres in breadth with a storage capacity of around 170,000 cubic metres or about four petajoules of gas. The LNG is stored within a cargo area comprising separate cargo tanks suitable for carrying LNG at low temperatures (about minus 161 degrees Celsius) and at atmospheric pressure.

The FSRU would receive LNG from regularly scheduled LNG carriers from external suppliers. It is anticipated that in the order of 24 LNG carriers would visit Port Kembla in any one year during project operations. The LNG carriers will tether alongside the FSRU for around 24–36 hours while they transfer their LNG cargo into the cargo holds of the FSRU.

The FSRU has four key functional elements: facilities to receive LNG from LNG carriers; facilities to store LNG; facilities to convert LNG to high pressure gas; and connection to the gas pipeline.

Purpose built flexible hoses will be used to transfer LNG from visiting LNG carriers to the FSRU. It is expected that the FSRU itself will have six hoses, which will include four for receiving LNG and two for maintaining a balance of vapour gas between ships.

Cargo tanks to store the LNG in the FSRU are purpose built and designed to achieve two outcomes:

- to insulate and contain LNG cargo at cryogenic temperatures (approximately minus 161 degrees Celsius); and
- to prevent leakages and isolate the cargo from the hull structure.

Boil-off gas (BOG) management facilities are also in place to capture small amounts of natural gas that is generated from LNG in the storage tanks. This BOG is used to fuel the on-board generators for the operation of pumps and other equipment used on-board.

The regasification unit located on board the FSRU is typically located toward the bow or centre of the vessel. The regasification process involves LNG being pumped up from the cargo tanks into a suction drum. The LNG is then pumped through a series of heat exchanges, which utilise seawater as a source of natural heat differential to warm up the LNG. Once in a gaseous form, the gas is exported, under pressure, through the marine loading arms into the gas pipeline.

Berth and wharf facilities are proposed to be located at Berth 101 within the Inner Harbour of Port Kembla. The berth and wharf facilities will incorporate a quay wall configuration to provide the necessary space for the FSRU and LNG carriers to be configured side-by-side without limiting the existing navigability of the Inner Harbour.

A range of topside facilities will be established at the wharf, including mooring infrastructure, gas transfer infrastructure including offloading arms, and gas pipeline tie-in and maintenance infrastructure. A range of ancillary facilities would also be required at the wharf including access roads, fencing and other security, lighting, telecommunications, electricity, water, sewerage and other utilities.

Excavation and dredging will be required in order to establish the berth and wharf facilities. It is estimated that about 600,000 cubic metres of material would be excavated and dredged for the construction of berth and wharf facilities. Allowing for typical bulking factors, this volume would equate to about 720,000 cubic metres, which will be disposed of in the Outer Harbour as part of the Outer Harbour reclamation works.

A short gas pipeline would connect the FSRU to the a tie-in point at Cringila, which in turn is connected to the EGP. The gas pipeline would be a DN450 carbon steel pipeline about 45 centimetres (18 inches) in diameter and about 6.3 kilometres in length.

Subject to receiving approval, construction will commence in 2019 and is expected to take around 10 to 12 months. Construction of the project will involve a capital investment of about $200–$250 million and employ about 150 workers at its peak.

Subject to approval processes, the project expected to receive first gas delivery by 2020 and have a design life of around 10 to 15 years, which may be extended subject to sufficient ongoing gas demand. Once fully operational, the project is expected to employ about 40–50 personnel.

Project approval process

The project has been declared critical state significant infrastructure (CSSI) in accordance with section 5.13 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and Schedule 5 of the *State Environmental Planning Policy (State and Regional Development) 2011*. This Environmental Impact Statement (EIS) has been prepared to support the development application for determination by the NSW Minister for Planning.

This EIS has been prepared in accordance with the *Environmental Planning and Assessment Act 1979* (EP&A Act), Schedule 2 of the Environmental Planning and Assessment Regulation 2000 and the Secretary's Environmental Assessment Requirements (SEARS) issued by the Department of Planning and Environment (DPE) on 10 August 2018.

All applicable NSW and Commonwealth legislation has been considered in during the preparation of this EIS.

The project is not considered to have potential to have a significant impact upon any listed matters of national environmental significance including listed threatened species and communities. A referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is therefore not required for the project.

Stakeholder Consultation

A wide range of consultation activities have been undertaken as part of the project. This includes more than 40 group or one on one briefings and a project website (www.ausindenergy.com), which has been developed to provide comprehensive, clear and accessible information that is updated on a regular basis.

As well as the local Port Kembla and broader community of the Wollongong region, extensive engagement was also undertaken with a range of other interested key stakeholders, such as local commerce organisations, the Port Authority and local and state government.

The engagement activities provided an opportunity to inform stakeholders about the project and the CSSI assessment process, and to answer questions and obtain feedback on additional benefits, concerns or challenges associated with the project.

The issues and opportunities identified during the consultation process have been considered by the project team in relation to the proposed scope and design of the project and have been used to inform the preparation of this EIS.

Port Navigation

Port Kembla has a deep-water shipping channel that can accommodate vessels with ship length of up to 311 metres and has capacity for Capesize vessels at nominated berths. Pilotage is compulsory for all vessels over 30 metres in length.

The Port Authority of NSW is responsible for the management of shipping operations in Port Kembla, including the provision of Harbour Master functions, pilotage, navigation services and ship scheduling. The Harbour Master establishes port operational procedures (port instructions) relating to vessel navigation protocols, ship scheduling, berthing and under keel depth requirements, as well as performance standards to achieve safe, effective, reliable and cost efficient shipping.

The project proposes an LNG shipment every two to three weeks, which equates to around 4 vessel movements on average per month. The LNG carrier movements are low in proportion to the vessels movements anticipated from other operational arrangements at the port (1,680 to 2,380 vessel movements per year) and are not expected to significantly increase vessel movements or restrict navigability within the port.

A navigation simulation study was undertaken during the development of the project to determine potential risks associated with interaction with other vessels and to refine the layout of the proposed berthing arrangements. The final berth layout was moved slightly to the north and is aligned to be parallel with Berth 102 as part of the design process. The layout provides a 40 metre offset from the Inner Harbour turning basin when the LNG carrier is berthed alongside the FSRU. This typically occurs every two to three weeks for a period of around 24 to 36 hours so an additional buffer distance is available for the majority of the year.

The navigational study indicated there is a need for some modifications to the current operating practices when turning other vessels in the Inner Harbour to maintain safe clearances. Currently, vessels commence turning once they cross the Eastern Basin (eastern side of the turning basin). When an LNG carrier is in berth, vessel turning will have to occur further towards the north-west quadrant of the turning basin to allow for vessel leeway, particularly under westerly wind conditions. This was successfully tested in the simulators and will require modifications to the current turning circle, extra Pilot training, extra aids to navigation for Pilots (upgraded portable Pilot Unit computers using differential global positioning systems) and to include the turning circle, and extra monitoring by the VTIC. Additionally, the Harbour Master may need to modify port parameters for vessels using the turning basin in higher wind conditions, which may also involve the use of existing Port Kembla tugs or reduced wind conditions.

Overall, results of the navigational simulation study showed that safe navigation through the channel and in the Inner Harbour is possible for all vessels when combined with the proposed berth layout.

Ship-handling protocols will be developed by the Harbour Master to ensure adequate management measures are implemented for passing vessels which may cause interaction with vessels berthed at Berth 101 (LNG carrier’s and FSRU).

Hazard and Risk

The project represents a new industry to NSW and introduces potential associated hazards and risk to people and property located in the surrounding area. The project is being developed in accordance with a range of global best practice and international, Australian and NSW regulations, standards and guidelines that would mean the risk posed by the project is inherently low.

A preliminary hazard analysis (PHA) was carried out in accordance with the NSW Department of Planning and Environment guideline *Hazardous Industry Planning Advisory Paper No 6 Hazard Analysis*, including quantitative risk assessment of the LNG carriers, FSRU, berth and wharf facilities and the gas pipeline. The PHA involved the identification of specific hazardous events, the probability of them occurring and the consequences for people and property if they did occur. The overall risk associated with the hazards was determined in relation to defined criteria under *Hazardous Industry Planning Advisory Paper No 4 Risk Criteria for Land Use Safety Planning*.

The main hazards that were identified related to a loss of containment of liquid natural gas from a LNG carrier or the FSRU, or a loss of containment of natural gas from the FSRU, the gas pipeline or connecting unloading arms and pipes at the berth and wharf facilities. The potential impact of propagation risk to and from adjacent industrial sites was also considered. Lastly, the potential for collision between a LNG carrier and another vessel was also considered. The potential consequences of those hazardous events, including potential fire and explosion, were then determined in specialist risk modelling software.

The assessment found that risk to people or property in sensitive areas, residential areas or commercial areas was very low and complied with the stringent risk thresholds in the Department of Planning and Environment guideline *Hazardous Industry Planning Advisory Paper No 4 Risk Criteria for Land Use Safety Planning*. Risk at adjacent industrial areas or open land were also assessed to be low given the low probability of a hazard event occurring.

In addition to various safety features proposed to be built into the project, a comprehensive safety management system would be implemented in accordance with relevant regulations, standards and guidelines including *Hazardous Industry Planning Advisory Paper No 9 Safety Management*. A detailed safety case will be developed for the project in accordance with the *Work Health and Safety Act 2011* and *Work Health and Safety Regulation 2017*. The safety case would require separate approval from SafeWork NSW and would provide further detailed assessment of safety risks, emergency planning and management systems informed by the detailed design of the project.

Soils and contamination

The project site is located primarily within industrial land that has been reclaimed from Tom Thumb Lagoon during the establishment of Port Kembla. While the source of fill cannot be confirmed, it is likely that it may contain dredge material from the Inner Harbour and steelworks slag throughout the project footprint.

Contamination in the fill material at Berth 101 was assessed to be relatively minor and generally consistent across the development area. Only two soil samples exceeded adopted criteria for benzo(a)pyrene (health limits) and for heavy end petroleum hydrocarbons (management limits) near the inferred base of fill material between four metres and five metres below ground level. The review of potential source-pathway-linkages for this contamination indicates that it is unlikely to pose any significant constraints to the project, subject to further delineation of hotspots and mitigation measures developed to manage potential health impacts during construction works as part of an environmental management plan. Potential risks to marine environmental receptors from relocation of the berth material is considered low and acceptable based on measured concentrations of contaminants.

Groundwater inflows at Berth 101 were typically encountered at depths between about 3.7 metres and 5.0 metres below ground level. There were no obvious signs of groundwater contamination identified during well installation or groundwater sampling, however laboratory analysis indicated some relatively minor impacts from heavy metals and ammonia with a perched fresh to brackish groundwater lens. The proposed piling and excavation works will limit the amount of perched water discharging into the marine environment, which will in any event significantly reduce the concentrations of contaminants observed in this investigation.

The investigations did not identify any widespread, gross contamination of soils along the proposed pipeline alignment. However, fill materials are considered to have a moderate likelihood of contamination based upon current and historical land uses. The potential for localised contamination to be present within fill along the pipeline alignment should be anticipated in the development of environmental management plans for the project.

Potential acid sulphate soils (ASS) occur in natural sediments below the level of fill and within marine sediments, particularly where dark grey and green clays exist. Disturbance of these natural sediments during excavation or dredging has the potential to impact the surrounding marine environment. The activities will need to be carefully managed and it is recommended that an acid sulphate soil management plan (ASSMP) be prepared as part of the environmental management plan for the project. The ASSMP will include measures to minimise the potential oxidation of sediments such as minimising the time of exposure to oxygen during excavation and transport and placement at depth beneath the sea level within the disposal footprint.

Marine sediments within Port Kembla harbour are known to be contaminated as a result of the historical industrial land use in surrounding areas. Several previous contamination investigations have determined the upper soft silty clays to be contaminated within both the Inner Harbour and Outer Harbour sediments. Heavy metals commonly exceeded the screening levels for cadmium, chromium, copper, lead, nickel, mercury and zinc and Tributyltin (TBT), dioxins and polycyclic aromatic hydrocarbons (PAHs) were reported above the nominated guidelines in several previous studies.

Additional sediment sampling within the proposed dredge footprint adjacent to Berth 101 and at two locations within the disposal area was completed to confirm the findings of the previous assessments. Elevated metal concentrations were reported above the nominated screening levels in the dredge footprint at both Berth 101 and the Outer Harbour disposal area. Other contaminants of potential concern, including PAH, TBT and hydrocarbons reported 95% UCL average concentrations below the nominated screening levels in the dredge area at Berth 101 with some elevated concentrations within the Outer Harbour.

Analytical results were generally consistent with those reported previously by others including detailed studies undertaken by AECOM (2010) for the Outer Harbour Project and Worley Parsons (2012) for a previously proposed redevelopment of Berth 101. No new contaminants of potential concern were identified at levels exceeding screening criteria during the current investigations.

Overall, the findings of the assessment indicate the presence of contaminated sediments within the proposed dredging and disposal areas. Concentrations of contaminants of concern were largely consistent across the two areas, with the primary contaminants of concern including heavy metals, PAH and dioxins at concentrations above the nominated screening levels.

As Port Kembla has been operating for many years, both capital and maintenance dredging impacts are well understood. As a result, mitigation measures and procedures are also well understood and can be captured in any dredging management plan.

A dredging management plan should be prepared by the proponent prior to the dredging of Berth 101, outlining the contamination management and mitigation measures, including surface water monitoring, which will be implemented during the course of the works to minimise potential impacts to the receiving waters.

Water Resources

Water quality within the Inner Harbour and Outer Harbour of Port Kembla has historically been impacted by urban and industrial discharges as well as port activities. In particular, these past activities led to contamination of marine sediments, groundwater and harbour waters.

A number of water quality monitoring studies have been undertaken in order to define ambient water quality within the port and to monitor water quality parameters during previous dredging campaigns. The 2002-2005 monitoring program undertaken by the Port Kembla Environment Group is considered to be the most comprehensive study of ambient water quality conditions within the harbour. The program aimed to establish benchmarks to determine trends and future improvements in water quality and assess whether contaminant concentrations exceed the ANZECC / ARMCANZ Guidelines (2000).

The program identified concentrations of aluminium, cadmium, copper, lead, zinc, tin and arsenic in excess of the ANZECC (2000) 95% trigger values for protection of marine waters with elevated concentrations generally found in the vicinity of creeks and waterways that drain industrial and stockpile areas. Total suspended solid (TSS) concentrations are influenced by shipping movements and freshwater flood events and are slightly higher within the Inner Harbour than the Outer Harbour. Monitoring indicates pH levels are lower in the Inner Harbour than the Outer Harbour and are likely to be influenced by freshwater discharges from existing waterways. Water temperatures within Port Kembla are generally higher than those measured offshore due to tidal flushing patterns and existing warm water industrial discharges into the Inner Harbour.

Potential impacts during the construction phase are primarily associated with water quality impacts generated during the removal, handling and placement of dredged sediments. In particular, dredging and reclamation activities may generate turbid plumes, mobilise contaminants, disturb dinoflagellate cysts within the Outer Harbour and increase rates of sedimentation.

Numerical modelling was undertaken to assess impacts to Total Suspended Solids (TSS) and sediment deposition associated with the dredging and disposal of harbour muds within the Inner and Outer Harbours respectively. The dredge plume is predicted to be confined to waters within the port with significant TSS concentrations confined to the vicinity of the dredging and disposal areas. Sedimentation is predicted to occur in the immediate vicinity of the dredging and disposal activities with no noticeable impacts to sedimentation rates outside of the port. Potential impacts to turbidity levels and sedimentation rates will be further restricted through the use of silt curtains surrounding equipment and activities where there is a potential for impacts to water quality.

Potential impacts during operations are primarily associated with seawater discharges from the FSRU generated during the regasification process and hydrodynamic impacts associated with the altered port configuration.

The regasification process on board the FSRU relies on the use of seawater extracted from the Inner Harbour to heat the LNG to convert it to gas. The seawater used in the regasification process will then be released back into the Inner Harbour at up to 7^{o} Celsius cooler than the ambient sea water temperature. Modelling predicted that initial mixing will reduce the temperature differential to one degree at each end of the proposed berth and average temperatures within the port are expected to decrease by 0.1 to 0.2 degrees. This will be partially offset by the current warm water discharges from industrial releases into Allans Creek.

The FSRU operates a Marine Growth Prevention System (MGPS), which helps to ensure no marine growth in the various pipes and other processes which use seawater within the operations. The MGPS takes seawater from the surrounding area, uses its natural salts to produce a solution of sodium hypochlorite to act as a natural biocide. The sodium hypochlorite degrades naturally and so most of the created solution will be used within the vessel well before the water is ready for re-release.

Prior to re-releasing the seawater back into the surrounding area, the operators of the vessel will aim to match the profile of the discharged water, as close as possible, to the pre-discharge profile and will ensure that free chlorine (total residual oxidant in estuarine/marine water) concentrations remain below 0.2 ppm. The discharge plume is predicted to have been diluted by a factor of four by the time the plume reaches the floor of the Inner Harbour and a dilution factor of 30 at a distance of 400m from the discharge point. Slightly elevated levels of chlorine residual in receiving waters is expected to be primarily restricted to the Inner Harbour and are not expected to extend beyond the Outer Harbour.

Modelling has also been undertaken to understand the impacts of the project on hydrodynamic processes within the Inner and Outer Harbours. Results demonstrate that the revised disposal footprint is expected to increase long wave heights at select locations within the Outer Harbour.

These predicted impacts will require consideration by NSW Ports during the design development of the berthing and mooring infrastructure associated with the proposed Outer Harbour Development. No impacts to long waves are predicted within the Inner Harbour.

The location of the proposed terminal berth has been refined through navigation simulations to be located as close possible to the existing turning basin. This approach minimises hydrodynamic impacts and reduces dredging and disposal volumes as far as possible.

Marine Ecology

Marine habitat within Port Kembla is primarily restricted to the hard substrates and the soft sediments. Hard substrate habitat consists of infrastructure such as piles, quay walls and breakwater around the perimeter of the port, which presents ideal habitat for biofouling communities within the sheltered environment. Assemblages are generally sparse with community structures reflective of the highly disturbed environment with introduced species accounting for more than half of the hard substrate assemblages in the Inner Harbour.

The seabed within the Inner Harbour consists of fine, unconsolidated silt expanses with large decapod burrows. There are no known seagrass habitats, however macroalgae has been known to occur in sparse distributions across soft sediments habitats within the port.

The different habitats within the Inner and Outer Harbour have been found to support varying diversities in fish assemblages and compositions. A number of listed marine species are considered to potentially occur on occasions within Port Kembla despite the disturbed nature of the marine environment.

Redevelopment of the berth will alter the existing biofouling, benthic and marine fauna communities through a range of processes as discussed below.

Direct disturbance to biofouling and benthic communities

Disturbance to the biofouling community will be short term as recolonisation of the new piles is expected to commence following installation, after which, the biofouling community will undergo a long-term natural recruitment succession process reaching mature level community within years.

Dredging activities will directly impact on biofouling and benthic communities through direct removal of the substrate from the environment, and indirectly through generation of turbid plumes. The dredged areas within the berth will eventually be covered with fine layers of silt from the vessel propeller wash, and will be colonised with similar benthic communities from the surrounding areas within the Inner Harbour.

The construction of the perimeter bund and subsequent dredged sediment disposal is expected to permanently remove a maximum of 16.5 hectares of benthic habitat and associated benthic communities from the Outer Harbour area. This will be offset by the creation of the disposal area infrastructure providing new surface for colonisation by biofouling communities.

Deterioration in water quality

Deterioration of water quality through increased turbidity, mobilisation of contaminants and seawater releases has potential to impact upon marine ecology values within the port.

Turbidity from removal and placement of the sediment has the potential to impact on fish feeding ability, fish gills and filter-feeding organisms. However, it is likely that organisms are already established within a marine environment historically exposed to numerous dredging and disposal campaigns and regular sweeping within Port Kembla. These species will be resilient to any short-term increases in suspended solids resulting from dredging and disposal activities. The potential release of contaminants will be localised within the harbour and medium-term in nature. Suspended sediment will be confined within silt curtains at Berth 101 while dredge material will be confined within the perimeter bund at the Outer Harbour to minimise the migration of sediments following disposal. Contaminated sediment will be capped with clean material at the disposal area, so the duration of exposure to toxicants are considered to be short in duration while long-term toxic effects are considered unlikely.

Handling of sediment may trigger blooms of the toxic dinoflagellate *Alexandrium catenella* when conditions are favourable. Such blooms may deplete dissolved oxygen and produce toxins, causing environmental damage including fish kills. The risk of blooms is considered to remain given the historical records of toxic dinoflagellate species at Port Kembla; however, the likelihood of a bloom occurring is low because cysts have not been detected during recent investigations.

Release of cold water from the FSRU will have minor impacts on seawater temperatures confined within the port limits. Release of cold water from the FSRU will also involve release of residual chlorine. The discharge plume is predicted to have been diluted by a factor of four by the time the plume reaches the floor of the Inner Harbour and a dilution factor of 30 at a distance of 400 m from the discharge point and residual chlorine is expected to be primarily restricted to the Inner Harbour environment.

Marine communities in close proximity to the discharge point have potential to be adversely affected by the decrease in temperature/presence of residual chlorine. This is likely to include the biofouling communities at adjacent pylons, the benthic community under and adjacent to the FSRU and benthic/pelagic fish passing through the plume area. Decreases in temperature and the presence of residual chlorine may lead to the avoidance of the area by mobile species, and the inhibition of growth, spawning or larval settlement of sessile organisms.

Noise pollution from pile driving and rock placement

Piling and dredging construction activities have potential to generate noise that could displace fauna from the area realising a temporary reduction in diversity. They also have potential to cause a temporary or permanent threshold shift (TTS or PTS) in the hearing ability of sensitive fauna that use acoustic means of navigation or communication. Underwater noise impacts from dredging are not anticipated to cause permanent auditory damage to marine fauna in the area. Once construction is completed, underwater noise will be restricted to standard shipping noise associated with vessel movements between port environments.

Artificial light emissions

Artificial light emissions may occur through the use of vessel and site construction safety lighting during the construction phase of the project and from lights installed as part of the new berth infrastructure and FSRU. Artificial lighting may affect fauna by altering use of visual cues for orientation, navigation or other purposes, resulting in behavioural responses, which can alter foraging and breeding activity in marine turtles, cephalopods, birds, fish, dolphins, and other pelagic species.

The existing berth is currently lit at night, it is therefore assumed that marine fauna species currently using the project area will be habituated to extant light conditions. Similar lighting will be installed on the redeveloped berth and on the FSRU and LNG Carriers when in berth. This lighting is expected to be minimal in comparison to cumulative light emissions of other illuminated infrastructure within Port Kembla. As such, site lighting is not predicted to result in any change in migratory behaviours of birds that use the area and are already habituated to current light conditions.

Introduction or assisting the spread of marine pests

The project has potential to introduce pests via vessels and proliferation. However, through implementation of mitigation measures this issue can be appropriately managed. These include adhering to relevant port requirements and international vessels will adhere to relevant requirements, sourcing vessels locally (within NSW waters) for construction works, and following the correct channels of notification in the event that an invasive marine pests is identified or suspected

Marine fauna collisions

The risk of potential vessel strike during construction is considered low for all marine species likely to occur in the project area, including cetaceans, sharks and fish.

Accidental release of waste or oil spills following vessel collisions

Accidental release of waste or oil spills following vessels collisions has potential to impact upon water quality and the heath of marine ecology in the area.

Overview

To reduce or eliminate the impacts from identified hazards on marine ecology, a number of management controls are recommended for implementation as part of the project. The environmental risks associated with these hazards will be limited within the port environment and are expected to be short term in nature, with low risk on existing species with the implementation of the nominated management controls. As such, risks associated with the project on marine ecology are generally considered acceptable and as low as reasonably practical.

Terrestrial Biodiversity

A detailed assessment of biodiversity has been undertaken as part of this EIS. The project is located in a highly disturbed and modified industrial environment with minimal native vegetation and associated habitat for threatened species present in the area.

A single patch of native vegetation is located on the pipeline's alignment on the western side of Springhill Road. This patch comprises a small area of dense revegetation on modified/cleared lands and does not constitute a threatened ecological community. The project will result in the removal of 0.25 hectares of planted native vegetation (PCT 1326 Woollybutt – White Stringybark – Forest Red Gum grassy woodland) and is not expected to have a significant impact upon the habitat values of the locality.

Potential impacts upon native vegetation and fauna habitat have been further avoided by the use of directional drilling instead of open trenching for the pipeline (in particular to avoid areas of Illawarra Lowlands Grassy Woodland and natural swamp areas that intersect the proposed alignment).

The Port Kembla Key Population of the Green and Golden Bell Frog (Litoria aurea) occurs in the Port Kembla and southern Wollongong areas. This species is listed as an endangered species (Biodiversity Conservation Act 2016) and a vulnerable species (Environment Protection and Biodiversity Conservation Act 1999). Green and Golden Bell Frogs have also been found in unnatural habitats in the area including detention ponds and residential ponds, and can use disturbed habitats to disperse between breeding sites (DEC 2007).

The pipeline construction corridor has also been reduced in some locations to minimise temporary impacts on potential Green and Golden Bell Frog habitat. Following construction, groundcover would be re-established, thus minimising impacts in the long-term. Construction of the pipeline may result in temporary short term disturbance to the potential movement corridor for the Green and Golden Bell Frog. Given the temporary nature of the impacts on connectivity and avoidance of direct impacts on high quality areas of habitat, the project is unlikely to have a significant impact on this species.

During construction of the new berth, the project proposes to remove four, small artificial detention ponds on the existing coal terminal Berth 101 site that may be used on occasion by the species while moving to more attractive habitat, but are unlikely to provide breeding habitat. There have been no sightings of Green and Golden Bell Frog's in these detention ponds in recent years. Nevertheless, a number of measures are recommended to minimise potential impacts on the Green and Golden Bell Frog, including pre-clearing surveys at detention basins before they are to be removed, use of frog fencing, and management and daily inspection of the pipeline trench for any trapped individuals.

The project would not impact upon any threatened freshwater biota listed under the Fisheries Management Act 1994. There would be no direct impacts on key fish habitat or marine vegetation within Allans Creek or Gurungaty Waterway.

No biota impacted by the project were identified as being a candidate for Serious and Irreversible Impact classification.

The project would have limited impacts on any other threatened or migratory biota and no impacts on important habitat for migratory species.

To further avoid and minimise potential impacts of the project on biodiversity, a suite of mitigation and management measures have been identified, which would be implemented as part of the construction and operation environmental management plan for the site.

Heritage

A detailed assessment of impacts upon Aboriginal and historical heritage from the project has been undertaken as part of this EIS.

The Aboriginal heritage assessment showed that areas of potential for Aboriginal heritage features and archaeological deposits are located on Spring Hill, to the east and west of Springhill Road. The proposed pipeline route has been designed to avoid impacts to areas of potential for Aboriginal cultural material and no significant impacts are anticipated to either tangible or intangible heritage values.

Results of the historic heritage assessment showed that the study area has been heavily modified with little to no potential for historical features and/or archaeological deposits to survive. Pockets of less disturbed land with potential for historical heritage features and archaeological deposits are located on Spring Hill to the east and west of Springhill Road. Industrial moveable heritage items are also on display in the study area as part of the Inside Industry Visitor Centre on Bluescope Steel land.

The proposed pipeline route avoids areas of potential historical heritage values and items of moveable heritage and no impacts are anticipated.

Traffic and transport

A detailed assessment of traffic and transport impacts from the project has been undertaken as part of this EIS. Results showed that the majority of key roads in the vicinity of the project are expected to operate well within the acceptable capacity for weekday morning and evening peak periods. Traffic modelling indicates that the key intersections in the study area would operate with a satisfactory level of service under the construction traffic conditions.

The additional traffic generated by the construction activities and minor increase in traffic during operation are not anticipated to impact pedestrians, bicycle riders, pedestrian or bicycle facilities, and public transport (train or bus) services operating in the vicinity of the site.

The project is not anticipated to have an adverse impact on the road network subject to adoption of appropriate management through the implementation of a Construction Traffic Management Plan.

Noise and vibration

A detailed assessment of noise and vibration impacts from the project has been undertaken as part of this EIS.

The noise modelling demonstrates that project related noise for construction and operation of the LNG import terminal is expected to be compliant with the project noise trigger levels. The closest sensitive residential receivers are located approximately two kilometres from Berth 101 and will not be impacted by the project. This includes, impacts from noise associated with an increase in traffic during to construction and operation, sleep disturbance impacts due to awakening events during construction, and operational noise across all periods.

No vibration impacts above the vibration criteria are predicted from construction of the project due to the large distance between the construction area and the nearest residential receivers.

The predicted noise levels are expected to exceed the noise management levels during pipeline construction works located in the closest proximity to the residential receivers. However, the impacts from pipeline construction activities would be intermittent in duration as the pipeline construction would progress sequentially along the construction corridor and will not impact upon any individual receiver for an extended period of time.

Minor exceedances of the noise management levels are also predicted during standard and outside of standard construction hours for fixed construction activities. However, the impacted receivers would be subject to existing ambient rail traffic noise and industrial noise from the port area.

To manage these impacts from construction noise, mitigation measures have been recommended. No specific operational noise mitigation measures are recommended.

Air quality

A detailed assessment of air quality impacts associated with the project has been undertaken as part of this EIS.

Key sensitive receptors within proximity to the project site include residential areas located approximately 2 kilometres from the proposed LNG import terminal site.

The project has potential to generate dust through construction activities, notably earthworks and the handling and transfer of earth and other material. Modelling results show that sensitive receptors in the study area will not experience dust related impacts during construction.

The modelling results for operation of the FSRU showed that there are no predicted exceedances of the criteria during normal operations, which consists of two gas engines operating on the FSRU and two gas engines on the LNG carrier.

The assessment identified that formaldehyde had the potential to exceed the criteria in a worst case operating scenario comprising four gas engines operating on the FSRU and two gas engines operating on the docked LNG carrier. This scenario is unlikely to occur in reality as four gas engines are only required to be operated on the FSRU when travelling at full speed on open seas and the potential exceedance of the criteria is restricted to water within the Inner Harbour. No other exceedances of the impact assessment criteria are predicted during operation of the project.

The predicted pollutant emissions from the project are expected to comply with the relevant criteria when assessed in accordance with the EPA Approved Methods. The application of standard dust mitigation measures will assist to minimise potential impacts from construction of the project. Compliance with International Maritime Organization legislation and guidelines will minimise the impacts from the operations of the project.

Landscape and visual

The landscape and visual assessment showed significant landscape characteristics within the study area included the Illawarra Escarpment, the escarpment foothills, the coastal plain, beaches and foreshore, and Lake Illawarra. Key urban features include the Wollongong City Centre, the port precinct, and the residential development on the surrounding foothills.

Key views were found to be achieved from elevated locations within the study area, and headland locations with clear open views across the water. The most important of these are sensitive receptor locations such as tourist lookouts, as well as residential areas.

Of particular note are the following key viewing locations within the project viewshed:

- Mount Keira lookout
- Wollongong Head Lighthouse lookout
- Hill 60 Park lookout
- Heritage Park / Breakwater Battery Military Museum

Also of note are residential areas on elevated locations within the viewshed, on the foothills and to the south of the project. The elevated topography forms a visual ‘bowl’ within which the flat landscape of the project site lies. As the topography and vegetation decreases from the escarpment towards the coast, views open up from the foothills to the east, from elevated buildings and from roadways.

While the FSRU and visiting LNG carrier will be visible from a variety of viewer locations, the magnitude of change is considered low as they will be visually integrated with other industry and port infrastructure at Port Kembla.

Social and Economic

A social and economic impact assessment was prepared as part of the EIS with reference to relevant guidelines including the NSW Department of Environment and Planning *Social impact assessment guideline* (2017). Existing social and economic conditions were considered with reference to stakeholder feedback received during consultation as well as publicly available demographic and economic data from sources including the Australian Bureau of Statistics and Wollongong City Council.

Construction of the project is predicted to generate social and economic benefits directly through capital investment and job creation, and indirectly through industrial and supply chain effects such as the supply of goods and services to the construction workforce. It found that construction of the gas pipeline could lead to some temporary amenity impacts at nearby residences such as noise and dust from pipeline construction activities and equipment as well as additional road traffic.

Operation of the project would also generate social and economic benefits through job creation and the potential local supply of gas to industrial users that could support in the order of 15,000 gas dependent jobs in the region and over 300,000 jobs across NSW. It found that the ongoing operation of the project would not have any material impacts on amenity of nearby residences or the broader community.

A number of management measures are proposed to enhance the social and economic benefits and mitigate the potential social and economic impacts of the project. The proposed measures included development and implementation of continued stakeholder engagement, especially during construction, to provide information and a feedback mechanism to residents, and the implementation of noise and vibration, air quality and traffic management plans for management of those amenity issues during construction.

Development of a contracting and procurement strategy, which seeks to maximise local content for both construction and operation, will support local employment and business opportunities. During operation the project will seek to work with interested local parties to support new qualification/certification pathways for some of the specialised roles on the FSRU, which is unique to Australia at this stage and is both a marine vessel and a regasification plant.

Waste management

Waste management matters relevant to the project was identified as part of the EIS including type and quantities of waste that may be generated during the construction and operation of the project.

Construction would have various waste streams including demolition and construction waste, excavated and dredged material and waste vegetation. The largest waste stream will be excavated and dredged sediment and soil material, which will primarily be placed at the disposal area in the Outer Harbour generally in accordance with NSW Ports reclamation plans.

Waste generated by the project during operation would largely be limited to the waste generated by the FSRU and the workforce stationed on board the vessel including the generation of sewage and other wastewater as well as general rubbish and food waste.

Waste generated by construction and operation would be managed in accordance with the waste hierarchy defined in the *Waste Avoidance and Resource Recovery Act 2001* through separate waste management plans developed for construction and operation.

Waste in NSW is regulated under a number of laws including the *Protection of the Environment Operations Act 1997*, *Waste Avoidance and Resource Recovery Act 2001* and *Marine Pollution Act 2012*, which gives effect to the International Convention for the Prevention of Pollution from Ships.

The International Convention for the Prevention of Pollution from Ships (MARPOL) includes regulations aimed at preventing both accidental pollution and pollution from routine marine vessel operations. MARPOL protocols prescribe procedures for minimizing, collecting, storing, recording, recycling, processing and/or disposing of waste, including from the crew and use of equipment on board.

These requirements include the maintenance of detailed waste management plans, protocols and record keeping such that every discharge to a port reception facility (for example) shall include date and time of discharge, port or facility or name of ship, categories of waste discharged, and the estimated amount discharged for each category in cubic metres.

Greenhouse and climate change

The greenhouse gas assessment was undertaken in accordance with the *National Greenhouse and Energy Reporting Act 2007* and *National Greenhouse and Energy Reporting (Measurement) Determination 2008* and supplementary documentation in line with good accounting practice.

The assessment estimated that greenhouse gas emissions would be about 8,314 t CO_2-e during construction, mainly due to diesel consumption, and 44,145 t CO_2-e each year during operation, mainly due to electricity generation on board the FSRU. During operation this would comprise about 0.03% of emissions in NSW and 0.01% of emissions in Australia.

A preliminary climate change risk assessment was also undertaken to inform the project proponent of potential vulnerabilities of the proposed asset from climate change and identify ways to address and minimise this vulnerability. The assessment has been prepared in accordance with Australian Standard 5334-2013 *Climate change adaptation for settlements and infrastructure – A risk based approach*.

This preliminary climate change risk assessment identified eleven risks which are applicable to the proposed FSRU and associated infrastructure. The risks were associated with climate variables including extreme temperatures, sea level rise, storm surge, sea water temperature, east coast lows, hail and extreme winds

An FSRU and associated wharf infrastructure may inherently be more resilient to the effects of climate change than a fixed asset. An FSRU is a moveable, seaworthy vessel designed to operate in a wide variety of climates across the world, which may be more extreme than Australia's under the effect of climate change for some variables. Given that FSRUs are also required and designed to travel across the sea in rough conditions, risks from storm surge and hail were assessed as low. Typically impacts identified have consequences for the infrastructure service, causing delays or early renewal, and financial cost to the operation of the asset.

Cumulative Impacts

An assessment was undertaken to consider the potential for cumulative impacts of the project with other existing or proposed major developments. The main areas where potential cumulative impacts could occur were considered to be hazard and risk, water resources, traffic and access, noise and vibration, air quality and visual impacts.

The potential for cumulative hazards and risks was assessed in accordance with propagation risk criteria under *Hazardous Industry Planning Advisory Paper No 4, Risk Criteria for Land Use Safety Planning*. The propagation risk criteria define the extent to which a hazardous event at one facility could trigger another hazardous event at an adjoining facility.

The assessment found that the propagation risk from potential hazard events caused by the project, including the LNG carriers, FSRU, berth and wharf facilities, and gas pipeline, would not extend to adjacent industrial facilities including the Port Kembla Coal Terminal and proposed Port Kembla Bulk Liquids Terminal. Further, a review of the available hazard assessments undertaken for adjacent industrial facilities found that the propagation risk from potential hazard events from those facilities would similarly not extend to the project.

Water quality impacts are primarily associated with dredging operations during construction and cold sea water releases during operation of the project. Dredging is regularly undertaken at Port Kembla to facilitate the development of new shipping berths and maintenance of the navigation channels, with impacts associated with the project analogous to other dredging operations. The release of cold water from the FSRU during operation is predicted to only have minor impacts on seawater temperatures which will somewhat offset the warm industrial releases currently discharged from Allans Creek.

There is potential that the construction of the project may coincide with the Port Kembla Bulk Liquids Terminal resulting in additional truck movements on the local road network. An analysis of the traffic modelling undertaken indicated the peak hour traffic generation during construction for these projects is not planned to occur at coinciding times and that the combination of traffic from both projects is not expected to have a significant impact on the surrounding road network. Consultation between the relevant proponents should be undertaken during preparation of traffic management plans to minimise the disruption to the local community should concurrent construction occur.

Similarly, the distance between nearby developments is expected to preclude excessive impacts to local amenity such as noise, air quality and visual impacts during construction and operation the project.

The potential for cumulative impacts in each of these areas was considered limited, drawing on specialist assessments of the project and the other identified projects where relevant.

Conclusion

The project as a whole is considered to have a well-established strategic need and justification in that it responds to potential gas supply and price pressures in the east coast gas market and has been declared Critical State Significant Infrastructure by the NSW Government. The project has been developed with consideration to the matters for consideration under the EP&A Act, and is broadly consistent with the principles of ecologically sustainable development. The biophysical, economic and social costs of the project are generally limited due to a number of factors including its location in an industrial port, its distance from residential areas, its small project footprint within largely industrialised land under State Environmental Planning Policy (Three Ports) 2013, the small scale of the project and quick construction period. The potential economic benefits of the project are potentially significant and wide reaching, given the project has the capacity to deliver a new source of natural gas into the NSW and east coast gas market.

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Terms and abbreviations

Term	Definition
ACM	asbestos containing material
ADGSM	Australian Domestic Gas Security Mechanism
AEC	areas of environmental concern
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AHD	Australian Height Datum
AHIP	Aboriginal Heritage Impact Permit
AIE	Australian Industrial Energy
AMSA	Australian Maritime Safety Authority
AQIA	Air Quality Impact Assessment
AQIS	Australian Quarantine and Inspection Service
ARTC	Australian Rail Track Corporation
AS	Australian Standard
ASS	acid sulphate soils
ASSMP	Acid Sulphate Soil Management Plan
BAM	NSW Biodiversity Assessment Method
BC Act	NSW Biodiversity Conservation Act 2016
BDAR	Biodiversity Development Assessment Report
Biosecurity Act	Biosecurity Act 2015
BOG	Boil of Gas
BoM	Bureau of Meteorology
CAPEX	Capital expenditure
CCGT	Combined Cycle Gas Turbine
CD	chartered depth
CEEC	critically endangered ecological community
CEMP	construction environmental management plan
CLM Act	Contaminated Land Management Act 1997
Coastal Management SEPP	State Environmental Planning Policy (Coastal Management) 2018
CRS	chromium reducible sulphur suite
CSIRO	Commonwealth Science and Industrial Research Organisation
CSM	conceptual site model
CSSI	critical state significant infrastructure
DCP	Development Control Plan
DGPS	differential global positioning system
DJF	December-January-February
DO	Dissolved Oxygen
DP	Douglas Partners

Term	Definition
DP&E	Department of Planning and Environment
DPTI	Department of Planning Transport and Infrastructure
DWT	deadweight tonnage
EEC	endangered ecological community
EGP	Eastern Gas Pipeline
EHS	Environmental, Health, and Safety
EIS	Environmental impact statement
EP&A Act	Environmental Planning and Assessment Act, 1979
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPL	environment protection licence
ESCCI	Eastern Seaboard Climate Change Initiative
ESD	Ecologically sustainable development
FM Act	NSW Fisheries Management Act
FM Act	Fisheries Management Act 1994
FSRU	Floating storage and regasification unit
GCU	Gas Combustion Unit
GDE	Groundwater Dependent Ecosystems
GJ	Gigajoule – a billion or 10^9 Joules
GSOO	Gas Statement of Opportunities
HDD	Horizontal directional drilling
Heritage Act	Heritage Act 2015
HIPAP	Hazardous Industry Planning Advisory Paper
HOBr	Hypobromous acid
IAP2	Core Values and Code of Ethics of the International Association for Public Participation
ICNG	Interim Construction Noise Guideline
ICOLL	Intermittently Closed or Open Lake or Lagoon
IMO	International Maritime Organization
Infrastructure SEPP	State Environmental Planning Policy (Infrastructure) 2007
IPCC	Intergovernmental Panel on Climate Change
JGN	Jemena Gas Network
LCZs	Landscape Character Zones
LNG	liquefied natural gas
LNG	liquefied natural gas
LNGCs	LNG carriers
LOR	Limits of Reporting
LVIA	landscape and visual impact assessment
Marine Safety Act	The Marine Safety Act 1998
MARPOL	International Convention for the Prevention of Pollution from Ships
MEIA	Marine Ecology Impact Assessment

Term	Definition
MGO	Marine gas oil
MGPS	Marine Growth Prevention System
MMBTU	Million British Thermal Units (units of energy)
MNES	Matters of National Environmental Significance
MPa	Megapascal
MSDS	Materials Safety Data Sheet
NAGD	National Assessment Guidelines for Dredging
NAPL	non-aqueous phase liquids
NCA	Noise catchment areas
NEPM	National Environment Protection (Assessment of Site Contamination) Amendment Measure (No. 1) 2013
NML	Noise management level
NPI	Noise Policy for Industry
NPW Act	National Parks and Wildlife Act 1974
NPWS	National Parks and Wildlife Service
NSW EPA	NSW Environmental Protection Authority
NSW WQOs	NSW Water Quality Objectives
NTU	Nephelometric Turbidity Units
NWQMS	National Water Quality Management Strategy
OEMP	Operation Environmental Management Plan
ORP	Oxygen Reduction Potential
PAH	polycyclic aromatic hydrocarbons
PASS	potential acid sulphate soil
PCT	plant community type
PEA	preliminary environmental assessment
PFM	planning focus meeting
PIANC	World Association for Waterborne Transport Infrastructure
PJ	petajoules
PKCT	Port Kembla Coal Terminal
POEO Act	Protection of the Environment Operations Act 1997
Project	Port Kembla Gas Terminal
RCP	Representative Concentration Pathway
RMS	NSW Roads and Maritime Services
SAII	serious and irreversible impact
SEPP	State Environmental Planning Policy
SEPP 55	State Environmental Planning Policy No 55—Remediation of Land
SIGTTO	Society of International Gas Tanker and Terminal Operators
SPR	Source-Pathway-Receptor
SRD SEPP	State Environmental Planning Policy (State and Regional Development) 2011
SSD	State Significant Development

Term	Definition
SSI	State Significant Infrastructure
t CO2-e	tonnes of carbon dioxide
TBT	tributyltin
TDS	Total Dissolved Solids
the Roads Act	NSW Roads Act 1993
the Sea Dumping Act	Environment Protection (Sea Dumping) Act 1981
TJ	Terajoule a trillion (10^12) joules
TSS	Total Suspended Solids
UFP	unexpected finds protocol
UST	underground storage tank
VCR	Volume Capacity Ratio
VTIC	Vessel Traffic Information Centre
WHP	Wilton to Horsley Park Pipeline
WM Act	Water Management Act 2000
Wollongong LEP	Wollongong Local Environmental Plan 2009
Work Health and Safety Act	Work Health and Safety Act 2011
WQMP	Water quality management plan
WQOs	Marine Water Quality Objectives
WWP	Wilton to Wollongong Pipeline

1. Introduction

1.1 Background

Australian Industrial Energy (AIE) proposes to develop the Port Kembla Gas Terminal (the project). The project involves the development of a liquefied natural gas (LNG) import terminal at Port Kembla, south of Wollongong in NSW. The project will be the first of its kind in NSW and provide a simple, flexible solution to the state's gas supply challenges.

NSW currently imports more than 95% of the natural gas it uses, with the majority of supplies coming as interstate supplies from Victoria and South Australia. In recent years, gas supplies to the Australia east coast market have tightened, resulting in increased prices for both industrial and domestic users. Several recent economic studies, including from the Australian Energy Market Operator (AEMO) and EnergyQuest have predicted significant future gas shortfalls for NSW by 2022.

The project provides an immediate solution to address predicted shortages and will result in considerable economic benefits for both the Illawarra region and NSW. The project will have capacity to deliver 100 petajoules of natural gas, equivalent to more than 70% of NSW's gas needs and provide between 10 to 12 days of natural gas storage in case of interstate supply disruption. LNG will be sourced from worldwide suppliers and transported by LNG carriers to the Port Kembla Gas Terminal. The LNG will then be re-gasified for input into the NSW gas transmission network.

Key objectives of the project are to:

- Introduce a new source of competitively priced gas to meet predicted supply shortfalls and help put downward pressure on prices
- Provide gas security to NSW with ability to supply more than 70% of the State's gas needs
- Provide long term contracts to industrial users and ability to meet 100% of the State's industrial demand (manufacturers, power stations, hospitals, small businesses etc.)
- Help support the 300,000 jobs across NSW, and the 15,000 jobs in the Illawarra region, which rely on the competitive, reliable supply of natural gas
- Support the diversification and future growth of Port Kembla consistent with the NSW Ports 30 Year Master Plan.

1.2 The proponent

AIE was formed in 2017 by a consortium of Australian and international companies with extensive global expertise and experience in the energy sector. The consortium consists of:

- ***Squadron Energy*** — a privately owned energy company forming part of the Minderoo Group, with a record of world class natural resource projects across Australia.
- ***Marubeni Corporation*** — a major Japanese trading and investment business with significant energy sector expertise and interests in over 25 countries including LNG import terminals, gas pipelines and power plant.
- ***JERA Co., Inc.*** — established as part of a comprehensive alliance between TEPCO Fuel & Power, Incorporated (a whole owned subsidiary of Tokyo Electric Power Company Holdings, Incorporated) and Chubu Electric Power Co., Incorporated. JERA Co., Inc. is the largest buyer of LNG in the world (about 10 to 15% of the global market) and operates

eight import terminals, is an equity owner in four Australian LNG export projects, and operates a fleet of LNG transport ships and approximately 70GW of power generation.

1.3 Project Overview

The project incorporates four key components proposed to be located primarily within industrial land declared under the State Environmental Planning Policy (Three Ports). These include:

- LNG carriers (LNGCs) — of the hundreds currently in operation transporting LNG from production facilities to demand centres globally.
- Floating storage and regasification unit (FSRU) — a vessel which will be moored at berth 101 on the eastern side of the Inner Harbour at Port Kembla. There are around 30 of these currently in operation worldwide with a further 75 ordered or in feasibility planning. The FSRU contains all of the equipment necessary to safely store, regasify, and dispatch the gas into the NSW distribution network. Once no longer required the vessel can be relocated and reused.
- Wharf and berth facilities — such as offloading arms which transfer gas from the FSRU into the pipeline.
- Gas pipeline — a short underground gas pipeline connection from Berth 101 to the existing east coast gas transmission network at Cringila.

At present it is envisaged that an LNG shipment will be required every 2 to 3 weeks to provide for an annual supply of up to 100 petajoules of gas per annum. Supply could be increased further to around 140 to 150 petajoules per annum through a slight increase in LNG delivery schedules and pipeline upgrades.

It is expected to take about 10 to 12 months to complete construction and other works in order to commence operations. Sub to approval processes it is possible to have first gas by the end of Quarter 1 in 2020.

The estimated capital investment for the development is between $200 and $250 million.

1.4 Project approval process

This Environmental Impact Statement (EIS) has been prepared in accordance with the *Environmental Planning and Assessment Act 1979* (EP&A Act), Schedule 2 of the Environmental Planning and Assessment Regulation 2000 and the Secretary's Environmental Assessment Requirements (SEARS) issued by the Department of Planning and Environment (DPE) on 10 August 2018.

The project has been declared critical state significant infrastructure (CSSI) in accordance with section 5.13 of the EP&A Act and Schedule 5 of the *State Environmental Planning Policy (State and Regional Development) 2011*. This EIS has been prepared to support the development application for determination by the NSW Minister for Planning.

1.5 Document purpose and structure

This EIS has been prepared by GHD Pty Ltd on behalf of AIE to support the development application. The EIS has been prepared using a risk-based assessment approach to identify and evaluate environmental, social and economic matters relevant to the project.

This has been achieved through a process of ongoing engagement with stakeholders from government agencies and the community, risk assessments to identify and scope key environmental assessments and development of mitigation and management measures.

The EIS is presented in multiple volumes. Volume 1 includes a standalone EIS including a detailed description of the proposed development and consideration of potential impacts upon environmental aspects potentially affected by the Project. Volume 2 contains a series of specialist assessments that have informed the overall assessment in Volume 1.

The structure and contents of Volume 1 summarised in Table 1-1 while the supporting specialist assessments included in Volume 2 are listed in Table 1-2.

Table 1-1 Volume 1

EIS chapters		
1	Introduction	Provides an overview of the project, proponent and approval process
2	Site description	Describes the site within the context of the existing port operations and interaction with existing approved projects at Port Kembla
3	Strategic context	Explains the strategic need for the project in the context of the NSW energy policy setting
4	Project alternatives	Outlines alternatives considered during development of the preferred project
5	Project description	Provides a detailed description of the project
6	Statutory context	Discusses relevant State and Commonwealth laws and planning instruments
7	Stakeholder consultation	Discusses the engagement strategies for the project and the consultation outcomes
8	Issues identification	Outlines the process for the identification and prioritisation of the assessment for key environmental aspects
9	Port navigation	Provides an assessment the projects impacts upon vessel navigation within Port Kembla and the safe handling of LNG carriers
10	Hazard and risk	Provides an outline of potential hazards and associated control measures for the project
11	Soils and contamination	Describes the existing soil and landforms within the project site and considers the potential for disturbance of contaminated soils, sediments and acid sulfate soils
12	Water resources	Considers the impact of the project on water quality and hydrodynamic processes
13	Marine ecology	Provides an outline of the marine ecological values within the harbour and the potential impact upon those values
14	Terrestrial biodiversity	Provides an outline of the terrestrial biodiversity values for the project application area and potential impacts upon those values
15	Heritage	Considers the impact of the project upon Aboriginal and non-Aboriginal heritage values in the Project application area
16	Traffic and access	Considers impacts of the project on the local and regional transport network
17	Noise and vibration	Considers the impact of noise and vibration during construction and operation of the project
18	Air quality	Consider the impacts to local air quality associated with emissions during construction and operation of the project

EIS chapters		
19	Landscape and visual	Provides an assessment of potential impacts of the project on the amenity of its surrounds
20	Social and economic	Provides an assessment of social and economic impacts and benefits associated with the construction and operation of the project
21	Waste management	Discusses waste identification and management practices for the likely waste streams generated during construction and operation of the project
22	Greenhouse gas	Provides an assessment of the likely greenhouse emissions during construction and operation of the project and its ability to tolerate and adapt to potential climate change
23	Climate change risk assessment	Provides the findings of a preliminary climate change risk assessment undertaken to inform the design development process
24	Cumulative Impacts	An assessment of potential cumulative impacts of the project with other approved major developments
25	Environmental management	Provides an outline of the proposed environmental management framework and a consolidated list of the proposed mitigation and management measures
26	Justification and conclusion	Provides an overview of the conclusions from the assessment process and discusses the project's justification on balance of environmental, social and economic considerations.

Table 1-2 Volume 2

Appendices	
A	Indicative design drawings
B	Stakeholder consultation materials
C	Port navigation
D	Hazard and risk
E	Contamination
F	Hydrodynamic modelling report
G	Marine ecology
H	Biodiversity Assessment Report
I	Aboriginal heritage
J	Historic heritage
K	Traffic and access
L	Noise and vibration
M	Air quality
N	Landscape and visual
O	Social and economic
P	Greenhouse gas
Q	Climate risk

2. Site description

2.1 Overview

This chapter describes the site of the project and its surrounds. Section 2.2 describes the regional context of the site of the project including Port Kembla and surrounding localities. Section 2.3 describes Port Kembla in more detail including other existing and proposed facilities. Section 2.4 describes the site of the project and its relationship to adjacent land uses at Port Kembla.

2.2 Regional context

The site of the project is situated at Port Kembla within the Illawarra region of NSW, about 80 kilometres south of Sydney. Port Kembla is mainly characterised by the existing import and export terminal and multiple other business, cargo, logistics, bulk goods and heavy industrial facilities in the vicinity.

Port Kembla and its regional context including the surrounding localities are shown in Figure 2-1.

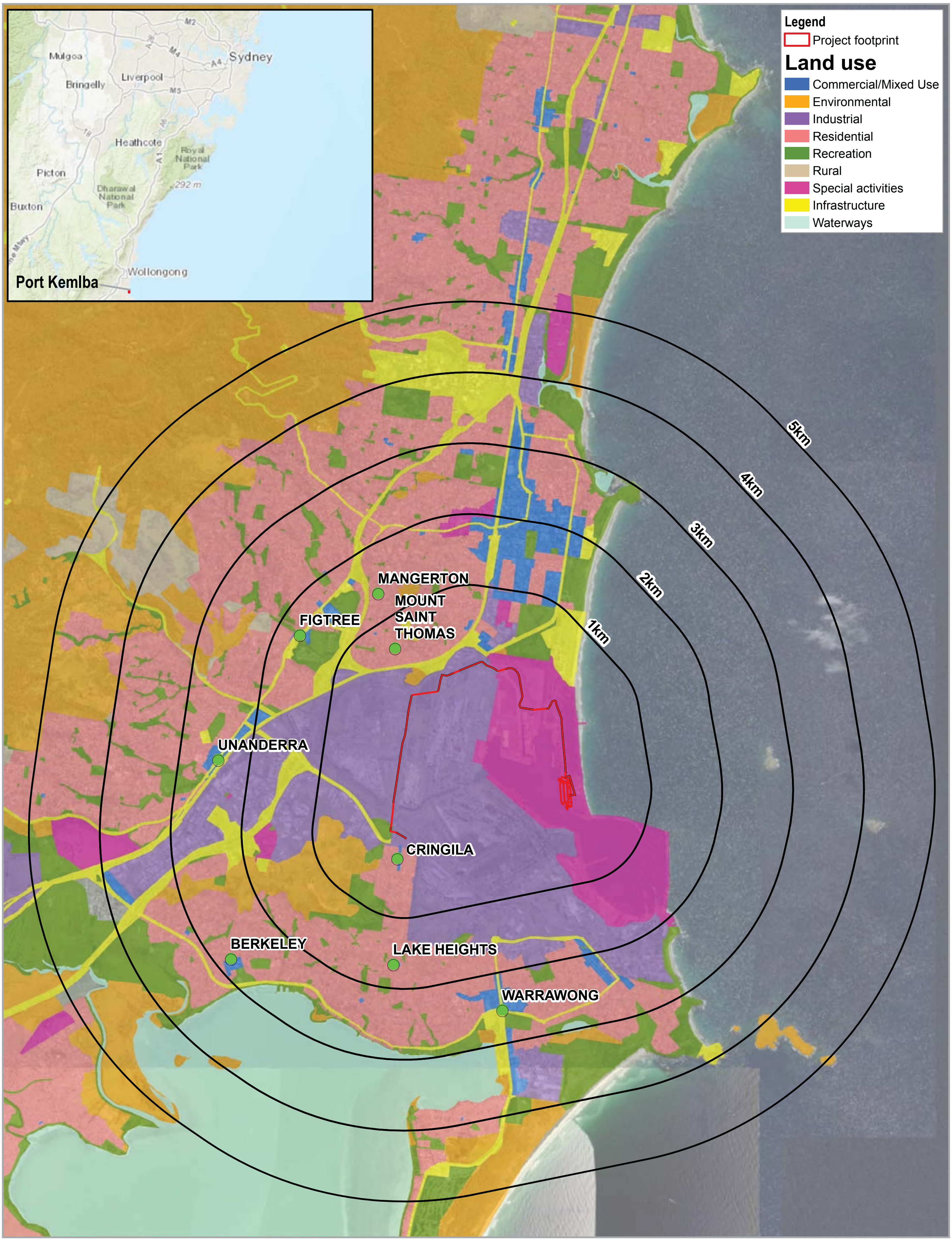
As shown Port Kembla is situated about two kilometres south of the centre of Wollongong. Other localities surrounding Port Kembla and the project site include Mangerton, Mount St. Thomas and Figtree to the north-west; Unanderra to the west; Berkeley to the south-west; and Cringila, Lake Heights, Warrawong and the residential region of Port Kembla to the south.

The zoned land use in the region include special use and industrial use at Port Kembla and a mix of primarily residential and commercial uses at the surrounding localities.

Major infrastructure in the region of Port Kembla includes the Princes Highway, which is a major state and regional highway connecting Sydney and Wollongong and regional areas further south. Princes Highway provides access to Port Kembla through turnoffs at Masters Road, Five Islands Road and Northcliffe Drive and is broadly utilised including by heavy vehicles from the port.

The South Coast railway line runs along the periphery of Port Kembla including the stations Port Kembla, Port Kembla North, Cringila and Lysaghts. The rail line services commuters and is also used to transport bulk solid goods like coal, grain, copper and steel from Port Kembla.

The environmental features of Port Kembla and the surrounding region are limited given the extensive industrial, commercial and residential development. Waterways in the region include the Gurungaty Waterway, Allans Creek, American Creek and Byarong Creek. Green space includes JJ Kelly Park and Wollongong Golf Club to the north and a larger open area to the south west.



Paper Size ISO A4

0 750 1,500 2,250 3,000

Metres

Map Projection: Mercator Auxiliary Sphere
Horizontal Datum: WGS 1984
Grid: WGS 1984 Web Mercator Auxiliary Sphere

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GHD

Australian Industrial Energy
Port Kembla Gas Terminal

Regional context

Project No. 21-27477
Revision No. A
Date 31 Oct 2018

Figure 2-1

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Data source: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

2.3 Port Kembla

Port Kembla was first established in 1883 to facilitate the export of coal. Since then it has had a long, continuous history as a working port, with the construction of Port Kembla's Outer Harbour given approval by the NSW State Government more than a century ago, in 1898. An increase in shipping traffic over the subsequent years led to a decision in the 1950s to carry out extensive dredging and the construction of the Inner Harbour, which opened in 1960. NSW Ports became the custodian of Port Kembla in May 2013 with its purchase of the 99 year lease of Port Kembla along with Port Botany, Cooks River Intermodal Terminal and Enfield Intermodal Terminal. The seabed at Port Kembla is under ownership of NSW Roads and Maritime Services.

Port Kembla has grown to become NSW's largest motor vehicle import hub, its second largest coal export terminal, the leading grain export terminal for Southern and South-Western NSW and a significant location for the import and export of a range of other bulk liquids and cargoes. More recently, it has also been a location for day-visits for large cruise ships seeking to offer their clients a unique industrial tourism opportunity, as well as access to the rich cultural, environmental and recreational qualities of the area.

Port Kembla operates 24 hours per day 7 days per week and is a key infrastructure asset for NSW and economic driver for the Illawarra region.

The port is divided into an Inner Harbour and Outer Harbour, including a deep-water shipping channel to facilitate the arrival and departure of large carriers and cargo ships. The existing facilities include a total of 18 import and export berths and a total of six major independently operated terminals. The berths are allocated numbers from 101 to 113 in the Inner Harbour and 201 to 206 in the Outer Harbour as shown in Figure 2-2.

Existing users of the berths include Port Kembla Coal Terminal at Berth 101 and 102, Australian Amalgamated Terminals general cargo facilities and Quattro Port grain facility at inner harbour Berths 103, 105, 106 and 107, a GrainCorp grain terminal at Berth 104, and bulk liquids facilities operated by NSW Ports at outer harbour Berths 201 and 206.

In addition to operations at import and export berths there are multiple other business, cargo, logistics, bulk goods and heavy industrial facilities in and around Port Kembla including Ceva Logistics, AutoNexus, PrixCar, Patrick Autocare, Linx, Qube Stevedores, BlueScope, Port Kembla Gateway, Svitzer, Cement Australia, NSW Port Maritime Centre, Pacific National and TQ Holdings and a bulk fuel storage facility yet to be constructed.

The location of these facilities is shown in Figure 2-2.

The precinct also hosts almost 3,500 metres of quay line, 3.5 kilometres of roads and 29 kilometres of rail network. The rail network includes multiple rail lines, siding and loops, that connects to the Illawarra Line and Moss Vale-Unanderra Line and thereafter the Main South Line. The rail lines mainly function to transport bulk solid goods like coal, grain, copper and steel.

The project footprint will be restricted to a highly disturbed area primarily within reclaimed and industrial land. The nearest residential area is approximately two kilometres from the proposed LNG import terminal location.

Toward the south of Port Kembla is the Cringila gas transfer station owned and operated by Jemena, which provides a connection to the NSW Eastern Gas Pipeline (EGP). The EGP is a 797 kilometre long gas pipeline with an operational capacity of about 300 terajoules per day. The pipeline supplies gas to major gas markets in Victoria, Wollongong and Sydney as well as regional NSW and the ACT.

2.4 Site of the project

2.4.1 Existing landuse

The project will be predominantly located within land zoned for dedicated port and industrial uses as shown on Figure 2-2. Berth and wharf facilities and the FSRU would be situated at Berth 101 at the Inner Harbour while the gas pipeline would extend around the periphery of port operations from Berth 101 to a tie-in point at Cringila. A small section of the pipeline will traverse beneath Bluescope sporting fields in Cringila, which are zoned RE2 Private Recreation under the *Wollongong Local Environmental Plan 2009*.

The real property descriptions of the land occupied by the project are listed in Table 2-1.

Table 2-1 Real property description

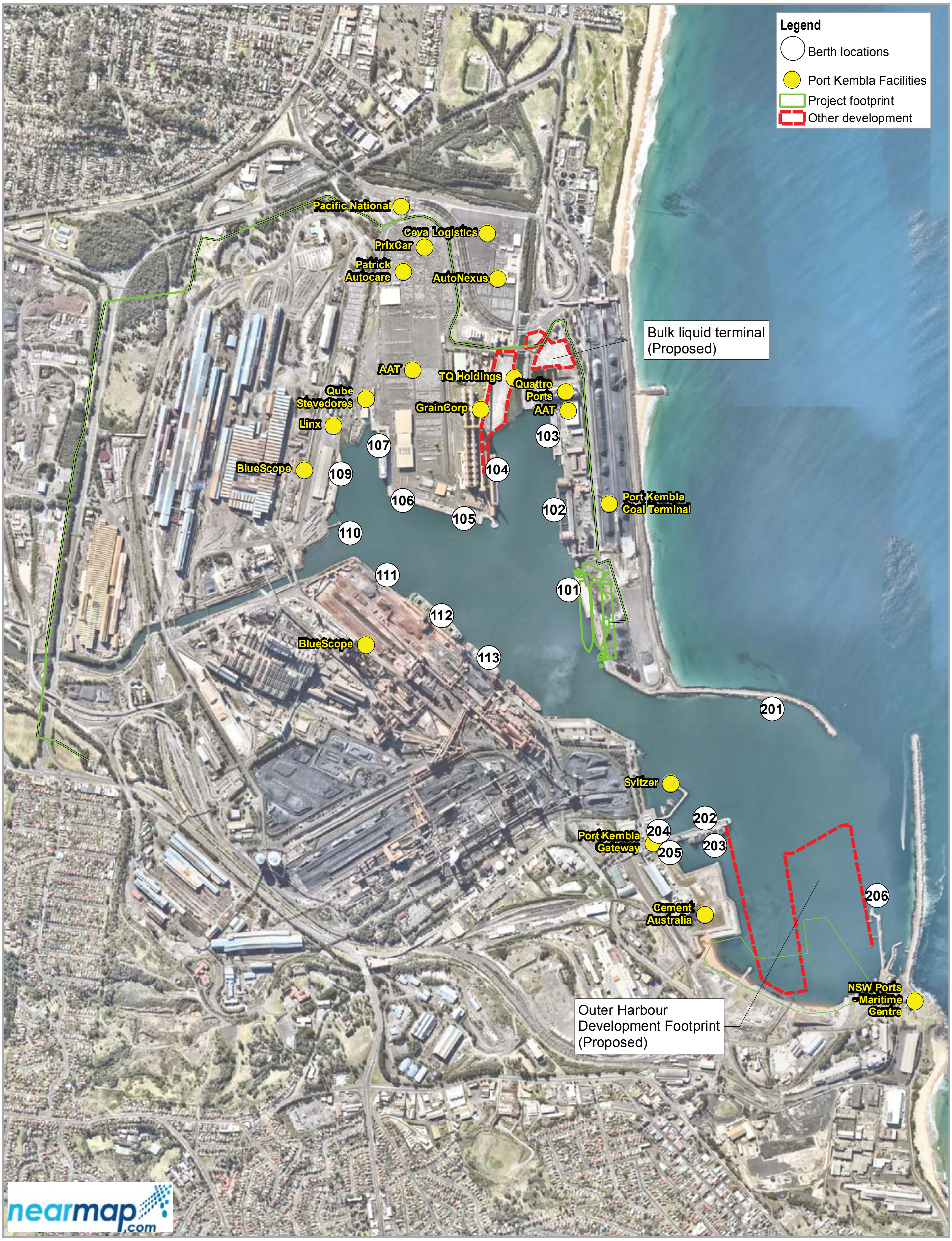
Component	Lot	Plan
Berth and wharf facilities	22	DP1128396
	8	DP1154760
	70	DP1182824
Gas pipeline	1	DP1125445
	2	DP1125445
	11	DP1182111
	12	DP1182111
	103	DP801243
	501	DP1035674
	81	DP1170187
	3	DP837554
	1	DP606434
	6	DP837554
	1	DP203783
	64	DP1188514
	2	DP837554
	1	DP606430
	2	DP570107
	3	DP606430
	1	DP785374
Disposal area	2001	DP1176582
	2	DP1182823
	105	DP1013971

The import terminal is proposed to be located at Berth 101 which currently forms part of the Port Kembla Coal Terminal site. Berth 101 was most recently utilised as an off-loading wharf for materials handling equipment, but does not currently have any regular use with the majority of coal exports operating out of Berth 102 located to the north of Berth 101.

There are two key agreements in place, one between NSW Ports and the Port Kembla Coal Terminal to release the area from the current lease back to NSW Ports, and a second between NSW Ports and AEI to negotiate for a new lease. Both agreements are subject to a number of conditions being met, such as receiving development consent for the project.

Existing land uses in the vicinity of the gas pipeline route include Port Kembla Coal Terminal at Berth 102 and Australian Amalgamated Terminals general cargo facility and Quattro Ports grain facility at Berth 103. The gas pipeline route also passes in the vicinity of a number of cargo and logistics facilities including AutoNexus, Ceva Logistics, Pacific National and PrixCar and for a distance runs along the periphery of the BlueScope Steel facility. The gas pipeline route runs near road or rail infrastructure including Tom Thumb Road, Springhill Road and Port Kembla Railway. Environmental features along the gas pipeline route are limited but include Gurungaty Waterway, Allans Creek and some green spaces or vegetated areas.

The above land uses and other features are shown in Figure 2-2.



Australian Industrial Energy
Port Kembla Gas Terminal

Project No. 21-27477
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Date 31 Oct 2018

Site of the project

Figure 2-2

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Data source: Aerial imagery - nearmap 2018 (image date 19/07/2018, date extracted 12/10/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

2.4.2 Relationship to other developments

The CSSI application (18_9471) is seeking authorisation for all aspects associated with the development of the project including the construction and ongoing operation of infrastructure associated with the project. The site's location within an established port results in considerable interaction with other planned developments in the port precinct. An overview of the interaction with other key developments within and surrounding Port Kembla is provided below.

Port Kembla Outer Harbour Development

The Port Kembla Outer Harbour Development received concurrent concept and project approval under Part 3A of the EP&A Act in March 2011. The development of the Outer Harbour was proposed to occur in stages over a relatively long period of time with the ultimate footprint indicated on Figure 2-2.

Concept approval was granted for the overall development and project approval was specifically granted to authorise the Stage 1 development. The majority of dredging and land reclamation activities were approved to be undertaken as part of the Stage 1 development and included a number of management procedures developed as part of a dredging environmental management plan.

The majority of dredged sediments and excavated material required for the establishment of a new berthing pocket at Berth 101 is proposed to be disposed within a 17 hectare disposal area within the Outer Harbour.

The disposal area has been developed through discussion with NSW Ports to accommodate the latest options for redevelopment of the Outer Harbour. The disposal footprint falls predominantly within the approved development area for Stage 1 of the Outer Harbour Development Project. A small portion of the disposal area does extend beyond the approved footprint near the southern shoreline of the Outer Harbour as shown on Figure 2-2.

All disposal activities form part of the current development application and have been assessed as part of this EIS. The disposal of sediments will be undertaken to be consistent with the existing management requirements for disposal in the Outer Harbour and will be authorised by approval of this CSSI application.

Bulk Liquids terminal

The Port Kembla Bulk Liquids terminal was approved as a state significant development in September 2016 and involves the construction and operation of a bulk liquids storage and distribution terminal. The terminal is located at three sites on either side of Tom Thumb Road within the Port Kembla Industrial precinct.

The gas transmission pipeline proposed as part of the project will follow the alignment of Tom Thumb Road and will run immediately adjacent to the approved bulk liquids terminal. While there is no direct overlap between the project footprints, key interaction in relation to traffic, and risk have been considered as part of the preparation of this EIS.

Eastern Gas Pipeline

The Eastern Gas Pipeline (EGP) is a key gas supply artery between the Gippsland Basin in Victoria and NSW. The pipeline delivers natural gas supplies to demand centres in Sydney, Canberra and Wollongong and passes through Kembla Grange to the west of Port Kembla. An EGP lateral extends approximately 6.5 kilometres from Kembla Grange to an existing Cringila metering station and services industrial customers at Port Kembla. The proposed tie in location for the project is at Cringila to facilitate the transport of gas to the market.

The existing lateral spur line between Kembla Grange and Cringila has a diameter of 200 mm (8 inches). The existing spur line will be utilised for the project and may be upgraded in the future to accommodate the maximum potential gas flows from the project. A separate approval process under the EP&A Act would be undertaken by Jemena as operators of the existing gas infrastructure to upgrade the spur line to accommodate future prospective flows for the project.

3. Strategic context

3.1 Overview

This chapter describes the strategic context of the project with regard to the NSW gas market, predicted gas shortfalls, as well as other key NSW government policies.

NSW is the only mainland eastern state that does not have its own material local gas supplies. As such, NSW relies on Queensland, Victoria and South Australia for 95% of its gas needs. While this means NSW is widely exposed to supply and/or price disruptions from other States, the requirement to transport natural gas over large distances via on-shore transmission networks also puts NSW gas consumers at an immediate financial disadvantage. According to the Australian Competition and Consumer Commission's April 2018 Interim Report on the Gas Inquiry (ACCC 2018), NSW consumers may pay as much as an additional $3.50 per gigajoule (GJ) in transportation costs.

Forecasts from a range of market analysts and the Australian Energy Market Operator (AEMO) note the east coast gas market is becoming increasingly reliant on undeveloped, contingent or prospective sources of supply in order to meet forecast demand. These supplies may never be realised. In addition, gas producers in Queensland are expected to continue to focus on the export markets while gas producers in the south continue to note declining production levels and increasing extraction costs. Other prospective sources of gas such as unconventional gas from the Northern Territory or gas transported from Western Australia via a new transnational pipeline are speculative, and would take at least 5 –10 years to develop.

Government policies such as the Australian Domestic Gas Security Mechanism (ADGSM) have the potential to provide some short-term relief to potential gas shortfalls, however, any gas to be supplied to NSW from interstate would likely remain expensive due to upstream production and pipeline transportation costs.

The project provides NSW with its own 'virtual pipeline' to natural gas produced from existing and new LNG projects all around Australia and the world. With the potential to supply approximately 100 petajoules (PJ) of natural gas per annum, the single terminal location in Port Kembla could meet in excess of 70% of NSW's total natural gas needs. The FSRU has a typical storage capacity of up to four petajoules of natural gas at any one time. This is equivalent to 10–12 days of emergency supply for the entire NSW economy, should there be a significant disruption to gas supplies from other sources.

The key objectives of the project are to:

- Introduce a new source of competitively priced gas to meet predicted supply shortfalls and help put downward pressure on prices
- Provide gas security to NSW with ability to supply more than 70% of the State's gas needs
- Provide long-term contracts to industrial users and ability to meet 100% of the State's industrial demand (manufacturers, power stations, hospitals, small businesses, etc.)
- Help support the 300,000 jobs across NSW, and the 15,000 jobs in the Illawarra, which rely on the competitive, reliable supply for natural gas
- Support the diversification and future growth of Port Kembla.

Subject to planning approvals, the project could be in a position to supply gas to NSW customers by early 2020. The project will not only support manufacturing jobs in NSW but also increase the natural competitive pressures in the entire east coast gas market, keep a cap on prices and ensure adequate, secure and reliable supplies for NSW into the future.

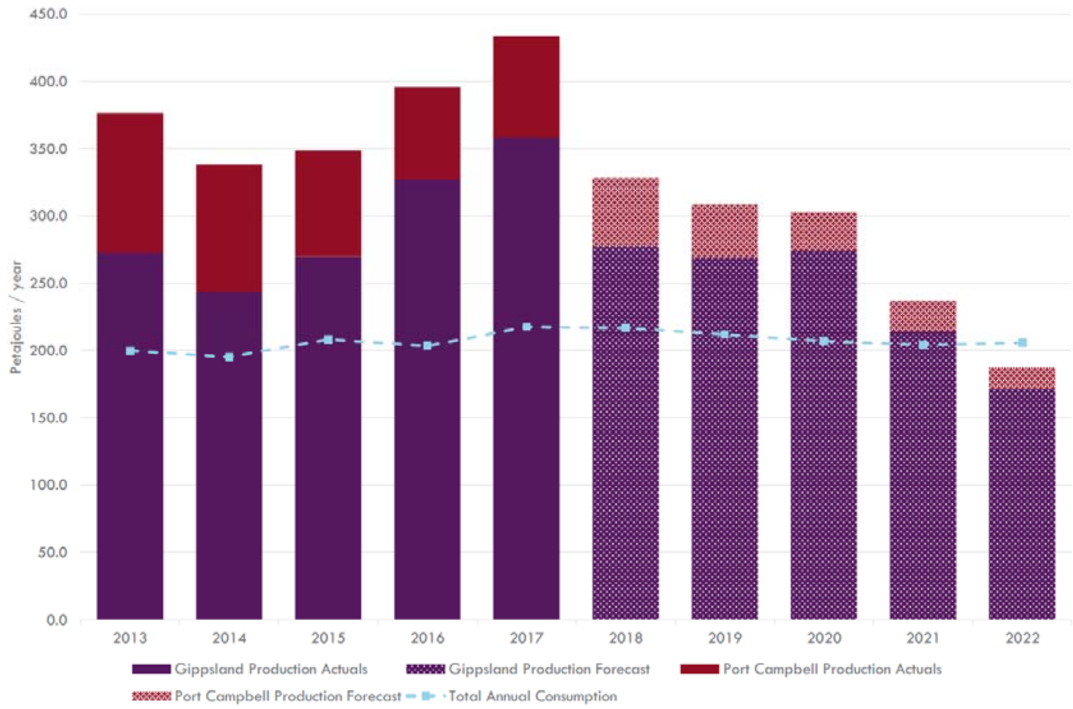
3.2 Need for gas

Gas is an important natural resource for households, businesses and industries. The NSW Gas Plan notes more than a million households use gas for everyday uses like cooking or heating. It also notes about 33,000 NSW businesses and 500 heavy industrial operations rely heavily on natural gas for their operations. These businesses are estimated to support over 300,000 jobs across NSW. In addition, over 10% of NSW's current electricity generation capacity is gas powered, with a number of proposed expansions already approved or well advanced in the planning process.

AEMO is responsible for operating the retail gas markets across NSW, Victoria, Queensland and South Australia. Every year AEMO releases a Gas Statement of Opportunities (GSOO) to forecast the ability of Australian gas markets to meet demand. AEMO's latest GSOO (2018) shows NSW has a heavier reliance on natural gas for use in its industrial sector than other east coast states. In NSW, industry accounts for 42% of demand, gas powered generation accounts for 21% of demand while residences account for the remaining 37% of demand.

Total annual gas consumption in NSW is about 130 PJ per annum (2017) with growth in demand expected to continue out to 2038 when demand is forecast to reach around 150 PJ per annum (AEMO 2018a). However, as noted in more recent publications, gas demand may increase further this if gas powered generation is increasingly relied upon to provide a firming solution for the increasing penetration of renewable energy in the National Energy Market.

In March 2018, while AEMO noted shortfalls in 2019 were unlikely, its Victorian Gas Planning Report (2018b) specifically stated that without additional gas supply, a potential shortfall in meeting annual Victorian gas consumption is likely from 2022 as shown in Source: AEMO (2018b) Figure 3-1. Furthermore, this shortfall could have potential flow-on effects for NSW, South Australia and Tasmania, which are all heavily reliant on Victorian gas.



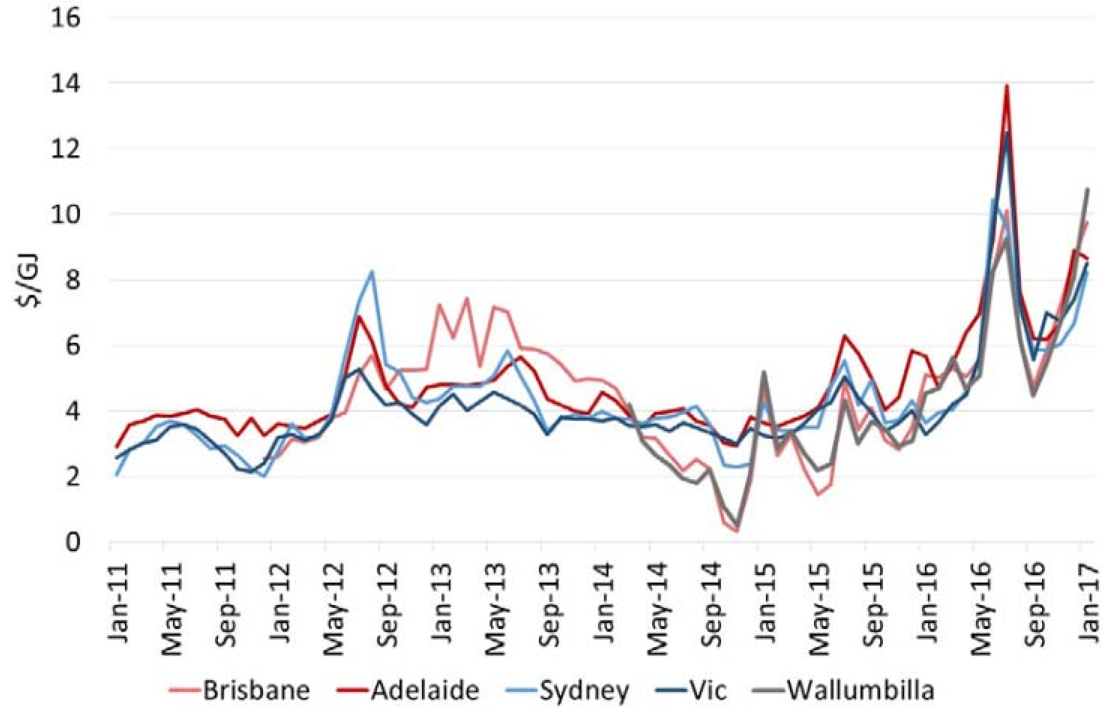
Source: AEMO (2018b)

Figure 3-1 Predicted shortfall in Victorian gas supply

AEMO has also stated that “from 2030, additional gas supply infrastructure will be needed to deliver gas to southern customers, unless early investment in exploration and development programs brings highly uncertain — and as yet undiscovered — southern prospective resources to market” (2018). Gas supply is discussed further in Section 3.4.

3.3 Gas pricing

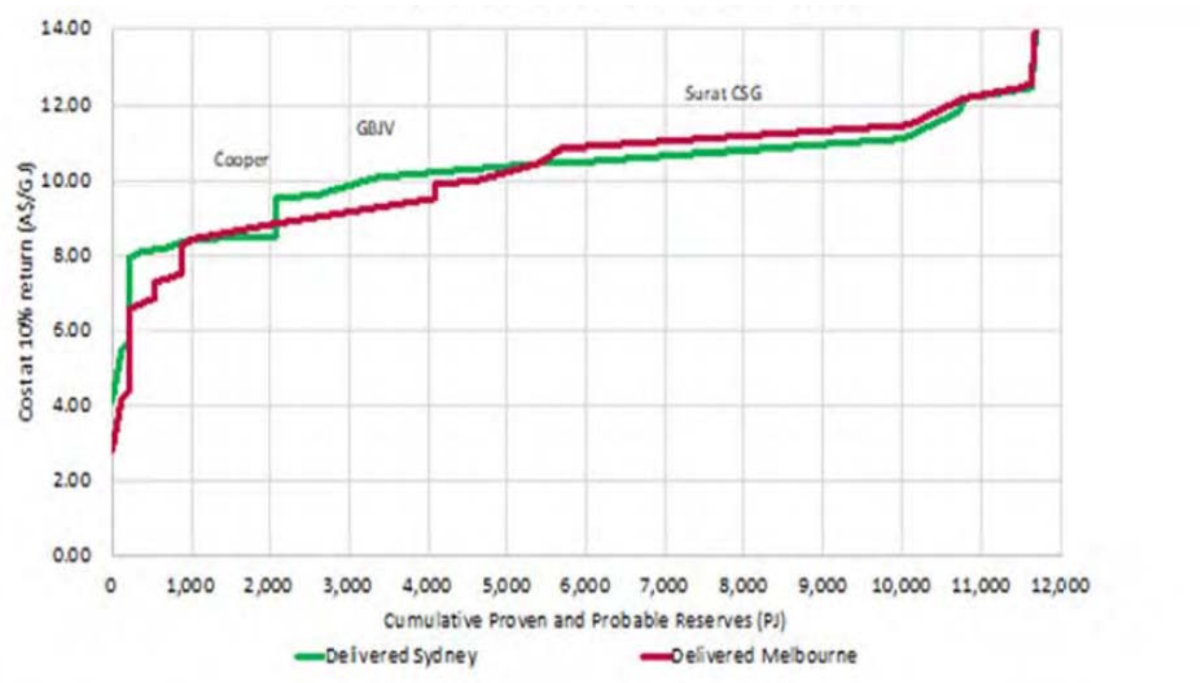
The Gas Price Trends Review Report 2017 (Department of the Environment and Energy 2018) found substantial increases in wholesale gas prices on the east coast gas market. Between 2015 and 2017 wholesale gas prices for large industrial users were found to have risen by 21% in NSW, 78% in Victoria and 60% in Tasmania (Department of the Environment and Energy 2018). The volatility of gas prices and potential for sharp increases is demonstrated in the wholesale spot gas price trends over the longer term between 2011 and 2017 as shown in Figure 3-2.



Source: Australian Industry Group (2017)

Figure 3-2 Monthly average wholesale gas prices

Future gas prices will be set by competitive forces, which amongst other drivers such as policy settings or demand, is heavily influenced by the amount of supply competition in the market. Locally developed supply will need to price at the cost of production plus an acceptable margin, with the lowest cost supply generally developed ahead of higher cost supply. Figure 3-3 highlights that of the majority of remaining uncontracted reserves available to the east coast domestic gas market, the price will need to be well in excess of $10/GJ delivered to Sydney to ensure they are brought to market in an economically viable manner. The project will provide competitively priced alternatives to ensure continued downward pressure on prices and may be able to source supply from Western Australia, Northern Territory or elsewhere internationally at prices below these local alternatives.



Source: EnergyQuest (2018)

Figure 3-3 Non-LNG related delivered gas costs and reserves

3.4 Gas supply

The most recent AEMO GSOO has a specific section on supply adequacy. In that section, AEMO notes, “there are no gas supply gaps forecast in 2019, or in the short term, under expected conditions, although some field expansions are needed”. Furthermore, the GSOO states:

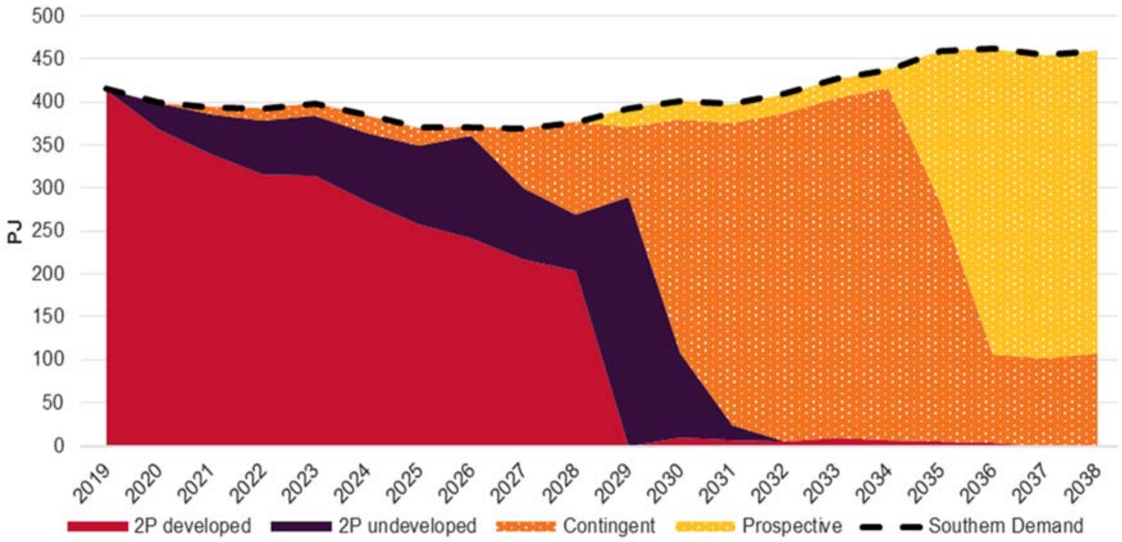
Provided yet undeveloped reserves do come online there is anticipated to be a level of resilience in the domestic market. However, should demand exceed neutral forecasts, there may be some pressure on the market.

Specifically, as existing fields decline, exploration and development will be needed to deliver contingent and prospective resources to market. These new gas supplies will help improve adequacy of supply but, as flagged in the 2017 GSOO, supply from these fields is likely to be more costly than existing production.

Without exploration and development of new southern resources, additional investment in gas supply infrastructure will be required by 2030 to deliver the gas to where it is needed.

[There is expected to be a] southern field decline of developed and undeveloped reserves, and [increased] need for contingent and prospective resource development to meet southern demand (New South Wales, Victoria, South Australia, and Tasmania). The location of this exploration and development will influence the needs for pipeline infrastructure.

Figure 3-4 below shows the predicted decline of developed and undeveloped reserves.



Source: AEMO (2018)

Figure 3-4 Status of southern resources to meet demand 2019–38

LNG import terminals have been and are being used around the world to provide fast, economical access points to global gas supplies for markets seeking to increase their independence from traditional suppliers, increase pricing competition and/or to support decarbonisation plans in the electricity sector as economies move from a dependency on coal to more renewable sources of energy.

The use of FSRU technology has the additional advantages of being faster to develop than onshore LNG storage and distribution facilities, and being easily decommissioned and relocated once no longer required.

An LNG import terminal in Port Kembla, NSW would provide the same benefits to NSW in the face of a tightening eastern gas market.

3.5 Policy setting

3.5.1 NSW Gas Plan

NSW Government gas policy is put forward in the *NSW Gas Plan — Protecting what's valuable Securing our future*. The Plan outlines a strategic framework to secure "vital gas supplies for the State". It recognises that "without affordable and reliable gas supplies our manufacturers will struggle to compete and … households will pay higher prices". The Plan identifies five priority pathways, including a pathway dedicated to "securing NSW gas supply needs" which includes a range of measures to diversify supply sources and keep downward pressure on prices.

The project is consistent with the NSW Gas Plan as it contributes to a diversification of gas supply and an increase in competition in both the wholesale gas and the pipeline transmission markets while also avoiding some of the concerns over potential impacts of on-shore gas field development on land valued for its agricultural, environmental, social or cultural heritage values.

3.5.2 Australian Domestic Gas Security Mechanism (ADGSM)

The ADGSM was established to enable the Australian Government to place export controls on uncontracted LNG exports liquid natural gas to shore up domestic supply.

The mechanism has not yet been triggered, as under the Australian East Coast Gas Domestic Gas Supply Commitment some east coast LNG exporters have agreed to "offer sufficient gas to meet [expected shortfalls] through the good faith offering of gas to the domestic market on reasonable terms" (Department of Industry, Innovation and Science 2017). This agreement is set to expire in 2020.

While the ADGSM and associated commitments may provide additional domestic supply, it is reasonable to expect they would remain at relatively high prices due to production and transportation costs, especially for users in NSW.

3.5.3 Illawarra Shoalhaven Regional Plan

The Illawarra Shoalhaven Regional Plan is an overarching regional plan applying to the local government areas of Kiama, Shellharbour, Shoalhaven and Wollongong. The plan identifies a number of key planning principles for the region that include:

- Protecting land with high environmental value and recognising cultural heritage values
- Sustainable use of land and resources while building resilience to climate change
- Supporting a strong, resilient and diversified economy
- Supporting improvements to transport infrastructure including active, public and freight
- Provide for the balanced and orderly supply of land for housing development
- Increase housing density around centres with access to jobs and transport
- Encourage urban design that reduces car dependency and promote energy efficiency
- Improvement coordination on the delivery of infrastructure

The project is considered broadly consistent with these planning principles. The project would not have direct impacts on land with high environmental value. The proposed berth and wharf facilities would be at the existing Berth 101 that has been subject to prior disturbance while the FSRU would be a floating facility that would not involve any disturbance to land.

The alignment of the gas pipeline is the result of a detailed options and alternatives development process. The alignment has been selected to minimise disturbance, including directional drilling to entirely avoid areas of environmental or cultural heritage sensitivity.

As discussed in Section 3.6 the project would have a number of economic benefits including increasing NSW's gas security and price competition, providing capital investment and substantial employment opportunities during construction and operation to support a strong, resilient and diversified economy in the region.

The regional plan identifies that Port Kembla as a major economic asset that directly and indirectly supports over 3,500 jobs and contributes $418 million to the regional economy each year. It makes a number of specific directions in relation to Port Kembla including to grow the capacity of the port as an international trade gateway. The project is considered to be consistent with this direction given operations would involve international trade and the disposal of dredged and excavated material would support the development of the Outer Harbour.

3.5.4 NSW Ports 30 Year Master Plan

The NSW Ports 30 Year Master Plan provides the long-term strategy for ports and other assets operated by NSW Ports including Port Kembla, Port Botany and intermodal facilities.

The plan states that Port Kembla is an economic asset of national significance and will be required to cater for growing trade volumes over the next 30 years. It anticipates containers could more than triple from 2.3 million to 8.4 million in total, bulk liquids more than double from 5.1 million kilolitres to 10.8 million kilolitres; motor vehicles more than double from 390,000 to 850,000 and dry bulk products grow from 20.3 million to 30 million tonnes over that time.

It states that the priority to address growing trade volumes is to maximise utilisation of existing port infrastructure before investing in new infrastructure, and identifies five objectives:

- Provide efficient road connections to the port
- Grow rail transport of containers
- Use land and infrastructure efficiently
- Grow port capacity with new infrastructure
- Protect ports from urban encroachment

The project would be contained to the existing Berth 101 area and is considered to be consistent with the overall strategy to utilise existing port infrastructure. During operation of the project, natural gas would be transported through a gas pipeline rather than by road or rail and would not affect the ability of NSW Ports to implement its objective to improve road efficiency and rail utilisation.

With regard to the objective to use land and infrastructure efficiently, the NSW Ports 30 Year Master Plan states that it would prioritise the allocation of land at the ports for uses that require a direct connection to berths. The project is consistent with this objective as it would require a direct connection to the berth and would operate 24 hours per day, 7 days per week from that berth.

With regard to the objective to grow port capacity with new infrastructure, the NSW Ports 30 Year Master Plan states that it will facilitate early reclamation works in the Port Kembla Outer Harbour by supporting opportunities to use surplus material from excavation projects. The project will involve excavation and dredging of a large volume of material form the Inner Harbour that would be disposed largely within the approved footprint for the Port Kembla Outer Harbour Development and adjacent areas and is therefore considered to be consistent with future development plans for the port.

With regard to the objective to protect ports from urban encroachment, the NSW Ports 30 Year Master Plan states that planning should prevent incompatible uses surrounding Port Kembla and that authorities should consult with NSW Ports regarding developments that may impact, or be impacted by, port operations. The project is consistent and compatible with the use of Berth 101 and surrounding port land and is not expected to impact surrounding developments.

3.5.5 NSW Ports Sustainability Plan

The NSW Ports Sustainability Plan the long-term sustainability strategy for ports and other assets operated by NSW Ports being Port Kembla, Port Botany and intermodal facilities.

The plan identified five focus areas for sustainability, being:

- Transport and logistics
- Development and land use planning
- Local environmental outcomes
- Resource conservation and efficiency
- Stakeholder consultation and relations

With regard to transport and logistics, the plan identifies a goal to support commercial shipping as the most efficient mode of transport by providing and maintaining port infrastructure to meet demand. It also states that rail transport should be promoted and road/rail efficiency improved. As noted above, the project is consistent with these goals as it would involve commercial shipping to transport natural gas to the port and would not affect road/rail efficiency during its operation.

With regard to development and land use planning, the plan identifies goals to promote development for expected long-term increases in trade volumes, promote development that is compatible with ports, promote sustainable design and operations, and assess the likely impacts of climate change on ports and adapt as necessary to ensure long-term resilience. The project could increase its LNG import capacity, if demand increases, and as such is consistent with these goals. The design of the berth and wharf facilities has also been carried out with consideration to the potential impacts of climate change at the port over the life of the project.

With regard to local environmental outcomes, the plan identifies the goal to maintain local environmental values and the amenity of communities. The potential impacts of the project on environmental values and the amenity of communities is assessed throughout the EIS. The environmental values of the site of the project are largely limited and the project is not expected have significant impacts on these values or the amenity of communities. As such the project tis not expected to materially impinge on the identified goal for these values to be maintained.

With regard to resource conservation and efficiency, the plan identifies the goal to minimise resource consumption and waste through the better use of land, infrastructure, renewable energy and recycled materials. The project would involve relatively limited landside development by utilising floating infrastructure such as the FSRU, while the demolition and construction of berth and wharf facilities would be consistent with the existing intended use of Berth 101. During operation, the project would largely generate its own power on board the FSRU from LNG supplies. This results in considerably lower emissions when compared to other marine oil or diesel marine powered vessels.

With regard to stakeholder consultation, the plan identifies that NSW Ports should engage proactively with stakeholders to ensure a coordinated and transparent approach to sustainability. AIE has engaged extensively with local stakeholders and community members as discussed in Chapter 7. In addition, AIE and NSW Ports have been in close consultation throughout the design of the project. It is planned that NSW Ports will continue to be engaged through to construction and operation.

3.6 Other project benefits

The project is expected to involve a capital investment of about $200–250 million and employ about 150 workers at its peak. Once fully operational, the project is expected to employ about 40–50 workers. The project is also expected to contribute to the realisation of a number of other NSW State and Local Government Policy and Program commitments, including:

- **NSW's commitments to the COAG Energy Council** — including the Australian Gas Market Vision and Gas Market Reform Package — which note the critical need to increase the volume of gas available domestically, the number of competitors in wholesale supply and pipeline transmission, and the level of pricing transparency
- **NSW Energy Security Taskforce Final Report** — which in part recommended the NSW Government be more proactive in managing risks to NSW's energy security, including disruption from other states and fuel supplies, albeit primarily for electricity
- **NSW Renewable Energy Plan** — designed to increase the participation of renewable energy in a stable, safe electricity grid and reduce carbon emissions A local supply of natural gas, not only supports existing firming solutions but also potentially provides a reliable fuel supply for any additional Combined Cycle Gas Turbine power stations needed to support NSW's stable transition to a more decarbonised electricity sector.

- **NSW Climate Change Policy Framework** — which aims to achieve net-zero emissions by 2050
- **Regional Development Framework** — which in part notes the importance of “fast tracking infrastructure projects that supports business confidence, private sector investment and job creation in regional areas
- **Wollongong Economic Development Strategy 2013–2023** — which outlines a desire to support the diversification of the economy and the Port, as well as the attraction of new industrial investment, especially around the surplus industrial landholdings located near the Port.
- **Industry Action Plan for Manufacturing** — which outlines a vision for manufacturing in NSW to 2021 and includes an “objective of sustaining existing manufacturing capability”.

The consultation process for this project has identified a number of additional economic benefits of possible interest to the local region, including:

- Possible use of the facilities for **open tolling**
- Possible use of the facilities to support new value-add capabilities in port, such **as LNG Bunkering** (refuelling marine vessels in port). This is also relevant when noting international regulations governing emissions of the marine transportation sector are set to change in 2020. As such, an increasing number of marine vessels, including cruise ships and car carriers are moving to use LNG in place of other marine fuels. Ports which cannot provide LNG re-fuelling facilities may become marginalised over time.
- Possible optionality for a new **Combined Cycle Gas Turbine (CCGT) power station** in the Illawarra region. Latest technology CCGT power stations can provide both baseload and dispatch load, keeping downward pressure on prices and delivering greater grid stability.
- Possible **additional investment appeal for new industrial manufacturers seeking to move to the region** due to the availability of a local source of gas supply, with the corresponding avoidance of unnecessary interstate in transportation costs for securing gas supplies. This appeal would be even greater, if the region also hosted a local CCGT power station.

4. Project alternatives

4.1 Overview

A number of technical studies have been undertaken to investigate alternatives for the project. The investigations have been undertaken by AIE in conjunction with Advisian, responsible for leading the feasibility and design process and with input from GHD regarding environmental and social constraints and opportunities.

This section examines the key alternatives considered at each of two major phases; Concept and Feasibility. In each case, the alternatives proposed have been assessed considering key outcomes such as engineering, design, operational, environmental, social, economic, schedule, cost, approvals, availability/reliability and accessibility. The analysis of alternatives has been presented to address a key requirement of the SEARs, which requires a justification for the proposed project as opposed to other alternatives considered during the development of the project.

4.2 Site selection considerations at Concept Phase

In the initial feasibility studies, three NSW ports where LNG could potentially be imported were considered including Port Kembla, Port Botany and Port of Newcastle. The initial site selection screening was undertaken in 2017 (Worley Parsons, 2017). The availability of viable berthing options, plus the feasibility of pipeline connections to existing gas systems near the ports were considered as part of the process.

A framing workshop (1 February 2018) considered six locations (i.e. Port Kembla, Port Botany, Port of Newcastle, Offshore Shellharbour, Offshore Stockton Beach, Offshore Port Kembla) and five regasification/storage technologies (i.e. FSRU, floating storage unit [FSU], shuttle LNG carrier, onshore storage, onshore regasification) for the project. Analysis of these alternatives incorporated the outcomes from the initial site selection (Worley Parsons, 2017) carried out for Port Kembla, Port Botany and Port of Newcastle.

Figure 4-1 shows the locations of the identified sites for the project during the Concept Phase.

A narrowing workshop (15 February 2018) developed the alternatives identified at the framing workshop. These comprised three locations of nearshore and offshore (Port Kembla, Port Botany and Port of Newcastle); a range of regas/storage technologies (FSRU, FSU, onshore storage and onshore regas) and a generic berth within each port.

Key issues investigated to inform the narrowing workshop included: pipeline configuration, technology selection, offshore mooring (Turret Mooring System versus Submerged Soft Yoke), meteorology and oceanography limitations, screening cost estimates, location/port constraints, advantages (e.g. distances from residential areas), and identification of potential berthing and loading configurations (e.g. side-by-side or in-line). Multi-criteria analysis (schedule, cost, approvals, availability/reliability and accessibility) was undertaken using a range of screening tools.

4.2.1 Initial project options considered - Concept Phase

An overview of all the options considered during the framing workshop are provided in Table 4-1 (Advisian 2018a).

Paper Size ISO A4

0 9,100 18,200 27,300 36,400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Australian Industrial Energy
East Coast Gas Project

Project No. 21-27477
Revision No. A
Date 19 Oct 2018

Initial port location options

Figure 4-1

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Print date: 19 Oct 2018 - 09:58 (SMA record: 2)

Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community; (c) Department of Finance, Services and Innovation 2015; (c) Department of Finance, Services and Innovation 2012; (c) Forest Corporation of NSW 2017; (c) State of New South Wales and Office of Environment and Heritage; NSW Crown Copyright - Department of Planning and Environment; (c) Commonwealth of Australia (Department of the Environment) 2013; (c) Commonwealth of Australia (Department of the Environment) 2014. Created by: afoddy

Table 4-1 Comparison of initial project options considered

Option / Criteria	Port Kembla option 1	Port Kembla option 2	Port Kembla option 3	Port Kembla option 4	Offshore option 1 (at Port Kembla)	Port Botany option 1	Port of Newcastle option 1	Port of Newcastle option 2
Location	Port Kembla	Port Kembla	Port Kembla	Port Kembla	Offshore	Port Botany	Port of Newcastle	Port of Newcastle
Gas storage	FSRU	FSU	Shuttle LNG carrier	Shuttle LNG carrier	FSRU	FSRU	FSRU	Shuttle LNG carrier
Onshore storage	No	No	Yes	Yes	No	No	No	Yes
Loading of gas	Side by side	Side by side	In line using loading arms	In line using loading arms	Side by side	Side by side	Side by side	In line using loading arms
Regas	FSRU	Onshore	Onshore	Onshore	FSRU	FSRU	FSRU	Onshore
Pipeline	8 km to the Eastern Gas Pipeline network	8 km to the Eastern Gas Pipeline network	8 km to the Eastern Gas Pipeline network	8 km to the Eastern Gas Pipeline network	6 km of horizontal directional drills and 8 km onshore	43 km to Horsley Park network	3 km	3 km plus 33 km for stage 2

Additional pipeline options considered

Along with the pipeline options outlined in Table 4-1, additional pipeline options were considered including their connection to the gas network and cost. Options included those for Port Kembla, Port Botany and Port of Newcastle.

An overview of these and their associated costs, connections and lengths are outlined in Table 4-2 (Advisian, 2018a).

Table 4-2 Comparison of pipeline connection options considered

Port Kembla	Port Botany	Port of Newcastle
A new pipeline to the Eastern Gas Pipeline, 18 inch pipe, 1.6 km in length and costing around $7 million A new pipeline to the Eastern Gas Pipeline, 18 inch pipe, 6 km in length, costing around $32 million A new pipeline from Berth C to Wilton to Wollongong pipeline junction at Figtree, 20 inch pipe, 6.1 km in length, and costing around $40 million	A new pipeline from Port Botany to Leppington or Smithfield (both around 40 km in length), 20 inch pipe 47 km pipeline, costing around $240 million	Upper River berth to Kooragang metering station, 20 inch pipe, 3 km in length, and costing around $14 million Kooragang metering station to Hexham (loop 14 inch), 20 inch pipe, 12 km in length, costing around $43 million

Based on the estimated cost and difficult of construction of the Port Botany pipeline option, this option was dismissed as unviable and was dropped from consideration.

Instead, a more detailed comparison between the Eastern Gas Pipeline (EGP) connection option at Port Kembla and the Hexham pipeline connection option at the Port of Newcastle was considered. See Table 4-3 (Advisian, 2018a).

Table 4-3 Comparison of pipeline connection options at Port Kembla and Port of Newcastle

Port Kembla: Eastern Gas Pipeline connection	Port of Newcastle: Hexham pipeline connection
Low cost option (1.6 km) using existing 8 inch branch line Could loop existing branch line to Kembla Grange EGP pipeline has capacity up to 300 TJ/d, with average of 200 TJ/d Greater than 300 TJ/d would require looping Low cost, fastest schedule Limited landowners to negotiate easements within an industrial area	Approximately 11 km long pipeline from Mayfield 6 to Hexham Size pipeline to match Hexham capacity 12" pipeline at 10 MPa inlet would deliver over 300 TJ/d at 7 MPa * Jemena confirm capacity of system at Hexham: • Current limit of pipeline is 5 MPa which would deliver 200 TJ/d • * Would need $30 million upgrade (heating) to go to 7 MPa, 300 TJ/d Power company AGL, their LNG's plant injects up to 120 TJ/d: • This could restrict amount of new gas into the pipeline

Capacity, operating pressure, anticipated licensing requirements, and existing pipeline condition were assessed for both of these options.

The more detailed comparison showed that insufficient capacity existed in the current pipeline system in the Newcastle area to accommodate the required flowrates.

As such, Port Kembla provided a more suitable site for pipeline connection, as it is well served for connection to the Jemena Gas Network (JGN) upstream of the greater Sydney gas market via either of the Jemena owned and operated EGP or the Wilton to Wollongong Pipeline (WWP) with the latter being connected with the Wilton to Horsley Park (WHP) main trunk line.

The preferred site location for pipeline connection was therefore nominated as Port Kembla with a connection to the EGP tie-in point at Cringila.

Technology options

A range of technologies for storage and regasification of the LNG were considered including offshore FSRU, LNG carrier shuttle tankers, onshore storage and regasification, FSRU, and FSU.

Technology options considered for each project option outlined in were:

- FSRU (Port Kembla option 1, Port Botany option 1 and Port of Newcastle option 1)
- FSU and onshore regasification (Port Kembla option 2)
- LNG carrier shuttle tankers, onshore regasification and small storage tank (Port Kembla option 3 and Port of Newcastle option 2)
- LNG carrier shuttle tankers, onshore regasification and large storage tank (Port Kembla option 4)
- Offshore FSRU with soft yoke mooring and subsea pipeline (Offshore option 1 at Port Kembla)

A comparison of the technology options considered are provided in Table 4-4.

Table 4-4 Comparison of technology options considered

Technology	Advantages	Disadvantages
Offshore FSRU	n/a	This option does not meet the availability targets Uses new technology which is not well proven Offshore environment is multi-directional with harsh and extreme meteorology oceanography conditions Requires a subsea pipeline
LNG carrier shuttle tanker	Has some onshore storage: • Manage LNG carrier changeover • Manage weather events Single wharf requirement Option to expand into full onshore storage	Requires onshore regasification: • Higher initial capital expenditure • More space required • Permits • Scheduling impacts
Onshore storage and regasification	Highest availability Minimal use of the wharf	High costs (highest capital expenditure and initial capital expenditure) Longest schedule Mostly onshore facilities, which require large areas of land Not suited to a short term development
FSRU	Low overall cost Minimal onshore works Fasted schedule	Potentially higher operating expense in comparison to FSU
FSU	(The FSU has not advantages over the FSRU)	FSU has no advantages over the FSRU Requires onshore regasification

Overall, the FSRU option was selected as it was considered the fastest, cheapest option with minimal works onshore. The schedule is critical as the project is required to be operational in 2020, therefore meeting market demands for a new gas supply.

Berth options

With Port Botany having been dismissed early on in the Concept Phase, and the preferred technology for the project identified as an FSRU, consideration of berthing options at the Port of Newcastle and Port Kembla were then considered.

Berth options for both ports were compared and ranked according to a set of evaluation criteria.

Outer harbour options at Port Kembla were dismissed early on in the Concept Phase due to the negative impact of meteorology and oceanography constraints such as long period waves. Long period waves are a well documented and frequent occurrence in Port Kembla. In recent times, such events had resulted in at least 12 instances where vessels were required to leave their locations. This frequency of supply interruption would have been an unacceptable risk to reliability and therefore all Outer Harbour options were dismissed as unviable.

Subsequent comparisons therefore focused on more protected options for the selected technology (FSRU); Port of Newcastle at Berth Mayfield 6; Port Kembla at Berth 111 West Inner Harbour and Port Kembla Berth 101 - FSRU and LNG carrier side-by-side as outlined in Table 4-5 (Advisian, 2018a). The option at Port Kembla Berth 101 was identified as an option through consultations with Port Kembla Coal Terminal (PKCT).

Table 4-5 Comparison of berth options at Port Kembla and Port of Newcastle

Berth option	Advantages	Disadvantages
Port Kembla Berth 111 West - FSRU and LNG carrier side-by-side	Minimal impact to port operations Requires minimal redirection of Allans Creek due to flow velocity	Requires a new berth Requires using BlueScope land Excavate landside to create more room for navigation Dredging required
Port of Newcastle Berth Mayfield 6 - FSRU and LNG carrier in-line	Minimal impact to port operations Some dredging required	Requires a new berth for the FSRU and upgrade/extension to Berth Mayfield 7 for the LNG carrier Additional pipework and loading arms required
Port Kembla Berth 101 – various alignment options considered *	Site is rarely used Identified by Port Kembla Harbour Master as being preferable from a navigation perspective Additional remoteness of location from nearest residential areas	n/a

*Various berthing options considered for Berth 101 included both a side-by-side and an in-line configuration. An end to end arrangement would interfere with coal loading operations at Berth 102 located to the north of Berth 101 and would require additional loading arms and cryogenic piping. A side-by-side option would require a cut into the existing berth to accommodate the two vessels side-by-side.

The preferred alternative for Berth 101 was a side by side transfer of LNG at Berth 101 in Port Kembla (Figure 4-2).

After site visits and discussions with third parties the final recommendation on the preferred Berth was Port Kembla Berth 101.

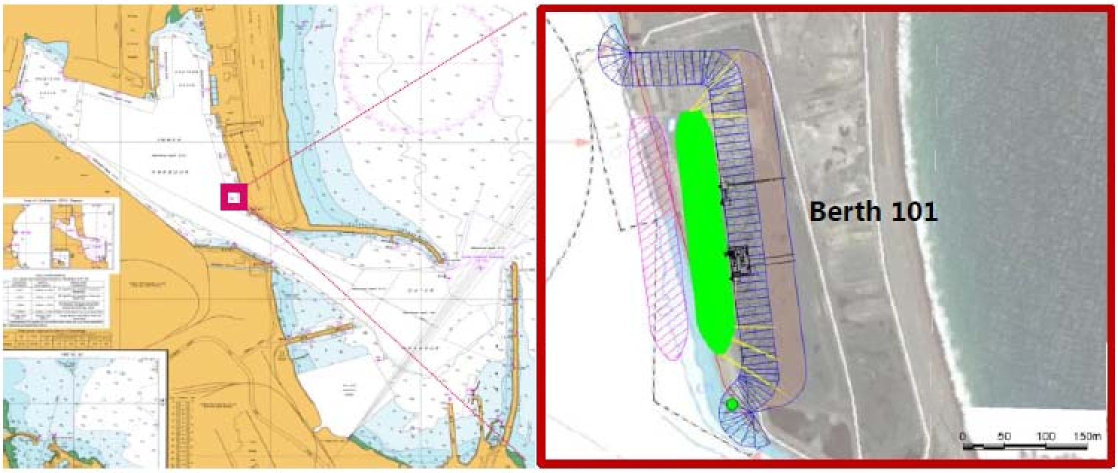

Figure 4-2 FSRU in Port Kembla at Berth 101 East

Pipeline options from Berth 101

With a berth location selected, additional consideration of pipeline options was required. The following options were identified for further investigation (Advisian, 2018):

- A 6.1 kilometre pipeline, mainly land based conventional construction, skirting to the north of the industrial port precinct (Figure 4-3).
- A 2.65 kilometre pipeline, primarily consisting of two major horizontal directional drills (HDDs) under the Inner Harbour (about 1.3 kilometre) to a location on the south bank of Allans Creek and then a drill around 660 metres from EGP tie-in point also to a location on the south bank of Allans Creek. A 690 metre conventional connection pipe segment would be required to join the two HDDs along Allans Creek Road (Figure 4-3).

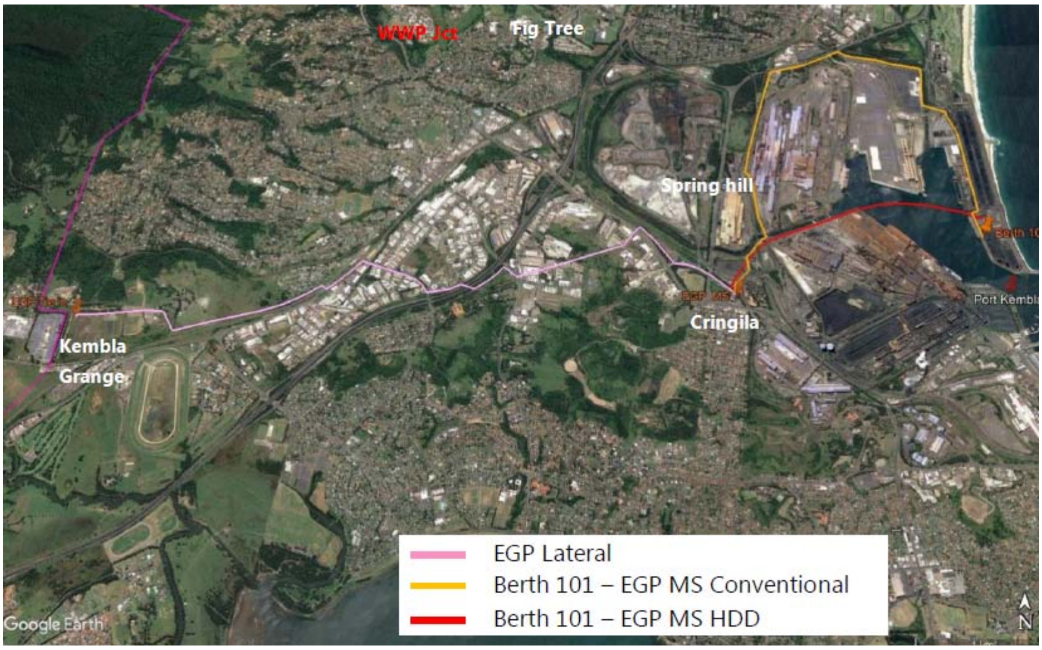

Figure 4-3 Initial concept pipeline and connection options

The existing EGP lateral pipeline from Cringila to Kembla Grange can be utilised by the project. However, upgrades to the EGP lateral could be undertaken to expand the project capacity to greater than 100 petajoules per annum. An upgrade to the EGP lateral does not form part of the scope of the project.

A comparison between the two pipeline options from Berth 101 at Port Kembla is provided in Table 4-6 (Advisian, 2018c).

Table 4-6 Comparison of pipeline options from Berth 101 at Port Kembla

6.1 km conventional pipeline option	2.65 km HDD pipeline option
Disadvantages	
Significantly longer Has several land holders Slow installation Requires multiple crossings including at least two horizontal directional drills under road/rail areas	Would involve disruption to traffic on the Steelworks road alongside Allans Creek where pipe strings would be made up Would be contingent on the geological conditions beneath the harbour sustaining the drill hole integrity and the feasibility of establishing a pipeline make up area along the Steelworks road, plus acceptance by BlueScope of the temporary traffic disruption that would result May interfere with port operations, either ship movements and/or maintenance dredging schedules Technically more difficult than open trench and/or land-based horizontal directional drills
Advantages	
Default option for gas hydraulics and pipeline sizing due to a relative minimal risk surety of implementation	Reduced length in comparison resulting in a shortened construction phase

Further consideration of pipeline connection options were completed during the Feasibility Phase and are outlined in Section 4.3.2.

4.2.2 Summary of Concept Phase pipeline, technology and berth options

The preferred alternative selected at the conclusion of the concept phase featured an FSRU berthed in side by side configuration with LNG carriers at Berth 101 in the Inner Harbour or Port Kembla. Pipeline options were evaluated in further detail at Feasibility Phase.

4.3 Feasibility Phase

The Feasibility Phase (Advisian, 2018c) confirmed the preferred option of a side by side configuration of LNG transfer at Berth 101 in Port Kembla Inner Harbour. It also dismissed the pipeline option under the sea bed.

In reaching these conclusions, the Feasibility Phase (Advisian, 2018c) considered a number of design options. Key options included:

- Wharf layout and geometry design options for a quay wall versus an island berth
- Pipeline options to connect the FSRU to the tie-in point at Cringila

These are summarised below.

4.3.1 Wharf layout and geometry design options

Two design options were considered for the wharf at Berth 101; a quay wall and an island berth. Typical designs of these are provided in Figure 4-4 and Figure 4-5.

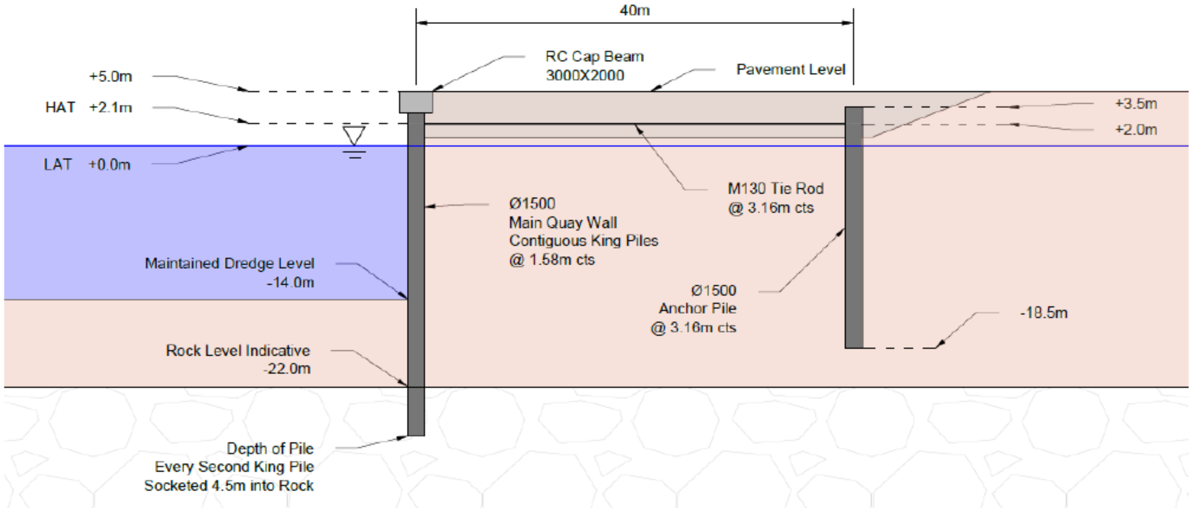

Figure 4-4 Typical quay wall option cross section

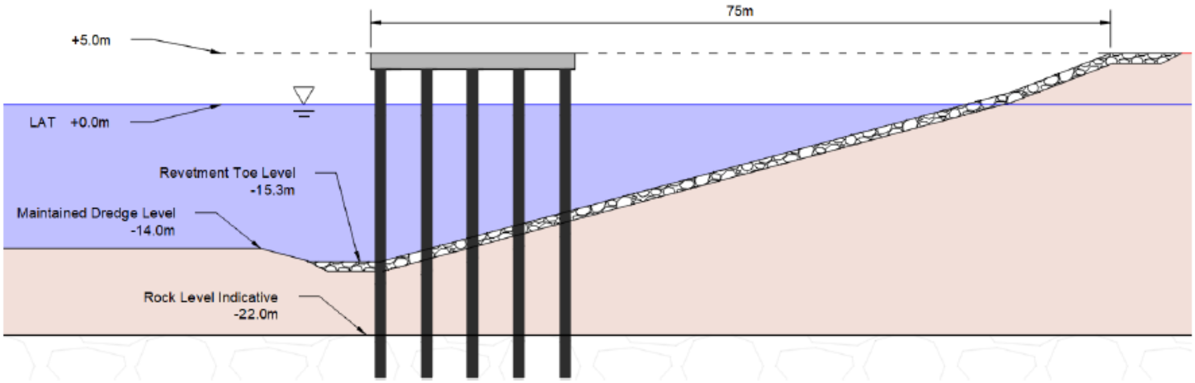

Figure 4-5 Typical island berth option cross section with no under layer fill

The Feasibility Phase (Advisian, 2018c) assessed key issues such as design, cost, construction sequence/methodology and timeframe for these options. Key points of comparison included:

- Less piling is required for the island berth thus the revetment can be installed earlier
- Cost saving of approximately 20 % between the island berth with no under layer fill and the quay wall option
- The island berth requires more dredging and land to be excavated to build the revetment and, hence, more land would need to be excavated in comparison to the vertical quay wall
- For the Island berth approximately 140,000 cubic metre of rock fill would need to be brought in from offsite to fill over the lower strength in-situ material to steepen the revetment slope and, hence, garner more land area.

The quay wall alternative was selected as it would require considerably less dredging and excavation and would result in less restriction of vessel movements within the Inner Harbour.

Navigation simulation studies were undertaken to identify the degree of separation required from the berth to the Inner Harbour turning basin as detailed in Chapter 9 and Appendix C in

Volume 2 of this EIS. A buffer of 40 metres was selected to provide the optimum balance to ensure safe navigation and passage of vessels within the Inner Harbour and minimising the extent of dredging and reclamation required for the berth (refer to Figure 5-4 in Chapter 5: Project Description).

Sediment disposal options were considered in conjunction with NSW Ports with the aim of disposal of the dredged material within disposal areas dedicated within the Outer Harbour. Alternatives for both submerged and emergent disposal in the Outer Harbour were investigated to best meet NSW Ports latest plans for the expansion of the Outer Harbour. Transport of sediments from the dredging and excavation of Berth 101 could be undertaken by either barge within the harbour or through road haulage. A combination of disposal options has been selected for the project as described in Chapter 5.

4.3.2 Pipeline alignment options

Options were assessed for the connection of regasified LNG from the FSRU send out facilities at Port Kembla Berth 101 to the Eastern Gas Pipeline. FSRU constraints, pipeline constraints and compression requirements were considered.

This options' assessment included:

- Constructability Issues (technical difficulty, operational impacts on the port etc.)
- Pipeline hydraulic analysis to determine maximum achievable flow capacity and compression requirements
- Assessment of pipeline and compression capital expenditure (CAPEX)
- Assessment of compression natural gas consumption and associated cost
- A number of pipeline alignments were considered (Figure 4-6).

Alignments considered included:

- A central alignment involving a single directional drill directly under the harbour to the Cringila meter station. This option was rejected reasonably quickly due to greater technical challenges and possible impacts on Port operations (ship movements and/or maintenance dredging schedules).
- A southern alignment involving a series of directional drills and traditional trenching through the southern areas of Port Kembla (Figure 4-6).
- A northern alignment passing through the northern and western areas of Port Kembla.

The northern alignment was selected as the preferred option and will involve pipeline installation primarily using traditional trench methods with directional drilling adopted at road and rail crossings and areas of environmental sensitivity. The alignment was refined throughout the preparation of this EIS to avoid biodiversity and heritage constraints.

Construction of the pipeline will be primarily restricted to previously disturbed sites and road verges within the Port Kembla industrial precinct. The pipeline will be designed and constructed to Australian standard AS2885, which is the standard applicable to the design, construction, testing, operations and maintenance of gas pipelines of this nature.

Paper Size ISO A4

0 200 400 600 800

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Australian Industrial Energy
Port Kembla Gas Terminal

Pipeline alignment options

Project No. 21-27477
Revision No. -
Date 05/07/2018

FIGURE 4-6

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Print date: 05 Jul 2018 - 14:57

Data source: © DFSI Spatial Services 2017. Created by: mking3

4.4 Summary of project alternatives considered

The preferred development selected during the Concept Phase included a FSRU side-by-side configuration for LNG transfer at Berth 101 at the Inner Harbour of Port Kembla with a pipeline connection to the existing EGP. The preferred project was considered to have a number of advantages in comparison to other alternatives including:

- Ability to accommodate side by side berthing of the FSRU with the LNG carrier
- Inner harbour sheltered from long period wave action
- Site is located more than two kilometres from residential receivers
- Relatively short pipeline connection and ease of access into the existing gas network.

The Feasibility Phase then considered further detail on wharf layout and geometry and pipeline alignment options. A quay wall design was selected as the preferred wharf layout as it would require less dredging and pose less restrictions to port navigation. A buffer of 40 metres from the Inner Harbour turning basin was selected to provide the optimum balance between the required dredge and excavation volumes and safe navigation of vessels within the Inner Harbour.

The northern pipeline alignment was selected and comprises a connection from the FSRU to the tie-in point at Cringila, which is connected to the EGP. Installation of the pipeline would primarily use traditional trench methods with directional drilling adopted at road and rail crossings and areas of environmental sensitivity.

5. Project description

5.1 Overview

AIE proposes to develop the Port Kembla Gas Terminal (the project) in Port Kembla, New South Wales. The project involves the development of a liquified natural gas (LNG) import terminal, which would be the first such import terminal in NSW and provide a simple, flexible solution to the State's gas supply challenges.

NSW currently imports more than 95% of its natural gas requirements from Victoria, South Australia and Queensland. An import terminal would enable NSW to control and secure its own direct supplies. The project has the capacity to deliver in excess of 100 petajoules of natural gas per annum to NSW. This is equivalent to more than 70% of the State's annual needs. Supply could be increased further to around 140–150 petajoules per annum through a slight increase in scheduled deliveries and pipeline upgrades.

The project consists of four key components:

- LNG carrier vessels — there are hundreds of these in operation worldwide transporting LNG from production facilities all around the world to demand centres;
- Floating Storage and Regasification Unit (FSRU) — a cape-class ocean-going vessel which would be moored at Berth 101 in Port Kembla. There are around 30 such vessels currently in operation around the world;
- Berth and wharf facilities – including landside offloading facilities to transfer natural gas from the FSRU into a natural gas pipeline located on shore; and
- Gas pipeline – a Class 900 carbon steel high-pressure pipeline connection from the berth to the existing gas transmission network.

The project design and layout, construction, operation and decommissioning is described in the following pages. A layout of the entire project is shown in Figure 5-1. Indicative general arrangement designs for the berth and FSRU are included as Appendix A.

The project, subject to approvals, is scheduled for construction in 2019 with first gas delivery in 2020. The project life is 10–15 years but could be extended with sufficient demand.

Construction of the project is expected to involve a capital investment of about $200–250 million and employ about 150 workers at its peak. Once fully operational, the project is expected to employ about 40–50 personnel.

5.2 Structure

This project description is divided into sections covering the design, construction and operation of the project followed by the decommissioning of the project at the end of its life.

Section 5.3 describes the overall design of the infrastructure that makes up the project including berth and wharf facilities, the gas pipeline and the FSRU.

Section 5.4 describes how the project would be constructed including the construction schedule, the material and equipment required, the workforce and vehicle movements and specific works to be carried out for construction of the project including excavation, dredging and disposal.

Section 5.5 describes how the key components of the project would operate including the transfer of LNG from LNG carriers to the FSRU, through to the berth and wharf facilities, into the gas pipeline and then on to market.

Section 5.6 outlines plans for decommissioning at the end of the project.

Paper Size ISO A4

0 50 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Australian Industrial Energy
Port Kembla Gas Terminal

Project layout

Project No. **21-27477**
Revision No. **A**
Date **02 Nov 2018**

Figure 5-1

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

5.3 Design

5.3.1 Floating storage and regasification unit

The FSRU is a cape-class ocean-going vessel approximately 300 metres in length and about 50 metres in breadth. It has a total capacity of about 170,000 cubic metres or equivalent to about 4 PJs of gas. This in turn is equivalent to about 10 – 12 days of natural gas supply for the whole of NSW.

The FSRU is a double-hulled vessel with a cargo area which consists of four cargo tanks suitable for carrying LNG at low temperatures (about minus 161 degrees Celsius) and at atmospheric pressure. There are also two high pressure manifolds located on the vessel that are required to export the natural gas produced via the regasification process into the pipeline.

The FSRU, for the term of the project, and subject to any maintenance requirements or Port Authority directions, would be moored at the berth and wharf facilities discussed in Section 5.3.2.

The vessels will be obtained and operated under long-term charter by Höegh LNG, the world's largest and most experienced owner and operator of FSRUs globally. All Höegh LNG vessels are designed to comply with comprehensive international safety regulations and standards.

One of the key purposes of the FSRU is to receive LNG from regularly scheduled LNG carriers visiting Port Kembla. These vessels will be operated by the suppliers of LNG contracted to the project. A global tender is currently underway to select the most competitive sources of reliable scheduled supply. It is anticipated that in the order of 24 LNG carriers would visit Port Kembla in any one year during project operations.

These LNG carriers will tether alongside the FSRU for around 24–36 hours while they transfer their LNG cargo, still under atmospheric pressure, into the cargo holds of the FSRU. Once the transfer is completed the LNG carriers will leave the port subject to suitable navigational conditions.

The FSRU has four key functional elements: facilities to receive LNG from LNG carriers; facilities to store LNG; facilities to convert LNG to high pressure gas; and connection to the gas pipeline.

Purpose built flexible hoses will be used to transfer LNG from visiting LNG carriers to the FSRU. It is expected that the FSRU itself will have six hoses, which include four for receiving LNG and two for maintaining a balance of vapour gas between ships.

Cargo tanks to store the LNG in the FSRU are purpose built. The vessel is double-hulled enabling both a primary and secondary barrier to exist, further supported by insulation and intervening spaces. These cargo tanks are designed to achieve two outcomes:

- to insulate and contain LNG cargo at cryogenic temperatures (approximately minus 161 degrees Celsius); and
- to prevent leakages and isolate the cargo from the hull structure.

Boil-off gas (BOG) management facilities are also in place to capture small amounts of natural gas that is generated from LNG in the storage tanks. This BOG is used to fuel the on-board generators for the operation of pumps and other equipment used on-board.

The regasification unit located on board the FSRU is typically located toward the bow or centre of the vessel. The regasification module contains all necessary pumps, motors, heat exchangers, instrumentation, control and emergency shutdown systems to ensure the operation of the unit can occur. The regasification unit involves LNG being pumped up from the cargo tanks into a suction drum. The LNG is then pumped through a series of heat exchanges, which utilise seawater as a source of natural heat differential to warm up the LNG. Once in a gaseous form, the gas is exported, under pressure, through the marine loading arms into the gas pipeline.

The operations of the FSRU and the LNG carriers are discussed further in Section 5.5. The general arrangement plan for an example FSRU is included in Appendix A.

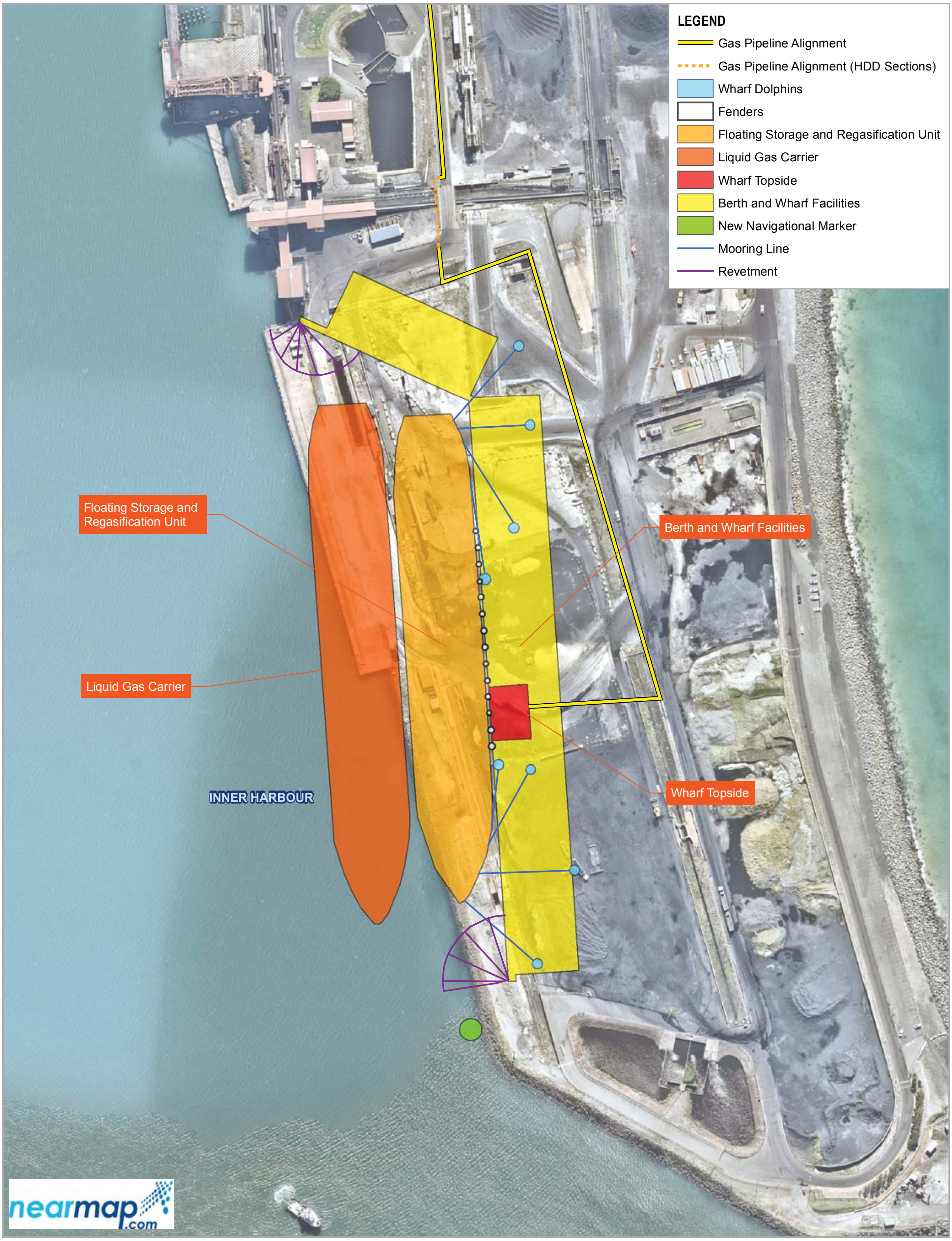
5.3.2 Berth and wharf facilities

Berth and wharf facilities are proposed to be situated at Berth 101 within the Inner Harbour of Port Kembla. The berth and wharf facilities will incorporate a quay wall configuration to provide the necessary space for the FSRU and LNG carriers to be configured side-by-side without limiting the existing navigability of the Inner Harbour. Excavation and dredging will be required in order to establish the berth and wharf facilities to support such a configuration and is discussed in further detail in Section 5.4.

A range of topside facilities will be established at the wharf. These facilities will include mooring infrastructure for the FSRU, gas transfer infrastructure including offloading arms, and gas pipeline tie-in and maintenance infrastructure.

A range of ancillary facilities will also be situated at the wharf including access roads, fencing and other security, lighting, telecommunications, electricity, water, sewerage and other utilities.

An indicative site layout is included in Appendix A.



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Berth and Wharf Facilities

Figure 5-2

G:\21\27477\GIS\Maps\Deliverables\EIS\21_27477_EIS_Z002_Berth_and_Wharf_Facilities.mxd

Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

5.3.3 Gas pipeline

A short gas pipeline would connect the FSRU to the a tie-in point at Cringila, which in turn is connected to the Eastern Gas Pipeline (EGP). The gas pipeline would be a DN450 carbon steel pipeline about 45 centimetres (18 inches) in diameter and about 6.3 kilometres in length. The gas pipeline would be designed to comply with all current environmental and safety requirements including those required under Australian Standard (AS) 2885. The tie-in point would either be at the existing metering station at Cringila or a similar facility that could be established nearby along the existing EGP spur line. A custody transfer meter will measure gas transferred from the project into the gas network. This will either be installed at the tie in point for the project or alternatively at a location on the existing Jemena network. The pipeline would be operated and maintained in line with relevant standards and guidelines including AS 2885.3.

The route of the gas pipeline is shown in Figure 5-3. The alignment of the gas pipeline is the result of a detailed options and alternatives development process as described in Chapter 4. The alignment has been selected to minimise disruption to public access, port operations and avoid areas of environmental and cultural sensitivity. Directional drilling has also been adopted for key road, rail and waterway crossings and to avoid previously undisturbed areas of biodiversity and heritage value. The drilling methodology is discussed in further detail in Section 5.4

As shown, the gas pipeline would follow a route about 6.3 kilometres in length from Berth 101 to the north along the road verge of Road No 1 within the Port Kembla Coal Terminal. It would then turn west along the road verge of Tom Thumb Road, including a horizontal directional drill beneath Gurungaty Waterway. It would continue along the road verge of Tom Thumb Road to the north and west, generally following the boundary of the existing car storage facilities and BlueScope facilities, including a horizontal directional drill beneath the crossings of Tom Thumb Road, the Pacific National railway and BlueScope’s Northgate access. It would then continue east including a horizontal directional drill beneath the crossing of NSW RailCorp’s South Coast Line and Springhill Road and the intervening vegetated area. It would then follow the road verge of Springhill Road south including a horizontal directional drill beneath Allans Creek. It would then tie in to Jemena’s assets connected to the EGP.

The project application area for the purpose of the EIS includes a 20 metre corridor (10 metres either side of the pipeline centre line) where there are no limitations such as road, rail, power lines or other constraints. The disturbance footprint will be limited in key locations to minimise disturbance to adjoining areas with biodiversity or archaeological sensitivity and adjoining land uses. A maximum of 16 metre corridor as been considered for section of pipeline running through native vegetation west of Springhill Road and the corridor will be narrowed in small sections to avoid swamp or constructed wetland habitat. The construction right of way will allow for temporary working areas and micro-siting within the proposed corridor. The final easement width for the pipeline (outside of the road reserve areas) will be 6 metres (3 metres either side of the pipeline centre line).

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Gas Pipeline

Figure 5-3

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

Australian Industrial Energy
Port Kembla Gas Terminal

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Date **02 Nov 2018**

Gas Pipeline

Figure 5-3

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

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Gas Pipeline

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Figure 5-3

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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Australian Industrial Energy
Port Kembla Gas Terminal

Project No. 21-27477
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Date 02 Nov 2018

Gas Pipeline

Figure 5-3

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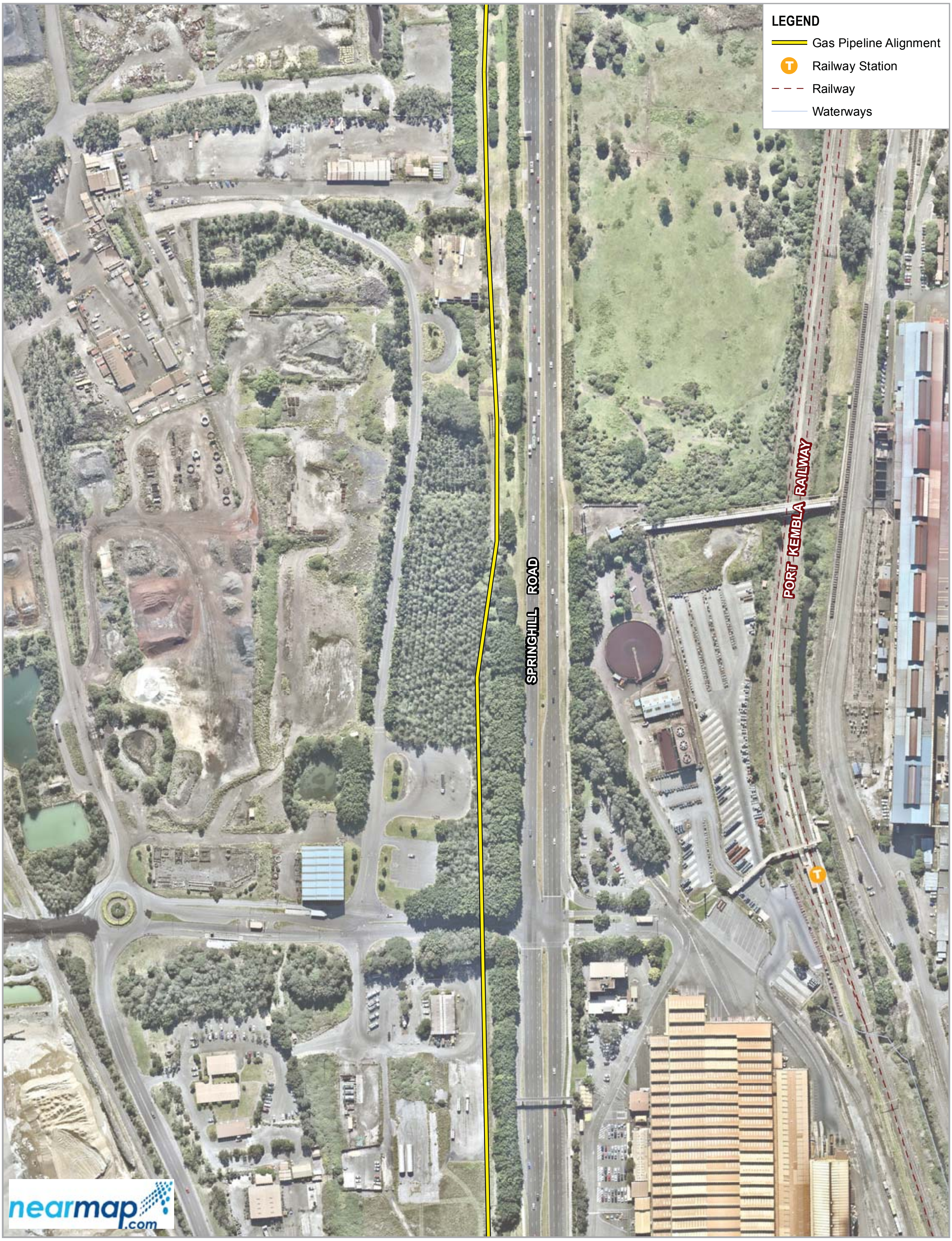
Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy



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Map Projection: Transverse Mercator
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Gas Pipeline

Figure 5-3

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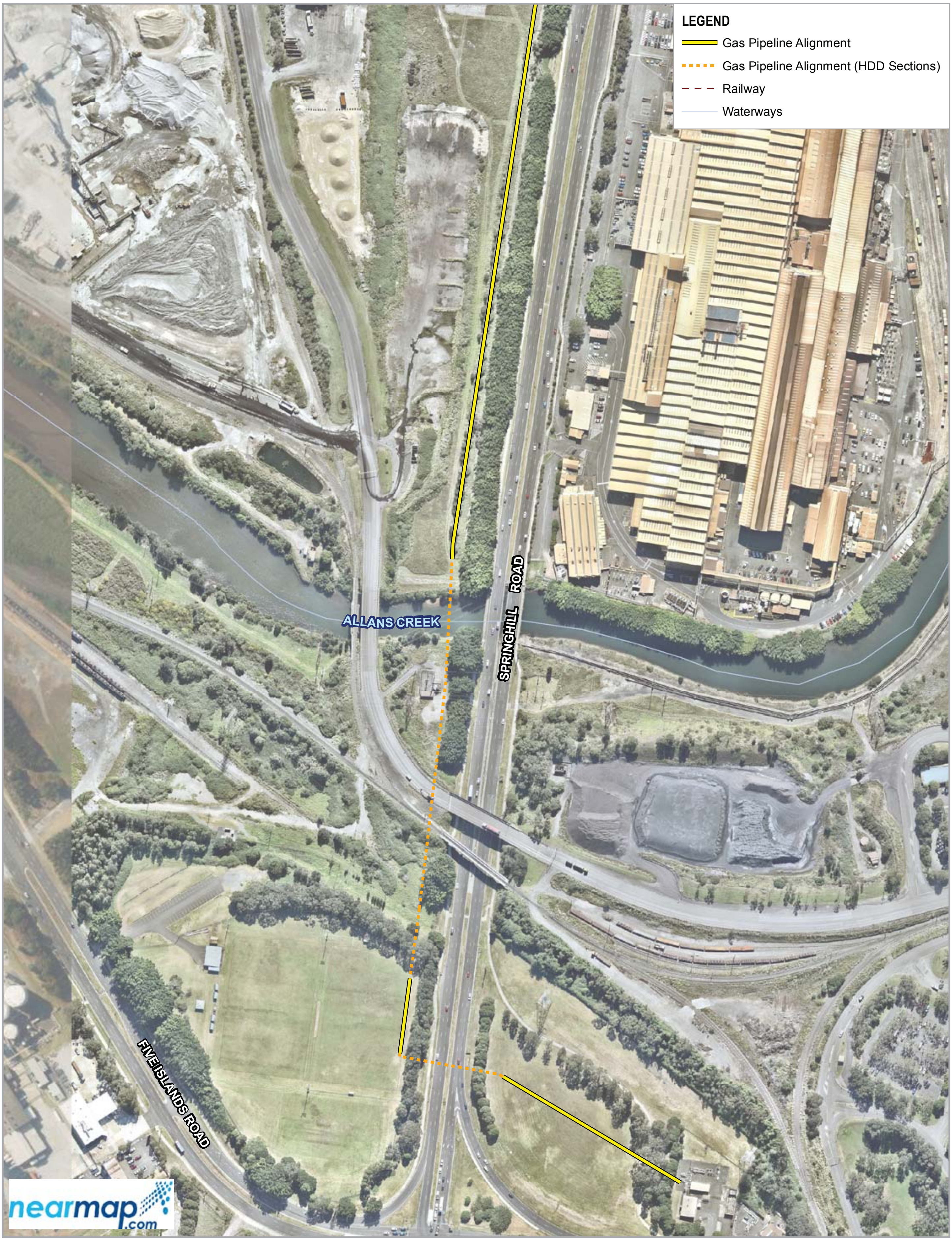
Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy



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Gas Pipeline

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Figure 5-3

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

5.4 Construction

5.4.1 Overview

The project is scheduled for construction during 2019 subject to CSSI approval. Construction of the berth and wharf facilities including required excavation, dredging and disposal is expected to take about 10–12 months. Construction of the pipeline is expected to take about 6 months.

Construction is proposed to be carried out continuously 24 hours per day and 7 days per week for the duration of the construction program. Construction is planned for completion by 2020.

5.4.1 Construction workforce

At the peak of the construction program the project is expected to employ a construction workforce of about 125–150. An indication of the split of the workforce is provided in Table 5-1.

The construction workforce would generally work on 10 or 12 hour shifts. Changeover of the construction workforce would generally occur at the start of a morning shift at around 7 am, an evening shift at around 5 pm or a night shift at around 7 pm. Changeover of the workforce that would be conducting dredging would generally occur at 6 am and 6 pm or 12 am and 12 pm.

Table 5-1 Construction workforce

Construction sites	Workers
Berth and wharf facilities	76
Disposal area	37
Gas pipeline	37

5.4.2 Construction equipment

Indicative equipment required for construction is shown in Table 5-2.

Table 5-2 Indicative equipment

Activity	Equipment	Quantity
Demolition	Excavator	9
	Barge with crane/excavator	1
	Loader	2
	Dump truck (50 t)	4
	Truck and trailer	4
Construction	Piling rig	4
	Pile driving hammer	4
	Vibro-hammer	3
	Crane (150–300 t)	5
	Crane (30–150 t)	6
	Drilling machine (90 t)	3
	Concrete pump	2
	Truck and jinker	2
	Telehandler	2
Dredging	Backhoe dredger	1
	Survey crew/boat	1
	Tug boat (1200 HP)	2

Activity	Equipment	Quantity
	Tug boat (600 HP)	1
	Barge	2
Excavation	Long reach excavator	1
	Loader	1
	Dozer	1
	Excavator	3
	Haul truck (32 t)	10
Disposal	Long reach excavator	1
	Loader	1
	Dozer	1
	Dump truck (50 t)	2

5.4.3 Construction materials

Construction of the project would involve the use of a range of materials. These would include building materials for the construction of berth and wharf facilities and gas pipeline. Building materials would include materials such as piles, concrete and pipeline lengths.

Construction of the project would also involve the use of excavated and dredged materials as discussed in Section 5.4.7.

Construction of the project would involve the use of construction water for dust suppression when required. Water for dust suppression will primarily be sourced from stormwater run-off collected in existing stormwater ponds at the southern end of the Berth 101 area or tertiary treated water from the coal terminal.

Construction of the project would also involve the use of potable water for the construction workforce. The demand for potable water is expected to be about 100 litres per day per person. This would total up to 15,000 litres per day at the peak of the construction program.

It is expected the demand for potable water would in part be serviced by existing coal terminal infrastructure.

Construction of the project would involve the use of fuel for the equipment in Section 5.4.2. The estimate volume of fuel required is described and assessed in Chapter 22.

5.4.4 Construction traffic

At the peak of the construction program the project is predicted to generate light and heavy vehicle movements. The light vehicle movements would reflect travel to the site of the maximum construction workforce plus a nominal number of additional light vehicle movements to support construction. The heavy vehicle movements would be primarily due to the transport of excavated and dredged material from the berth and wharf facilities to the disposal area (where not practical to be transported by barge) plus a nominal number of additional heavy vehicle movements for general deliveries of materials to support construction.

The light vehicle movements would typically occur at the start and end of each shift at the construction sites and are expected to involve travel between Port Kembla and the places of residence of the construction workforce. While the exact routes followed by the workforce are not known it is expected most would access Port Kembla from roads including Princes Highway, Masters Road, Springhill Road, Port Kembla Road, Five Islands Road and Flinders Street.

Heavy vehicle movements will mainly occur between the berth and wharf facilities and the disposal area along Port Kembla Road, Springhill Road, Five Islands Road, Flinders Street and Old Port Road. Other heavy vehicle movements for general deliveries are expected to follow similar routes to the light vehicles to and from Port Kembla from Princes Highway.

The light and heavy vehicle movements during construction, including during peak periods, are quantified and assessed in the traffic assessment in Chapter 16.

It is expected that construction traffic would utilise existing parking at Port Kembla in the vicinity of Berth 101. Additional parking is not anticipated to be required to support construction. Construction traffic and access is described in further detail in Chapter 16.

Construction of the project would also involve some marine traffic for excavation, dredging and reclamation. This would be limited to movements of a small number of vessels including a backhoe dredger, barges and tug boats between the Inner Harbour and Outer Harbour. The vessels would be required to comply with the port navigation protocols in place at Port Kembla as described in Chapter 9.

5.4.5 Floating storage and regasification unit

The FSRU would be procured from Höegh LNG as an established global supplier. The project currently has an exclusivity agreement on two vessels pending final selection. Both vessels are purpose-built FSRUs (as opposed to retro-fitted LNG carriers). One is four years old on active service and the other is currently being built. Construction of the FSRU is under the operational control of the supplier and would occur outside of Australia. Therefore, the construction of the FSRU is not covered in this environmental impact assessment. FSRUs are designed to comply with comprehensive international safety regulations and standards and these would be a condition of the procurement process. Indicative drawings of the FSRU are in Appendix A.

5.4.6 Berth and wharf facilities

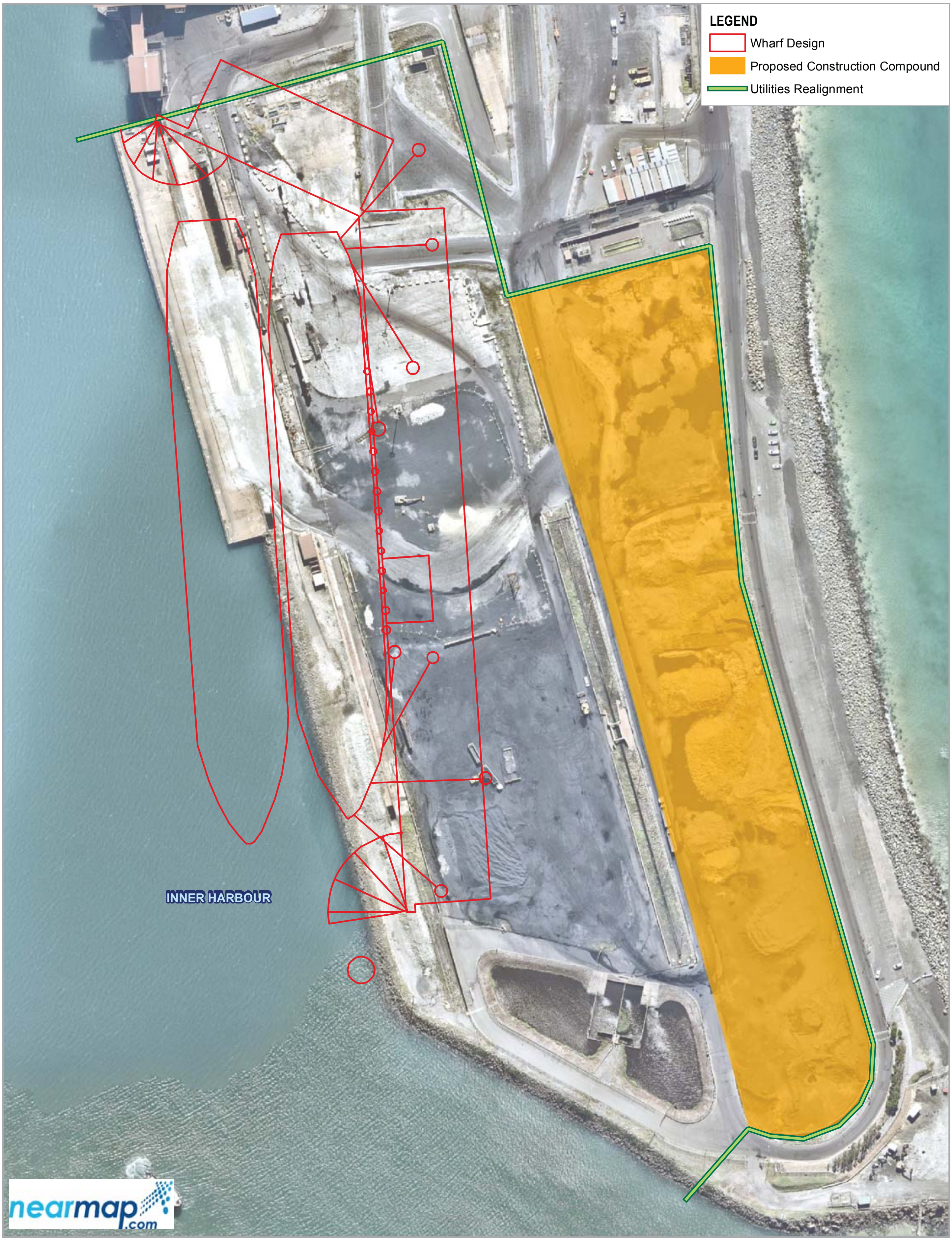
Construction of new berth and wharf facilities would involve establishment of a temporary construction compound, demolition of existing wharf facilities, and building of quay wall and topside facilities. In addition, a number of existing utilities used by neighbouring tenants and/or the project will need to be realigned and reconnected prior to major construction disturbance. It is understood that the following utilities would need to be realigned and reconnected:

- Bunker oil pipeline
- Domestic water pipeline
- Electricity supply
- Communications

The temporary construction compound would be established adjacent to the berth and wharf facilities at the start of construction as shown on Figure 5-4. The temporary construction compound would include site offices, storage sheds, hardstand areas and stockpile areas and would be fully bunded.

The expected construction sequence for the demolition of existing wharf facilities and building of quay wall and topside facilities is shown in Figure 5-5. Demolition of existing wharf facilities would include removal of existing structures, services and support structures. Installation of the quay wall would include the installation of piles and tie rods, placement of fill and pavement to complete the wharf surface.

As shown in Figure 5-5, demolition of existing wharf facilities and building of quay wall and topside facilities would involve significant excavation and dredging which is described in Section 5.4.7.



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Temporary Construction Compound

Figure 5-4

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

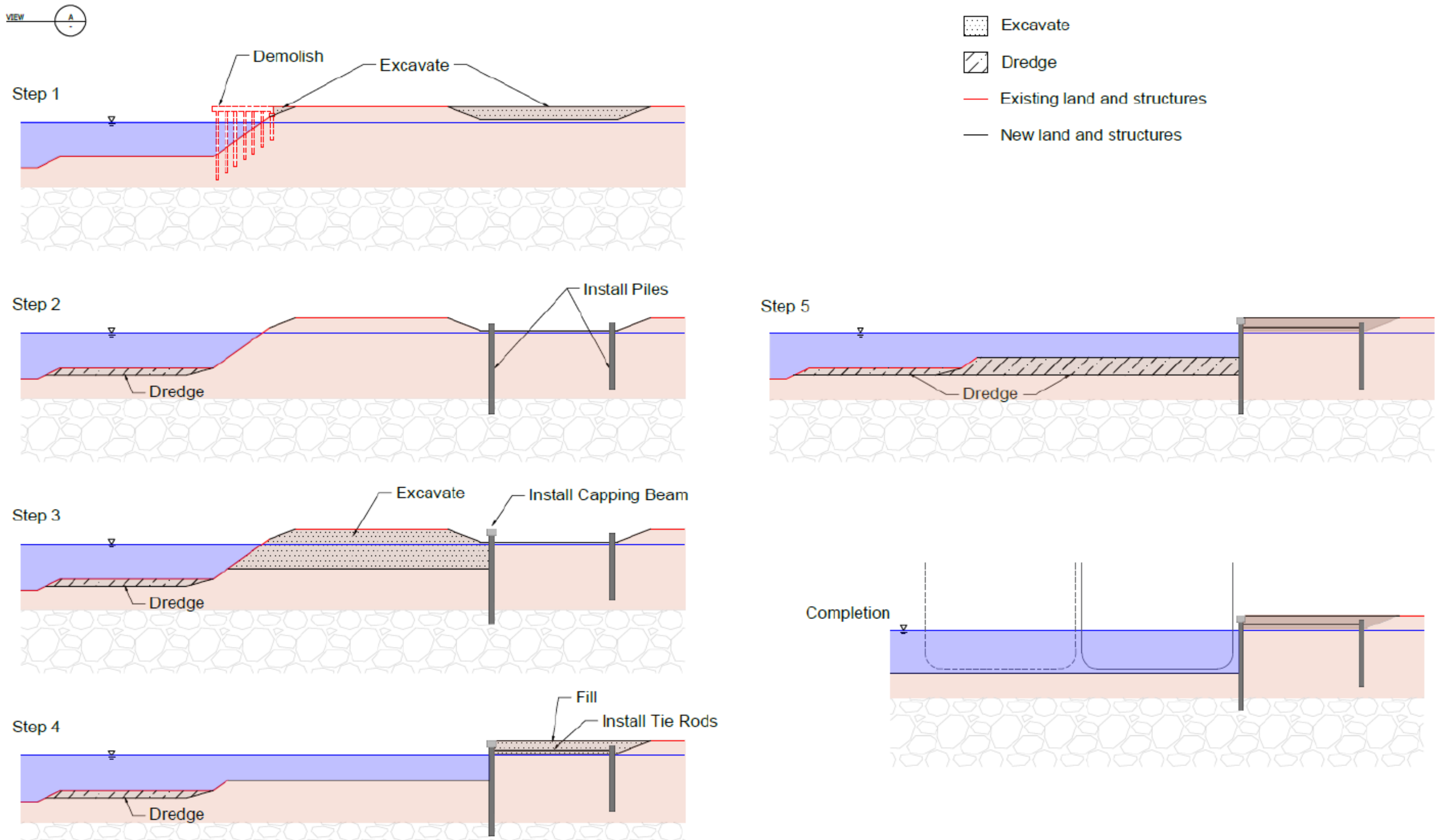


Figure 5-5 Indicative wharf and berth construction sequence

5.4.7 Excavation and dredging

It is estimated that about 600,000 cubic metres of material would be excavated and dredged for the construction of berth and wharf facilities. Allowing for typical bulking factors, this volume would equate to about 720,000 cubic metres. The excavation and dredging would occur over an area of about 8 hectares including parts of the existing berth and wharf as shown in Figure 5-6.

Excavation and dredging would be carried out by long reach excavator and backhoe dredger. The long reach excavator would be situated on land and would primarily be used to excavate the existing berth and revetment. Material excavated by the long reach excavator would be put in haul trucks and transported a short distance to a stockpile at Berth 101. The stockpile would be formed by dozers and prepared for transportation to the Outer Harbour for disposal.

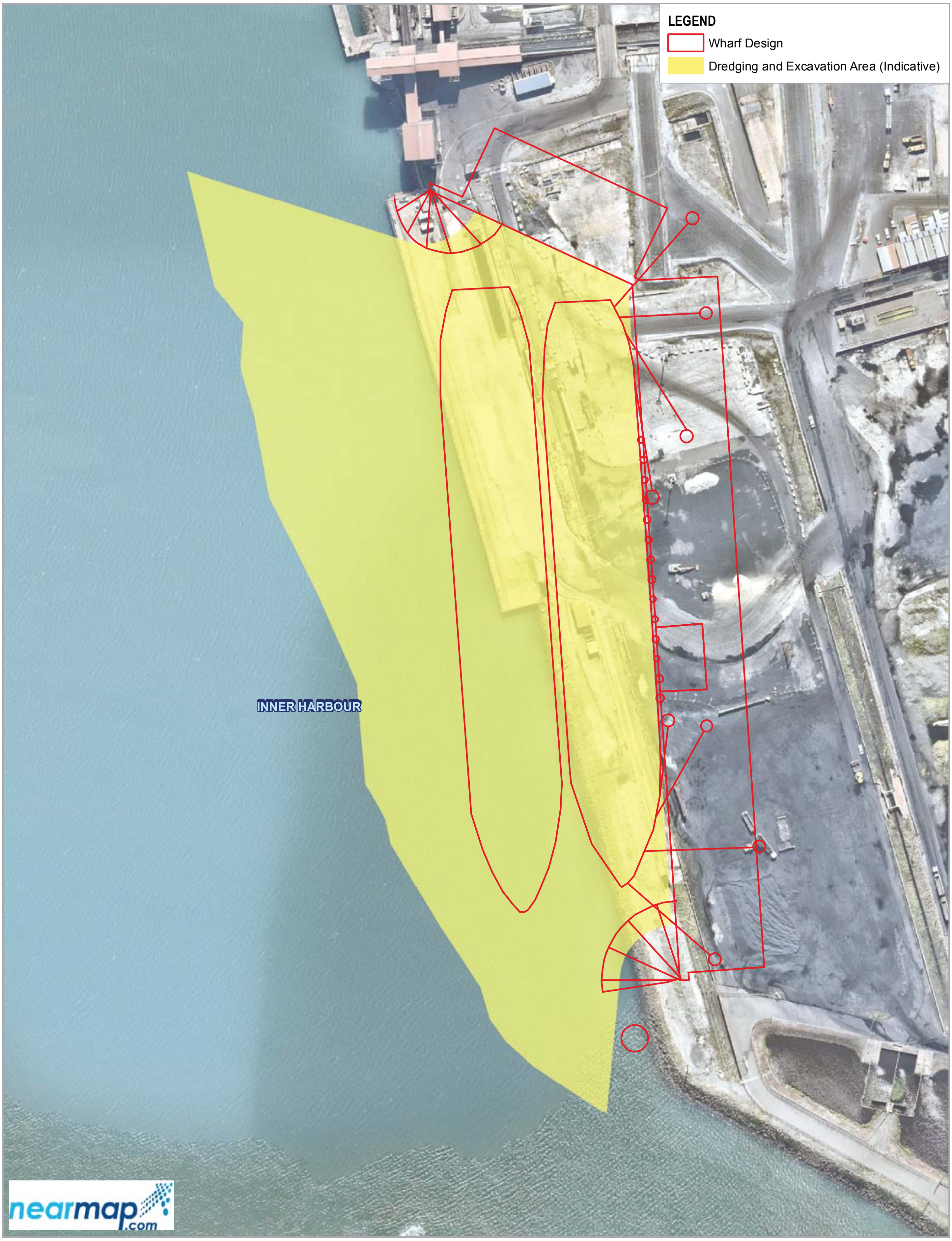
The backhoe dredger would be situated in the Inner Harbour adjacent to Berth 101 and would primarily be used to excavate the deeper sediments at Berth 101. Material dredged by the backhoe dredger would be put in barges for transport to the Outer Harbour for disposal.

The volume of material to be excavated by long reach excavator and transported by haul truck versus the volume of material to be dredged by backhoe dredger and transported by barge may vary depending on the preference and capacity of the construction contractor.

It is expected that about 370,000 cubic metres could be excavated by a typical long reach excavator and transported by truck. That volume could be increased to 620,000 cubic metres in the event that a long reach excavator with an extended reach and depth is procured.

It is expected that about 350,000 cubic metres of material could be dredged by backhoe dredger and transported by barge. That volume could be increased to 720,000 cubic metres if the barges were unloaded by excavators at a temporary berth at the reclamation area.

Actual volumes may comprise any combination of the above methodologies totalling about 720,000 cubic metres. The maximum potential volume of 720,000 cubic metres has been adopted for each methodology for the purpose of worst case impact assessment.



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Excavation and Dredging

Figure 5-6

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

5.4.8 Disposal

It is planned that the 720,000 cubic metres of material that would be excavated and dredged for the construction of berth and wharf facilities would be deposited at a disposal area in the Outer Harbour. The disposal area would cover about 17 hectares as shown in Figure 5-7. Material may be temporarily stockpiled on land adjacent to the disposal area prior to placement.

The deposition will comprise emerged and submerged disposal. Prior to any emerged disposal a stabilising bund would be constructed along the perimeter of the emerged disposal area. The stabilising bund would be constructed from the granular and sandy material excavated and dredged from the Berth 101 site. Sandstone material already stockpiled in the Outer Harbour lands on Foreshore Road may also be used as appropriate for bund construction.

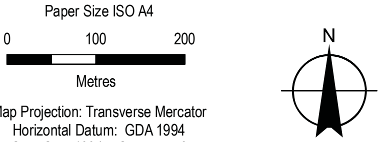
The disposal area contains sediments previously deposited from dredging at Berth 103. About 70,000 cubic metres of the sediments would need to be dredged along the perimeter and redeposited further within the disposal area to support construction of the stabilising bund.

Once the stabilising bund is completed the material that would be excavated and dredged for construction of berth and wharf facilities would be deposited within the bund. The material would be deposited in an order such that potentially contaminated material would be dumped well within the bund and sealed over with lower risk material.

Potential acid sulphate forming material would be dumped below mean low water to ensure the material remains moist. Some disposal areas may not emerge above sea level. Any such areas will be filled to a level of around 3 m below Port Kembla height datum. Prior to disposal of any dredged soft sediments in these areas a low containment bund will be constructed to prevent the sediments form spreading across the harbour floor. Soft sediments will not be placed above 4 metres below Port Kembla height datum to prevent re-dispersion.

The disposal area is mostly within an area marked for future development of the Outer Harbour by NSW Ports in its 30 Year Master Plan (NSW Ports 2015). The consistency of the disposal area and other approvals is discussed further in Chapter 6.

A portion of the dredged material may be utilised for the establishment of a landscaped embankment on the eastern side of the project application area to separate the project facilities from Sea Wall Road. The landscaped embankment of up to four metres in height would create a visual barrier to publicly accessible areas and require about 70,000 cubic metres of soil material. The majority of dredged and excavated material is therefore still proposed to be disposed of within the Outer Harbour disposal area.



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Disposal area

Figure 5-7

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

5.4.9 Gas pipeline

The gas pipeline would be constructed progressively by a combination of trenching and horizontal directional drilling. A temporary right of way would be established along the length of the pipeline route to provide space for vehicles and stockpiles of topsoil, subsoil and vegetation. Temporary construction compounds may also established intermittently adjacent to the right of way for the laydown of segments of gas pipeline and other construction materials as necessary.

The gas pipeline temporary right of way and construction compounds would be situated to avoid the known constraints of existing facilities, roads and waterways in the area. The right of way would also allow for micro siting of the gas pipeline to minimise impacts such as clearing.

Trenches would be progressively excavated to a depth of between about 1 and 1.5 metres for the length of the gas pipeline route except where horizontal directional drilling would be employed. Trenches would be progressively backfilled with bedding material, subsoil and then topsoil. The backfilled areas would be progressively restored to their pre-existing landform or land use.

As identified in Section 5.3.3, horizontal directional drilling would be employed instead of trenching to avoid impacts to some surface features such as road, rail and waterways. Initially horizontal directional drilling would require the excavation of launch and receive pits at either end of the horizontal directional drill. A horizontal directional drilling rig would then be employed to drill a conduit between the launch and receive pits. The conduit would be drilled by progressively adding drilling head lengths at the drilling rig for the length of the horizontal directional drill.

Sections of the gas pipeline for horizontal directional drilling are shown in Figure 5-3.

5.5 Operation

5.5.1 Overview

Operation of the project is planned to commence in 2020. Once operational the project would operate 24 hours per day and 7 days per week supplying up to 100 petajoules of gas each year.

5.5.2 Operational workforce

The project is expected to employ an operational workforce of about 40–50 personnel. About 20–25 of the operational workforce would be on board the FSRU. The remaining workforce would be situated at the berth and wharf facilities or other operational tasks.

5.5.3 Operational traffic

Operational traffic on the road network would be limited to light vehicle movements associated with the operational workforce. Accommodation is available on the FSRU and is anticipated to be used by a portion of the workforce with the remainder travelling between Port Kembla and their places of residence. The workforce would utilise car parking facilities at Berth 101.

It is expected that a LNG carrier would arrive at the FSRU once every two to three weeks dependent upon operational demand. The LNG carrier would typically remain at the berth for around 24 to 36 hours to allow transfer of gas to the FSRU prior to departing. During arrival and departure the LNG carriers would be accompanied by pilot tug boats. The LNG carriers are expected to be able to travel to and from the FSRU within the existing marine traffic and access arrangements at Port Kembla, with some minor changes to operating practices for the duration a LNG carrier is present. LNG carriers and other vessels associated with the project will be required to comply with the port navigation protocols in place at Port Kembla. The interaction of the LNG carriers and existing marine traffic and access arrangements is considered in detail in Chapter 9.

Delivery trucks carrying supplies to the FSRU would include delivery of potable water, lubricant and consumables for the workforce. While the main source of fuel for the FSRU is expected to come from boil-off gas some delivery of fuel is also expected to be required. These delivery trucks would visit the FSRU relatively infrequently, in the order of 1–5 of trips per month and would not represent a significant increase to road traffic to and from Port Kembla.

Trucks transporting waste from the FSRU would include collection of waste streams such as grey water, sewage and bilge water, recyclable plastics, metals, cardboard and paper, and other general waste streams. Trucks transporting waste would also visit the FSRU relatively infrequently, in the order of 1–5 of trips per month. It should be noted that the technical processes on-board do not produce waste streams as such. Waste is mainly generated by packaging, food, consumables and maintenance work. Waste is assessed in further detail in Chapter 21.

It is also possible that from time to time the workforce on board an LNG carrier may change over or require deliveries of supplies or transport of waste to and from Port Kembla.

5.5.4 Floating storage and regasification unit

During operation LNG carriers operated by external suppliers will regularly visit Port Kembla with LNG shipments. They will pull alongside the FSRU, tether to the FSRU and then transfer their load to the FSRU. While the capacity of LNG carriers can vary, it is most likely that the LNG supplier to the project will seek to match the LNG carrier capacity to the FSRU capacity as closely as possible, in order to ensure a full transfer of cargo. As such, the LNG carriers are most likely to have a capacity of around 170,000 cubic metres. With a total annual capacity of around 100 PJs per annum, this would typically equate to about 24 LNG carriers per annum. Figure 5-8 is an indicative illustration of a LNG carrier tethered to a FSRU in side-by-side configuration.

Figure 5-8 LNG carrier and FSRU

The LNG within the LNG carriers will be in liquid form at very low temperatures in the order of minus 161 degrees Celcius. At very low temperatures the gas shrinks to about one six hundredth of its normal size. The LNG would need to be warmed back to normal temperatures (in the order of 5 degrees Celcius) on board the FSRU to become gas again and be able to be transported through the gas pipeline.

LNG will be transferred from a LNG carrier to the FSRU through purpose built cryogenic flexible hoses. As the FSRU will have a capacity of up to 170,000 cubic metres, at the nominal gas transfer rate a full load of LNG would be transferred from the LNG carrier to the FSRU over a duration of typically around 24–36 hours.

The LNG is then stored in purpose-built storage tanks on board the FSRU until needed. A small fraction of the gas in the order of 0.15% per day would evaporate and be captured in a boil-off gas management facility on board. The boil-off gas would be used as a source of fuel on board or would be reliquefied and sent back to the storage tanks.

The LNG would be pumped from the storage tanks to a regasification unit that brings the LNG to a temperature of about 5 degrees at which point it would revert to a gaseous state. The gas would then be transferred through offloading arms from the FSRU to the gas pipeline tie-in facilities as discussed in Section 5.5.5.

A process flow diagram of the FSRU including the loading hoses and marine offloading arms, storage tanks, boil-off gas management facility and regasification unit is shown as Figure 5-9.

The FSRU will use seawater from the Inner Harbour at various times during the regasification process, as well as for a number of other purposes including engine cooling, ballast and fire-fighting, similar to any ocean-going vessel visiting the port. However, the use of seawater for the purpose of a water curtain during transfer of LNG from the LNG carrier to the FSRU, and for heat exchange purposes during regasification is unique to an FSRU.

It is expected that about 9.5 megalitres of seawater per hour would be used in the regasification system during its operation while about 2.4 megalitres of seawater per hour would be used for cooling of engines and other machinery. During offloading of gas it is expected that about 5.2 megalitres of seawater per hour would be used for ballast systems and about 0.16 megalitres of seawater per hour would be used for a water curtain.

Seawater used for these purposes is usually re-released into the ocean. However, before releasing water back into the ocean, vessels must comply with both international and national regulations on the treatment of seawater.

The findings of studies undertaken as part of the EIS indicate the release of seawater back into the Inner Harbour is not expected to have a significant impact on water quality or biodiversity. The release of seawater back into the Inner Harbour is assessed in further detail in Chapter 12.

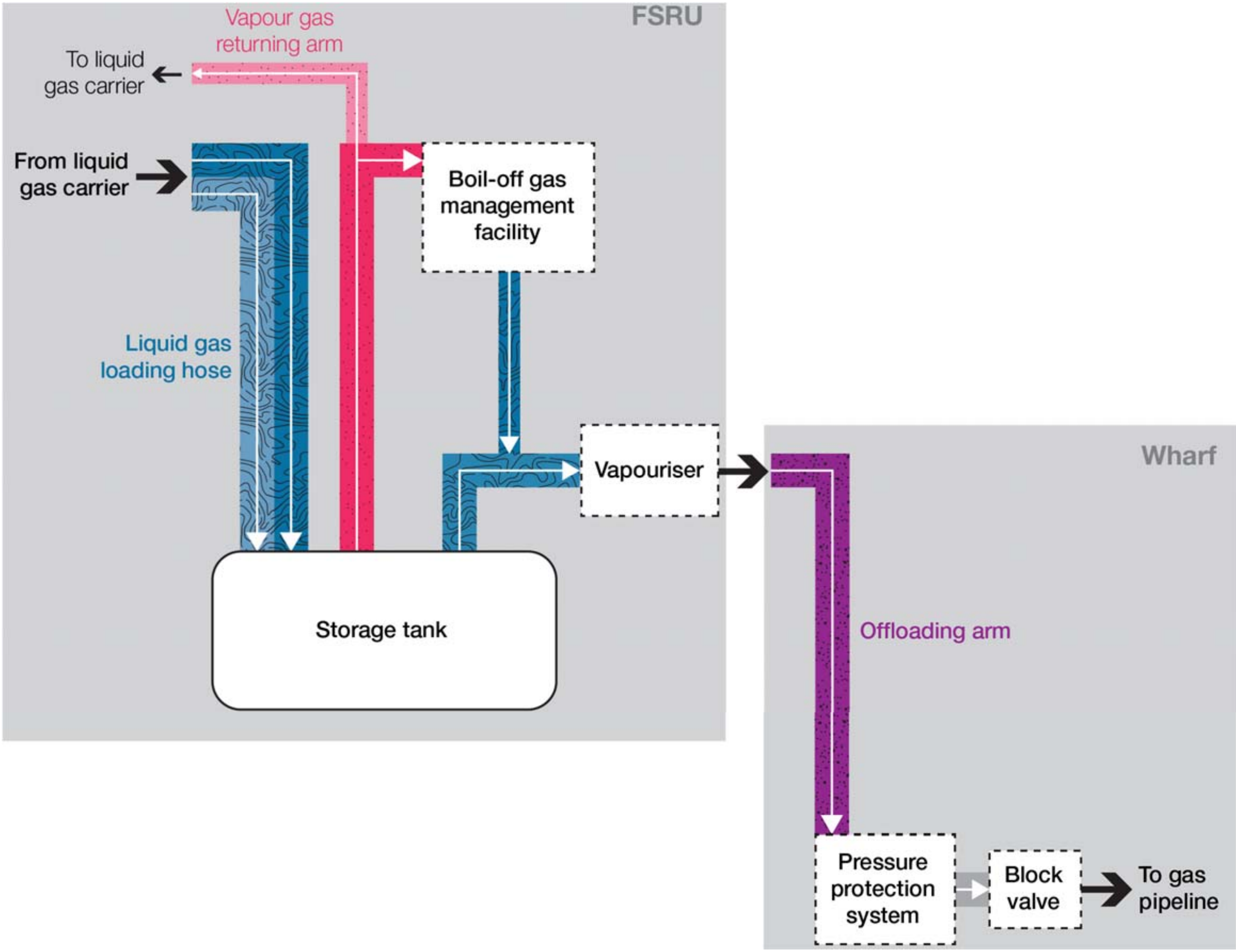


Figure 5-9 Process flow diagram

5.5.5 Berth and wharf facilities

During operation the berth and wharf facilities would mainly function to receive pressured gas from the FSRU through an offloading arm that would connect to the gas pipeline tie-in facilities and flow through to the gas pipeline. A process flow diagram of the pipeline tie-in facilities at the berth and wharf facilities is shown in Figure 5-9.

5.5.6 Gas pipeline

The operation of the gas pipeline would involve the transport of gas from the berth and wharf facilities through the gas pipeline to Jemena's existing assets and from there to market. The existing EGP can transport about 300 terajoules per day.

During the operation of the gas pipeline the flow rate and pressure of gas would be continuously monitored by an automated system at the control room. The pipeline is expected to operate at a pressure consistent with the network operator requirements for the Eastern Gas Pipeline.

The gas pipeline would occupy an operational easement about 6 metres wide. During operation the gas pipeline would be routinely inspected and maintained as necessary for safe operation. The easement would be routinely maintained to manage issues that may arise such as vegetation, erosion and subsidence as well as any landholder issues.

5.6 Decommission

The project would be decommissioned at the end of the project life. The FSRU is an ocean going vessel, which can simply sail away from port at the completion of the project.

The activities involved in decommissioning would depend on the intended use of the land occupied by the project. It is expected the berth and wharf facilities would be retained for other port related uses. The gas pipeline would likely remain in situ subject to landholder agreements and either decommissioned completely or placed into care and maintenance arrangements.

A detailed decommissioning plan for the entire project, including the pipeline, would be developed in consultation with relevant stakeholders including NSW Ports at the end of the project life.

6. Statutory context

6.1 Introduction

This chapter sets out the key planning and environmental regulatory framework applicable to the project, including the identification of relevant environmental planning instruments and key development approval requirements. Both NSW and Commonwealth legislative requirements are identified.

6.2 Environmental Planning and Assessment Act 1979

6.2.1 Overview

The key legislation in NSW for regulation of the use of land is the Environmental Planning and Assessment Act 1979 (EP&A Act) and the Environmental Planning and Assessment Regulation 2000 (EP&A Regulation). The EP&A Act institutes a system for environmental planning and assessment, including approvals and environmental impact assessment requirements for proposed developments. The EP&A Act contains three key parts that impose requirements for planning approval. These include:

- Part 4, which provides for the assessment and approval of ‘development’ that requires development consent from the local council, a regional planning panel or the NSW government for development which is classed as State Significant Development (SSD).
- Part 5 (Division 5.1), which provides for the environmental assessment of ‘activities’ that do not require approval or development consent under Part 4.
- Part 5 (Division 5.2), which provides for control of State Significant Infrastructure (SSI) including critical SSI.

The need or otherwise for consent for a new development application is set out in environmental planning instruments as described below.

The project has been declared critical SSI in accordance with Section 5.13 of the EP&A Act. The Minister for Planning is the consent authority and the project is to be assessed in accordance with the provisions of Division 5.2 of the EP&A Act.

This EIS has been prepared to address the Secretary’s environmental assessment requirements (SEARs) issued under section 5.16 and the environmental assessment and consultation requirements under section 5.17 of the EP&A Act.

6.2.2 Environmental planning instruments

State Environmental Planning Policy (State and Regional Development) 2011

State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP) identifies development that is considered to be of state significance and includes provisions for SSD and SSI.

The SRD SEPP provides for the declaration of development to be critical SSI in accordance with the provisions of Section 5.13 of the EP&A Act. Critical SSI is development that is considered to be essential to the State for economic, environmental or social reasons.

The project has been declared as critical SSI and is listed in Schedule 5 of the SRD SEPP.

State Environmental Planning Policy (Three Ports)

State Environmental Planning Policy (Three Ports) 2013 (Three Ports SEPP) provides a consistent planning regime for the development and delivery of infrastructure on land in Port Botany, Port Kembla and the Port of Newcastle and includes the identification of certain development as SSD or SSI.

The project falls within the Port Kembla land application map under the Three Ports SEPP and the provisions of the policy therefore apply to the project. The import terminal is located on land zoned SP1 Special Activities and the gas transmission pipeline will span both SP1 Special Activities and IN3 Heavy Industrial zones. The project meets the definition of a port facility in accordance with the SEPP and is considered to be consistent with the land zonings.

The project is permissible with consent under the provisions of the Three Ports SEPP. The project would also meet the definition of SSD in accordance with Clause 27 of the Three Ports SEPP as it is located within the Port Kembla lease area, is permissible with consent, has a capital investment value of more than $100 million dollars and would otherwise be considered a designated development.

However, the project has been declared critical SSI in accordance with Clause 16 of the SRD SEPP as discussed above. The project will therefore be assessed in accordance with Division 5.2 of the EP&A Act and can be undertaken without the need for development consent under Part 4 of the EP&A Act.

State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP) aims to facilitate the effective delivery of infrastructure across NSW and allows for a range of developments to be permitted with and without consent.

Division 9 of the Infrastructure SEPP includes consent requirements for gas transmission or distribution and pipelines. Clause 53(1) states that development for the purpose of a pipeline may be carried out by any person without consent on any land if the pipeline is subject to a licence under the *Pipelines Act 1967* or a licence or authorisation under the *Gas Supply Act 1996*. The project will require a licence under the Pipelines Act and the proposed pipeline is therefore considered permissible without consent.

Division 13 of the Infrastructure SEPP applies to port, wharf or boating facilities, but it is noted that the provisions of this division do not apply to development on land that the Three Ports SEPP applies, with the exception of certain areas in the City of Newcastle. Division 13 is therefore not applicable to the project.

Division 15 of the Infrastructure SEPP applies to railways and includes provisions for development in or adjacent to rail corridors. Clause 86 relates to development that includes penetration of land within, below or above a rail corridor and includes the need for notification of the development to the rail authority. The project includes a gas pipeline that will traverse a rail corridor trigger and therefore will trigger the notification requirements. Extensive liaison with the rail authority has been undertaken as part of the pipeline design and easement acquisition process regarding the preferred pipeline alignment. The consent authority will require concurrence from the rail authority prior to giving a development consent.

State Environmental Planning Policy (Coastal Management) 2018

State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP) aims to promote an integrated and co-ordinated approach to land use planning in the coastal zone in a manner consistent with the objects of the *Coastal Management Act 2016*.

Clause 7 of the Coastal Management SEPP states the policy does not apply to land within the Port Kembla lease area within the meaning of the Three Ports SEPP. The project is partly within this area, including the proposed berth and wharf facilities and part of the gas pipeline. The coastal management principles and assessment considerations in Coastal Management SEPP have nonetheless been considered in the development of the project.

State Environmental Planning Policy No 33—Hazardous and Offensive Development

State and Environmental Planning Policy No 33 – Hazardous and Offensive Development (SEPP 33) requires the consent authority to consider particular matters in determining a development application for a project that is a potentially hazardous industry or potentially offensive industry. A number of government agencies have responsibility for regulating risks and hazards associated with the project including:

- the Australian Maritime Safety Authority (AMSA), which will exercise safety jurisdiction over “vessels” including the FSRU.
- SafeWork NSW, which has jurisdiction to ensure safe operations on the FSRU.
- The Port Authority, which has jurisdiction to regulate any activity which may pose a risk to safety or security within their port operations including fixed facilities and vessels.

The proponent acknowledges that it has a primary duty to ensure the safety of its operations and extensive hazard and risk assessments have been undertaken during the development of the project. A preliminary hazard analysis has been undertaken as part of the EIS and presented in Chapter 10 and Appendix D. The assessment includes the identification and assessment of potential hazards during the construction and operation of the project and concludes that there is a low level of of risk associated with the project.

State Environmental Planning Policy No 55—Remediation of Land

State Environmental Planning Policy No 55—Remediation of Land (SEPP 55) provides for a statewide planning approach to the remediation of contaminated land and aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment by:

(a) specifying when consent is required, and when it is not required, for a remediation work,

(b) by specifying certain considerations that are relevant in rezoning land and in determining development applications in general and development applications for consent to carry out a remediation work in particular,

(c) by requiring that a remediation work meet certain standards and notification requirements.

In determining a development application, a consent authority is required to consider if the land is contaminated and, if contamination is identified, whether the land suitable in its contaminated state for the purpose for which the development is proposed to be carried out and if any remediation is required to make the land suitable for that purpose.

Contamination investigations have been undertaken as part of the EIS to understand the extent of existing contamination and determine treatment and disposal options for management of sediments. Further details are provided in Chapter 11 and Appendix E of this EIS.

Wollongong Local Environmental Plan 2009

The *Wollongong Local Environmental Plan 2009* (Wollongong LEP) provides local environmental planning provisions within the designated land application area for the LEP in the Wollongong local government area. As Port Kembla is covered by the Three Ports SEPP it does not form part of the land falling under the provisions of the Wollongong LEP.

The proposed FSRU, berth and wharf infrastructure and majority of the gas transmission pipeline are located within the Three Ports SEPP land application area. A small section of gas pipeline traverses beneath the BlueScope sporting fields in Cringila, which are zoned RE2 Private Recreation under the Wollongong LEP. The pipeline is permitted without consent in accordance with provisions of the Infrastructure SEPP and the project will be assessed as a critical SSI in accordance with the SRD SEPP.

6.3 Other NSW legislation

6.3.1 Marine Safety Act 1998

The *Marine Safety Act 1998* (Marine Safety Act) aims to ensure the safe and responsible operation of vessels in ports and other waterways so as to protect the safety and amenity of other users of those waters and occupiers of adjoining land. The Marine Safety Act provides that the *Commonwealth Marine Safety (Domestic Commercial Vessel) National Law Act 2012* apply as a law of the state. Commonwealth legislation is discussed in 6.4.

Part 2 and Part 3 of the Marine Safety Act provide for the making of regulations with regard to the safe operation of vessels and assign powers to authorised officers to give directions. Part 4 provides for the granting and conditioning of marine safety licences for registering and operating vessels. Part 5 defines requirements for vessels including requirements for vessel registration. Part 6 defines requirements for pilotage including a requirement that pilotage is compulsory in ports defined as pilotage ports. Part 7 relates to the appointment and functions of harbour masters while Part 8 deals with compliance and investigation of marine safety matters.

Vessels operated as part of the project would be subject to the provisions of the Marine Safety Act including requirements to obtain marine safety licenses. Pilotage would also be compulsory under Part 7 of the Marine Safety Act as Port Kembla is defined as a pilotage port. Further details on safe navigation within Port Kembla is provided in Chapter 9.

6.3.2 Ports and Maritime Administration Act 1995

The *Ports and Maritime Administration Act 1995* (Ports and Maritime Act) regulates the operation of ports in NSW across a range of matters including commercial operation and port charges that apply, management of port infrastructure, port safety and the functions of port corporations as well as NSW Roads and Maritime Services in relation to port operations.

The Ports and Maritime Act provides broad powers to port operators to regulate activities that may pose a risk to the safety or security of the port including but not limited to the movement of vehicles and the loading/unloading of material.

NSW Ports is the port operator at Port Kembla.

6.3.3 Work Health and Safety Act 2011

The *Work Health and Safety Act 2011* (Work Health and Safety Act) provides for a nationally consistent framework to secure the health and safety of workers and workplaces. To this end it prescribes a range of health and safety duties for employers and employees including a general duty of care to ensure the health and safety of workers so far as is reasonably practicable. It provides that SafeWork NSW is the regulator for the purposes of the Work Health and Safety Act.

The Work Health and Safety Regulation 2017 establishes a regime for the determination and licensing of major hazard facilities. Major hazard facilities are determined by the presence of chemicals listed in Schedule 15 of the Regulation in a quantity exceeding a defined threshold.

Schedule 15 lists natural gas with a threshold quantity of 200 tonnes. The project would involve storage and processing of natural gas in excess of this quantity. Section 530 states a facility is not a major hazard facility if it is in a port operational area under the control of a port authority, however it also states port operational area does not include any long-term storage areas where dangerous goods are usually kept for more than 5 days. The project would involve storage of dangerous goods for more than 5 days and therefore trigger the major hazard facility provisions.

A licence for a major hazard facility would therefore be required under Part 9.7 of the Work Health and Safety Regulation 2017 subject to consultation with SafeWork NSW. The application for a licence for a major hazard facility would include a safety case as required under Part 9.3.

6.3.4 Protection of the Environment Operations Act 1997

The objectives of the *Protection of the Environment Operations Act 1997* (POEO Act) are to protect, restore and enhance the quality of the environment, in recognition of the need to maintain ecologically sustainable development.

The POEO Act provides for an integrated system of licensing and contains a core list of activities requiring an environment protection licence (EPL) from the NSW Environmental Protection Authority (NSW EPA). These activities are called ‘scheduled activities’ and are listed in Schedule 1 of the POEO Act.

Clause 19 of Schedule 1 defines extractive industries that are considered scheduled activities and includes water based extraction activities that involve the extraction, processing or storage of more than 30,000 tonnes per year of extractive materials. The project will involve excavation and dredging of around 600,000 cubic metres of extractive materials. Allowing for typical bulking factors, this volume would equate to about 720,000 cubic metres. The excavation and dredging will therefore constitute a scheduled activity requiring an EPL.

Clause 9 of Schedule 1 applies to chemical storage facilities and includes developments with capacity to store more than 200 tonnes of liquefied gases. The FSRU will be permanently moored at Berth 101 and will therefore likely constitute a scheduled activity requiring an EPL.

In accordance with Section 5.24 of the EP&A Act, an EPL cannot be refused if it is necessary for carrying out an approved SSI project and is consistent with the development consent.

The POEO Act also defines a number of matters in relation to waste management including the definition of waste, management and licensing requirements and waste related offences.

6.3.5 Waste Avoidance and Resource Recovery Act 2001

The *Waste Avoidance and Resource Recovery Act 2001* promotes waste reduction and better use of resources. It includes provisions for waste strategies and programs, and for industry actions to reduce waste, including extended producer responsibility schemes and container deposit schemes. The Act establishes a waste hierarchy for the management waste. In accordance with the hierarchy, waste should in the first instance be avoided through avoidance of unnecessary resource consumption. When waste is produced, options to recover the waste should be looked at including options for reuse, reprocessing, recycling and energy recovery. Waste should only be disposed of where other options have first been investigated.

6.3.6 Pipelines Act 1967

Sections 12 and 13 of the *Pipelines Act 1967* (Pipelines Act) outline the licensing application requirements for pipelines. Under Section 11 of the Pipelines Act, a licence is required to:

- commence, or continue, the construction of a pipeline;
- alter or reconstruct a pipeline; or
- operate a pipeline.

A licence under the Pipelines Act is required for the construction and operation of the proposed gas transmission pipeline. In accordance with Section 5.24 of the EP&A Act, an EPL cannot be refused if it is necessary for carrying out an approved SSI project and is consistent with the development consent.

6.3.7 Fisheries Management Act 1994

The objectives of the *Fisheries Management Act 1994* (FM Act) are to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations. Part 7 of the FM Act requires a permit for a number of activities, including those involving dredging and reclamation work and those involving harm to marine vegetation.

In accordance with Section 5.23 of the EP&A Act, a permit under section 201, 205 or 219 of the FM Act is not required for approved SSI.

The potential impacts associated with dredging and disposal of sediments upon fisheries and marine vegetation has been investigated as part of the EIS with further details in Chapter 13 and Appendix G of this EIS. There is not anticipated to be any significant detrimental impacts to fisheries resources as a result of the project.

6.3.8 Water Management Act 2000

The *Water Management Act 2000* (WM Act) is intended to ensure that freshwater water resources are conserved and properly managed for sustainable use benefitting present and future generations. It is also intended to provide a formal means for the protection and enhancement of the environmental qualities of waterways and their catchments.

Part 2 of the WM Act requires a licence for the "taking of water" from a water source. A licence entitles its holder to specified shares in the available water within a defined water management area or from a specified water source. It enables the licence holder to take water from the environment in accordance with specified rates and conditions under the terms of the licence.

Part 3 of the WM Act specifies approval requirements for water use, water management works approvals and activity approvals. There are two kinds of activity approvals including controlled activity approvals and aquifer interference approvals.

Controlled activity approvals confer a right for the holder to carry out a specified controlled activity on waterfront land which is defined as land within 40 metres of a river, lake, estuary or shoreline. An aquifer interference approval may be required for any works that involve:

a. the penetration of an aquifer;

b. the interference with water in an aquifer;

c. the obstruction of the flow of water in an aquifer;

d. the taking of water from an aquifer in the course of carrying out mining, or any other activity prescribed by the regulations;

e. the disposal of water from an aquifer as referred to in paragraph (d).

The project will involve excavation within 40 metres of the shoreline and has the potential to intercept water within an aquifer during excavation or directional drilling. However, the project is not anticipated to require major dewatering of water from a water source and is not expected to trigger the need for a water use approval, water management works approval or controlled activity approval under sections 89, 90 or 91 of the WM Act as these approvals are not required for SSI in accordance with Section 5.23 of the EP&A Act.

6.3.9 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) aims to conserve biodiversity at a bioregional and state scale and lists a number of threatened species, populations and ecological communities to be considered in deciding whether there is likely to be a significant impact on threatened biota, or their habitats.

The project would be unlikely to have a significant impact on any threatened species, populations or ecological communities listed under the BC Act. A biodiversity assessment report has been prepared in accordance with Section 7.9 of the BC Act as part of the EIS. The report is provided as Appendix H and summarised in Chapter 14.

6.3.10 Biosecurity Act 2015

The *Biosecurity Act 2015* (Biosecurity Act) specifies the duties of public and private landholders as to the control of priority weeds and biosecurity matters including terrestrial, aquatic and marine species. The Biosecurity Act defines prior weeds by local government area and assigns duties for their control. Part 3 of the Biosecurity Act provides that any person who deals with biosecurity matter and who knows, or ought reasonably to know, the biosecurity risk posed or likely to be posed by the biosecurity matter has a duty to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated or minimised. As such, if present, priority weeds located on the project site should be assessed and controlled.

6.3.11 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) is concerned with all aspects of heritage conservation ranging from basic protection against indiscriminate damage and demolition of buildings and sites, through to restoration and enhancement.

Heritage places and items of particular importance to the people of NSW are listed on the State Heritage Register. Approval under section 60 of the Heritage Act is required for any direct impacts on an item on the register. Approval from the NSW Heritage Council under section 139 of the Heritage Act is required prior to the activities likely to disturb a relic while section 140 of the Heritage Act provides for the application for a permit for excavation likely to disturb a relic.

The project is anticipated to have a low potential to impact upon any identified heritage item or relic protected under the Heritage Act. Approval under Part 4 or an excavation permit under section 139 of the Heritage Act is also not required for SSI. Further details of items of heritage significance in the locality are provided in Chapter 15 and Appendix J of the EIS.

6.3.12 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) provides for the protection of Aboriginal objects (sites, objects and cultural material) and Aboriginal places. Under the NPW Act, an Aboriginal object is defined as any deposit, object or material evidence relating to indigenous and non-European habitation, being habitation both prior to and concurrent with the occupation of that area by persons of European extraction, and includes Aboriginal remains.

An Aboriginal place is defined under the NPW Act as an area which has been declared by the Minister administering the Act as a place of special significance for Aboriginal culture. An Aboriginal place may or may not contain physical Aboriginal objects.

It is an offence under Section 86 of the NPW Act to harm or desecrate an object the person knows is an Aboriginal object. It is also a strict liability offence to harm an Aboriginal object or to harm or desecrate an Aboriginal place, whether knowingly or unknowingly.

Section 87 of the NPW Act provides a series of defences against the offences listed in Section 86 which includes if the harm was authorised by and conducted in accordance with the requirements of an Aboriginal Heritage Impact Permit (AHIP) under Section 90 of the NPW Act. It is noted that an AHIP permit under Section 90 of the NPW Act is not required for approved SSI in accordance with Section 5.23 of the EP&A Act.

The project footprint will be restricted to a highly disturbed industrial precinct primarily within reclaimed and industrial land at Port Kembla. The design of the project has been amended to avoid areas of archaeological potential as outlined in Chapter 15 and Appendix J.

6.3.13 Roads Act 1993

The *NSW Roads Act 1993* (the Roads Act) requires applicants to obtain consent from the relevant roads authority for the erection of a structure, or the carrying out of work in, on or over a public road, or the digging up or disturbance of the surface of a road.

The project will require installation of a pipeline to connect the LNG import terminal to a tie-in point at Cringila. The pipeline will likely be installed through a combination of traditional trenching methods and directional drilling within the Port Kembla industrial precinct. The pipeline will pass along the edge of a number of road verges and directional drilling will be adopted to minimise disruption to traffic for major road crossings.

A permit will be required under section 138 of the Roads Act for the works.

6.3.14 Marine Pollution Act 2012

The *Marine Pollution Act 2012* gives effect to the International Convention for the Prevention of Pollution from Ships (MARPOL) in NSW. In line with the objectives of the convention, the Act aims to prevent both accidental pollution and pollution from routine vessel operations.

The *Marine Pollution Act 2012* contains a number of offences in relation to pollution from vessels including discharge of oil or oil residues, noxious liquids substances, sewage, garbage and other forms of pollution. It sets requirements for vessels including to develop and implement pollution emergency plans, on-board garbage management plans, and to keep records of on-board oil, garbage and cargo. It provides that the Minister administering the Act may provide notices to vessel operators to prevent pollution or clean-up pollution where it occurs.

6.4 Commonwealth Legislation

6.4.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's central piece of environmental legislation that provides a legal framework to protect and manage environmental values considered to be of national environmental significance.

The EPBC Act requires approval from the Commonwealth Minister for the Environment and Resources for actions that are likely to have a significant impact on listed matters of national environmental significance (MNES).It is the responsibility of the applicant proposing to undertake an action to initially consider whether the proposal is likely to have a significant impact on any MNES. If the applicant considers there is potential for significant impacts upon any matters protected under the EPBC Act, then a referral is required to be submitted to the Minister for the Environment and Energy. Developments considered likely to result in significant impacts are defined as "controlled actions" and require assessment and approval.

Consideration of potential impacts upon listed threatened species and communities and any other MNES potentially impacted by the project has been undertaken as part of the EIS. No impacts have been identified that are considered likely to be significant and consequently a referral to the Commonwealth Minister for the Environment and Energy has not been made.

6.4.2 Environment Protection (Sea Dumping) Act 1981

The loading and dumping of waste at sea is regulated under the *Environment Protection (Sea Dumping) Act 1981* (the Sea Dumping Act). Permits are required for all sea dumping operations with Commonwealth waters. The project includes placement of up to 720,000 cubic metres of excavated and dredged material within the Outer Harbour of Port Kembla. The outer harbour has sufficient capacity to receive all dredged material generated by the project. The relationship of the project and approved Port Kembla Outer Harbour Development footprint is discussed in 2.4.2. There will be no requirement for disposal of material within Commonwealth waters and a sea dumping permit will therefore not be required.

6.4.3 Commonwealth Marine Safety (Domestic Commercial Vessel) National Law Act 2012

The *Commonwealth Marine Safety (Domestic Commercial Vessel) National Law Act 2012* creates a national cooperative scheme between the Commonwealth, States and Territories to provide a single framework for safe operation, design, construction and equipping of domestic commercial vessels. The provisions of the law are enacted in NSW through the *Marine Safety Act 1998* as discussed in Section 6.3.1. The law provides that the Australian Maritime Safety Authority established under the *Australian Maritime Safety Authority Act 1990* is the National Marine Safety Regulator. Its functions are defined in section 10 of the law and include developing national standards for marine safety and undertaking monitoring and enforcement.

7. Stakeholder consultation

7.1 Introduction

This chapter provides an overview of the stakeholder and community consultation activities undertaken prior to the lodgement of the project EIS. Also included are details of the activities proposed to continue during the assessment determination and ongoing development of the project:

The project will be the first of its kind in NSW and with no similar facility currently operating in Australia, an introduction to the concept of an LNG import terminal, the workings of the facility and the need for the project have been key focuses in community and stakeholder engagement.

A wide range of stakeholders have been identified and consultation activities have been undertaken, including more than 40 group or one on one briefings. A project website (www.ausindenergy.com) has been developed and provides comprehensive, clear and accessible information that is updated on a regular basis.

As well as the local Port Kembla and broader community of the Wollongong region, extensive engagement was also undertaken with a range of other interested key stakeholders, such as local commerce organisations, the Port Authority and local and state government.

Examples of various stakeholder engagement activities undertaken includes briefings to:

- Community Consultative Committees of Bluescope Steel, and Port Kembla Harbour Environment Group — 30 attendees
- Illawarra Business Chamber & Regional Advisory Council, i3net, Australian Industry Group, Port Kembla Chamber of Commerce and other local economic development bodies — 50 attendees (More numbers)
- Community Neighbourhood Forums 5 & 7 – 60 attendees
- Emergency service providers — 20 attendees (included site tour)
- Government agency representatives at Planning Focus Meeting and other briefing sessions — 25 attendees (included site tour)

In addition:

- An advertised, drop-in style Community Information Session was held in Wollongong CBD (30 attendees)
- A newsletter with information about the project and advising date of Community Information Session, was letterbox dropped to around 16, 000 (15,732 homes and small businesses) in Port Kembla and surrounding neighbourhoods.
- Key note addresses were given to the Australian Institute of Energy, at the Australian Domestic Gas Outlook 2018 and the AFR Energy Summit– 650+ attendees

The engagement activities provided an opportunity to inform stakeholders about the project and the Critical State Significant Infrastructure (CSSI) assessment process, and to answer questions and obtain feedback on additional benefits, concerns or challenges associated with the project.

The issues and opportunities identified during the consultation process have been considered by the project team in relation to the proposed scope and design of the project and have been used to inform the preparation of this EIS.

This chapter outlines the consultation and engagement activities in accordance with the Secretary's Environmental Assessment Requirements (SEARs) issued in accordance with Section 5.16 of the *EP&A Act.*

7.2 Approach and objectives for community consultation

7.2.1 Engagement objectives

The objectives of the communication and engagement activities are to:

- proactively and regularly engage with stakeholders to ensure they are appropriately consulted throughout the assessment and development process;
- inform and advise the community, with a particular focus on the Port Kembla, Wollongong and wider Illawarra region community, of the current activity and the next steps in the assessment process;
- engage with the community to communicate the benefits of the project and address any points of concern;
- encourage participation, provision of feedback and submission of comments through community consultation opportunities; and
- provide accessible, reliable and updated information about the project.

7.2.2 Communication and engagement strategy

An overarching Stakeholder Engagement Plan was developed to support and guide the communication and engagement activities, generate relevant stakeholder interest and assist in securing the required project consents and approvals throughout the development of the EIS.

The Stakeholder Engagement Plan outlined: roles and responsibilities, actions and deliverables, a complaints management process and recording and reporting processes. Two stakeholder groups were defined to assist with targeting activities to best meet their needs and the objectives of the project:

- Stakeholders to be engaged via direct communication activities, such as one-on-one meetings and roundtables, including:
  - local landholders, environmental and community groups and business chambers
  - local Federal and State Members with a direct portfolio or geographic responsibility
  - Local Council and the Lord Mayor; and
  - Federal and State Departments, including consent authorities and regulators, with a direct portfolio responsibility.
- Community members and general stakeholders to be initially engaged via indirect activities, such as e-newsletters, letterbox mailouts (see Appendix B.1), newspaper advertising (see Appendix B.2) including:
  - general community and businesses in the Port Kembla region; and
  - national peak industry bodies with NSW members.
  - A detailed stakeholder matrix and engagement register spreadsheets were developed to assist with the tracking and reporting processes for both stakeholder groups.

7.2.3 Engagement approach

The engagement approach for the preparation of the EIS was guided by the Core Values and Code of Ethics of the International Association for Public Participation (IAP2).

The matrix below in Figure 7-1 is from stakeholdermap.com and provides a simple way to help prioritise engagement resources and efforts, it was used to assist in identifying the level of consultation to be undertaken for stakeholders of the project.

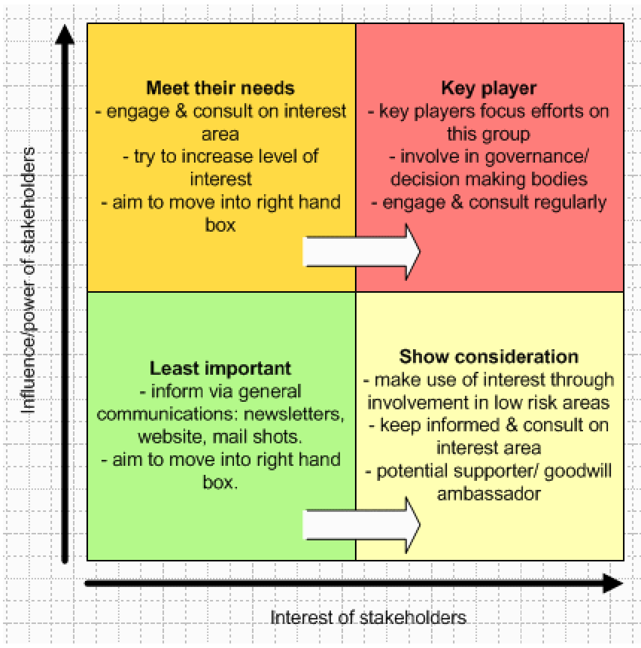


Figure 7-1 Stakeholder map

7.3 Overview of consultation

Due to the relatively short development timeframe of the project, engagement has been largely focused around key milestones. Once key stakeholders have been briefed on the project, regular updates have been provided to them to coincide with these milestones and to maintain open and accessible channels of communication. These channels of communication will remain throughout the project.

7.3.1 Initial engagement – February 2018 onwards

The consortium first announced their interest in a LNG import terminal in late February 2018 at the Australian Domestic Gas Outlook conference. The announcement was widely reported in domestic, international and industry specific publications. At the time, three locations were of potential interest – Port of Newcastle, Port Botany and Port Kembla as discussed in Chapter 4.

While AIE was investigating a number of possible locations for its proposed export terminal, early engagement centred around potential customers for the gas, as well as the various port authorities and administrators in the relevant regions. When Port Kembla began to emerge as the preferred location, broader engagement began with high level briefings arranged for local political, council and business stakeholders. This included a roundtable event held on the 27th of March 2018, hosted by NSW Ports and attended by a range of Port tenants, local gas exposed businesses and peak industry bodies.

In addition, several of the local economic development agencies including i3net, Illawarra Business Chamber, AiGroup and AdvantageWollongong co-funded, a business community briefing on the 16th of April. This was attended by a range of local government agencies, regional councils, peak industry bodies and local businesses.

7.3.2 Site announcement – 4 June 2018

The announcement of Port Kembla as the site for the facility was made on 4 June 2018.

Key stakeholders and the media were invited to attend the event, which afforded the opportunity to not only further increase understanding of the proposed project, but to meet with the international partner representatives who travelled to Port Kembla for the event. Key political stakeholders and representatives from various local organisations attended the launch including:

- NSW Minister for Primary Industries, Regional Water and Trade and Industry, Hon. Niall Blair
- Member for Wollongong, Paul Scully
- Member for Keira, Ryan Park
- Lord Mayor of Wollongong, Gordon Bradbery AM
- Regional Development – Illawarra
- Illawarra Business Chamber
- I3Net
- AI Group
- University of Wollongong

Journalists from both local and state media attended and the announcement was widely reported by local and state television news networks, local radio and local and state newspapers including:

- Channel 7 News Sydney
- Sky News
- ABC Illawarra TV and radio
- The Illawarra Mercury
- The Daily Telegraph, The Australian, The Sydney Morning Herald and the Financial Review.

As it was now timely to commence broader community engagement, several steps were taken at this juncture to make information accessible to those stakeholders:

- The AIE website was upgraded just prior to the site announcement to include several factsheets about the project (see Appendix B.3) and include the ability to email through enquiries and questions.
- 1800 phone number was set up to coincide with the site announcement and was promoted via the website, providing another information and contact avenue for stakeholders and the community.

7.3.3 Critical State Significant Infrastructure declaration – 22 June 2018

The project was granted CSSI status by the NSW Government on June 22 2018. All key stakeholders and community groups were emailed information about this milestone and any follow-up email or telephone questions surrounding the assessment process were answered.

The website was updated to include information about CSSI and comprehensive, project-wide Frequently Asked Questions were added to the website.

The media was notified and the story ran on the front page of the Sunday Telegraph and was picked up by local and state outlets.

7.3.4 Preliminary Environmental Assessment lodgement – 10 July 2018

Once again, key stakeholders were notified about the latest update to the project and the project website was updated and a link to the PEA provided.

A Planning Focus Meeting was scheduled with representatives from government agencies providing input to the Secretary's Environmental Assessment Requirements (SEARs). The meeting was held in Port Kembla and included a briefing on the project and site tour of the proposed berth and pipeline alignment.

Attendees included representatives from the:

- Department of Planning and Environment
  - Division of Assessment
  - Division of Assessment – Hazards Unit
  - Division of Energy, Water and Portfolio
- Environment Protection Authority
- SafeWork NSW
- Office of Environment and Heritage
- Wollongong City Council
- Port Kembla Port Authority
- NSW Ports

A comprehensive overview of the proposed development was provided by representatives from the project, Worley Parsons and GHD, including safety, pipeline, berth and vessel overviews.

Key issues raised included potential heritage concerns near Spring Hill, dredging and sediment disposal, hazard and risk and maintaining safe navigation within the harbour. These issues have been further explored and addressed in the relevant chapters of the EIS.

7.3.5 Community newsletter – July 2018

AIE produced the first edition of its quarterly newsletter in July (see Appendix B.1). The 4 page newsletter included:

- Key project facts
- Project location map
- How the project will work
- Information about liquefied natural gas
- Updates on community engagement
- Information about the assessment process and CSSI declaration
- The partners involved in the AIE consortium
- An invitation to the Community Information Session
- Website address and 1800 number
- The newsletter was widely distributed to local stakeholders and the community:

- Letterbox-dropped to approximately 16,000 (15,732) homes and small businesses in and around Port Kembla (Appendix B.1)
- Copies sent to the offices of the Member for Wollongong and the Member for Keira
- Copies sent to the Wollongong City Council
- Copies sent via the Council for distribution to the 6 Council-run public libraries in the area for display on noticeboards
- Email copy sent to the office of the Member for Cunningham
- Email copies sent to the Principals or key contacts at 10 local schools and 5 social clubs (eg. surf lifesaving/golf clubs) for distribution to their parents/members
- All key stakeholders and community groups were emailed copies of the newsletter and many groups, such as i3net and the Regional Development Authority, disseminated the newsletter to their members and promoted through their social media channels.
- The newsletter was posted on the AIE website.

7.3.6 Community Information Session – 14 August 2018

A drop-in style information session was held on August 14 2018 at the Steelers Club in Wollongong, a centrally located and well-known local venue (refer to Appendix B.1). The event was open to all and ran from 3pm – 8pm. The timing was designed to facilitate the attendance of those groups with work and school commitments as well as those community members unable to attend evening events. The session provided the community and stakeholders with the opportunity to increase their understanding of the project, see the project progress and discuss any issues with the project team.

The event was extensively promoted:

- Via the community newsletter (see distribution above)
- Advertised on 1/8/2018 in the free local publication The Advertiser/Lakes Times (average readership of 42,000 per issue). Refer to Appendix B.2 for the advertisement and Appendix B.1 for the distribution area map.
- Advertised in the Illawarra Mercury on Saturday 4/8/2018 (16,000+ papers produced) and on Tuesday 07/08/2018 (11,000+ papers produced) https://projects.ghd.com/oc/Sydney1/eastcoastlngterminal/Delivery/Documents/Stakeholder/Newsletters/Community Newsletter July.pdf. Refer to Appendix B.2 for the advertisement.
- Email invitation to attend the community information session sent to 10 local schools, along with the Community Newsletter
- Email invitation to attend the community information session sent to local golf and surf lifesaving clubs, along with the Community Newsletter
- AIE website updated to include details of the event

There were 30 attendees in total at the community information session. Thirteen were local community members and the remainder were from local businesses.

The general sentiment was supportive of the proposed project with general interest in how it will be constructed and the ongoing economic benefits.

The key themes raised during the information session included:

- construction and ongoing job and business opportunities
- pipeline alignment route options
- general environmental impacts, some expressed a preference for renewable energy as opposed to natural gas
- questions about the impacts to marine ecology due to dredging and cooled water from the re-gasification unit
- general interest about what the project involves and the economic benefits it can deliver to Port Kembla, Wollongong and broader Illawarra region.

These comments were documented in writing and provided for appropriate consideration by the project team and those involved in preparing the EIS.

7.3.7 Receipt of Secretary's Environmental Assessment Requirements and announcement of procurement of Floating Storage and Regasification Unit – August 20

Key stakeholders were notified by phone and email of the above key milestones. An update was posted on the AIE website and included a link to the SEARs on the NSW Government's Major Projects website. A media release was issued and the story appeared in The Australia, The Sydney Morning Herald, The Australian Financial Review and a number of industry publications.

In addition, news of these two major milestones were emailed to 60 individuals who had registered for regular updates through the website.

7.3.8 EIS lodgement

The next edition of the Community newsletter has been prepared and is planned for distribution just after the lodgement of the EIS. It will include updates on the project, including the lodgement of the EIS and information on where/ how to see the EIS. The newsletter will also detail how a submission on the project can be made.

Once again the newsletter will be letterbox-dropped to approximately 16,000 local homes and businesses and disseminated through stakeholder networks.

Once on public exhibition, a link to the EIS will be prominently featured on the AIE website.

7.3.9 Stakeholder engagement

While key milestones provided several natural opportunities to engage with stakeholders, AIE proactively reached out to key individuals and groups to offer briefings.

In all instances, with the exception of the Port Kembla Pollution Meeting Group, the offer of an in-person briefing was accepted. The Port Kembla Pollution Meeting Group declined as they felt they did not have a suitable venue. They were provided information on the Community Information session as an alternative and one of their members participated in the BlueScope Community Consultative Committee.

Table 7-1 provides an overview of the various different stakeholder and community groups engaged and the approach taken for consultation activities.

Table 7-1 Engagement approach for stakeholders

Stakeholder group	Level of consultation	Stakeholder	Tools and activities
Commonwealth	Informing	Offices of the Prime Minister & Deputy Prime Minister	Project briefing and updates provided
		Federal Members for Whitlam & Cunningham	Project briefing and updates provided. Email copy of Community Newsletter
		Offices of the Minister for Environment and Energy and Minister for Resources	Briefing provided to office
		Environment and Energy Committee	Project briefing provided
		Senator Concetta Fierravanti-Wells	Project briefing and updates provided
		Office of Shadow Minister for Energy	Project briefing
		Department of the Treasury Department of Industry, Innovation and Science Department of Environment and Energy	Project briefing and updates provided
		Office of Chief Economist	Project briefing and updates provided
		Regional Development Australia	Project briefing and updates provided
		AusIndustry	Project briefing and updates provided
NSW Government	Informing	Office of Premier	Project briefing and updates provided
		NSW Deputy Premier and Ministers for Trade and Industry, Energy and Resources, Planning and Environment, Roads, Maritime and Freight	Project briefing and updates provided
		Shadow Minister for Planning and Infrastructure Shadow Minister for Industry, Resources & Energy	Project briefing and updates provided
	Active participation	Member for Keira and member for Wollongong	Project briefing and updates provided Attended site announcement Newsletters in office for distribution Briefings provided to recommended groups at Member suggestions (e.g. Neighbourhood Forum 5, Port Kembla Chamber)

Stakeholder group	Level of consultation	Stakeholder	Tools and activities
		Department of Premier and Cabinet Department of Industry Department of Planning and Environment Department of Planning and Environment – Division of Energy, Water and Portfolio Environmental Protection Authority Safework NSW NSW Ports Authority Roads and Maritime	Project briefing and updates provided. Numerous agencies attended the Planning Focus Meeting and site visit. On-going discussion with several agencies on specific elements of the project of interest, for example, environment.
		Office of Regional Development	Project briefing and updates, with ongoing engagement specifically around business impacts and opportunities. Attendance at local engagement activities and circulation of Community Newsletter.
		NSW Police, Fire and emergency Services	Project briefing and site tour provided with safety consultant present
Local government	Active participation	Lord Mayor of Wollongong	Project briefing and updates provided Attendance at site announcement Attendance at Councillor briefing session
		Wollongong City Council	Project briefing and regular updates to senior staff Project briefing provided to a number of Councillors Engagement around the character of the area, demographics, Typical community consultation channels

Stakeholder group	Level of consultation	Stakeholder	Tools and activities
Landholders	Active participation	NSW Ports & Port Kembla Harbour Environmental Group & NSW Ports (Port Kembla) Tenants	Extensive input into the planning for the Project Briefing provided to the Port Kembla Harbour Environmental Group organised by NSW Ports Briefing organised for all interested NSW Port tenants
		Bluescope Steel & Bluescope CCC	Project briefing, updates provided to Bluescope representative at Port Kembla Harbour Environmental Group Briefing given to Bluescope CCC, ongoing engagement Re. pipeline route
		Port Kembla Coal Terminal & WHS Committee	Ongoing updates Regular contact and consultation as immediate neighbour and current lessee of the Terminal site Project briefing and safety briefing to staff
Environmental groups	Informing and active participation	Port Kembla Harbour Environment Group	Project briefing and updates emailed to members
		Port Kembla Pollution Meeting Group	Updates provided and briefing offered but declined Community newsletter and information session invitation Emailed to President for circulation amongst members Key member attended briefing given to the Bluescope CCC
State and Local Media	Informing	Illawarra Mercury ABC Illawarra WIN Television Daily Telegraph	Key note addresses at major events (eg Australian Domestic Gas Outlook) Media releases sent with regard to all major announcements

Stakeholder group	Level of consultation	Stakeholder	Tools and activities
		Sydney Morning Herald The Australian The Financial Review Various other media outlets	Invitation to attend site announcement Interviews given to a number of outlets including the Illawarra Mercury Project covered extensively by local and state media
Peak Industry Bodies	Informing	Australian Industry Group Illawarra	Regular briefings and updates provided
		Manufacturing Australia	Project briefing and ongoing discussions around how the project can assist their members
		Chemistry Australia	Project briefing
		NSW Business Chamber	Project briefing
		Australian Institute of Energy	Key note address on the project and import terminals
Education, skills and labour groups	Informing and active participation	University of Wollongong	Project briefing and regular updates Consultation around opportunities for future partnerships
		TAFE NSW	Project briefing and regular updates Consultation around opportunities for future partnerships
Key business stakeholders	Informing	Advantage Wollongong Illawarra Business Chamber Illawarra Innovation Industry Network Australian Industry Group Illawarra	Project briefing and regular updates Ongoing consultation with regard to how the Project can benefit members Community newsletters and project updates disseminated through their networks
		IBC Regional Advisory Council	Project briefing
		Port Kembla Chamber of Commerce	Project briefing and regular updates

Stakeholder group	Level of consultation	Stakeholder	Tools and activities
Key community interest groups	Informing	Neighbourhood Forum 5 and 7	Project briefing and regular updates sent to key contact within the group for dissemination to members
Local indigenous community	Informing	Illawarra Local Aboriginal Land Council	Project briefing and regular updates to the Illawarra Aboriginal Land Council Investigation potential pipeline alignments AIE website, Community newsletter and invitation to Community Information Sessions
Local community	Informing	Local residents Small business (not affiliated with any of the business organisations) Social groups School groups Local fishermen and surfers Recreational boat users	AIE website set up with email contact/enquiry facility, project factsheets and comprehensive FAQs. As at October 31 the website had received 2,149 visitors with 12,921 page views. Community newsletter with project information and invitation to attend Community Information Session: letterbox-dropped to 15,732 homes and businesses in the Port Kembla area, distributed to Wollongong Council libraries, emailed to local school principals and various local organisations and interest groups Community Information Session held and advertised in local media Various media stories providing updates to the community
First responders	Informing	NSW Police and security agencies	Project briefing and discussion on further involvement upon project approval

7.4 Issues raised during consultation

During the consultation process, a number of different questions, benefits and/or concerns were raised by various stakeholder groups. Table 7-2 provides an overview of the issues raised along with the response provided by AIE during the consultation process. Where applicable these issues have been further examined as part of the EIS.

Table 7-2 Issues raised during consultation

Issue raised	Interested stakeholder groups	Consultation response
Need for gas importation	Community Business groups Peak Industry Bodies State Government Media	A number of studies and reports have predicted shortfalls in the NSW gas supply from around 2022. NSW imports more than 95% of its natural gas from other states. The gasfields that have traditionally supplied the NSW market, offshore Victoria and the Cooper Basin in South Australia, are in decline, so volumes are decreasing and the gas is more costly to extract. In addition, the gas being developed from coal seam gas projects in Queensland is expensive to extract and is also contracted to overseas buyers via long term, high priced agreements. These changing east coast gas market conditions have made importation of natural gas a viable, fast and flexible solution to NSW energy challenges
Source of gas procured	Community Business groups	AIE will use the purchasing power of our partner, JERA Co., Inc., the world's largest buyer of LNG to source the best priced natural gas. It may come from Australia or overseas, whichever cargoes can be obtained most economically.
Port Kembla vs other Port locations	Community Business Groups Local Council State Government Landholders	A detailed engineering assessment was conducted on three potential port locations within NSW. Port Kembla was ultimately selected, given the specifics of the berth and inner harbour layout and the site's proximity to existing gas transmission pipelines. The facility will be a good fit with the surrounding infrastructure and industry and there was strong support for the Project from NSW Ports and the local business community.
Detail about how an LNG import terminal works	All stakeholders	Presentation briefings, project factsheets and collateral explain the workings of an LNG terminal.
Local job opportunities	Community Business groups Government	With a forecast capital cost of between A$200 and $250 million, it is estimated that the Project will create around 130 to 150 jobs during construction and between 40 – 50 ongoing roles during operations.

Issue raised	Interested stakeholder groups	Consultation response
Regional economic benefits	Community Business groups Local Government State Government	The key benefit to the region is the access to secure supplies of gas, delivered locally and thus avoiding expensive over-land transportation costs. It is estimated there are around 15,000 jobs in the Illawarra region that are associated with gas-reliant businesses. Access to competitive gas supplies provides some assistance in retaining those jobs in the region, as well as providing a potential incentive for new industrial clients to consider establishing operations in the region. In addition, the presence of LNG import handling facilities paves the way for new potential value-add services to be established at Port Kembla, such as LNG Bunkering or potentially even a local Combined Cycle Gas Turbine power station.
Gas storage	Community Local Council Landholders	There are no on-shore storage facilities associated with this project. Instead, the LNG will be contained in the FSRU and stored in a cooled, liquid form until it is required to be put into the gas network.
Impacts on Port Kembla Harbour	Community Business groups Landholders Port Authority NSW Ports Local Council State Government	With only a proportionally small number of additional ship movements each year (approx. 20 shipments of LNG, compared to 800+ vessels visiting Port Kembla each year) we expect impacts to be easily managed. NSW Ports and the Ports Authority have been extensively consulted throughout the planning and design phases of the project. Various studies have been carried out as part of the EIS have confirmed impact on the harbour will be minimal.
Impacts on the emerging cruise ship industry in Port Kembla	Community Business groups Landholders Port Authority NSW Ports Local Council	There should be no impact on the cruise industry. The number of ship movements is manageable and we have worked with Port Authority to ensure the project activities will not negatively impact other harbour users

Issue raised	Interested stakeholder groups	Consultation response
Changes to public access to Seawall Rd?	Community	We do not anticipate any additional access restrictions. Preliminary hazard and risk studies have identified no need to change the current regime around public access to Seawall Road. This will need to be confirmed by the detailed hazard and risk assessments which will form part of the EIS.
About CSSI and whether it means assessment will be less stringent	Community	To be declared Critical State Significant Infrastructure (CSSI), a project must be deemed by the State Government to be essential for NSW's economic, environmental or social benefit. While the CSSI designation is not a development consent. It simply sets out the approval pathway and the timelines for the project. It does not alter the robust planning assessment process which remains as stringent as for other similar scale projects
At least four gas import terminals are planned for Australia's east coast. Will this considerable investment in imported gas in any way slow down investment in renewable energy production?	Community	This is not anticipated for a number of reasons: First - there are many manufacturing processes for which renewable power is not a substitute for gas. For example, elements of natural gas are often used as an ingredient in many manufacturing process for things like soft and hard plastics (e.g. milk bottles), dyes, fertilizers, medicines. This is known as "feedstock". Second - in relation to heating, while research continues, there is still no affordable alternative to some of the very intense industrial heat and burning functions required for various manufacturing and waste management processes our economy currently needs. eg smelting, glass production, incineration of hazardous waste etc. Lastly - in relation to power, gas provides an important transition to a lower emission future and an immediate need for large-scale, quick, dispatchable power to balance out renewable energy volatility. Large scale batteries are not yet viable, and while they no doubt will continue to get better and better, reliance on coal or hydro for base-load and dispatchable power is difficult given coal emissions and increasing drought challenges. There is also a strong case for a new entrant in the power market (just like in the gas market) to increase competition between the three current incumbents. A Combined Cycle gas turbine power station consisting of the latest technologies, partnered with a wind energy provider, for example, would

Issue raised	Interested stakeholder groups	Consultation response
		probably provide the best option for the NEM in terms of the trifecta of grid stability, affordability and low emissions. So we are hopeful, new gas power might actually support new wind or solar investment.
You tell us that studies show NSW face gas shortages in the early 2020s? Please provide references for these studies.	Community	References provided to AEMO https://www.aemo.com.au/-/media/Files/Gas/National_Planning_and_Forecasting/GSOO/2018/2018-Gas-Statement-Of-Opportunities.pdf EnergyQuest - https://www.energyquest.com.au/reports.php?id=1
Is LNG dangerous?	All stakeholders	LNG is not flammable or explosive. The transportation of LNG by ship commenced almost 60 years ago and the industry is well established. Both the carriers and the FSRU are designed to strict international standards. They are purpose-built and have double hulled tanks to provide protection against accidental leaks or rupture. The vessels are equipped with automated leak detection mechanisms and Emergency Shut Down Systems.
What are the fire risks of the terminal?	All stakeholders	The storage and transfer of gas will be carefully managed at all times to minimise any risk. LNG is not flammable. When the LNG is regasified onboard the FSRU and put under pressure for transfer into the pipeline it is flammable, but there are a number of stringent safety and emergency mechanisms in place to manage the risk. The FSRU terminal will be required to be located a prescribed distance from any potential external ignition point and a sufficient distance from any other facilities should a fire break out. These distances would be calculated as part of the hazard studies carried out during the regulatory assessment process for the project.
Visual impacts	Community Landholders	The visual impacts of the terminal will be minimal and in keeping with other Port facilities. The visual impact will not vary considerably from that of Berth 101 in its current use as part of the Port Kembla Coal Terminal.

Issue raised	Interested stakeholder groups	Consultation response
The impact on marine ecology due to dredging and cooled water from the re-gasification unit	Community	A number of studies, including baseline studies, will be undertaken including environmental studies on aspects of the project like noise, air quality, water quality, hazard and risk and social impacts. These studies will be used to inform the best approaches to avoid, minimise or mitigate any impacts. The sea water used on board the FSRU to warm the LNG and convert it to gas will be released back into the harbour. Its composition will be largely unchanged but it will be no more than 7 degrees cooler that the ambient water temperature. This water should blend into the rest of the harbour and is not expected to impact the overall water temperature. However, studies will be conducted to ensure this process can be managed and not materially impact the marine environment.
Placement and management of the dredged materials	Community Port Authority NSW Ports Local Council	Extensive contamination studies will be carried out to identify the most appropriate management and disposal methods for dredged material. In addition, AIE has worked closely with NSW Ports to ensure any timing, location and/or disposal techniques they may prefer are considered in the design of the Project.
Traffic movements and trucking of LNG	Community Landholders Local Council	During operation of the terminal we do not anticipate an increase in existing traffic movements. The LNG will not be transferred by truck, it will be transferred via underground pipeline. The construction period for the terminal may result in increased traffic movements, we anticipate a maximum 10 – 12 month construction period. Traffic studies have been included as part of the EIS.
Noise Impacts of the Terminal	Community Landholders Local Council	Noise levels associated with the operations of the terminal will be minimal and appropriate for facilities located in a major existing industrial hub. As there is a full-time crew stationed on the FSRU, the vessel is also designed to minimise noise outputs and impacts. Noise studies have been included as part of the EIS.

Issue raised	Interested stakeholder groups	Consultation response
Emissions and flaring	Community Landholders State Government	Modern LNG carriers, powered by natural gas, are among the most environmentally friendly vessels on the ocean and have substantially lower emissions than the diesel-powered vessels that dock at Port Kembla. The systems on board both the LNG carriers and the FSRU are designed to avoid accidental or fugitive emissions by capturing the small amount of liquid that continuously seeks to return to its natural gaseous state and re-using it in the vessels engines or reliquefying it and returning it back into the tanks. Flaring of gas does not occur on either LNG carriers or the FSRU. Venting capacity (not flaring) exists as a safety feature to be used only as a last resort measure.
How will gas get to users? Will a pipeline need to be constructed?	Community Business Groups Local Council	Gas will not need to be trucked. Instead a short pipeline will be constructed to link the terminal to the tie-in point at Cringila and then onto the Eastern Gas Pipeline (EGP). The pipeline will pass largely through existing industrial land at the Port and be designed and constructed to Australian Standard 2885. A Safety Management Study will also be conducted to identify and manage any hazards.
Handling of waste from FSRU	Community	Waste from the FSRU vessel will be contained onboard and then removed and managed as with any other vessel visiting the Port and in accordance with existing Port procedures
Will LNG vessels anchor offshore?	Community	Under normal operating schedules, vessels will not anchor offshore. The manageable number of LNG carrier arrivals (around 20 per year) will allow swift turnaround of vessels.

7.5 On-going consultation

Consultation with key stakeholders and the wider community on the project will continue until the project is fully operational. Table 7-3 below provides details of the key methods of engagement used to date and which ones will be provided on an on-going basis.

These measures will ensure the stakeholders, including the wider community, remain informed of the outcomes of the development application and the project's progress.

Table 7-3 Ongoing community consultation tools

Engagement tool	Description
Community Information Line	1800 810 680 community enquiries number established on 4 June 2018 following the site announcement. No enquiries have been received to date, despite widespread publication of the number.
Company Website	Provides extensive FAQs, Fact Sheets, and project updates. Also provides clear information on alternative ways to seek information: email, 1800 telephone number and/or subscription service. Website analytics as of October 31, 2018 show there have been 2,419 visits to the website, with 12,921 page views.
Website Enquiries	info@ausindenergy.com established for community enquiries. To date 41 enquiries have been received through this channel, 34 seeking employment/contract opportunities; 4 media enquiries, 1 project information request; 1 invitation to present on the project and 1 ASX listing timeframe query.
Subscriber updates	Around 60 individuals / organisations have recorded their interest in receiving regular email updates on project developments through the Subscriber feature on the AIE website. These subscribers will receive regular updates around key project milestones.
Community information session	Drop-in style event (3pm -8pm) in a convenient, public access venue. One such event has already been held and a second will occur during the EIS exhibition period. However, the EIS session will be run by the NSW Department of Planning.
Community newsletter	Every 3 – 4 months a Community Newsletter is prepared, published and distributed (hardcopy & electronic)
Letterbox drop	Community Newsletter will be letterbox dropped to approximately 16,000 homes and small businesses in the local area, in line with the delivery zone for the first Community Newsletter. These leterbox drops ensure wide-spread promotion of key events such as the Community Informatino Session and EIS exhibition period.
In-person group briefings	> 40 delivered to date
CCC briefings	2 delivered to date
1:1 meetings/telephone /discussions/email exchanges	Daily Activity
Media engagement	On-going responsiveness to media enquiries, as well as proactive distribution of key project developments to local, state and national media

8. Issues identification

8.1 Approach to impact assessment

Australian Industrial Energy (AIE) are proposing to develop the Port Kembla Gas Terminal involving the development of a liquefied natural gas (LNG) import terminal to provide a simple, flexible solution to the State's gas supply challenges. The use of a pre-assembled and operating floating storage regasification unit (FSRU) moored semi-permanently within the inner harbour at Port Kembla provides an immediate solution to meet predicted New South Wales (NSW) gas shortages without the lengthy construction timeframes and risks associated with development of an equivalent land based import facility.

The framework for the impact assessment has been designed to provide a structured and objective approach to identifying environmental, social and economic impacts, and to developing effective mitigation, management and offset measures. The approach has generally involved:

- project definition including analysis of the need and alternatives to introduce a new source of gas to NSW and meet predicted supply shortfalls;
- identification of key issues through risk assessment process and consultation with key government and community stakeholders;
- identifying existing environmental, social and economic baseline conditions;
- completion of impact assessments for the project based on the broad description of the project having regard to the baseline conditions;
- refinement of the project having regard to the impact assessments; and
- identification of appropriate mitigation, management, monitoring measures for the identified potential impacts.

The baseline (or existing environment) conditions for Port Kembla and surrounding locality were derived using a combination of desktop and field investigations relevant to each environmental aspect or value. Where possible, the investigations built on previous studies that have been completed over a number of years at Port Kembla in recognition of the extent of historical development that has been undertaken in the region.

The impact assessment methodology for each environmental, social and economic value was developed to meet the Secretary's Environmental Assessment Requirements (SEARs) for the project issued by Department of Planning and Environment (DP&E) and the requirements of the Environmental Planning and Assessment Act 1979 (EP&A) Act and the EP&A Regulation.

Mitigation and management measures were applied to reduce the level of identified potential impacts. These measures aim to protect the identified environmental values and will be applied as required during the planning and design, construction and operation phases of the project. A number of monitoring plans will also be developed and implemented to monitor potential impacts associated with the development of the project.

8.2 Stakeholder and community engagement

Consultation and liaison with government authorities and key stakeholders has been integral in refining the project and development of the assessment method for the completion of the Environmental Impact Statement (EIS).

Consultation with the NSW Port Authority, NSW Ports and the Port Kembla Coal Terminal has been integral to defining the preferred location for the project and defining the extent of dredging and excavation required for the establishment of a new berth, while minimising impacts upon safe operations and vessel movements within the harbour.

Consultation has been undertaken with DP&E and relevant government authorities throughout the preparation of the EIS including a planning focus meeting (PFM) on 25 July 2018. A preliminary environmental assessment (PEA) including a description of the project and risk screening assessment were distributed to each government authority and presented on the DP&E Major Projects web site. The assessment and PFM were used to provide a common understanding of the project for each government authority providing input into development of the SEARs for the project.

The SEARs for preparation of an EIS for the Port Kembla Gas Terminal were issued by the DP&E on the 10 August 2018. An outline of the key issues raised in the SEARs, together with an outline of where each issue has been addressed in the EIS is presented in Table 8-1.

Consultation with local community representatives has also been undertaken and has assisted in identifying key issues to be considered as part of the assessment process.

Issues raised during consultation are outline in Chapter 7 and have been addressed as part of the EIS where applicable.

Table 8-1 Secretary's environmental assessment requirements

Secretary's Environmental Assessment Requirements	Cross-reference
General Requirements	
The EIS for the project must comply with the requirements in Schedule 2 of the Environmental Planning and Assessment Regulation 2000.	
In particular, the EIS must include:	
• a stand-alone executive summary	Executive Summary
• a full description of the project, including:	Chapter 5
– all components, materials and activities required to construct and operate the project (including any infrastructure that would be required for the project, but the subject of a separate approvals process);	Chapter 5 and Section 2.4.2
– site plans and maps at an adequate scale with dimensions showing:	Chapter 5 and Appendix A
○ the location and dimensions of all project components;	Chapter 5
○ existing infrastructure, land use, and environmental features in the vicinity of the project (including any other existing, approved or proposed infrastructure in the region); and	Chapter 2
○ the pipeline corridor that has been assessed, including any allowance for micro-siting and identification of the key environmental	Sections 5.3.3 and 5.4.9

Secretary's Environmental Assessment Requirements	Cross-reference
constraints that have been considered in the design of the pipeline;	
– a strategy for the management, and disposal of excavated and dredged material in the short, medium and long term;	Sections 5.4.7 and 5.4.8, Chapter 11 Appendix E3
– the likely interactions between the project and any other existing, approved or proposed major projects in the vicinity of the site, including the Eastern Gas Pipeline (including the Port Kembla Lateral), the Port Kembla Bulk Liquids Terminal, and the Port Kembla Outer Harbour Development Project, and in particular how the project's activities such as disposal of dredged and excavated materials would be integrated into other approvals;	Section 2.4.2
– details of construction, operation and decommissioning, including any proposed staging of the project or replacement of infrastructure over time;	Sections 5.4, 5.5 and 5.6
• a justification for the proposed project as opposed to other alternatives;	Chapter 4
• the statutory context for the project, including any approvals that must be obtained before the project can commence, including the role/s of the NSW Port Authority, SafeWork NSW and Australian Maritime Safety Authority in regulating hazards and risks;	Chapter 6
• an assessment of the likely impacts of the project on the environment, focusing on the specific issues identified below, including:	
– a description of the existing environment likely to be affected by the project, using sufficient baseline data;	Chapters 9 through 24 Appendices C through Q
– an assessment of the potential impacts of the project, including any cumulative impacts, and taking into consideration any relevant legislation, environmental planning instruments, guidelines, policies, plans and industry codes of practice;	Chapters 9 through 24 Appendices C through Q
– a description of the measures that would be implemented to avoid and minimise impacts of the project;	Chapters 9 through 25 Appendices C through Q
– a description of the measures that would be implemented to monitor and report on the environmental performance of the project if it is approved;	Chapters 9 through 25 Appendices C through Q

Secretary's Environmental Assessment Requirements	Cross-reference
– a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; and	Chapter 25
– consideration of the project against all relevant environmental planning instruments;	Section 6.2.2
• an evaluation of the project as a whole having regard to:	
– relevant matters for consideration under the EP&A Act including ecologically sustainable development;	Chapter 26
– the strategic need and justification for the project having regard to gas security and reliability in NSW and the NSW Gas Plan; and	Chapter 3
– the biophysical, economic and social costs and benefits of the project.	Chapter 26
While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of the project.	
The EIS must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the capital investment value (as defined in Clause 3 of the Environmental Planning and Assessment Regulation 2000) of the project, including details of all the assumptions and components from which the capital investment value calculation is derived.	Provided with EIS
Key Issues	
The EIS must address the following specific issues with the level of assessment of likely impacts proportionate to the significance of, or degree, of impact on, the issue, within the context of the project location and the surrounding environment:	
Port Navigation – an assessment of;	
• the project's impacts on vessel navigation within Port Kembla during construction and operation, including consideration of current and future port operations (including expansion and changes to shipping configurations);	Section 9.3 Appendix C
• protocols for safe handling of LNG vessels including under adverse meteorological conditions; and	Chapter 9 Appendix C
• additional and/or upgraded port resources that may be required.	Chapter 9 Appendix C

Secretary's Environmental Assessment Requirements	Cross-reference
Hazards and Risks – including a comprehensive Quantitative Risk Assessment (QRA), covering all aspects of the project which may impose public risks, to be prepared consistent with Hazardous Industry Planning Advisory Paper No. 6 – Guidelines of Hazard Analysis (DPE, 2011). This QRA must include:	Chapter 10 Appendix D
• identification of all potential hazards and associated control measures for all aspects of the project, including but not limited to entry of LNG carriers into port, mooring, refilling of FSRU, regasification, and transfer of LNG into gas network distribution tie in point, and other external threats (such as propagation risks from other facilities and vessel movements and cargoes and impacts from adverse sea conditions on the FSRU);	Section 10.3 Appendix D
• a quantitative risk assessment to estimate the risks from activities of LNG carrier and/or FSRU operation, with reference to applicable International and/or Australian Standards and Industry Best Practice. The risk assessment must consider the worst-case scenarios from all identified potential hazards that may result in off-site impact. It must also consider:	Section 10.3 Appendix D
– the potential risk exposure to all shipping terminal activities at the port, including cruise shipping; and	Section 10.3 Appendix D
– the potential propagation risks to and from neighbouring industrial facilities, such as the steelworks, onshore approved bulk liquid storage facilities and other berth activities (such as loading/unloading of dangerous goods at nearby berths);	Section 10.3 Appendix D
• a quantitative pipeline risk assessment to estimate the risks from the pipeline to the surrounding land uses, with reference to Australian Standards AS2885 Pipelines – Gas and Liquid Petroleum – Operation and Maintenance;	Section 10.3 Appendix D
• demonstration that the risks from the project comply with the criteria set out in Hazardous Industry Planning Advisory Paper (HIPAP) No. 4 – Risk Criteria for Land Use Safety Planning (DoP, 2011);	Section 10.3 Appendix D
• an assessment of the adequacy of existing firefighting systems on shore and within the harbour (e.g. fire tugs) through a preliminary Fire Safety Study; and	Section 10.4 Appendix D

Secretary's Environmental Assessment Requirements	Cross-reference
• proposed on-going maintenance and safety management of the project inclusive of associated pipeline infrastructure;	Section 10.4 Appendix D
Contamination – including:	Chapter 11 Appendices E1 through E3
• an assessment of the extent and nature of any contaminated materials or acid sulphate soils on site or in dredged material;	Section 11.3 Appendices E1 through E3
• as assessment of potential risks to human health and the receiving environment; and	Section 11.5 Appendices E1 through E3
• a description of the measures that would be implemented to avoid or mitigate impacts;	Section 11.6 Appendices E1 through E3
Air Quality – including:	Chapter 18 Appendix M
• an assessment of the likely air quality impacts of the project in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA, 2016);	Chapter 18 Appendix M
• demonstrated ability to comply with the relevant regulatory framework, specifically the Protection of the Environment Operations Act 1997 and the Protection of the Environment Operations (Clean Air) Regulation 2010; and	Section 18.4 Appendix M
• an assessment of the likely greenhouse gas impacts of the project;	Chapter 22 Appendix P
Water and Soils – including:	
• a description of water demand, a breakdown of water supplies and the measures to minimise water use;	Sections 5.4.3 and 5.5.4
• a statement of the ambient NSW Water Quality Objectives (NSW WQOs) and environmental values for the receiving waters relevant to the project, including the indicators and associated trigger values or criteria for the identified environmental values;	Section 12.2 Appendix G
• a demonstration of how construction and operation of the project will, to the extent that it can, ensure that:	
– where the NSW WQOs for receiving waters are currently being met they will continue to be protected; and	Sections 12.3 and 12.4 Appendix G

Secretary's Environmental Assessment Requirements	Cross-reference
– where the NSW WQOs are not currently being met, activities will work toward their achievement over time;	Sections 12.3 and 12.4 Appendix G
• an assessment of the likely impacts of the project on the marine environment, watercourses, riparian land, water related infrastructure and other water users, and soil resources - including sediment/turbidity plumes from dredging and reclamation activities, the release of cold water from LNG regasification (including thermal pollution discharge modelling), and the use and discharge of water during construction, commissioning and maintenance of the pipeline infrastructure;	Sections 12.3, 13.4 and 11.5 Appendices G and H
• an assessment of the flood impacts of the project;	Section 12.3 Appendix F
• a hydrodynamic assessment having regard to the hydrodynamic assessment completed for the Port Kembla Outer Harbour Development;	Section 12.3 Appendix F
• identify and estimate the quality and quantity of all pollutants, including dioxins and biocides (particularly tributyltin) from antifouling paints and chemicals used over the life of the project, that may be mobilised by project activities, and describe the nature and degree of impacts that mobilisation may have on the receiving environment and human health;	Section 12.3 Appendix G
• assess the impacts of the project on protected and environmentally sensitive lands and processes, and the impacts of coastal inundation and rising sea levels on the project;	Section 14.3 Chapter 23 Appendices H and Q
• identify sensitive receiving environments and include a strategy to avoid or minimise impacts on these environments;	Chapters 13 and 14 Appendices G and H
• a description of the erosion and sediment control measures that would be implemented to mitigate any impacts during construction; and	Section 11.6
• assessment of any water take requirements that may be relevant under the Water Management Act 2000;	Section 6.3

Secretary's Environmental Assessment Requirements	Cross-reference
Biodiversity – including an assessment of the biodiversity values and the likely biodiversity impacts of the project, including the impacts on the Green Golden Bell Frog, in accordance with the NSW Biodiversity Conservation Act 2016, the Biodiversity Assessment Method (BAM) and documented in a Biodiversity Development Assessment Report (BDAR); an assessment of the impacts of the project on aquatic ecology, including impacts on key fish habitat and threatened species of fish;	Chapter 14 Appendices G and H
Heritage – including an assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the project, including adequate consultation with Aboriginal stakeholders having regard to the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (OEH 2010) and the Aboriginal Cultural Heritage Consultation Requirements for Proponents (OEH, 2010);	Chapter 15 Appendices I and J
Noise and Vibration – including:	
• an assessment of the likely construction noise impacts of the project under the Interim Construction Noise Guideline (DECCW, 2009);	Section 17.4 Appendix L
• an assessment of the likely operational noise impacts of the project under the NSW Industrial Noise Policy (EPA, 2000);	Section 17.4 Appendix L
• an assessment of the likely road noise impacts of the project under the NSW Road Noise Policy (EPA, 2011);	Section 17.4 Appendix L
• an assessment of the likely vibration amenity and structural impacts of the project under Assessing Vibration: A Technical Guideline (DEC, 2006) and German Standard DIN 4150-3 Structural Vibration – effects of vibration on structures; and	Section 17.4 Appendix L
• where blasting is required during construction, an assessment of blast impacts in accordance with relevant guidelines (see Attachment 1);	Section 17.4 Appendix L
Transport – including:	Chapter 16 Appendix K
• details of traffic types and volumes likely to be generated by the project;	Section 16.4 Appendix K
• details of the proposed transport routes, site access, rail crossings and safety issues;	Section 16.3 Appendix K

Secretary's Environmental Assessment Requirements	Cross-reference
• an assessment of the likely transport impacts of the project on the capacity, condition, safety and efficiency of the road network, in particular heavy vehicles, oversize/ over-mass vehicles; and	Section 16.4 Appendix K
• details of measures to mitigate and / or manage potential impacts during construction, developed in consultation with the relevant road and rail authorities (if required).	Section 16.5 Appendix K
Visual – including an assessment of the likely visual impacts of the project on the amenity of the surrounding area and private residences in the vicinity of the project.	Chapter 19 Appendix N
Social & Economic – including an assessment of the social and economic impacts and benefits of the project for the region and the State as a whole, including consideration of any increase in demand for community infrastructure and services;	Chapter 20 Appendix O
Waste Management – including identification, quantification and classification of the likely waste streams likely to be generated during construction and operation, and describe the measures to be implemented to manage, reuse, recycle and safely dispose of this waste including waste to be used for reclamation or other project activities; and	Chapter 21
Cumulative – including all industrial facilities in the area and other nearby approved and proposed development, particularly in relation to hazards and risk, air quality, noise and vibration, traffic and soil and water	Chapter 24
Consultation	
During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities (including NSW Port Authority), other port stakeholders (including NSW Ports, Port Kembla Coal Terminal and other port users), infrastructure and service providers, community groups and affected landowners.	Chapter 7
The EIS must describe the consultation that was carried out, identify the issues raised during this consultation, and explain how these issues have been addressed in the EIS.	Chapter 7
Further consultation after 2 years	
If an EIS for the project is not lodged within 2 years of the issue date of these Environmental Assessment Requirements, the Applicant must consult further with the Secretary in relation to the preparation of the EIS.	—

9. Port navigation

9.1 Introduction

This chapter provides an assessment of the project's impacts to vessel navigation during construction and operation. The existing setting, including navigation within the port, port operations, vessel movements, navigational guidelines and port protocols are described and assessed in the context of the proposed LNG import terminal. Management measures to reduce the impact of the project on vessel navigation have been developed with reference to existing port protocols.

Port navigation has been considered through studies and assessments undertaken as part of the project's development and guidelines set by the industry, including:

- The Feasibility Study (Advisian, 2018) includes a summary of port navigation within Port Kembla.
- Guidelines set by Society of International Gas Tanker and Terminal Operators (SIGTTO) (SIGTTO, 2000) focus on best practice in the liquefied gas shipping and terminal industries. Guidelines relevant to port navigation include vessel turning diameter and channel width.
- Guidelines set by World Association for Waterborne Transport Infrastructure (PIANC) (PIANC, 2014) provide expert guidance, recommendations and technical advice relevant to the shipping industry. Guidelines relevant to port navigation include vessel turning diameter.
- *Navigation Simulation Summary of Outcomes* (Appendix C) provides a summary of the navigation simulations undertaken for the project. The aim of the simulations were to determine if safe passage of an LNG carriers was possible and combined with the interaction of the proposed berth layout on other shipping movements in the Inner Harbour and is included in full in Appendix C.
- The project *Risk Assessment* (Risk Register, 24th April 2018) is a live document that investigates risks associated with the development of the LNG import terminal and identifies mitigation measures. Risks associated with port navigation include damage to ships or facilities from other port users which results in safety and production implications; and Port congestion / interference, impacting reliability and availability.

The above studies, assessments and guidelines have been used to form the basis of this chapter.

9.2 Existing environment

9.2.1 Navigation within the port

The Port Authority of NSW is responsible for the management of shipping operations in Port Kembla, including the provision of Harbour Master functions, pilotage, navigation services and ship scheduling.

The port has a deep-water shipping channel that can accommodate vessels with ship length (LOA) of up to 311 metres and has capacity for Capesize vessels (at nominated berths) (Port Authority of NSW, 2015). Pilotage is compulsory for vessels over 30 metres in length.

Passage from Port Kembla's Outer Harbour to the Inner Harbour requires navigating through a relatively narrow channel known as The Cut and in close proximity to other berthed vessels (Figure 9-1).

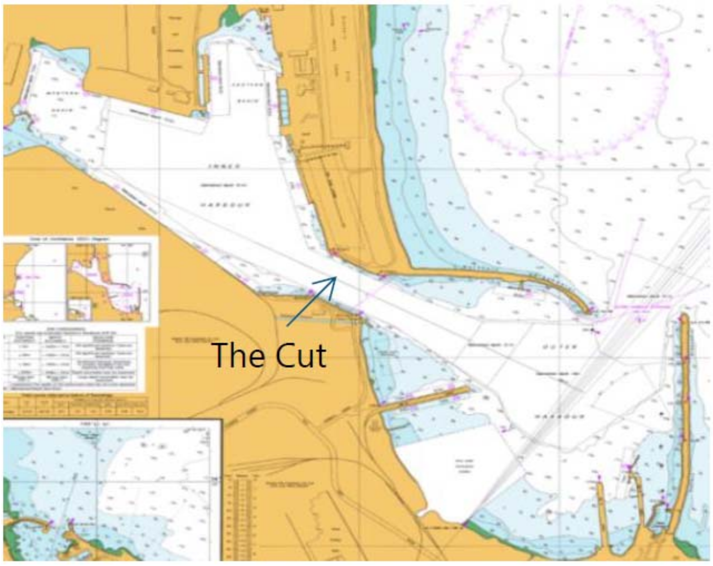


Figure 9-1 Port Kembla's navigational area

As shown in Figure 9-1 the entrance to Port Kembla's Outer Harbour is open to the north-east, which exposes the Outer Harbour to swell and wind. After arriving through the entrance, a 90 degrees turn is required to pass through The Cut into the Inner Harbour. A vessel speed of at least 2.5 knots through The Cut is required to maintain vessel steerage. Ship-to-ship interactions can occur between transiting and berthed vessels depending on vessel speed and proximity.

The channel is well marked with navigational buoys, sector lights and leading marks.

Challenges to navigating the channel include unpredictable currents at the port entrance, as well as strong winds and currents in and around The Cut resulting from waves and vessel or tide induced currents. There is also a localised water level change in the Inner Harbour as vessels enter and exit through The Cut (Advisian, 2018), especially fully laden Panamax and Capesize vessels.

9.2.2 Vessel movements

Historical vessel numbers at Port Kembla provided by NSW Ports include:

- 2010 to 2013 - over 1,000 vessels (over 2,000 vessel movements) per year
- 2015 - 851 vessels (1,702 vessel movements)
- 2016 - 842 vessels (1,684 vessel movements)
- 2017 - 840 vessels (1,680 vessel movements)

The current trend for total number of vessel movements is down from 2015. However, for robustness it is assumed that existing vessel movements are consistent with the past three years:

- 2018 to 2020 - 1,680 to 1,702 vessel movements per year

The 30 year Master Plan (2015) states that Port Kembla vessel numbers forecast for 2025 is:

- around 1,025 – 1,190 vessels (2,050 - 2,380 vessel movements)

This forecast shows an increase in vessel movements by 2025. As a result, it is assumed that the vessel movements for operation are:

- 2020 onwards - 1,680 to 2,380 vessel movements per year

9.2.3 Navigational guidelines

Guidelines set by SIGTTO (SIGTTO, 2000) and PIANC (PIANC, 2014) state that the diameter of the turning basin should be twice the LOA of the maximum vessel length (600 metres). This guideline recognises that the diameter can be rationalised subject to further investigation and study. The diameter of the existing turning basin in the Inner Harbour is 500 metres (Advisian, 2018).

With respect to the channel width, SIGTTO (2000) states that the channel width required is five times the vessel beam (B), which is 250 metres for the 50 metres design beam. PIANC (2014) states the channel width to be at least 3.5 x B, which is 175 metres (Advisian, 2018). Both these required widths are greater than the 160 metres width of The Cut. This guideline recognises that the channel width can be rationalised subject to further investigation and study.

To determine whether safe passage of LNG carriers are possible, navigation simulations for the project were undertaken (refer to Section 9.3.2).

9.2.4 Port protocols

Within Port Kembla, the Harbour Master and the Port Authority of NSW are accountable for the safe navigation of all vessels, including LNG carriers. Emergency response and navigational safety within the port is managed by the Port Authority of NSW and the Harbour Master establishes port operational procedures (port instructions) relating to vessel navigation protocols, ship scheduling, berthing and under keel depth requirements, as well as performance standards to achieve safe, effective, reliable and cost efficient shipping (Port Authority of NSW, 2015).

Detailed Port Kembla protocols are provided in the Port of Kembla - Port Instructions document (Port Authority of NSW, 2015). This document outlines instructions for vessels accessing the port along with general port information. Instructions and protocols relevant to port navigation include those around vessel manoeuvring, anchorage, vessels at anchor, vessel sizes, traffic management, draught requirements, underkeel clearance depths, and mooring arrangements.

Key navigational safety guidelines (Port Authority of NSW, 2015) include:

- Port Parameters (Annex H of *Port of Kembla - Port Instructions*) detail port capacity and maximum vessel size, including maximum LOA, maximum displacement and limiting environmental conditions for the port.
- To allow for safe passage in the port, the underkeel clearance for ships undertaking pilotage in Port Kembla is required to be not less than 1.25 metres, or as required through the use of dynamic underkeel clearance.
- Static underkeel clearance is calculated by the following formula: Depth of channel + height of tide, divided by 1.08 metres (Annex D of *Port of Kembla - Port Instructions*).

- Alongside berth underkeel clearance requirements, vessels are required to have a minimum underkeel clearance of 0.6 metres in the Outer Harbour and 0.3 metres in the Inner Harbour at all times (Annex D of *Port of Kembla - Port Instructions*).

For the additional proposed port protocols developed for the project on the safe handling of LNG carriers during the day, night and in various adverse meteorological conditions, refer to Section 9.4.

9.3 Potential impacts

9.3.1 Construction

During construction, potential impacts on vessel navigation within Port Kembla harbour include:

- Collision of construction vessels (barges) transferring dredged material into structures or other vessels entering and exiting the channel and their berths (as a result of increased traffic), impacting other vessels port navigation and safety, including potential delays to shipping operations.
- Grounding of construction vessels (barges) transferring dredged material from the new berth to the Outer Harbour disposal area, impacting other vessels port navigation and safety, including potential delays to shipping operations.

Collison and grounding

Construction is proposed to commence in 2019 and for a duration of around 10 to 12 months. During construction, the total amount of material that will be dredged and excavated at the new berth is around 600,000 cubic metres. Allowing for typical bulking factors, this volume would equate to around 720,000 cubic metres. A backhoe dredger will be used to dredge the material and then place onto a split hopper barge. This material will then be transported to the disposal area in the Outer Harbour. Two split hopper barges with the capacity of around 1,200 cubic metres each will either be towed by tugs or self-propelled. Tug or work boats would assist with dredger positioning and movement of barges.

It is anticipated that two split hopper barge loads per day (around 4 to 6 vessel movements) would be required to traverse from the Inner Harbour to the Outer Harbour. Based on the number of vessel movements from the existing port operations (refer to Section 9.2.2), it is anticipated that the base case (without the project) vessel movement during 2019 would be between 1,680 and 1,702 vessel movements. This equates to around 5 vessel movements per day. The additional split hopper barge movements are not anticipated to result in significant disruption to other shipping operations in the port.

Accidental collision of the barges with other vessels has potential to result in impact to vessel navigation and disruption to port operations. Dredging barges will be a shorter length than the average shipping vessels using the port and would be able to navigate and manoeuvre with limited interaction with other port users. The operations of the barges will be controlled through a permit system under the control of the Harbour Master (through the VTIC) and Masters will be required to obtain Certificates of Local Knowledge as required by the Harbour Master and *NSW Marine Safety Regulation 2016*.

The movement of barges would be coordinated by the Port Authority Vessel Traffic Information Centre (VTIC). A construction marine traffic management plan is also proposed for the project to manage interactions with other marine traffic.

With the permission of the Harbour Master, split hopper barges may be used at night, however this will be coordinated so as to not impact other vessels and port navigation, with due regard to the port instructions and port protocols (outlined in Section 9.2.4).

Grounding of barges has the potential to occur in the shallow sections of the Outer Harbour disposal area where the dredged material will be deposited. The disposal area would have an increasingly shallow seabed due to ongoing disposal activities of bottom dumping. It is anticipated that, due to the draft of the barges, material can be bottom dumped to a maximum level of minus 3 metres chartered depth (CD). Flat bottom barges may be used when the disposed material is at a height that can longer accommodate a split hopper barge. The material would be pushed off with a dozer (or similar).

Through implementation of the management measures outlined above (and in Section 9.4), along with the adherence of existing navigational protocols (refer to Section 9.2.4), and due to the temporary short term timeframe of the construction phase, impacts on other vessels port navigation and safety from risk of collision and grounding of the barges are expected to be managed and therefore anticipated to be minimal.

9.3.2 Operation

During operation, potential impacts on vessel navigation within Port Kembla harbour include:

- Collision of LNG carriers into structures or other vessels entering and exiting the channel and their berths, therefore impacting other vessels port navigation and safety, as well as safety of personnel on or around vessels, impacts to infrastructure and economic impacts to other businesses.
- Grounding of LNG carriers transferring LNG from the new berth through the navigational channel, therefore impacting other vessels port navigation and safety, and potentially resulting in partial or full port closures.
- Interaction of LNG carriers with other vessels transiting past Berth 101 as they enter or exit the port, impacting their speed and ability navigate the port.
- Reduced visibility from other vessels navigating the port due to the stationed FSRU and LNG carriers side by side at the new berth, therefore impacting other vessels port navigation and safety.

Collision and grounding

The project is proposed to commence in 2020 and will be operational for around 15 years. The route of entry for LNG carriers will be through the Outer Harbour, The Cut and into the Inner Harbour, with the reverse for departures.

Based on the number of vessel movements from the existing port operations (refer to Section 9.2.2), it is anticipated that the base case (without the project) vessel movement during operation would be between 1,680 and 2,380 vessel movements per year.

The project proposes an LNG shipment every two to three weeks which equates to around 4 vessel movements on average per month. There is potential for the supply to be increased further from around 100 PJ of gas per annum to around 140 to 150 PJ per annum through a slight increase in LNG delivery schedules and pipeline upgrades.

The anticipated number of LNG carrier movements are 4 on average per month and 48 on average per year. Proposed LNG carrier movements are low in proportion to the vessels movements anticipated from other operational arrangements at the port (1,680 to 2,380 vessel movements per year). LNG carrier movements are not expected to significantly increase traffic in the port. To assist with manoeuvring, LNG carriers will require a fourth tug of at least 75 t bollard pull to act as an escort tug.

Grounding of the LNG carriers transferring LNG from the new berth through the navigational channel has the potential to impact other vessels port navigation and safety, resulting in partial or full port closures. However, this is unlikely to occur as Port Kembla has a deep-water shipping channel. The risk of grounding will be analysed and mitigated by the Port Authority in upgrades to Port Parameters and Business Continuity Management Plans.

Through implementation of the management measures outlined above (and in Section 9.4), along with the adherence of existing navigational protocols (refer to Section 9.2.4), impacts on other vessels port navigation and safety from risk of collision and grounding of the LNG carriers are expected to be managed and therefore anticipated to be minimal.

Interaction with passing vessels

Port Kembla handles loaded Capesize and Panamax vessels which would host a total carrying capacity in tonnes of up to 205,000 deadweight tonnage (DWT), including vessels departing Berth 102 where coal loading operations would be taking place. Impacts associated with the LNG carrier’s interaction with these passing vessels includes reduced speed of vessels passing Berth 101. A reduced speed of these vessels may require the use of existing Port Kembla tugs for shiphandling, especially when wind speed is over 10 knots.

Results from the navigation simulation study (Advisian, 2018) included as Appendix C in Volume 2 indicated that there will need to be some modifications to the operating practices when turning other vessels in the Inner Harbour to maintain safe clearances. Currently, vessels commence turning once they cross the Eastern Basin (eastern side of the turning basin). When an LNG carrier is in berth, vessel turning will have to occur further towards the north-west quadrant of the turning basin to allow for vessel leeway, particularly under westerly wind conditions. This was successfully tested in the simulators and will require modifications to the current turning circle, extra Pilot training, extra aids to navigation for Pilots (upgraded portable Pilot Unit computers using differential global positioning system (DGPS) and to include the turning circle, and extra monitoring by the VTIC. Additionally, the Harbour Master may need to modify port parameters for vessels using the turning basin in higher wind conditions, which may also involve the use of existing Port Kembla tugs or reduced wind conditions.

Overall, results of the navigational simulation study showed that safe navigation through the channel and in the Inner Harbour is possible for all vessels when combined with the proposed berth layout.

Ship-handling protocols will be developed by the Harbour Master to ensure adequate management measures are implemented for passing vessels which may cause interaction with vessels berthed at Berth 101 (LNG carrier’s and FSRU).

Outcomes of the navigation simulation study along with additional management measures outlined above, and in Section 9.4, it is anticipated that the interaction with other vessels will be managed and the project will not impact on existing port operations. It is also anticipated that risk of collision (as discussed in the section above) into structures or other vessels entering and exiting the channel and their berths, therefore impacting other vessels port navigation and safety, as well as safety of personnel on or around vessels, impacts to infrastructure and economic impacts to other businesses, would be minimal.

Visibility from other vessels

The navigation simulation study assessed the visibility of other vessels entering and existing the Inner Harbour with the FSRU and LNG carrier at berth. Results showed that vessels entering the Inner Harbour experienced reduced visibility of the aid to navigation located at the north-western side of The Cut, south of Berth 101, as a result of the bow of the LNG carrier at berth. Results also showed that vessels departing berths in the Eastern Basin experienced reduced visibility of The Cut due to the bow of the LNG carrier at berth.

As such, the aid to navigation (the navigational lead light) located at the north-western side of The Cut will be impacted by the facility and require relocation and/or raised to a new height to increase the visibility and avoid collision (Advisian, 2018). The new navigation light tower will be piled into the water area. The final position to be confirmed with further consultation with the Port Authority of NSW.

Visibility and clearance through The Cut was improved within the design process by refining the layout of the berth. The final layout of the new berth was moved slightly to the north and is aligned to be parallel with Berth 102. The layout provides a 40 metre offset from the Inner Harbour turning basin when the LNG carrier is berthed alongside the FSRU. It should be noted that the LNG carrier would typically be berthed every two to three weeks for a period of around 24 to 36 hours, so additional clearance is available for the majority of the time.

This layout provides suitable clearance from the turning basin whilst improving visibility of the aid to navigation and for transiting vessels through the port. The 40 metre offset layout minimises the impact to existing navigational operations within the port while also minimising the extent of dredging and excavation required during berth construction. This was tested in the simulators with emergency and extreme weather scenarios to the satisfaction of the Harbour Master and attending Pilots, although more detailed training and analysis will be required. Two Pilots will be required for arrival and departure of the LNG carrier until the pilots are familiarised with the LNG carrier manoeuvring or as directed by the Harbour Master.

Through implementation of design improvements as a result of the navigation simulation study along with management measures outlined above and in Section 9.4, it is anticipated that the project will have little impact on existing port operations and the FSRU and LNG carrier at berth will not limit other vessels visibility and therefore their ability to safely navigate the port.

9.4 Management measures

Table 11-5 outlines the management measures proposed to address the port navigation issues associated with project. All management measures would be collated in management plans prepared for construction and operation of the project.

All mitigation measures have been designed and/or considered with the input and support of NSW Ports and the Port Authority of NSW.

Table 9-1 Management measures for port navigation

ID	Issue	Measure	Timing
PN1	Port navigation	Design measures as a result of the navigational simulations include: • The berth pocket has been moved north and rotated to align parallel with Berth 102; • The stern of the LNG carrier will be moved to a 40 metre offset from the turning basin; and • The navigational lead light located at the north-western side of The Cut, south of Berth 101, will require relocation and/or raised to a new height to increase the visibility and avoid collision (Advisian, 2018). The final position to be confirmed with further consultation with the Port Authority of NSW.	Design
PN2	Port navigation	The movement of barges will be coordinated by the Port Authority VTIC. Adherence with existing Port Kembla navigational protocols through close liaison and compliance to directions of the Harbour Master (refer to Section 9.2.4).	Construction
PN3	Port navigation	Development of a construction marine traffic management plan for submission to the Harbour Master.	Construction
PN4	Port navigation	Barge operation will be controlled through a permit system under the control of the Harbour Master (through the VTIC) and Masters will be required to obtain Certificates of Local Knowledge as required by the Harbour Master and NSW Marine Safety Regulation 2016.	Construction
PN5	Port navigation	Permission of the Harbour Master will be sought for split hopper barges to be used at night. Construction will be coordinated so as to not impact other vessels and port navigation, with due regard to the port instructions and port protocols (Port Authority of NSW, 2015) (outlined in Section 9.2.4).	Construction

ID	Issue	Measure	Timing
PN6	Port navigation	Monitoring of the depth of deposited dredged material from the seabed in the disposal area to ensure that the barges transferring dredged material are not at risk of grounding.	Construction
PN7	Port navigation	Adherence with the existing port instructions and port protocols (Port Authority of NSW, 2015) (refer to Section 9.2.4).	Operation
PN8	Port navigation	The existing port wind limitation of 20 to 25 knots for the car carriers is not suitable for the LNG carriers. Reduced wind conditions of 15 to 20 knots will be implemented and will be reviewed by the Harbour Master as operations commence.	Operation
PN9	Port navigation	The use of three existing Port Kembla tugs and one additional tug of at least 75 tonne bollard pull and adequate sea-keeping ability. The additional tug will act as an escort tug. Pending the results of the passing vessel study, other vessel traffic may experience a reduction in speed when passing Berth 101, where additional tugs may be required to maintain vessel manoeuvrability	Operation
PN10	Port navigation	Two Pilots will be required for arrival and departure of the LNG carrier until the pilots are familiarised with the LNG carrier manoeuvring or as directed by the Harbour Master.	Operation
PN11	Port navigation	The Inner Harbour turning circle to be modified and appropriate monitoring contingencies will be implemented.	Operation
PN12	Port navigation	Ship-handling protocols will be developed by the Harbour Master to ensure adequate management measures are implemented for passing vessels which may cause interaction with vessels berthed at Berth 101 (LNG carrier's and FSRU) pending the outcome of the vessel passing study.	Operation

ID	Issue	Measure	Timing
PN13	Port navigation	Modifications to the operating practices when turning other vessels in the Inner Harbour to maintain safe clearances will be determined by the Harbour Master and may include: Extra Pilot training for the 40 metre offset from the turning basin. Extra aids to navigation for Pilots including upgraded portable Pilot Unit computers using DGPS (navigational software) with the turning circle added Extra monitoring by the VTIC. Potential modification of port parameters for vessels using the turning basin in higher wind conditions, which may also involve extra tugs or reduced wind conditions, by the Harbour Master.	Operation
PN14	Port navigation	The risk of grounding will be analysed and mitigated by the Port Authority in upgrades to Port Parameters and Business Continuity Management Plans.	Operation
PN15	Port navigation	As noted in the design measures above, the navigational lead light located at the north-western side of The Cut, south of Berth 101, will require relocation and/or raised to a new height to increase the visibility and avoid collision (Advisian, 2018). The final position to be confirmed with further consultation with the Port Authority of NSW.	Operation

10. Hazard and risk

10.1 Overview

This chapter describes the hazards and risks associated with construction and operation of the project. It summarises the key findings of the preliminary hazard analysis in Appendix D.

The design, construction and operation of the project would be carried out in accordance with a range of global best practice and international, Australian and NSW regulations, standards and guidelines that would mean the risk posed by the project is inherently low.

The preliminary hazard analysis was carried out in accordance with planning guidelines for hazardous development adopted by the NSW Department of Environment and Planning including *Hazardous Industry Planning Advisory Paper No 6 Hazard Analysis* (2011a). The preliminary hazard analysis involved the identification of specific hazardous events, the probability of them occurring the consequences for people and property if they did occur. The overall risk associated with the hazards was determined in relation to defined criteria under *Hazardous Industry Planning Advisory Paper No 4 Risk Criteria for Land Use Safety Planning* (2011b).

The main hazards that were identified related to a loss of containment of liquid natural gas from a LNG carrier or the FSRU, or a loss of containment of natural gas from the FSRU, the gas pipeline or connecting unloading arms and pipes at the berth and wharf facilities. The potential for collision between a LNG carrier and another vessel was also considered.

The potential consequences of those hazardous events, including potential fire and explosion, were then determined in risk modelling software as discussed in Section 10.3.

The assessment found that risk to people or property in sensitive areas, residential areas or commercial areas in the area was very low and complied with the stringent risk thresholds in the Department of Planning and Environment guideline *Hazardous Industry Planning Advisory Paper No 4 Risk Criteria for Land Use Safety Planning* (2011b). Risk at adjacent industrial areas or open land were also assessed to be low given the low probability of a hazard event occurring.

In addition to various safety features that would be built into the project, a comprehensive safety management system would be implemented in accordance with relevant regulations, standards and guidelines including *Hazardous Industry Planning Advisory Paper No 9 Safety Management* (Department of Planning and Environment 2011c). As identified in Chapter 6, a detailed safety case would be produced for the project in accordance with the *Work Health and Safety Act 2011* and *Work Health and Safety Regulation 2017*. The safety case would require separate approval from SafeWork NSW and would provide further detailed assessment of safety risks, emergency planning and management systems informed by the detailed design of the project.

10.2 Methodology

A preliminary hazard analysis was carried out in accordance with the NSW Department of Planning and Environment guideline *Hazardous Industry Planning Advisory Paper No 6 Hazard Analysis* (2011a), including quantitative risk assessment of the LNG carriers, FSRU, berth and wharf facilities and the gas pipeline. The assessment involved the following steps:

- Identification of specific hazardous events that have the potential to occur based on prior records, experience or professional judgement as necessary
- Analysis of consequences for people and property including modelling in risk modelling software to determine the extent and intensity of those consequences
- Analysis of the probability of the possible consequences occurring with reference to relevant industry guidance and data on the occurrence of such events
- Determination of the overall risk of the hazard in relation to defined criteria
- Description of relevant safety management measures to address identified risks.

The risk modelling software was utilised to determine consequences for a range of conditions and operating parameters based on the design of the project and the surrounding environment. Loss of containment of gas was modelled for small, medium, large and 'full rupture' scenarios in a range of conditions including calm, average and windy conditions. The modelling also took into account the pressure of the gas for each project component to determine consequence. The modelling determined the extent and intensity of resulting fire, explosions and heat.

The overall risk of the hazards to people and property based on surrounding land uses were then assessed against the quantitative criteria defined in the *Hazardous Industry Planning Advisory Paper No 4 Risk Criteria for Land Use Safety Planning* (Department of Planning and Environment 2011b). Management measures were then identified with reference to international, Australian and NSW safety regulations, standards and guidelines including *Hazardous Industry Planning Advisory Paper No 9 Safety Management* (Department of Planning and Environment 2011c).

10.3 Potential impacts

10.3.1 Hazard identification

The main hazardous material to be used by the project would be natural gas that would be expected to contain mostly methane and a proportion of ethane and other trace substances such as propane, butane, pentane and nitrogen depending on its particular properties.

In its liquid state LNG is clear, colourless, odourless, non-toxic, non-flammable and non-explosive. It is lighter than water in its liquid form and lighter than air in its vapour or gas form, meaning it dissipates quickly without leaving any residues. LNG is stored at very cold temperatures (around minus 160 degrees Celsius) so that it remains in liquid form, Should the LNG meet air at ambient temperatures it would turn to vapour and dissipate. This vapour is only flammable when a source of ignition is present and methane levels are present in a concentration in the air of about 5–15%. Any lower percentage and there is not enough LNG vapour to ignite, while any greater percentage means there is not enough oxygen for combustion.

These properties minimise the potential for hazards when the gas is stored in liquid form on board the LNG carrier and on board the FSRU. The hazard potential is greater when the LNG is in its gaseous state. This occurs when the LNG is converted to gas on board the FSRU, is transferred at higher pressure from the FSRU to the pipeline and is contained in the pipeline. It is important to note large quantities of gas will not be stored on the FSRU, In each case for a hazardous event to occur there would need to be an uncontrolled release of gas, a failure of leak detection and safety mechanisms, as well as an ignition event such as faulty sparking equipment, hot works occurring in the vicinity or an otherwise sufficient source of heat for ignition.

10.3.2 Probability and consequence

The probability of accidental release of gas occurring from project components was determined with reference to hydrocarbon industry failure rate data. Detailed statistics on probability of leaks per annum for each component of the project, including the various components of the FSRU, are provided in the hazard and risk assessment in Appendix D. Overall, the initial likelihood of releases which have potential for offsite impacts was found to be low for all components.

The probability of uncontrolled release of gas occurring from the gas pipeline was determined with reference to failure rate data from the United Kingdom Onshore Pipeline Operators Association that found a failure rate of about 0.08 failures per 1000 kilometres of gas pipeline. As the proposed gas pipeline would be about 6.3 kilometres, the probability would be very low.

As one potential source of an uncontrolled release of LNG, the potential for ship collisions was also considered with reference to navigation simulations discussed in Chapter 9, which showed that LNG carriers could safely travel to and from Berth 101. The probability of ship collision was estimated based on conservative assumptions and consequences and was found to be very low — in the order of 0.5 and 8 chances in 1 million for the LNG carriers and FSRU respectively.

In addition to an initial uncontrolled loss of gas, the probability of hazard events occurring also depends on release direction, release duration, and the presence of a source of ignition, such as hot works or malfunctioning equipment, and simultaneous a failure of safety mechanisms such as leak detection, isolation and depressurisation. As such the risk of the hazard event occurring would be lower again. Detailed statistics on the probability of fire or explosion at each component were calculated and provided in Appendix D.

Despite the unlikelihood of an initial leak followed by ignition and fire or explosion occurring, the worst case consequences of such hazard events were modelled to determine the extent and intensity of potential consequences to people and property. The type of consequences that could potentially occur have been identified in Table 10-1. The type of consequence would also depend on the size of the release and the nature of the surrounding environment.

As shown, the potential consequences that applied to most project components were jet fire and flash fire that would result where there is potential for an uncontrolled release of gas that is ignited at the same time. Jet fire and flash fire are fires involving the ignition of a release of volatile gas as opposed to liquid gas. A flash fire results from the ignition of vapour cloud while a jet fire results from ignition of a directional release of the gas from a pressurised source like the FSRU.

A pool fire is one in which the LNG would need to be released and pool on the ground or water prior to being ignited, so has the potential to occur in relatively few locations. As discussed in Section 10.3.1, released LNG is likely to vaporise and dissipate, reducing potential of a pool fire.

The potential for an explosion would occur in relatively fewer locations again, where natural gas could become captured in enclosed conditions on the LNG carrier of FSRU. Combustion in such enclosed conditions could lead to pressure build up and explosion.

Table 10-1 Potential hazardous events

Project component	Area or event	Potential consequence: Jet fire	Flash fire	Pool fire	Explosion
LNG carrier and FSRU	Ship collision		✓	✓	
	Transfer hoses	✓	✓	✓	
	Loading manifold	✓	✓	✓	
	Cargo tanks	✓	✓	✓	✓
	Headers	✓	✓	✓	
FSRU	Suction drum module	✓	✓	✓	✓
	Regasification module	✓	✓	✓	✓
	Unloading manifold	✓	✓		
Wharf facilities	Unloading arms	✓	✓		
	Gas pipeline connection	✓	✓		
Gas pipeline	Gas pipeline alignment	✓	✓		

10.3.3 Compliance with risk criteria

In the unlikely event these hazardous events occur, the actual consequences to people and property, including radiant heat from fire and overpressure from explosions, would depend on the distance of people and property from the place where the hazardous event occurs.

The terminal itself is located more than two kilometres from the nearest residence. The pipeline is around 6.3 kilometres and runs mainly through industrial land and is more than 200 metres from the nearest residence. Seawall Rd, the road which services the terminal, is a private road and not a through road. Seawall Rd terminates shortly after the terminal, is only open to the public in daylight hours and is often closed due to port operations, such as coal loading/unloading.

Contours showing the level of risk to people and property were prepared for each of the potential hazardous events that were identified, and took into account the proximity to land uses where consequences could occur such as residential, commercial or public open space.

The risk criteria for injury and fatality defined in the *Hazardous Industry Planning Advisor Paper No 4 Risk Criteria for Land Use Safety Planning* (2011b) are reproduced in Table 10-2. As shown the criteria are generally very stringent particularly for residential uses and increasingly so for more sensitive land uses such as hospital, care facilities or schools. Risk criteria are also set for propagation meaning the potential for cumulative effects with other developments.

Table 10-2 Risk criteria

Risk (per annum)	Land use
Fatality	
0.5 in 1 million (5E-07)	Sensitive land uses such as hospitals, care facilities or schools
1 in 1 million (1E-06)	Residential areas including hotels and motels
5 in 1 million (5E-06)	Commercial areas including shops and offices
10 in 1 million (1E-05)	Active open space including sport complexes
50 in 1 million (5E-05)	Industrial areas
Injury	
50 in 1 million (5E-05)	Sensitive land uses and residential areas
Propagation risk	
50 in 1 million (5E-05)	Industrial operations

The contours for fatality risk for sensitive land uses, residential areas, commercial areas, active open space and industrial areas are shown in Figure 10-1. The contours correlate to the risk criteria described in Table 10-2. The contours show that risks to sensitive, residential and commercial areas in the vicinity of the project were well within acceptable risk thresholds defined in *Hazardous Industry Planning Advisory Paper No 4 Risk Criteria for Land Use Safety Planning* (2011b). In other words, the risks posed by the project in these areas were less than the already stringently defined risk thresholds of 0.5, 1 and 5 chances in a million per annum respectively.

As shown in Figure 10-1, the risk contour for sensitive land use along the gas pipeline does not reach any such land uses, or any residential or commercial areas. Accordingly, the risks associated with the pipeline were found to comply with the relevant risk criteria in Table 10-2. It is also noted that the risk contour for residential land use did not reach the cruise ship terminal, which could be considered a residential use, but is about 550 metres from the FSRU.

The risk contours were instead contained to industrial and open areas adjacent to the project. These areas were limited in size and included a section of Seawall Road about 150 metres east of Berth 101 and parts of the coal terminal and Inner Harbour near of Berth 101. The presence of people, vehicles or vessels in these areas would be expected to be transitory and consequently subject to a very low level of risk in the order of 50 chances in a million per annum or fewer.

Seawall Road has the potential to be utilised by members of the public but is understood to be visited relatively infrequently, leads to the end of the breakwater and is not a through road, and is only open during the day, subject to arrival of shipments, weather, security or other concerns that may lead to the road to being shut by NSW Ports.

Parts of the coal terminal near Berth 101 included the existing truck wash station that may be utilised from time to time by visitors to the coal terminal while parts of the Inner Harbour near Berth 101 included areas that may be traversed by other vessels. These areas could be occupied temporarily, from time to time by passing vehicles or vessels including cruise ships.

The risk contour for injury, due to radiant heat from fire and overpressure from explosions, was contained to the area immediately surrounding the LNG carriers, the FSRU and the berth and wharf facilities and would consequently not affect any sensitive land uses or residential areas.

The risk contour for propagation to other facilities, creating a cumulative hazard, was found to be contained to the LNG carrier and FSRU and did not affect surrounding facilities. The assessment included the risk of propagation occurring between these other projects and the gas pipeline but found that the risk of propagation would very low in part due to the pipeline being buried.

The potential for hazard events at surrounding facilities to propagate to the project was also assessed based on a review of hazard assessments completed for the approval of those facilities. The review found the project was also outside modelled risk contours for those facilities indicating a low risk. The assessment included potential for propagation of hazard events to or from the proposed Port Kembla Bulk Liquids Terminal about 600—800 metres to the north/north-east of the berth and wharf.

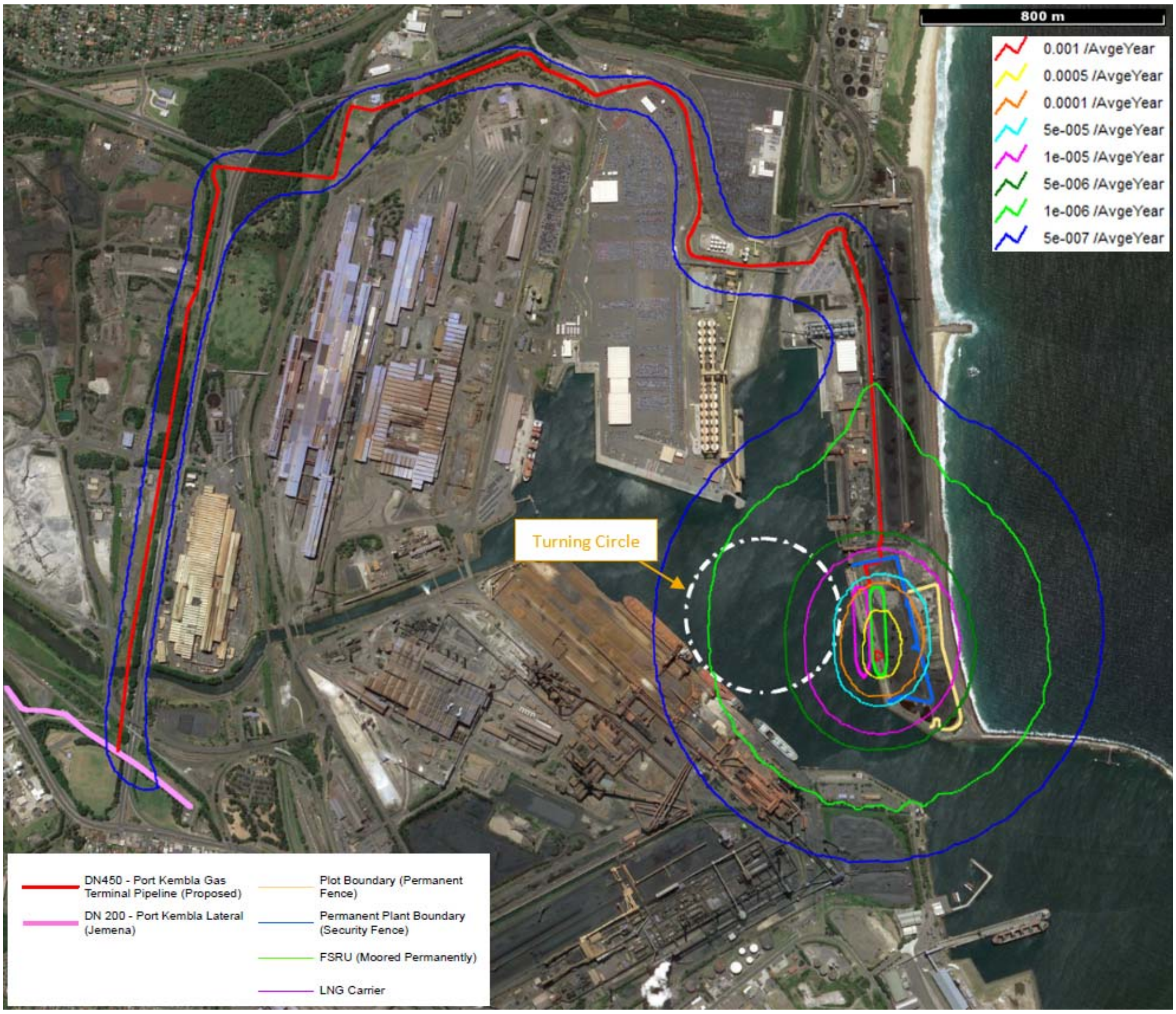


Figure 10-1 Risk contours

10.4 Safety management

10.4.1 Safety in design

The design, construction and operation of the project would be carried out in accordance with global best practice and international, Australian and NSW standards and certifications. This would also include the relevant legislative requirements discussed in Section 6 including those under the *Marine Safety Act 1998* and the *Work Health and Safety Act 2011*.

The FSRU would be designed, constructed and operated in accordance with the *International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk*. The purposes of which is to provide an international standard for the safe transport by sea in bulk of liquefied gases, by prescribing the design and construction standards of ships involved in such transport and the equipment they should carry so as to minimize the risk to the ship, its crew and to the environment, having regard to the nature of the products involved.

As the exclusive supplier of the FSRU to the project, Höegh LNG have an established safety management system with a strong record in terms of safety and environmental incident. For the 2017 calendar year, Höegh LNG achieved a Lost Time Injury Frequency of 0.4 with zero environmental incidents. For the 2018 calendar year to date, Höegh LNG has achieved a Lost Time Injury Frequency of 0.0 with zero environmental incidents. Over this time period (since January 2017) Hoegh carried out 485 ship-to-ship transfers. Further, the FSRU would be independently certified for its compliance with the relevant standards and certifications, being:

- Rules for Classification of Ships
- Classification Note No.61.3 Regasification Vessels

It is expected that independent certification would be carried out by DNV GL, being one of the largest and internationally leading certification agencies of its kind.

A number of safety features and systems would be built into the FSRU to avoid, mitigate and manage hazardous events. These would include fire and gas detection systems, fire protection and firefighting systems, and LNG drainage systems. Evacuation and rescue systems, procedures and protocols would also be in place in the unlikely event of an emergency. Site security and surveillance would be installed to prevent unauthorised access to the facilities.

The fire and gas detection system would provide continuous automatic monitoring throughout the FSRU in order to alert personnel to the presence of abnormal operating conditions and allow for an immediate response. The system would allow response actions to be initiated automatically or manually to minimise the chance of escalation to a hazard event. These automatic or manual actions could include emergency shutdown or isolation, or initiation of the firewater system.

Similar automatic shutdown or isolation systems would be in place in offloading arms at the berth facilities that would allow for automatic shutoff in the event of abnormal operating conditions.

The fire protection and firefighting systems would work in parallel with the fire and gas detection system and would include a combination of active and passive measures. The system would allow for continuous automatic monitoring and emergency shutdown or isolation of affected areas as well as activation of firefighting systems such as a water deluge system.

The FSRU would include multiple design features to avoid, mitigate and manage potential losses of LNG. Losses of LNG would be avoided in the first instance by minimising the instances of design features where losses could occur, such as at flanged valves. An LNG drainage system would be installed and would function to contain LNG in the unlikely event of a leak. The safety drainage system would include collection and containment devices at such locations.

The evacuation and rescue system would include defined evacuation routes throughout the FSRU that would maintain the safety of all personnel as they move through the FSRU. It would also incorporate emergency communication systems, including speakers throughout the FSRU, to provide directions to personnel in the unlikely event of an emergency. The FSRU would be designed to enable the operational workforce to seek shelter in situ in the unlikely scenario of a hazard event occurring on board the FSRU. Safe evacuation routes would also be provided. The escape, muster and rescue systems in operation on board the FSRU would be an important component the vessel's independent certification by DNV GL as discussed above.

The LNG carriers delivering cargo to the terminal would also be required to meet maritime global standards and would be similarly equipped with automated leak detection mechanisms and emergency release and shutdown systems, they are purpose-built to safely transport gas and keep it in its liquid form and are double-hulled to provide protection against accidental leaks or ruptures and to give extra protection to cargoes in the event of a collision.

The gas pipeline in would be designed, constructed and operated (including routine testing and maintenance) in accordance with Australian Standard *AS 2885 Pipelines – Gas and Liquid Petroleum*. Typical safety in design parameters that would be required to comply with the standard would include appropriate burial depth, pipeline wall thickness, cathodic protection to prevent corrosion, and concrete slabs above the pipeline where necessary.

Regular safety drills and training would be carried out throughout the operation of the project. A minimum of 15 personnel would stationed on board the FSRU at any one time, including an appropriate number of marine ticketed personnel. This would ensure the project workforce are able and qualified to appropriately respond in the unlikely scenario of a hazard event occurring on board the FSRU or at a nearby facility. If necessary, the response to such an event could include unmooring the FSRU and navigating away from the hazard to minimise risk.

10.4.2 Safety case

As identified in Chapter 6, the project is expected to require completion of a detail safety case in accordance with the *Work Health and Safety Act 2011* and *Work Health and Safety Regulation 2017*. The safety case would require separate approval from SafeWork NSW and would further detail the safety risks, emergency planning and safety management systems to be put in place.

The safety case would be developed in consultation with SafeWork NSW. The safety case would be a living document that would form the basis for ongoing safety management over the life of the project and would be maintained and updated as necessary. The safety case would include detailed descriptions of the project and identified hazards, safety management systems and related policies, standards, processes, specifications procedures, guidelines and work instructions. It would also provide for routine reporting and auditing of the safety management systems and contain emergency response plans.

10.4.3 Management measures

In addition to various safety features that would be built into the project discussed above, a comprehensive safety management system would be implemented in accordance with relevant regulations, standards and guidelines including the *Hazardous Industry Planning Advisory Paper No 9 Safety Management* (Department of Planning and Environment 2011c).

Table 10-3 outlines the management measures that are proposed to address the hazards and risks of the project. These should be read in conjunction with the safety management features that would be built into the project as discussed in Section 10.4.1. All management measures would be collated in management plans prepared for construction and operation of the project.

Table 10-3 Management measures for hazard and risk

ID	Issue	Measure	Timing
H1	Safety	Hazard identification and design assurance process safety activities such as HAZID, HAZOP and LOPA shall continue in the detailed design phase to ensure that the health and safety risk is reduced to As Low As Reasonably Practicable (ALARP). Major Accident Hazard events and the associated safeguards will be further defined to allow the development of performance standards for safety critical systems and elements.	Design
H2	Safety	A comprehensive safety management system would be developed in line with local standards and industry best practice for facilities handling LNG. The safety management system would address hazards to people and the environment in and around the project. The management system will define how the facility manages all aspects of personnel and process safety from the identification of hazards to the maintenance and testing of safety critical barriers, which either prevent or mitigate releases of LNG, and the emergency response to events from within or external to the project. The safety management system will interface with a computerised maintenance management system to manage facility maintenance of both safety critical and non-safety critical equipment.	Pre-operation
H3	Fire safety	The project would include safety systems including fire detection and firefighting systems in line with *AS 3846-2005 The handling and transport of dangerous cargoes in port areas*. A range of firefighting and protection systems will be installed on board the FSRU including gas detection, emergency shutdown and isolation, and firewater and suppression systems. The wharf area will also host gas detection and firefighting systems.	Pre-operation

11. Soils and contamination

11.1 Overview

This chapter provides a description and assessment of the contamination status of soils, sediments, the potential presence of acid sulphate soils (ASS) and a preliminary waste classification of materials likely to be excavated as part of the project. The potential for contaminated groundwater located within shallow aquifers in the project area to be intersected by the project has also been considered. Investigations were undertaken at the Berth 101 site including an area immediately east of the berth and six anchor points, along the proposed pipeline alignment and within the proposed dredge footprint and disposal area in the Outer Harbour.

This chapter summarises the more detailed contamination assessment reports including:

- Contamination Assessment Report for Berth 101 – Appendix E1
- Sediment Contamination Assessment Report, Preliminary Site Investigation - Pipeline Alignment – Appendix E2
- Sediment Contamination Assessment Report - Appendix E3

The contamination assessments have been undertaken with reference to the NSW EPA approved guidelines.

The scope of the contamination assessment for the Berth 101 site (Appendix E1) broadly includes:

- A description of the existing environment and site history. These were undertaken through a desktop study, which included a review of site history information, and information gathered from a site walkover.
- An assessment of the likelihood for contamination to exist on the site from past or present activities and the potential presence of ASS. The assessment was informed by the desktop study, site walkover and results of soil and groundwater sampling for contaminants of concern. Soil sampling comprised 39 environmental boreholes, opportunistic observations and from the ten geotechnical boreholes. The groundwater sampling program comprised installation of three groundwater monitoring wells, sampling and analysis of groundwater from the newly installed wells and three existing monitoring wells.
- An assessment of the preliminary waste classification of materials likely to be excavated as part of the project.
- Provision of recommendations for further investigation and/or options management in relation to the project (if applicable).

The scope of the contamination assessment for the site of the proposed pipeline alignment (Appendix E2) broadly includes:

- A description of the existing environment and site history. These were undertaken through a desk-top study which included a review of site history information, and information gathered from a site walkover.
- An assessment of the likelihood for contamination to exist on the site from past or present activities and the potential presence of ASS. The assessment was informed by

the results of the desk study, site walkover, search of NSW Environment Protection Authority (EPA) databases, a review of available previous reports conducted within the proposed alignment, field and laboratory testing for key contaminants of potential concern. Laboratory testing comprised opportunistic subsurface sampling (utilising 14 geotechnical boreholes) and analysis for contaminants of concern and acid sulphate soils and preparation of this report.

- Provision of recommendations for further investigation and/or options management in relation to the project (if applicable).

The scope of the contamination assessment for the proposed dredging area and proposed Outer Harbour disposal area (Appendix E3) broadly includes:

- A description of the existing environment including a review of previous contamination assessments, which provide a detailed analysis of the contamination status of the marine sediments of Port Kembla Harbour including assessments of sediments in the dredge area based upon a previously proposed upgrade to Berth 101 in 2012.
- An assessment of the likely contamination based on previous marine sediment investigations, of the sediments and contamination and additional site investigations to supplement the extensive historical baseline date for the project site. This was undertaken through a marine sediment investigation comprising seven sampling locations within the dredge footprint off Berth 101 and two locations at the reclamation area including vibracoring (five locations) and hand coring (four locations). Laboratory analysis was undertaken for 17 samples from the cores for contaminants of potential concern, 28 samples for screening for potential acid sulphate soils and 12 samples for chromium reducible sulphur suite.
- Provision of recommendations for further investigation and/or options management in relation to the project (if applicable).

For detailed contamination assessment methodologies for all three assessments, refer to Appendix E1, E2 and E3.

11.2 The project and potential contamination

Aspects of the project that relate to potential disturbance to contaminated soils and groundwater include excavation activities for establishment of the new berth, dredging and disposal activities and pipeline installation. These are described in detail within Chapter 5 with key activities relating to soils and contamination outlined below for context to the assessment of contamination risks.

11.2.1 Berth 101 and the Outer Harbour disposal site

Excavation of Berth 101 will likely proceed as follows.

Preliminary land based activities will include the following:

- Demolish existing Berth 101
- Remove and stockpile existing rock revetment
- Excavate fill layer across site to remove existing slabs, foundations and services

Once these enabling works are complete the excavation of the in-situ material beyond the new quay wall could proceed using a Long Reach Excavator. Due to the limitation on reach of such excavators currently in use in the area, it is possible that excavation of deeper material may need to be dredged. The backhoe dredger would be situated in the Inner Harbour adjacent to Berth 101 and would primarily be used to excavate the deeper sediments at Berth 101.

Material will be excavated into heavy haul trucks which will relocate the material into an area at the rear of the Berth 101 site (current Coal Terminal East Stockyard). The area potentially available for stockpiling is around 400 metres long by 50 metres wide. The stockpile will be up to 10 metres high ready for truck transportation.

Material disposal during construction

Stockpiled material from the Berth 101 excavation will be relocated to a disposal site within the Outer Harbour. A perimeter bund will be constructed to ensure the stability of the disposal site. This bund will need to be constructed on relatively stiff material which will necessitate the removal of existing soft sediments that have previously been placed across the disposal site.

Trucks will transport Berth 101 materials to the Outer Harbour site where they will be placed close to the shore line to be pushed out by bulldozers. Material dredged by the backhoe dredger would be put in barges for transport to the Outer Harbour for disposal. The volume of material to be excavated by long reach excavator and transported by haul truck versus the volume of material to be dredged by backhoe dredger and transported by barge may vary depending on the preference and capacity of the construction contractor.

The material removed during dredging off Berth 101, would be disposed on the south side of the Outer Harbour in a designated reclamation area

11.2.2 Proposed pipeline alignment

Trenching and horizontal drilling during construction

The gas pipeline is proposed to be constructed progressively by a combination of trenching and horizontal directional drilling.

Trenches would be progressively excavated to a depth of between about 1 and 1.5 metres for the length of the gas pipeline route except where horizontal directional drilling would be utilised. Trenches would be progressively backfilled with bedding material, subsoil and then topsoil. The backfilled areas would be progressively restored to their pre-existing landform or land use.

Horizontal directional drilling would be used instead of trenching to avoid impacts to some surface features such as road, rail, waterways and other environmentally sensitive areas. Initially horizontal directional drilling would require the excavation of launch and receive pits at either end of the horizontal directional drill. A horizontal directional drilling rig would then be employed to drill a conduit between the launch and receive pits. The conduit would be drilled by progressively adding drilling head lengths at the drilling rig for the length of the horizontal directional drill. Once drilled, a pre-welded and x-ray inspected section of pipeline is pulled through the open hole.

11.3 Existing environment

11.3.1 Berth 101

Current land use

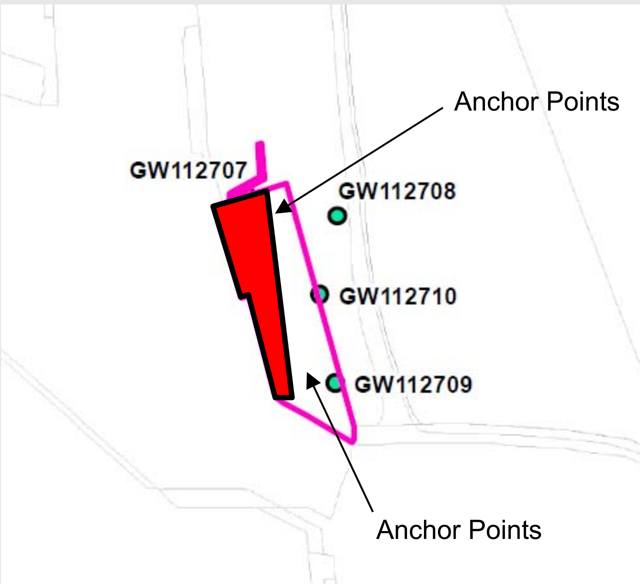
The existing land at Berth 101 the adjoining land uses comprise industrial and coal terminal.

Topography, drainage, soil, geology & hydrogeology

Table 11-1 summarises the topography, drainage, soil, geology and hydrogeology associated with the site of Berth 101.

Table 11-1 Topography, drainage, geology and hydrogeology at Berth 101

Elevation:	Between 3 metres and 5 metres above Australian Height Datum (AHD) (from Google Earth Pro).
General slope direction:	Information obtained from Google Earth Pro indicates that the berth gently slopes down towards the south and west.
Closest surface water body:	Berth 101 is adjacent to the Inner Harbour (Tom Thumb Lagoon) and Port Kembla Harbour. Tom Thumb Lagoon, a remnant saline coastal lagoon, has been progressively reclaimed through pot development; originally 500 hectares in area, the lagoon is now 50 hectares (BES 2010, p. 15).
Drainage:	Surface water is generally directed to the PKCT stormwater system, which includes a number of settlement ponds; one of which is located immediately south-east of Berth 101.
Regional geology:	The 1:100,000 Geological Series Sheet of Wollongong-Port Hacking indicates that the regional underlying geology is Quaternary sediments described as quartz and lithic fluvial sand, silt, and clay.
Site specific geology: (DP, 2014)	The *1:100,000 Geological of the Wollongong-Port Hacking Sheets 9029, 9129* indicates that the site is underlain by Quaternary sediments described as quartz and lithic “fluvial” sand, silt and clay. The site is located on land reclaimed for the establishment of the Inner Harbour and consists of mixed fill of unknown origins.
Acid Sulphate Soils (ASS):	The ASS Risk Map indicates that the Berth (in red outline) is situated in an area mapped as disturbed terrain at an elevation >4 metres (shown in grey shading). Estuarine sediments exist within the harbour and are mapped as high probability of ASS. 
Soil landscape:	Disturbed Terrain

Groundwater bore search:	The four closest registered bores are located within or adjacent to the Berth's eastern boundary and are groundwater monitoring wells installed by Douglas Partners (DP, 2014). 
Depth to groundwater:	Based on previous reports, standing groundwater levels were measured between 3.87 metres and 6.6 metres below ground surface (DP 2014, p. 25)
Inferred groundwater flow direction:	Groundwater is expected to be tidally influenced, with a general flow towards the south-west (DP 2014, p. 24).

Site history

Available site history information indicates Berth 101 (also known as the Bulk Products Berth) was constructed in 1964 and commissioned for the loading of coal, coke and slag. Dredge material from the Inner Harbour and steelworks slag may have been used in the berth's construction, although the source of fill could not be confirmed.

The berth had an array of surface infrastructure including substation, conveyors and a diesel underground storage tank (UST). Majority of the surface infrastructure was removed in around 2011 and the UST was removed in the early 1990's. No evidence of contamination was observed at the time of UST removal.

Relevant historical details identified in the site history searches are shown on Figure 11-4.

Site observations

Key site observations at Berth 101 (19 August and 25 September 2018) were as follows:

- The investigation area comprised Berth 101 and immediately surrounding area to the east. The investigation area largely comprised of near level open concrete surfaces or gravel surfaces. Coal stockpiling was taking place at the time of fieldwork towards the southern end of the investigation area, this area is slightly raised due to the stockpiling activities.
- A decommissioned coal conveyor belt is positioned to the east of the investigation area, aligned in a north-south direction, located behind a concrete wall that broadly separates

the greater area into two halves. Concrete panels were present from structures now partly demolished and steel frames and elevated walking platforms were seen in several areas around the site. An electrical substation was seen on the western side of the site, at the southern end of the berth, this area was largely fenced off with brick structures built around some areas. The substation was in relatively good condition with no leaks or damage observed. Anthropogenic material was observed generally scattered across the whole site, including slag, steel, plastic and wood.

- Several services are present on-site including an above ground water pipe which was observed on the western side of the site positioned in a north-south direction. A buried low pressure oil pipeline was also present along a similar alignment running to the west of the water pipe. An asbestos water pipe is located east of the substation and two fragments of suspected asbestos containing material (ACM) were noted. No suspected ACM was observed within other areas of the site.
- Two large stockpiles, approximately 700 cubic metres to 800 cubic metres of mixed sandy gravel material were observed in the south-western section of site, slag gravel, cobbles and boulders were seen mixed with this stockpiled material. Water was found to be largely captured by internal site drainage except in areas were the coal was stockpiled, ponding was found to occur due to inadequate drainage in these areas. A partitioned pond was observed in the southern portion of Berth 101 and outside the proposed excavation area and anchor points.
- Large industrial equipment and plant including coal loaders were observed on paved areas around the site. The site is actively used by light and heavy vehicles at most times of the day.
- There is no permanent vegetation or trees in the investigation area, only small patches of grasses and weeds.

11.3.2 Proposed pipeline alignment

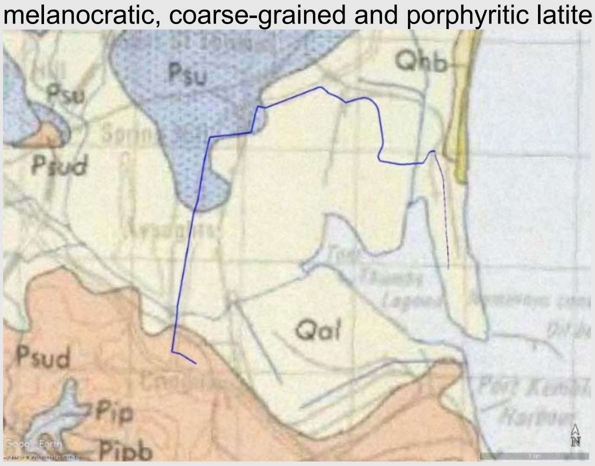
Current land use

The existing land use along the proposed pipeline alignment comprises land currently occupied by PKCT, Bluescope Steel and NSW Ports industrial facilities as well as crossing road and rail infrastructure and public parkland.

Topography, drainage, soil, geology & hydrogeology

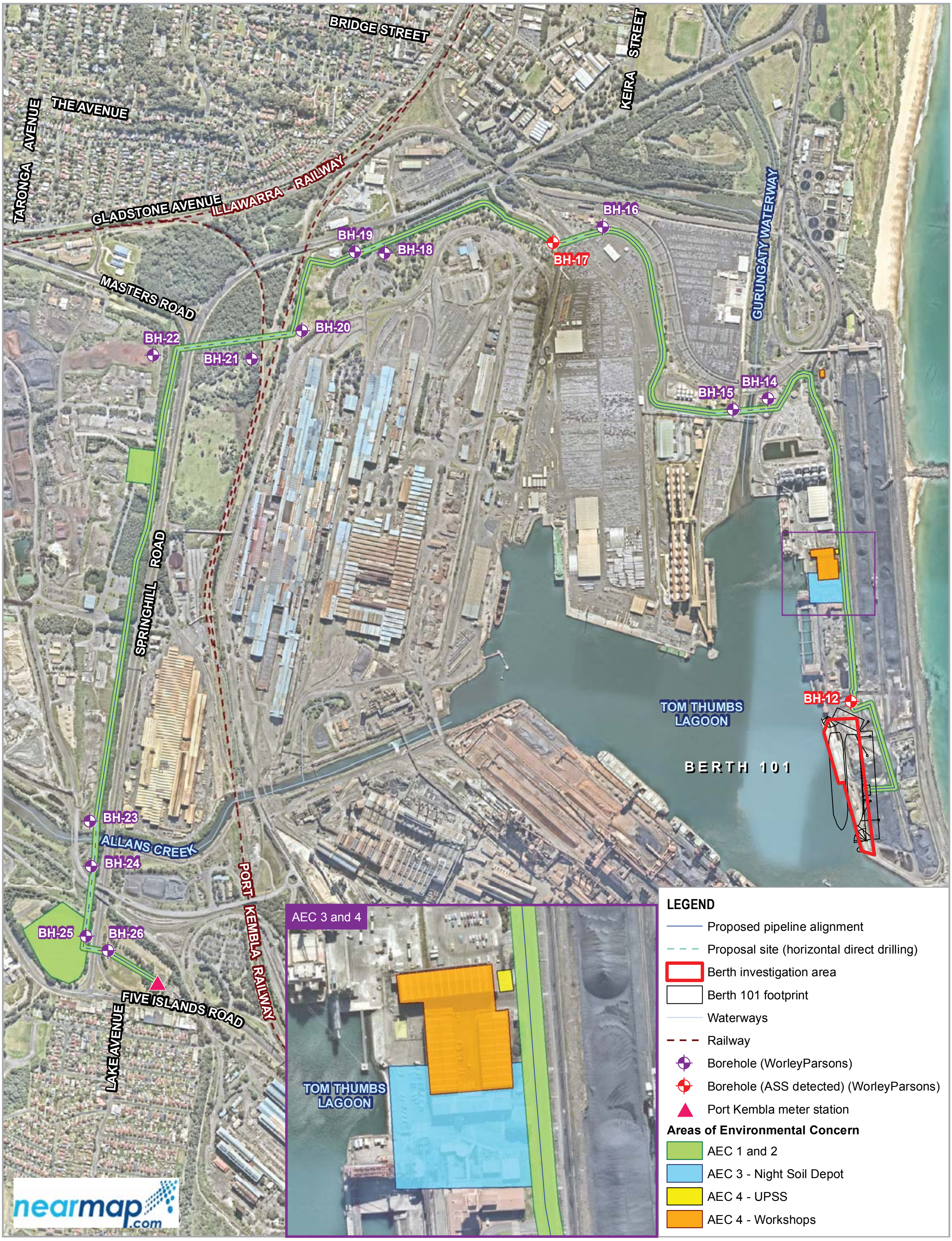
Table 11-2 summarises topography, drainage, soil, geology and hydrogeology associated with the site of the proposed pipeline alignment.

Table 11-2 Topography, drainage, geology and hydrogeology of the proposed pipeline alignment

Elevation:	Between 1 metre and 16 metres above Australian Height Datum (AHD) (from NSW Land and Property Information).
General slope direction:	Natural landforms along the pipeline alignment have been heavily altered by human activity. Where residual natural slope remains in the western extent of the alignment the site slopes generally south and / or east towards the nearest waterbody (Allans Creek or Inner Harbour). Areas on the southern side of Allans Creek slope to the north. All other areas and in particular the eastern extent of the alignment are generally level or with a slight grade towards Inner Harbour
Closest surface water body:	The pipeline alignment crosses Allans Creek in the south and Gurungaty Waterway in the north east. All parts of the alignment will ultimately drain into Inner Harbour (Tom Thumb Lagoon) either through surface runoff, stormwater drainage systems. Tom Thumb Lagoon, is a remnant saline coastal lagoon, has been progressively reclaimed by development of the Steelworks and Port Kembla harbour. The Lagoon was originally 500 hectares and now has an extent of 50 hectares (BES 2010, p. 15).
Drainage:	Where ground surfaces have hardstand coverage surface water drainage is generally directed to PKCT, BlueScope or public road stormwater systems, which include a number of settle ponds in PKCT area. Where no hardstand coverage exists it is expected that surface water will penetrate ground surfaces at a rate reflective of local soils. It is expected in high rainfall events, surface water will flow directly into the harbour or connecting tributaries.
Regional geology:	The *1:100,000 Geological of the Wollongong-Port Hacking Sheets 9029, 9129* indicates that the site is underlain by three geological units (Most of the alignment is underlain by Quaternary sediments (Qal) described as quartz and lithic "fluvial" sand, silt and clay. The north western extent of the alignment is underlain by the Budgong Sandstone (Psu) of the Shoalhaven Group, described as red, brown and grey lithic sandstone. The area on the southern side of Allans Creek is underlain by the Dapto Latite Member (Psud) of the Shoalhaven Group, described as melanocratic, coarse-grained and porphyritic latite. 

Soil landscape:	The *Soil Landscapes of the Wollongong-Port Hacking 1:100,000 Sheet* indicates the site is underlain by **Disturbed Terrain**. The topography of this landscape varies from level plains to undulating terrain and has been disturbed by human activity to a depth of at least 100 cm. The original soil has been removed, greatly disturbed or buried. Most of these areas have been levelled to slopes of <5%. Landfill includes soil, rock, building and waste material. The original vegetation has been completely cleared. Limitations of this soil landscape are dependent on the nature of fill material resulting in a mass movement hazard (subsidence), soil impermeability leading to poor drainage, low fertility and toxic material. Care must be taken when these sites are developed.
Site specific geology: (WorleyParsons, 2018)	A concurrent geotechnical investigation of the berth and pipeline route was undertaken by WorleyParsons. To assist with the preparation of this report GHD was supplied with field logs from this investigation which have been summarised below and in Section 11.5.2 with locations shown in Figure 11-1. Fill materials encountered generally contained coal, coal wash and slag with trace fragments of asbestos containing materials and other anthropogenic materials. Residual soils were encountered in all locations and tended towards sand in the east with increasing clay content in the western extents of the alignment. Bedrock was not encountered in the east within the depth of investigation (up to 30.0 metres at BH15) but consisted of predominately siltstone or mudstone in the west
Acid Sulphate Soils:	The *Wollongong 1:25,000 Acid Sulfate Soil Risk Map* indicates that the pipeline alignment is underlain by areas of Disturbed Terrain (grey) from 2 metres to > 4 metres thickness or areas of No Known Occurrence (no colour). Estuarine sediments (dark pink) exist within Allans Creek, Gurungaty Waterway and Inner Harbour and are mapped as having a high probability of occurrence of acid sulphate soils. 

Groundwater bore search:	A search of publically registered groundwater bores within 500 metres of the alignment returned 61 results, of these only a single bore (GW100678) contained standing water level information. This location is on the western extent of the pipeline alignment, approximately 150 metres east of the alignment and had a standing water level of 8.2 metres. Bores with reliable location data are shown in the image below. 
Depth to groundwater:	Based on information obtained during the concurrent WorleyParsons geotechnical investigation and the groundwater bore search groundwater along the western boundary of the site is inferred to be between 4.5 metres and 8.2 metres. Based on the above and recorded ground conditions it is anticipated that groundwater along the alignment will stabilise at approximately sea level. Localised ground conditions such as shallow bedrock, material porosity, material permeability, proximity to surface water bodies and tides are likely to cause variation on geographical and temporal scales.
Inferred groundwater flow direction:	Groundwater is expected to be tidally influenced in areas in close proximity to surface water bodies, with a general flow towards the nearest surface waterbody.



Paper Size ISO A4

0 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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GHD

Australian Industrial Energy
Port Kembla Gas Terminal
Pipeline PSI
Berth 101, Port Kembla, NSW, 2505

Project No.	21-27477
Revision No.	-
Date	05/11/2018

AECs and Site Features

FIGURE 11-1

G:\21\27477\GIS\Maps\Deliverables\Contam\PipelinePSI\21_27477_Z004_PipelinePSI_AECs.mxd

Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

Site history

Available site history information indicates that the proposed pipeline alignment was generally unoccupied until between 1951 and 1961. Development along the pipeline alignment commenced between 1951 and 1961 and included the upgrade of transport infrastructure to the current standard, the reclamation of land within Tom Thumb Lagoon and the construction of the steelworks and port facilities. The site usage has remained heavy industrial since this period and site activities appear to have been relatively unchanged since 1994.

Relevant site features identified in the site history searches and locations of previous investigations are shown on Figure 11-1.

Site observations

Key site observations (19 August and 25 September 2018) are as follows:

- **PKCT Boundary** - The walkover was conducted along the main access road within PKCT site boundary and immediately north of the boom gates along Port Kembla Rd. The pipeline route exits the Berth 101 area and heads north running adjacent to the main road of PKCT. Buildings, including administration and project buildings are located to the west of the pipeline route, while coal stockpiles and loaders are present to the east. The route follows Port Kembla Rd, heading north past the boom gates until the intersection of Tom Thumb Rd and Port Kembla Rd. Drainage in these areas is likely to get captured by internal drainage systems or existing road drainage as most of the landscapes are paved surfaces.
- **Bluescope visitor carpark area** - The walkover was conducted in the area around the Bluescope visitor car park which was in the general vicinity of WorleyParsons geotechnical borehole BH-19 (refer to Figure 11-1 for location). The area immediate area around BH-19 was mainly lightly vegetated with grasses and light tree cover, the vegetation did not appear to be distressed. The area to the south-west of BH-19 was a visitor carpark for BlueScope, south south-east are the boom gates and entrance into BlueScope. There was a building west of BH-19 and paved car parking area located behind it. Drainage in this area is likely to infiltrate into the soil in unpaved areas, with runoff expected to get captured in existing stormwater drains.
- **Cnr Five Islands Rd & Springhill Rd** - The walkover was conducted on the grassed reserve on the corner of Five Islands Rd and Springhill Rd The immediate area south, east and north of BH-26 was a grassed reserve (refer to Figure 11-1 for location); existing gas infrastructure was present in this area and the location where the proposed pipeline is expected to cross Springhill Road. Drainage in this area is likely to infiltrate into the soil in unpaved areas, with runoff expected to get captured in existing stormwater drains located on Springhill Rd.

There was no direct evidence of stockpiling or surface contamination (e.g. asbestos) in the areas directly observed. It is likely that fill does exist in all areas given the location is a built environment and the proximity to roads and major services is seen in all areas.

11.3.3 Dredging area and the proposed Outer Harbour disposal area

Site observations

The site for investigation of marine sediment contamination consists of two areas. One comprising the waters off Berth 101 and the other area in the Outer Harbour, where the dredge sediment will be disposed of as part of harbour reclamation works. These are shown in Figure 11-2 and Figure 11-3.

The wharf of Berth 101 extends into the water and is supported by timber piles. Revetments consisting of angular boulders protect the shoreline to the south of Berth 101, comprising half of the length of the study area. The water off Berth 101 is a high traffic area for cargo ships accessing the eastern and western basins of the Inner Harbour. The water off Berth 101 was turbid with a high suspended sediment load, water based dust suppression systems were observed on Berth 101 and a coal/coke stockpile was located at the northern end of Berth 101, these are assumed to be contributing runoff to the marine area.

The disposal area encompasses a portion of the waters of the Outer Harbour, and has a wharf at its eastern end approximately 150 metres from the Outer Harbour wall. The wharf is armoured on its western side with angular boulders, and the remainder of the shoreline on the southern side is comprised of a sand beach at water level. The area is low traffic for shipping with smaller vessels using the wharf. Water of the reclamation area was of lower turbidity, with a reduced suspended sediment load.

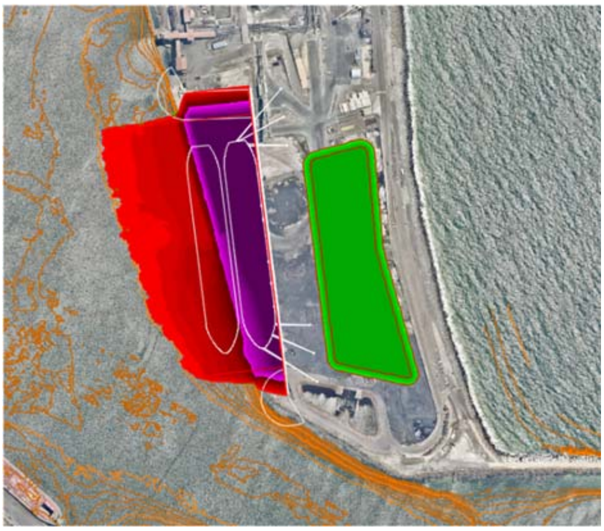

Figure 11-2 Excavation of Berth 101

Purple area is the current Berth 101 and the red is the proposed dredging area. Green is the proposed stockpiling area.

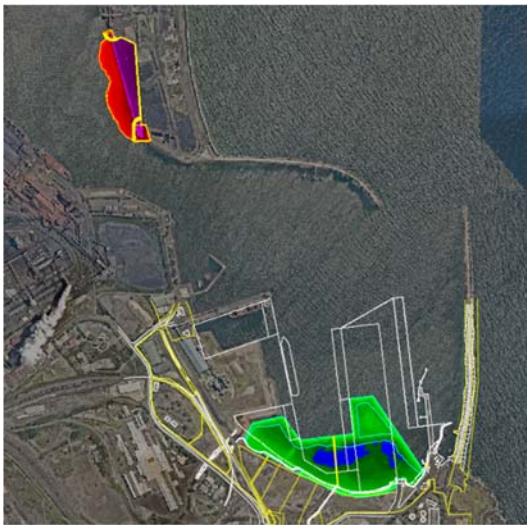

Figure 11-3 Proposed disposal area

The blue-green area southeast of the Berth 101 is the proposed disposal area.

Historical investigations

Previous investigations have been undertaken to assess the contamination of the marine sediments in Port Kembla Harbour including detailed analysis of sediments adjacent to Berth 101 by Worley Parsons in 2012 and in the Outer Harbour by AECOM in 2010 as part of the Outer Harbour Development project. For detail on the samples taken, the exceedances/non-exceedances reported and the recommendations and conclusions made, refer to Appendix E3.

From the previous investigations, the following points are noted:

- Commonly two main sedimentary units were identified with a soft silty clay layer overlying a stiffer clay layer.
- The upper soft silty clays were contaminated throughout all sampling areas.

- Heavy metals commonly exceeded the screening levels for cadmium, chromium, copper, lead, nickel, mercury and zinc.
- Tributyltin, dioxins and PAHs were reported above the nominated guidelines in several studies.

The investigations identified a number of activities that would have likely contributed to the possible contamination of marine sediments including:

- Industrial discharges associated with licensed activities
- Spill events within the harbour
- Overflows from Port Kembla Sewage Treatment Plant during storms
- Catchment road and industrial runoff
- Particulate matter, e.g. coal dust, through atmospheric deposition
- Redistribution of previously contaminated sediments through tug manoeuvring, passage of deep draft vessels and currents action , e.g. during floods
- Redistribution of sediments during dredging and sweeping operations
- Leaching from reclaimed and waste filled areas of the harbour foreshores
- Antifoulant coatings leaching and flaking, e.g. TBT

11.4 Assessment criteria

The criteria applied in the contamination assessments (Section 11.5) are detailed in Appendix E1, E2, and E3. The sources of these criteria are provided below.

11.4.1 Soil contamination

The soil assessment criteria was sourced from the following:

- NEPC (1999) National Environment Protection (Assessment of Site Contamination) Amendment Measure (No. 1) 2013 (NEPM)
- Friebel and Nadebaum (2011) CRC Care Technical Report No. 10 – Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater

Exceedances of the soils and groundwater contamination criteria do not necessarily mean that remediation is required, however they should be regarded as triggers for further assessment, (e.g. a site specific risk assessment), and/or management.

11.4.2 Groundwater contamination

Laboratory results for groundwater samples will be compared to guidelines which afford protection to the identified receptors (human direct contact and marine water) and are contained within the following references:

- ANZECC/ARMCANZ (2000) [1]Australian Water Quality Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council and

[1] ANZG (2018) criteria were endorsed by NSW EPA under S105 of the CLM Act on 4 September 2018. At the same time the ANZECC (2000) water quality guidelines were revoked. While the ANZG (2018) have been endorsed, AZNG (2018) authors have stated that there were not intended to be any new criteria to ANZECC 2000 at the time of publishing. However, a preliminary review of the AZNG guidelines by GHD and others has identified a number of discrepancies with ANZECC (2000)

Agriculture and Resource Management Council of Australia and New Zealand, Canberra, October 2000. For a working harbour, 80% species protection level criteria are considered to be applicable for this highly modified environment and have been adopted.

- National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended in 2013), (NEPC 2013), National Environment Protection Council, Canberra (this document references ANZECC 2000)Verbruggen, E.M.J. (2004) Environmental Risk Limits for Mineral Oil (Total Petroleum Hydrocarbons) for the National Institute for Public Health and the Environment, Netherlands, Report Ref: RIVM report 601501021/2004.
- Friebel and Nadebaum (2011) CRC Care Technical Report No. 10 – Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater, listed in Table 1A(4).

11.4.3 Waste classification

Waste classification of site soils is undertaken in general accordance with the six step procedure for classifying waste as detailed in the Waste Classification Guidelines - Part 1: Classifying Waste (NSW EPA, 2014). Because excavated material may contain potential or actual ASS, the waste classification has also been carried out in accordance with Waste Classification Guidelines - Part 4: Acid Sulfate Soils.

11.4.4 Acid sulphate soils

ASS criteria applied to the assessment has been sourced from Queensland guidance:

- QLD (2014) Acid Sulfate Soils Technical Manual – Soil management Guidelines V4.0 based on greater than 1,000 tonnes of fine texture soils to be disturbed. Which is based on the guidelines of the Acid Sulphate Soils Management Advisory Committee (ASSMAC 1998).

11.4.5 Sediment contamination

The sediment assessment criteria was sourced from the following guidelines:

- National Assessment Guidelines for Dredging (NAGD 2009).
- ANZECC/ ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality (as recommended in the NAGD (2009)).

11.5 Potential impacts

11.5.1 Berth 101

As discussed in Section 11.4.1, the site is a highly disturbed area with evidence of historical contamination. As a result, the investigations and sampling focused on soil and groundwater contamination and identification of ASS.

An analysis of the results from the previous investigations and sampling and a comparison with adopted criteria (Section 11.4) are provided below. Management measures recommended to reduce/ eliminate the impacts of contamination are provided in Section 13.5.

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which have yet to be clarified. As such, ANZECC (2000) criteria have still been adopted for the purposes of this report until the issues with ANZG (2018) have been resolved.

Soil contamination

Fill was encountered at all locations up to 5.5 metres depth, typically comprising gravelly sand and sandy gravel overlying sand (probable reclaimed sand). Results show that contamination in the fill material within the area to be excavated at Berth 101 is relatively minor, and generally consistent.

As shown in Figure 11-4, the laboratory analytical results for soil samples taken from boreholes were below adopted criteria with the exception of two soil samples which exceeded the adopted criteria. These were at GHB09 and GBH26 and were for BaP (TEQ) (health criterion) and for heavy end petroleum hydrocarbons (Management Limits) near the inferred base of fill material between 4 metre to 5 metres below ground level.

A summary of the laboratory analytical results are as follow:

- Samples GBH09/4.2-4.4 and GBH26/4.75-4.90 m had benzo(a)pyrene (TEQ) concentrations of 150 mg/kg and 110 mg/kg, respectively, which exceed the HIL-D assessment criterion of 40 mg/kg.
- Samples GBH09/4.2-4.4 and GBH26/4.75-4.90 m had TRH F3 (>C_{16}-C_{34}) concentrations of 5,400 mg/kg and 4,100 mg/kg, respectively, which exceeds the Management Limit for this fraction of 3,500 mg/kg.
- Fibre cement samples PACM 1 and PACM 2 collected from the ground surface east of the substation were identified to contain chrysotile, amosite and/or crocidolite. Asbestos was also tested in selected soils samples. No asbestos was detected in soil samples.

Remaining contaminants of potential concern (COPC) tested were below the reporting limit of adopted assessment criteria where available.

Source-pathway-linkages identified for contamination at Berth 101 indicates that it is unlikely to pose any significant constraints to the project, subject to further assessment of the extent of BaP TEQ hotspots and mitigation measures developed to manage potential health impacts during construction works. Potential risks to marine environmental receptors from relocation of the berth material are considered low and acceptable based on measured concentrations of contaminants.

Asbestos was identified on site in the form of fragments of asbestos containing material (ACM) on the ground surface (refer to the Site Observations subsection in Section 11.3.1). These are assumed to be associated with historical demolition on site. No asbestos was identified in samples below the ground surface, and it is therefore unlikely that asbestos containing materials are present in the fill, although this cannot be precluded.

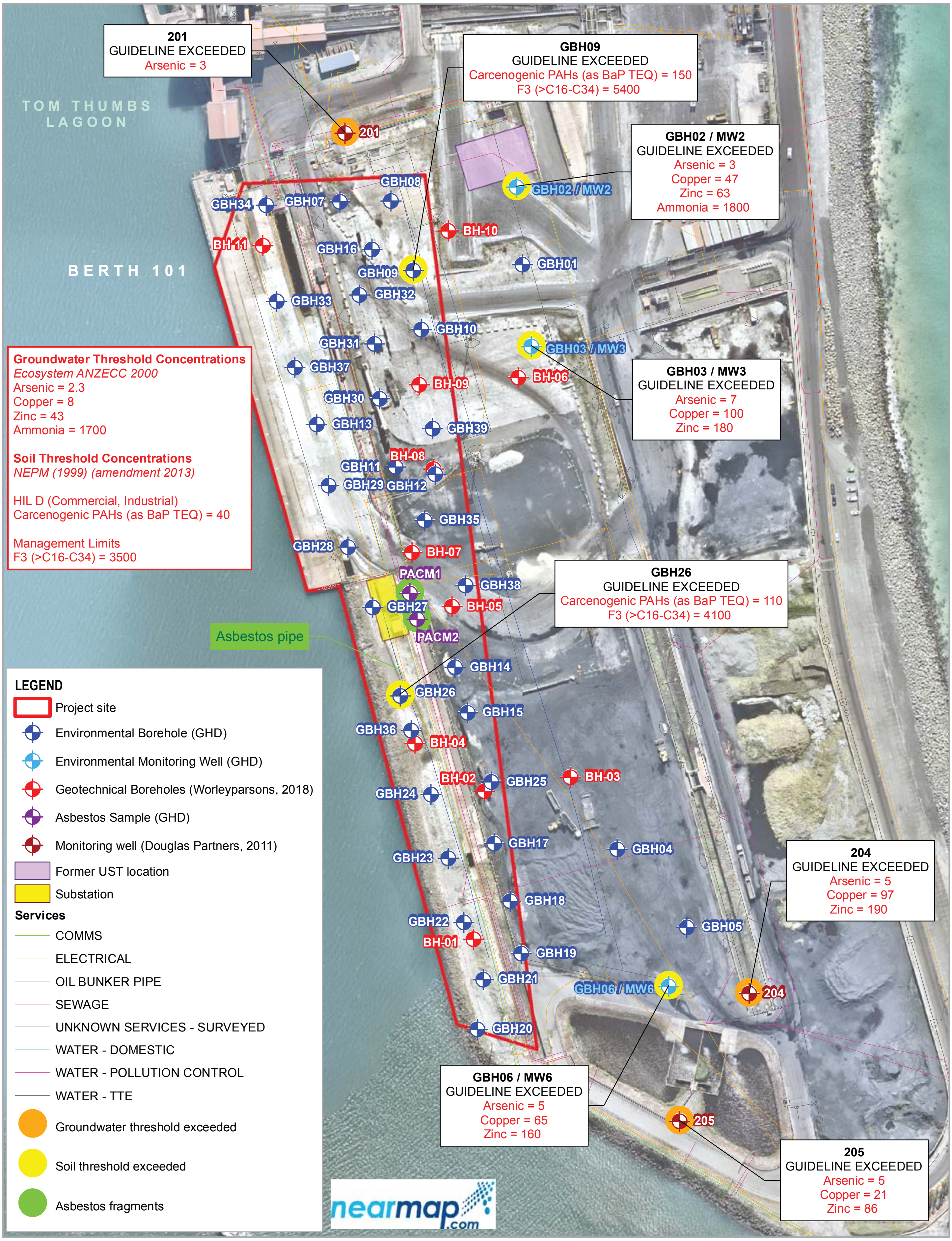
Groundwater contamination

Groundwater inflows were typically encountered in at depths between about 3.7 metres and 5.0 metres. No hydrocarbon odours were noted in groundwater during drilling or sampling at any of the wells. No evidence of non-aqueous phase liquids (NAPL) was observed during groundwater sampling. No odours or sheens were noted on the surface of the groundwater from monitoring wells during purging and sampling for the remaining locations.

As shown in Figure 11-4, three GHD environmental monitoring wells exceeded the adopted criteria for arsenic, copper, zinc and ammonia.

Concentrations of TRH, BTEX, PAH and remaining heavy metals were either close to or below the laboratory limit, which was also below adopted assessment criteria.

Overall, some relatively minor impacts from heavy metals and ammonia were identified in a perched fresh to brackish groundwater lens within Berth 101. The size of the lens is not well understood, however, the proposed piling and excavation works will limit the amount of perched water discharging into the marine environment, which will in any event significantly attenuate the concentrations of contaminants observed in this investigation.



Paper Size ISO A4

0 40 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Australian Industrial Energy
Port Kembla Gas Terminal
Preliminary Contamination Assessment
Berth 101, Port Kembla, NSW, 2505

Soil and Groundwater Exceedances at Berth 101

Project No.	21-27477
Revision No.	-
Date	05/11/2018

FIGURE 11-4

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

Acid sulphate soils

Field screening and laboratory results of 170 samples show that ASS occurs in natural sediments below the fill (variable and to depths between 2.5 metres and 5.5 metres below ground level) to at least 14 metres depth and probably beyond, particularly where dark grey and green clays exist.

Disturbance as a result of construction activities, primarily excavation and dewatering, of these natural sediments have the potential to impact the surrounding marine environment. The activities will need to be carefully managed and it is recommended that an Acid Sulphate Soil Management Plan (ASMP) is prepared by a consultant experienced in the identification and management of ASS (refer to Section 11.6).

Preliminary waste classification

The preliminary waste classification assessment of fill and underlying natural materials in the event that off-site disposal to land is required, is General Solid Waste (non-putrescible) based on the available data. This classification was undertaken in accordance with NSW EPA (2014) Waste Classification Guidelines, Part 1 – Classifying Waste. This preliminary classification needs to be confirmed during excavation works, and is not applicable to any material types, which differ in nature from those sampled.

Results show that proposed excavated material contains ASS. Therefore, handling, treatment and disposal of ASS will be carried out in accordance with Part 4 of the waste classification guidelines (EPA 2014).

Erosion and sediment control

Construction activities at Berth 101 have the potential to cause erosion of sediment and mobilisation of contaminants into the nearby marine environment. The erosion risk is considered relatively low as the site is flat and implementation of appropriate controls with reference to the *Managing Urban Stormwater: Soils and Construction Volume 1* (The 'Blue Book'; Landcom, 2004) together with management of controls for the dredge area (described below) will limit the potential for impacts upon receiving waters in the Inner Harbour.

Conceptual site model

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM is developed using information obtained from previous investigations, site history, site observations, proposed land use and expected ground conditions. Once the contamination status is understood through the sampling and analysis process, the CSM then allows the assessor to evaluate the risk posed by the contamination to the identified receptor, and whether remediation is required to manage that risk.

The potential Source-Pathway-Receptor (SPR) contaminant linkages identified at the Berth 101 site is provided in Table 11-3.

Table 11-3 Source-Pathway-Receptor linkages for Berth 101

Sources (Primary and secondary)	Pathway	Receptor	Potentially Complete?
Contaminated fill impacted by volatile /semi-volatile compounds (impacted by either historic or current leaks or spills from former underground infrastructure)	Volatilisation and lateral migration to outdoor air and subsequent inhalation.	Construction workers / Intrusive Maintenance Workers	No – no volatile contaminants were detected above adopted criteria.
	Direct contact (during material handling)	Construction workers / Intrusive Maintenance Workers	No – no volatile contaminants were detected above adopted criteria.
	Direct contact/ leaching	Marine environment (disposal area)	Unlikely, volatile contaminant concentrations were low in soil, and below detection in groundwater.
Contaminated fill impacted by non-volatile compounds	Direct contact (during material handling)	Construction workers / Intrusive Maintenance Workers	**Possible** – concentrations of BaP TEQ exceeded HIL-D at two locations within the fill between 4 – 5 bgl. However, material handling is likely to be short duration, and further assessment / mitigation should address this risk.
	Direct contact/ leaching	Marine environment (disposal area)	Unlikely, contaminant concentrations in soil were generally low. While two locations indicated concentrations of BaP and PAH well above background, leachability testing of BaP was < LOR as were groundwater results.
Asbestos	Dust inhalation	Construction workers / Intrusive Maintenance Workers	Unlikely – while two fragments of asbestos were confirmed at ground surface, this is likely from historical above ground demolition. No asbestos was detected in the fill, however its potential presence cannot be discounted.

Sources (Primary and secondary)	Pathway	Receptor	Potentially Complete?
Dissolved phase volatile contaminants in groundwater	Volatilisation and lateral migration to outdoor air and subsequent inhalation.	Construction workers / Intrusive Maintenance Workers	No – no volatile contaminants were detected above adopted criteria.
Dissolved phase volatile and non-volatile contaminants in groundwater	Direct contact / incidental ingestion	Construction workers / Intrusive Maintenance Workers	Unlikely – contact with groundwater is unlikely in the deep excavation, and would be expected to be controlled by mitigation measures in a construction and environmental management plan.
	Lateral migration in groundwater.	Ecological receptor (marine environment)	Unlikely – while concentrations of some contaminants are above adopted criteria in the lens of groundwater sampled, the volume of impacted perched fresh water is likely to be small, and any discharges would be rapidly attenuated within the marine environment.

Based on review of the potential SPR linkages, it is considered that the only potentially complete linkage for the project is exposure to carcinogenic PAHs in fill material by construction workers as a result of direct contact during excavation and material handling. This should be further assessed to confirm whether management will be required during redevelopment.

11.5.2 Proposed pipeline alignment

Four potential areas of environmental concern (AEC) were identified as part of the desktop investigations as shown on Figure 11-1 and outlined below :

- AEC 1 - Fill materials along the entire pipeline alignment including dredged materials, coal and coal by-product, steel production by-product (slag) and possible building demolition materials
- AEC 2 - Spills and surface application of fuels along the entire pipeline alignment, oils and other chemicals associated with current and former industrial land uses
- AEC 3 - Historical impacts associated with former nightsoil depot within PKCT
- AEC 4 - Current and historical impacts associated with use of land adjacent to the alignment as workshops and fuel depots.

The site shows evidence of historical contamination (AEC3 and AEC4) and potentially contaminating activities have been occurring in the area since the 1950s. The pipeline alignment potentially intersects with the former Night Soil Depot, which is located in the poorly defined area within PKCT. Due to the age of the depot and the time since active use the likelihood of residual contamination from this source is considered low. Later site activities including reclamation and land filling are likely to have further reduced the contamination potential.

The land adjacent to the alignment as workshops and fuel depots is considered to have a moderate likelihood of contamination. Previous investigations did not identify any contamination likely to be associated with the UPSS infrastructure at the PKCT refuelling depot. Impacts from current or historical sources along the alignment have not been specifically identified by this investigation but are considered possible in a localised context along the alignment.

Based upon the findings from the desktop study, soil sampling for waste classification and identification of ASS was undertaken. An analysis of the results from the sampling and comparison with adopted criteria (Section 11.4) are provided below.

Subsurface conditions

The investigation was concurrent with a geotechnical investigation of the pipeline route being conducted by WorleyParsons. Fill materials have been identified along the entire pipeline alignment and have been found to include dredged materials, coal and coal by-product, steel production by-product (slag) and possible building demolition materials, and potentially contaminating activities have been occurring in the area since the 1950's.

Soil contamination

With regards to human health and management limits, the laboratory analytical results for soil showed that no exceedances of adopted human health assessment criteria were reported in soil samples. Laboratory results were consistent with field observations.

Limited soil sampling and analysis conducted opportunistically as part of the concurrent WorleyParsons geotechnical investigation did not identify any widespread, gross contamination; however it is insufficient to provide a detailed understanding of the contamination status of soils along the alignment. Fill materials are considered to have a moderate likelihood of contamination based upon current and previous land use.

Groundwater contamination

The groundwater along the western boundary of the site is inferred to be between 4.5 metres and 8.2 metres. Trench excavation is expected to be between about 1 and 1.5 metres deep with deeper excavation required during directional drilling, particularly to traverse roads and railway lines and waterways.

Any groundwater encountered during construction has potential to be contaminated and will need to be appropriately managed.

Acid sulphate soils

Preliminary assessment of site soils for ASS identified actual ASS at two borehole location at depth of (>12.25 metres and 7.5 metres) and are from buried lagoon sediments. This is consistent with the findings of the investigation within the Berth 101 investigation area and is considered to be representative of the overall pipeline alignment.

The majority of trenching will be undertaken within fill material and is unlikely to disturb the deeper natural sediments more likely to contain ASS.

Construction activities will need to be carefully managed and it is recommended that an ASSMP is prepared by a consultant experienced in the identification and management of ASS (refer to Section 11.6).

Preliminary waste classification

Preliminary waste classification of collected samples indicates that the soils sampled as part of this investigation would be classified as General Solid Waste should off-site disposal be required. This does not constitute a full waste classification of material within the pipeline alignment and additional sampling and assessment will be required in order to confirm classification of specific materials to be disposed of off-site.

Assessment and classification of all material to be disposed of offsite as per NSW EPA (2014) *Waste Classification Guidelines, Part 1: Classifying Waste* and *Part 4: Acid Sulfate Soils* prior to off-site disposal.

Erosion and sediment control

Trenching and directional drilling has potential to cause erosion of sediment and mobilisation of contaminants into the nearby marine environment. The erosion risk is considered relatively low as the site is predominantly flat and implementation of appropriate controls with reference to the *Managing Urban Stormwater: Soils and Construction Volume 1* (The 'Blue Book'; Landcom, 2004 will limit the potential for impacts upon nearby receiving waters.

Conceptual site model

The potential SPR contaminant linkages identified for the proposed pipeline alignment site is provided in Table 11-4.

Table 11-4 Source-Pathway-Receptor linkages for the proposed pipeline alignment

<table>
<tr><th>AEC</th><th>Source</th><th>Pathway</th><th>Receptor</th></tr>
<tr><td>1</td><td>Fill material along alignment</td><td rowspan="3">Dermal contact with contaminated soil or groundwater.
Inhalation of dust from contaminated soils.
Inhalation of vapours/gases generated by soil and groundwater contaminated by volatiles and semi-volatiles (if present)</td><td rowspan="3">Future workers
Future site users
Intrusive maintenance workers</td></tr>
<tr><td>2</td><td>Surface spills associated with current and former land use</td></tr>
<tr><td>4</td><td>Adjacent workshops and refuelling depot</td></tr>
<tr><td>3</td><td>Historical night soil depot</td><td>Dermal contact with contaminated soils
Inhalation of dust from contaminated soils</td><td>Future workers
Future site users
Intrusive maintenance workers</td></tr>
</table>

While no potentially complete linkages have been identified through the sampling undertaken in this assessment, it should be noted that the sampling has been limited in nature, and the pipeline crosses over six kilometres of filled industrial land. Therefore, contamination has the potential to be encountered and should be anticipated when developing construction environmental management plans for the project.

11.5.3 Dredging area and the proposed Outer Harbour disposal area

Sediments within the proposed dredging and disposal areas are known to be contaminated as a result of historical use of the port. A review of previous investigations found:

- The upper soft silty clays were contaminated throughout all sampling areas.
- Heavy metals commonly exceeded the screening levels for cadmium, chromium, copper, lead, nickel, mercury and zinc.
- Tributyltin (TBT), dioxins and polycyclic aromatic hydrocarbons (PAHs) were reported above the nominated guidelines in several studies

During construction, dredging activities and transportation of material to the Outer Harbour will result in the suspension of sediments into the water column with associated impacts to the marine environment. This has been considered further as part of chapter 12 and 13.

Based upon the findings from the desktop study, additional sediment sampling within the dredge footprint off Berth 101 and at two locations within the disposal area was undertaken. An analysis of the results from the sampling and comparison with adopted criteria are provided below.

Subsurface conditions

Two main sedimentary units were identified in the dredge footprint at Berth 101 comprising a soft silty clay layer overlying a stiffer clay layer. Sediments encountered at the disposal area were stratigraphically different to Berth 101, predominantly comprising black-brown clayey silt.

Anthropogenic inclusions were noted in sediments at the disposal area including coal waste material, wood and concrete fragments interpreted as fill including a 10 centimetre layer of coarse coal waste.

Elevated metal concentrations were reported above the nominated screening levels in the dredge footprint at both Berth 101 and the disposal area. Other contaminants of potential concern, including PAH, TBT and hydrocarbons reported 95% UCL average concentrations below the nominated screening levels in the dredge area at Berth 101.

With the exception of one sampling location at the disposal area (REA01-1-1.5), concentrations of heavy metals were generally consistent between the Berth 101 dredging area and disposal area. Some metals, notably lead, mercury and zinc, were recorded in concentrations an order of magnitude higher within the disposal area than in samples taken outside of it. With the exception of one sample (REA01_1-1.5), Similarly concentrations of PAH, TBT and TPH in the disposal area were largely consistent with data reported for the dredge area, with the exception of one sample in the disposal area.

Dioxin levels were largely consistent across the two sampling areas with the sediments from the Berth 101 dredge footprint and disposal area reporting WHO $TEQ_{(0.5\ LOR)}$ of 9.4 ppt and 12.2 ppt respectively. Whilst Australian guidelines for dioxins are not currently available, these levels are within the range of background concentrations reported for Australian sediments (Muller et al., 2004) and consistent with the mean WHO $TEQ_{(0.5\ LOR)}$ reported by Worley Parsons (2012) of 15.4 ppt.

Analytical results were generally consistent with those reported previously by others including for the Outer Harbour Project and Worley Parsons (2012) for a previously proposed development of Berth 101. No new contaminants of potential concern were identified at levels exceeding screening criteria during the current investigation. Elutriate testing was not completed during the current investigation. However, based on the comparison of data with previous sampling events, the results of elutriate testing reported by AECOM (2010), Worley Parsons (2012) and Geochemical Assessments (2013) are considered relevant to these works and likely indicative of current conditions.

Overall, the findings of the investigation indicate the presence of contaminated sediments within the proposed dredging and disposal areas. Concentrations of contaminants of concern were largely consistent across the two areas, with the primary contaminants of concern including heavy metals, PAH and dioxins at concentrations above the nominated screening levels.

A dredging management plan should be prepared prior to the dredging of Berth 101, outlining the contamination management and mitigation measures, including surface water monitoring, which will be implemented during the course of the works to minimise potential impacts to the receiving waters (refer to Section 11.6).

Acid sulphate soils

Samples for potential acid sulphate soil (PASS) were initially submitted to the lab for a pH field screen. The results for pH_F range from 8.2 to 8.9. pH_{Fox} ranged from 5.1 to 8 with one sample with a value of 2.3. All samples showed a strong or extreme reaction with a decrease in pH for all samples ranging from 0.4 to 6.1. While a final pH of less than 3.5 is considered an indicator of PASS, they cannot be excluded here as pH is often higher when samples are from a marine source.

Consistent with the findings of previous investigations including AECOM (2010), Worley Parsons (2012) and Geochemical Assessments (2013), the results indicate the presence of PASS and potential acid generating capacity of the sediments.

Given the presence of acid sulphate soils in all measured samples an acid sulphate soil management plan should be devised if there is a likelihood that dredged material could become oxidised during the removal and disposal process (refer to Section 11.6).

11.6 Management measures

Table 11-5 outlines the management measures, including recommendation for further investigation, that are proposed to address the contaminations issues associated with project. All management measures would be collated in management plans prepared for construction and operation of the project.

Table 11-5 Management measures for contamination

ID	Issue	Measure	Timing
C01	Contamination at Berth 101	One or more of the following is proposed for assessing the potential risk to human health the two BaP (TEQ) hotspots identified at GHB09 and GBH26: • Development of a human health risk assessment for BaP (TEQ), to further refine the potential risk posed by these contaminants to future construction workers. Given the short duration of the works relative to the standard exposure assumptions in a commercial/industrial scenario, it is likely that derived site specific target levels for BaP (TEQ) would be higher than adopted for this assessment. • Additional investigation to delineate the vertical and lateral extent of BaP (TEQ). The investigation would involve step out borehole locations which will target materials at depths between 4 m and 5 m, to assess if the contamination is isolated or widespread. • The source of BaP (TEQ) at GHB09 and GBH26 was not identified nor was there apparent evidence of this contamination present at the time of sampling. The contamination may be a characteristic of the fill material, meaning it could be randomly distributed throughout the fill matrix. Therefore, in addition to further investigation, bioavailability testing is also recommended so that the risk to human health is better understood and appropriate safety control measures can be adopted during construction. The laboratory is presently maintaining these samples pending further analysis.	Pre-construction
C02	Contamination at Berth 101	Removal of any remnant ACM fragments from the ground surface. The removal should be undertaken by a licenced removalist in accordance with relevant SafeWork NSW codes of practice. Following removal, a licenced asbestos	Construction

ID	Issue	Measure	Timing
		assessor should inspect the site and provide a clearance certificate confirming removal of asbestos.	
C03	Contamination at Berth 101	Inclusion of an unexpected finds protocol for contamination in the Construction Environmental Management Plan (CEMP) for the work associated with construction activities.	Construction
C04	Berth 101; Proposed pipeline alignment; Dredging area and disposal area	Preparation of an ASSMP by a consultant experienced in the identification and management of ASS. This will also include appropriate treatment and / of management of ASS. The ASSMP will be developed in line with the requirements of the Acid Sulphate Soils Management Advisory Committee Guidelines (ASSMAC, August 1998 and as updated). The ASSMP will be prepared to identify, manage and treat the ASS encountered during excavation and dredging to minimise the production of acid leachate.	Construction
C05	Proposed pipeline alignment	Preparation and implementation of a construction environmental management plan (CEMP) to include an unexpected finds protocol (UFP) to effectively manage the potential contamination issues identified from both a human health and environmental perspective. This would include the assessment of materials to be disturbed across the site to inform appropriate management strategies	Construction
C06	Proposed pipeline alignment	Assessment and classification of all material to be disposed of offsite as per NSW EPA (2014) Waste Classification Guidelines, Part 1: Classifying Waste and Part 4: Acid Sulfate Soils prior to off-site disposal.	Pre-construction
C07	Proposed pipeline alignment	If the proposed pipeline alignment is likely to intersect groundwater, assessment of groundwater quality in those sections should also be carried out to inform construction management of potential contamination issues.	Construction

ID	Issue	Measure	Timing
C08	Dredging area and disposal area in the Outer Harbour	A dredge management plan will be prepared prior to the dredging of Berth 101, outlining the contamination management measures, including: • surface water monitoring, which will be implemented during the course of the works to minimise potential impacts to the receiving waters • use of a turbidity curtain to restrict the generation of turbidity plumes and localise any water quality issues	Construction

12. Water resources

12.1 Introduction

This chapter provides an assessment of the project's impacts to water quality, hydrodynamics and hydrology during construction and operation. The existing setting, including historical ambient water quality within the port is described and assessed in the context of development of the proposed LNG import terminal. Management measures to reduce the impact of the project on water quality, hydrodynamics and hydrology have been developed with reference to industry best practice.

Water quality, hydrodynamic and hydrology impacts have been considered through studies and assessments undertaken as part of the project's development and guidelines set by the industry, including:

- Guidelines set by Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000).
- Guidelines set by the NSW Marine Water Quality Objectives in NSW (DEC, 2006).
- Guidelines set by National Assessment Guidelines for Dredging (Commonwealth of Australia, 2009)
- Port Kembla Outer Harbour Development Environmental Assessment Report (Aecom, 2010)
- Long Waves, Sediment & Thermal Plume Modelling Report (Cardno, 2018) included as Appendix F in Volume 2.

The above studies, assessments and guidelines have been used to form the basis of this chapter.

12.2 Existing environment

12.2.1 Marine Water Quality Objectives

The National Water Quality Management Strategy (NWQMS) provides a national framework for improving water quality in Australia's waterways. The main policy objective of the NWQMS is to achieve sustainable use of the nation's water resources, protecting and enhancing their quality, while maintaining economic and social development.

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000) is a benchmark document of the NWQMS which provides a guide for assessing and managing ambient water quality in a wide range of water resource types and according to specified environmental values. The guidelines provide a framework for determining appropriate values or performance criteria to evaluate the results of water quality monitoring programs against defined objectives or values for the receiving waters. For each environmental value, the guidelines identify particular water quality characteristics or 'indicators' that are used to assess whether the condition of the water supports that value.

The Marine Water Quality Objectives (WQOs) were adopted by the NSW Government in 2005 and are intended as a guideline tool for strategic planning and development assessment (DEC 2006). The WQOs are consistent with the national framework for assessing water quality set out in the ANZECC 2000 Guidelines and include five objectives which describe the water quality needed to protect the following marine water quality values:

- Aquatic ecosystems i.e. aquatic ecosystem health
- Primary contact recreation i.e. swimming, surfing
- Secondary contact recreation i.e. boating, wading
- Visual amenity i.e. aesthetic qualities of waters
- Aquatic foods i.e. water suitable for growing seafood

In the case of Port Kembla Harbour, the relevant values relate only to Aquatic Ecosystems and Visual Amenity, for which the relevant guideline levels for ambient water quality are presented in Figure 12-1.

Marine Water Quality Objectives	**Aquatic ecosystem health** **To maintain or improve the ecological condition of ocean waters.**	**Visual amenity** **To maintain or improve ocean water quality so that it looks clean and is free of surface films and debris.**
Examples of indicative guideline levels for environmental (ambient) water quality The indicative guideline levels (indicators and numerical criteria) listed are examples only of some of the relevant water quality guideline levels recommended in the ANZECC & ARMCANZ Guidelines 2000. For a full list, refer to the appropriate tables as referenced in the ANZECC & ARMCANZ Guidelines 2000. These are available at www.deh.gov.au/water/quality/nwqms/index.html	**Biological** • Frequency of algal blooms – no change from natural conditions • Bioaccumulation of contaminants – no change from natural conditions. **Physico-chemical** • **Nutrients** Total Nitrogen < 120 µg/L Total Phosphorous < 25 µg/L • **Turbidity** 0.5–10 NTU* **Toxicants in coastal waters** • **Metals** Copper < 1.3 µg/L Lead < 4.4 µg/L Zinc < 15 µg/L • **Pesticides** Chlorpyrifos < 0.009 µg/L **Toxicants in bottom sediments** • **Metals** Copper < 65 mg/kg dry weight Lead < 50 mg/kg dry weight Zinc <200 mg/kg dry weight Mercury < 0.15 mg/kg dry weight • **Organochlorines** Chlordane < 0.5 µg/kg dry weight Total PCBs < 23 µg /kg dry weight	**Indicators to ensure water looks clean and free from pollutants** • **Surface films and debris** Oils and petrochemicals should not be noticeable as a visible film on the water, nor should they be detectable by odour. Waters should be free from floating debris and litter. • **Nuisance organisms** Macrophytes, phytoplankton scums, filamentous algal mats, blue-green algae, and sewage fungus should not be present in unsightly amounts.

Figure 12-1 Relevant guideline levels for ambient water quality (DEC 2006)

The ANZECC Guidelines provide the technical guidance to assess the water quality needed to protect identified environmental values. This guidance includes indicators (specific monitoring parameters) and numerical criteria (guideline limits for each parameter) for ambient water quality which must be considered in light of the individual development location.

It should also be noted that the environmental values and respective numerical indicator values apply to ambient background water quality and are not intended to be applied to point source discharges or mixing zones.

The guidelines have formed the basis of previously complete water quality assessment and would form the basis of further water quality monitoring proposed to be undertaken as outlined in Section 12.4.

12.2.2 Water quality within the port

Water quality within the Inner Harbour and Outer Harbour of Port Kembla has been historically impacted by urban and industrial discharges as well as port activities. In particular, these past activities led to contamination of marine sediments, groundwater and harbour waters. Further discussion of historical and current contaminant levels in the vicinity of the project site are described in Chapter 11 and Appendix E.

Water quality monitoring studies have been previously undertaken in order to define ambient water quality within the port and to monitor water quality parameters during previous dredging campaigns. Key water quality monitoring programs undertaken within the Inner Harbour and Outer Harbour of Port Kembla include the following:

- Port Kembla Water Quality Monitoring Program undertaken by BHP between 1990 and 1999.
- Port Kembla Harbour Water Quality Monitoring Program undertaken by the Port Kembla Environment Group between 2002 and 2005.
- Blue Scope Steel Water Quality Monitoring Program undertaken by the Port Kembla Environment Group between 2007 and 2008.
- MPB3 / Berth 107 Dredging Water Quality Monitoring Program undertaken by Cleary Bros on behalf of Port Kembla Port Corporation between 2006 and 2008.
- Outer Harbour Tug Berth Dredging Water Quality Monitoring Program undertaken on behalf of Port Kembla Port Corporation in 2011.
- Outer Harbour Stage 1A Reclamation Water Quality Monitoring Program (including baseline and impact monitoring) undertaken on behalf of Port Kembla Port Corporation between 2011 and 2012.
- Maintenance Dredging Water Quality Monitoring Program undertaken by ENRS on behalf of NSW Ports in late 2014.

The 2002-2005 monitoring program undertaken by the Port Kembla Environment Group is considered to be the most comprehensive study of ambient water quality conditions within the Port. The program aimed to establish benchmarks to determine trends and future improvements in water quality and assess whether contaminant concentrations exceed the ANZECC / ARMCANZ Guidelines (2000). The program identified monitoring locations within the Inner and Outer Harbours which have been subsequently adopted by a number of programs and are presented below in Figure 12-2.

Analysis of the following parameters was undertaken and the results compared to relevant trigger values derived from the ANZECC / ARMCANZ water quality guidelines (2000):

- Metals (Al, Cr, Mn, Fe, Ni, Cu, Zn, Sn, Pb, Cd, As, Se);
- Total Suspended Solids (TSS)

- Cyanide
- Ammonia
- Phenols

More recent monitoring programs associated with the 2014 Maintenance Dredging Program also considered the following parameters:

- Temperature
- Salinity
- Dissolved Oxygen (DO)
- pH
- Oxygen Reduction Potential (ORP)
- Turbidity

Figure 12-2 Port Kembla monitoring locations

It is important to note that in many instances the historical laboratory Limits of Reporting (LOR) adopted during previous studies are greater than the assessment criteria, meaning that the laboratory was not able to confirm whether contaminant concentrations were above or below the relevant criteria. Consequently, the results of detailed analysis of the full data set would be misleading and would be considered of relatively little value. Nevertheless, it is possible to summarise the key issues relating to existing water quality within the port through review of these previous investigations. Further observations of the historical water quality data set are summarised in Table 12-1.

Table 12-1 Historical water quality

Parameter	Summary of historical results
Contaminants	Water samples collected under ambient conditions during the 2002-2005 monitoring program undertaken by the Port Kembla Environment Group identified concentrations of aluminium, cadmium, copper, lead, zinc, tin and arsenic in excess of the ANZECC (2000) 95% trigger values for protection of marine waters. Concentrations of all other analytes were below the adopted trigger values. Elevated levels of adverse water quality parameters were generally found in the vicinity of creeks and waterways that drain industrial and stockpile areas such as the entrance to Allans Creek (Site 1), Gurangaty Waterway (Site 5), near No. 1 Products Berth (Site 3), the Cut (Site 7) and Darcy Road Drain (Site 15).
Suspended Solids / Turbidity	TSS concentrations are known to be influenced by shipping movements and freshwater flood events. Long term data collected during the 2002-2005 monitoring program undertaken by the Port Kembla Environment Group measured average TSS concentrations of 5.9mg/L and 3.2mg/L within the Inner and Outer Harbours respectively. TSS concentrations within the Inner Harbour were shown to vary between 1.0mg/L and 17.9mg/L. TSS concentrations within the Outer Harbour were shown to vary between 0.5mg/L and 11.8mg/L. Previous dredging campaigns (Berth 103) established a relationship between Nephelometric Turbidity Units (NTU) and Total Suspended Solids (TSS) of 1 NTU = 2mg/L TSS. It is critical to note that the relationship between NTU and TSS is highly dependent on the material properties of the sediments in suspension.
pH	Previous monitoring campaigns have recorded pH levels within the Inner and Outer Harbour ranging between 7.6 and 8.1 and in some instances below the recommended ANZECC criteria for harbour waters (8.0-8.5). Previous investigations concluded that pH levels are lower in the Inner Harbour than the Outer Harbour, indicating pH levels within the Inner Harbour are likely influenced by freshwater discharges from existing waterways.
Temperature	Water temperatures within Port Kembla are generally higher than those measured offshore due to tidal flushing patterns and existing industrial discharges to the Inner Harbour. As a result, water temperatures within the Inner Harbour are generally one to two degrees warmer than sea temperatures beyond the entrance to the harbour. The Outer Harbour benefits from greater tidal flushing and is generally less than 0.25 degrees warmer than sea temperatures beyond the entrance to the harbour.

Parameter	Summary of historical results
Salinity	Total Dissolved Solids (TDS) concentrations assessed during 2014 maintenance dredging campaign ranged from 31.15g/L to 35.38g/L. Concentrations have been shown to vary with depth indicating density stratification within the water column. Concentrations are also known to be influenced by freshwater flood events.

12.2.3 Hydrodynamics

Port Kembla's Inner Harbour is considered a relatively low energy environment with relatively low discharges from creeks and drains and relatively little wave energy propagation into the Inner Harbour. Tidal planes and percentage exceedance tables for offshore wave heights are provided in Table 12-2 and Figure 12-3 respectively.

The Outer Harbour is known to be impacted by long wave events, which are typically multi-directional, with long waves from multiple directions occurring at the same time. The predominant directions are from the east, the north, and also from the west, which is likely to be due to waves reflecting off the beach. Further information is provided in Appendix F.

Table 12-2 Tidal Planes for Port Kembla

Tidal Plane	Tidal Level (m PKHD)
Highest Astronomical Tide (HAT)	2.0 m
Mean High Water Springs	1.5 m
Mean High Water Neaps	1.3 m
Mean Sea Level	0.9 m
Mean Low Water Neaps	0.6 m
Mean Low Water Springs	0.3 m
Lowest Astronomical Tide (LAT)	0.0 m

PERCENTAGE EXCEEDANCE FOR Significant Wave Height(m)

Hsig	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	Hsig
0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.000	0.00
0.50	100.00	99.94	99.99	99.86	99.47	99.37	99.36	99.62	99.94	99.91	99.98	99.89	99.775	0.50
1.00	90.51	91.36	89.89	82.46	78.61	75.27	77.58	74.43	80.62	83.91	85.66	85.93	82.897	1.00
1.50	45.82	49.47	48.14	46.18	45.71	47.09	45.25	39.41	42.32	44.08	44.13	44.05	45.059	1.50
2.00	16.09	23.31	21.49	21.88	23.24	25.05	24.54	20.33	19.49	19.66	18.55	17.92	20.957	2.00
2.50	5.40	9.97	9.25	9.68	11.01	13.13	13.01	10.93	9.15	9.34	8.11	6.41	9.631	2.50
3.00	1.65	3.69	3.69	4.40	5.18	6.73	6.47	5.46	4.27	4.32	3.62	2.37	4.338	3.00
3.50	0.44	1.44	1.64	1.83	2.18	3.43	3.47	3.00	1.73	1.92	1.53	0.82	1.966	3.50
4.00	0.12	0.42	0.86	0.84	0.83	1.62	1.64	1.73	0.65	0.97	0.67	0.23	0.890	4.00
4.50	0.03	0.17	0.57	0.43	0.46	0.66	0.75	1.06	0.22	0.37	0.26	0.05	0.425	4.50
5.00	0.01	0.03	0.26	0.15	0.28	0.28	0.36	0.69	0.08	0.19	0.12	0.02	0.209	5.00
5.50	0.00	0.00	0.06	0.03	0.15	0.09	0.14	0.41	0.06	0.12	0.04	0.00	0.094	5.50
6.00	0.00	0.00	0.04	0.01	0.10	0.02	0.04	0.19	0.02	0.05	0.01	0.00	0.040	6.00
6.50	0.00	0.00	0.02	0.00	0.07	0.01	0.00	0.04	0.01	0.00	0.00	0.00	0.013	6.50
7.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.006	7.00
7.50	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.002	7.50
8.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.002	8.00
8.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	8.50
Average :	1.53	1.62	1.61	1.58	1.56	1.64	1.56	1.52	1.48	1.56	1.55	1.52	1.58	
Maximum :	5.01	5.39	6.88	6.14	8.43	6.74	6.30	7.41	6.65	6.47	6.09	5.62	8.43	
Minimum :	0.56	0.41	0.50	0.29	0.29	0.29	0.29	0.34	0.38	0.43	0.29	0.29	0.29	

Figure 12-3 Port Kembla percentage exceedance for significant wave height (MHL, 2018)

12.2.4 Hydrology

The proposed berth will be located at the existing Berth 101, which is characterised as a relatively flat area of reclaimed foreshore, where stormwater is currently managed via a series of detention basins (associated with the site's current use as a coal terminal).

The pipeline would cross Gurungaty Waterway in the north-east and Allans Creek in the south. Both waterways flow through highly disturbed land and have been modified through previous industrial development at Port Kembla, with modified banks and are crossed by numerous man-made structures including pipelines and bridges. Gurungaty Waterway does contain small areas of mangrove and saltmarsh upstream from the pipeline crossing and Allans Creek drains natural catchment areas of the Illawarra Escarpment.

The proposed Outer Harbour disposal area lies immediately seaward of Salty Creek and the Darcy Road Drain. These waterways drain heavily developed industrial catchments to the south and serve important functions with respect to conveying flood flows and wastewater effluent.

Both waterways have been heavily modified in order to facilitate industrial development of the adjacent lands.

It is also important to note that the approved Port Kembla Outer Harbour Development proposes to redirect and extend Salty Creek and the Darcy Road Drain through the proposed reclamation area. Further information regarding the existing catchments and approved future modifications are contained within the 2010 Environmental Assessment (Aecom, 2010).

12.3 Potential impacts

12.3.1 Construction

Potential construction phase impacts are primarily associated with water quality impacts generated during the removal, handling and placement of dredged sediments. In particular, dredging and reclamation activities may generate turbid plumes, mobilise contaminants, disturb dinoflagellate cysts within the Outer Harbour and increase rates of sedimentation.

Construction is proposed to commence in 2019 and for a duration of around 10 to 12 months. During construction the total amount of material that will be dredged and excavated at the new berth is around 600,000 cubic metres. Allowing for typical bulking factors, this volume would equate to around 720,000 cubic metres.

Excavation and dredging would be carried out by long reach excavator and backhoe dredger. The long reach excavator would be situated on land and would primarily be used to excavate the existing berth and revetment with road haulage to the Outer Harbour for disposal.

The backhoe dredger would be situated in the Inner Harbour adjacent to Berth 101 and would primarily be used to excavate the deeper sediments at Berth 101. The volume of material to be excavated or dredged may vary depending on the preference and capacity of the construction contractor.

The backhoe dredger will be used to remove material and load split hopper barges for transport to the disposal area in the Outer Harbour. Prior to placement of the dredged material within the Outer Harbour, it will be necessary to first construct a perimeter bund to ensure the stability of the disposal site. Construction of the bund will require removal of an existing layer of soft sediments that have been previously placed within the reclamation footprint. This activity will be undertaken using a backhoe dredger and hopper barge to relocate the material from within the footprint of the bund to the central portion of the reclamation area.

It is expected that two split hopper barges will be used with the capacity of around 1,200 cubic metres each. Removal of material at the berth will take place on a continuous basis whilst disposal barges will place material within the Outer Harbour every 4 to 6 hours.

A numerical modelling report has been prepared by Cardno (2018) which outlines the investigations undertaken in order to define the potential impacts associated with hydrodynamics, wave energy and sediment and thermal plume dispersion. The existing, calibrated 3-Dimensional hydrodynamic model of Port Kembla has been extended and applied as shown in Figure 12-4. The model utilises the Deltares modelling software, Delft3D, which has been previously used to assess similar projects within Port Kembla such as the Outer Harbour Development.

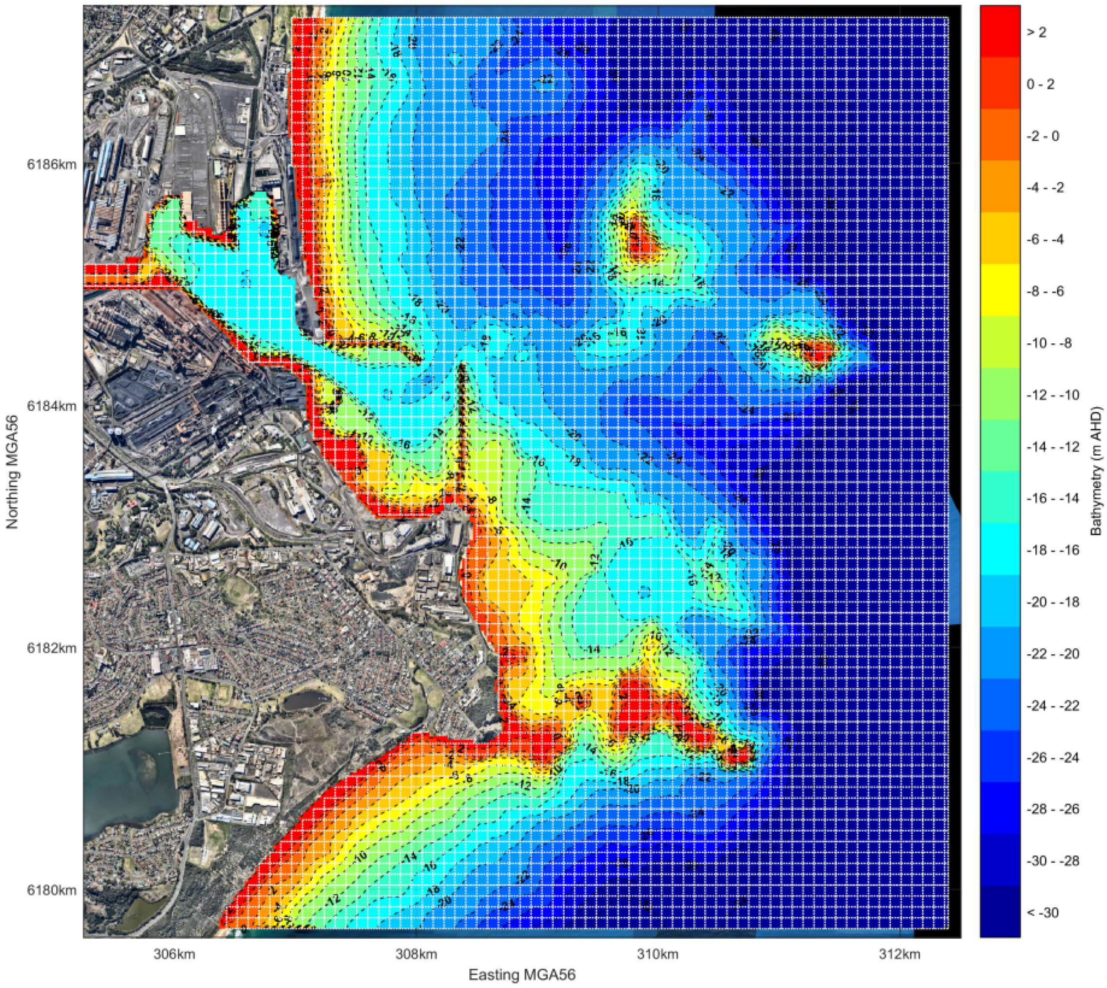

Figure 12-4 Delft 3D Model extent and bathymetry (Cardno, 2018)

A copy of the report is provided in Appendix F and a summary of the key results and conclusions relating to potential construction impacts is provided below. Results relating to the potential impacts associated with the operation of the facility are summarised in Section 12.3.2.

Dredge plume dispersion

Based on review of the proposed work methodology and available geotechnical information, the removal and placement of the harbour muds from the berth area was identified as the activity with the greatest potential to impact water quality. Model scenarios were developed in order to assess impacts to Total Suspended Solids (TSS) and sediment deposition associated with the dredging and disposal of harbour muds within the Inner and Outer Harbours respectively.

Consideration was also given to associated activities such as piling operations and the removal of sediments with poor engineering properties from beneath the proposed Outer Harbour perimeter bund however it was concluded that the turbid plumes associated with these activities would be less significant than those considered in the modelled scenarios.

Figure 12-5 presents the 95th percentile TSS concentrations for the surface, mid-depth and bottom layers of the model.

Further percentile plots are presented in Appendix F, including the minimum TSS concentration, 5th, 10th, 15th, 20th, 50th (median), 80th, 85th, 90th, 95th and the maximum. These plots provide a statistical representation of the plume extent and concentration over the duration of the project.

From examination of the plots, it is apparent that the predicted extent of the dredge plume will be confined to the port with significant TSS concentrations confined to the vicinity of the dredging and disposal areas.

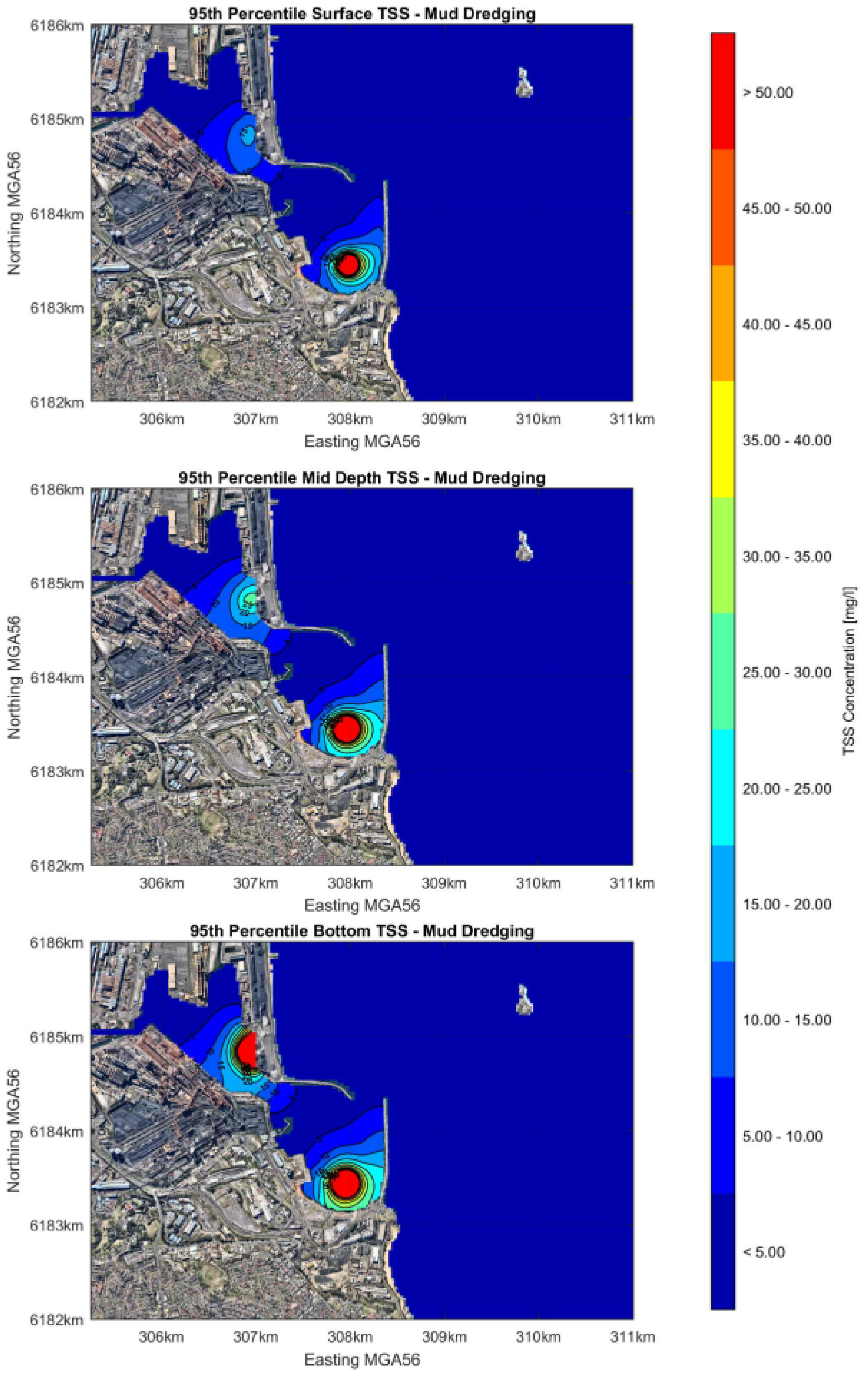

Figure 12-5 Suspended Solids concentration 95th percentile (Cardno, 2018)

Figure 12-6 presents the predicted sediment deposition thickness following the dredging and disposal of the mud layer. Sedimentation is predicted to occur in the vicinity of the dredging and disposal activities with no noticeable impacts to sedimentation rates outside of the port. Information regarding the potential impacts associated with the removal and placement of contaminated sediments is provided in Chapter 11.

It should be noted that the sedimentation expected to occur within the dredge area would be re-dredged where necessary to achieve the nominated design levels and tolerances. Similarly, the bulk of the predicted sedimentation within the Outer Harbour would occur within the footprint of the approved Outer Harbour Development and would ultimately be covered by the reclaimed material.

Figure 12-6 Predicted sedimentation of fines post dredging and disposal (Cardno, 2018)

In addition to the construction impacts outlined above, the proposed works include a number of activities which have the potential to impact water quality. These include:

- Demolition of the existing Berth 101, including pile extraction, has the potential to disturb sediments leading to localised plumes in the immediate vicinity of the works.
- Movement and anchoring of construction vessels such as spudded dredging equipment, hopper barges, tugs, crew transfer vessels and survey vessels, which may lead to hydrocarbon spills, disturb bottom sediments and contribute to dispersal of suspended sediments.
- Onshore earthworks undertaken in the vicinity of the harbour foreshore, which have the potential to result in the release of hydrocarbons and turbid stormwater into the harbour.

These potential impacts are expected to be minor in comparison to the proposed dredging and disposal works. Such activities would be undertaken in accordance with emergency spill plans and the objectives and development criteria outlined in the Port Kembla Development Code (NSW Ports 2016). Potential impacts to turbidity levels and sedimentation rates associated with these activities would also be mitigated through the use of silt curtains surrounding equipment and activities where there is a potential for impacts to water quality as shown in Figure 12-7 and discussed in Section 12.4.

Figure 12-7 Example of a silt curtain surrounding a dredging operation

It is worth noting Port Kembla Harbour has been subject to several capital dredging campaigns, which have been undertaken to facilitate the development of shipping berths. Maintenance dredging activities are undertaken less frequently, with management of declared depths primarily managed through annual sweep dredging (i.e. bed levelling using a sweep bar). These operations result in repeated mobilisation of sediments from within the channel and berth areas. Potential impacts during dredging activities will be managed in accordance with established practices at the port and potential impacts will be commensurate with previous dredging campaigns.

12.3.2 Operation

During operation, potential impacts to water quality and hydrology within and around Port Kembla Harbour include:

- Cold water discharge plume associated with the regasification process
- Hydrodynamic impacts associated with the expansion of the existing Berth 101 and changes to the previously approved Outer Harbour reclamation footprint.
- Hydrological and flooding impacts associated with reductions in available flood flow areas due to the presence of pipelines and reclamation areas
- Use of chemicals such as antifouling paints applied to LNG tankers and the FSRU to minimise marine growth
- Residual levels of sodium hypochlorite within the FSRU discharge to the harbour
- Stormwater and spill management

Thermal plume modelling

The regasification process on board the FSRU relies on the use of seawater extracted from the Inner Harbour to heat the LNG to convert it to gas. The seawater used in the regasification process will then be released back into the Inner Harbour via a horizontal discharge outlet on the side of the FSRU at a rate of approximately 10,000m^3/hr. When discharged, this water will be up to 7^o Celsius cooler than the ambient sea water temperature at the immediate point of discharge, falling rapidly to only 1 degree cooler at each end of the proposed berth. Given the overall artificially heightened temperature of the Inner Harbour due to warm water discharges from other facilities, the contribution of cooler water should assist with the overall temperature management of the Inner Harbour.

Near field and far field assessment has been undertaken using the Mixzon Inc. CORMIX and Delft3D software packages. The aim of the modelling was to assess the behaviour and extent of the thermal discharge plume in light of the existing intakes and outlets operated by BlueScope Steel which currently discharge warm water into the Inner Harbour.

A copy of the numerical modelling report is provided in Appendix F and a summary of the key results and conclusions relating to potential impacts during operations is provided below.

The modelling indicates that the release of cold water from the FSRU will only have minor impacts on seawater temperatures. These impacts are expected to be confined to within the port limits.

From examination of the 50th percentile summer seawater temperature plot shown in Figure 12-8, it is apparent that existing warm water discharges have a significant influence on water temperatures within the Inner Harbour during summer months. The model results indicate that the extent of the existing warm water plumes will be reduced by the proposed release of cold water within the Inner Harbour.

Predicted 5th percentile (low temperatures) summer and winter plots are shown in Figure 12-9 and differential plots of predicted seawater temperatures presented in Figure 12-10. The model results show that predicted reductions in temperature are greatest during winter when BlueScope warm water discharges are reduced. The model predicts that initial near field mixing will reduce the 5th percentile temperature differential to one degree at each end of the proposed berth. On average, temperatures within the port are generally expected to decrease by 0.1 to 0.2 degrees.

Further percentile plots are presented in Appendix F, including the minimum seawater temperature, 5th, 10th, 15th, 20th, 50th (median), 80th, 85th, 90th, 95th, the maximum and differential plots.

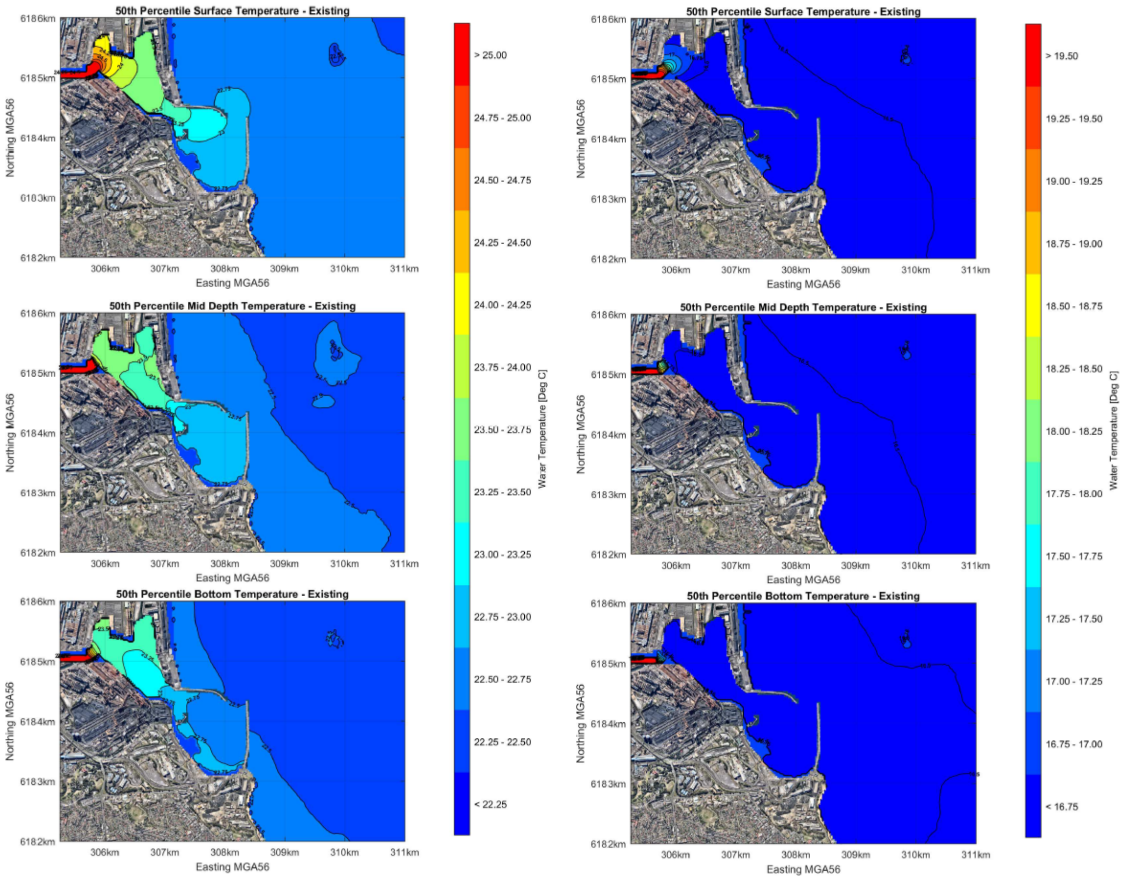

Figure 12-8 Existing 50th percentile summer and winter seawater temperatures (Cardno, 2018)

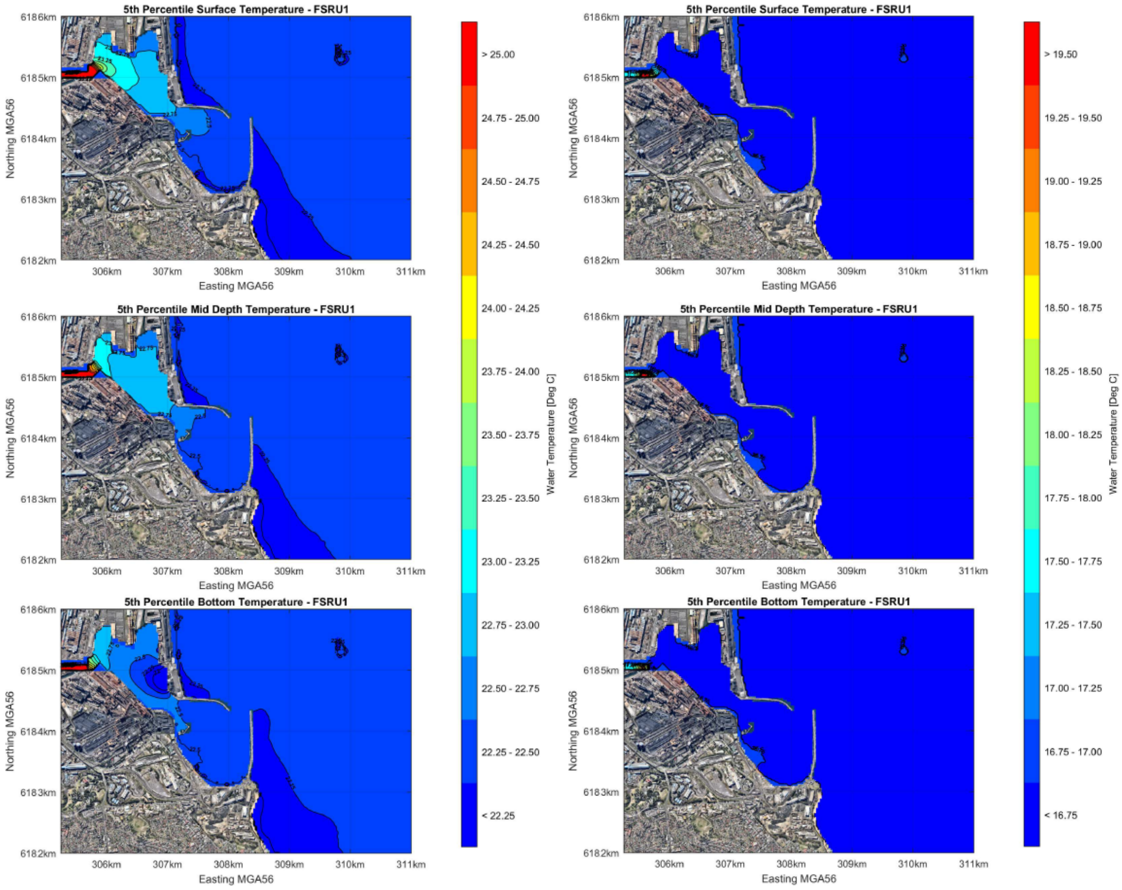

Figure 12-9 Predicted 5th percentile summer and winter seawater temperatures (Cardno, 2018)

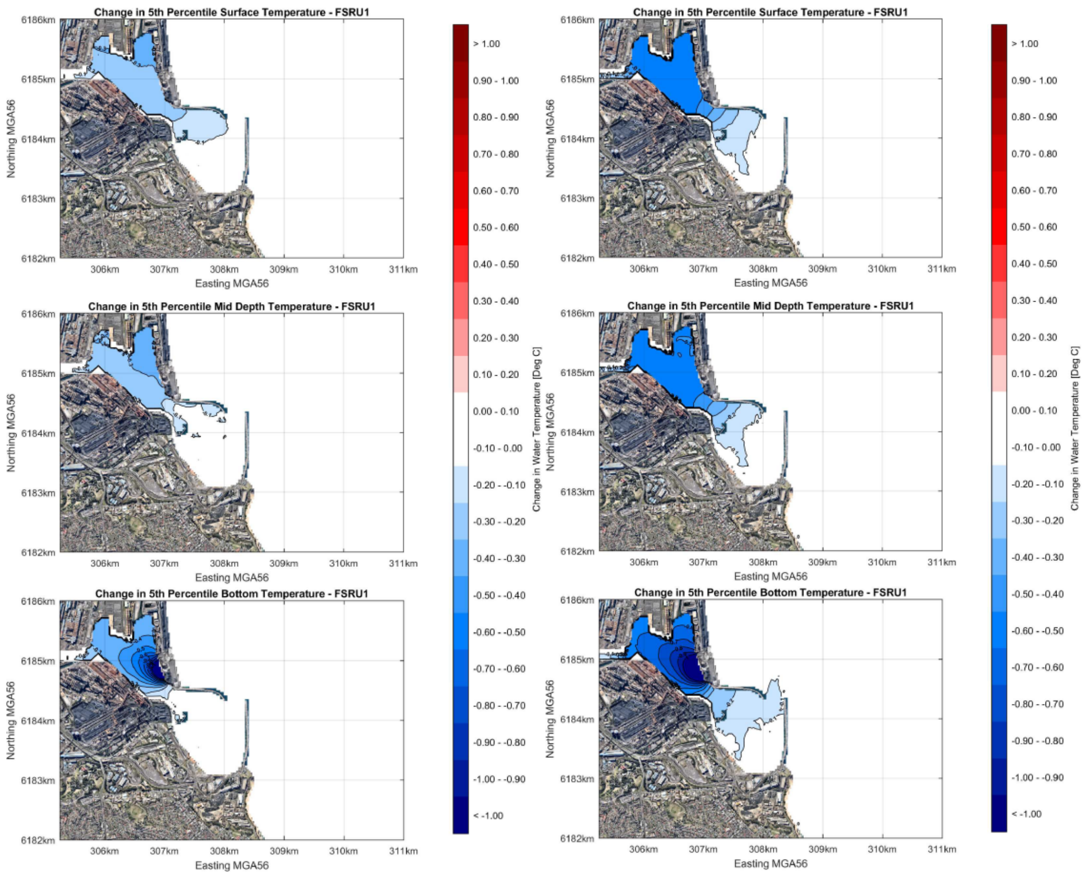

Figure 12-10 Predicted 5th percentile summer and winter seawater temperature differential plots (Cardno, 2018)

Use of Chemicals

Consideration has been given to the pollutants and contaminants to be used over the life of the project which have the potential to be released into the marine environment. Whilst the bulk of chemicals will be stored and processed at appropriate onshore facilities, consideration has been given antifouling hull treatments and seawater discharges.

Antifouling Treatments

Traditional antifouling treatments utilised harmful substances in paints and hull treatments to prevent the growth of marine organisms on vessels. These compounds slowly leached into the marine environment, killing marine life and potentially entering the food chain.

In accordance with the International Convention on the Control of Harmful Anti-fouling Systems on Ships of the International Maritime Organization, the FSRU has been issued with a certificate to confirm that an antifouling systems controlled under Annex 1 to the Convention has not been applied during the construction of the ship and that the antifouling system on the ship complies with the applicable requirements of Annex 1 to the Convention.

Seawater discharges

An FSRU uses seawater for a number of functions. Some functions like the use of seawater for ballast or for fire-fighting, are the same as any ocean-going vessel visiting the Port. Other functions like the use of seawater to warm up the liquid natural gas (LNG) in order to return it to its gaseous state, are unique to the FSRU.

Seawater used for these purposes is usually re-released into the ocean. However, before releasing water back into the ocean, vessels must comply with both international and national regulations on the treatment of seawater. The aims of these requirements are to ensure no foreign or malevolent marine life, no excessive particulates or sediments and no unacceptable concentrations of biocides or other chemicals are released into the surrounding waters.

Because both Hoegh vessels available for use by AIE are state-of-the-art, each is fitted with a Marine Growth Prevention System (MGPS) which helps to ensure no marine growth in the various pipes and other processes which use seawater on the FSRU.

The MGPS takes seawater from the surrounding area, uses its natural salts to produce a solution of sodium hypochlorite, which acts as a natural biocide, that is used on-board to ensure all the systems remain free of marine growths.

Sodium hypochlorite degrades naturally and so most of the created solution will be used within the vessel well before the water is ready for re-release. However, some excess sodium hypochlorite is expected to remain prior to discharge within the Inner Harbour.

The ANZECC guidelines provide a 95% species protection default guideline value (previously known as trigger value) for total residual chlorine within freshwater aquatic environments of 3 μg Cl/L. No equivalent values are provided for the marine environment however the guidelines note that the freshwater value "was adopted as a marine low reliability trigger value, to be used only as an indicative interim working level".

It is important to note that chlorine is very reactive in seawater, reacting with bromine to form chloride ions and hypobromous acid (HOBr). Therefore consideration should be given to concentration values of total residual oxidants measured as μg Cl per L or ppm.

Such values are provided in the IFC World Bank Group Environmental, Health, and Safety (EHS) Guidelines for Liquefied Natural Gas (LNG) Facilities, which include specific information relating to discharges associated with floating storage regasification units. These guidelines stipulate the following in relation to residual sodium hypochlorite in seawater,

"Free chlorine (total residual oxidant in estuarine/marine water) concentration in cooling/cold water discharges (to be sampled at point of discharge) should be maintained below 0.2 parts per million (ppm)." (IFC, 2017).

Prior to re-releasing the seawater back into the surrounding area, the operators of the vessel will aim to match the profile of the discharged water, as close as possible, to the pre-discharge profile and will ensure that free chlorine (total residual oxidant in estuarine/marine water) concentrations remain below 0.2 ppm. Changing the profile of the discharge water can be done by modifying the frequency of production and the concentration of sodium hypochlorite produced on-board from the intake of sea water.

Consideration has also been given to the dilution of the discharge stream within the mixing zone of the Inner Harbour based on the results of the near field mixing models. The discharge plume is predicted to have been diluted by a factor of four by the time the plume reaches the floor of the Inner Harbour and a dilution factor of 30 at a distance of 400m from the discharge point. Slightly elevated levels in receiving waters are expected to be primarily restricted to the Inner Harbour and are not expected to extend beyond the Outer Harbour.

Hydrodynamic assessment

Detailed numerical modelling of the previously approved Outer Harbour Development was undertaken as part of the 2010 Environmental Assessment undertaken on behalf of PKPC (Aecom 2010, Cardno Lawson Treloar 2009). The previous assessment included consideration of the following hydrodynamic and metocean processes:

- Infragravity (long) waves and seiching
- Gravity (ocean swell) waves
- Tidal hydraulics
- Water levels

During recent discussions between AIE and NSW Ports, a disposal footprint has been agreed as shown in red in Figure 12-11. The previously approved reclamation footprint for the Outer Harbour Development included a longer western berth area as shown in yellow in Figure 12-11.

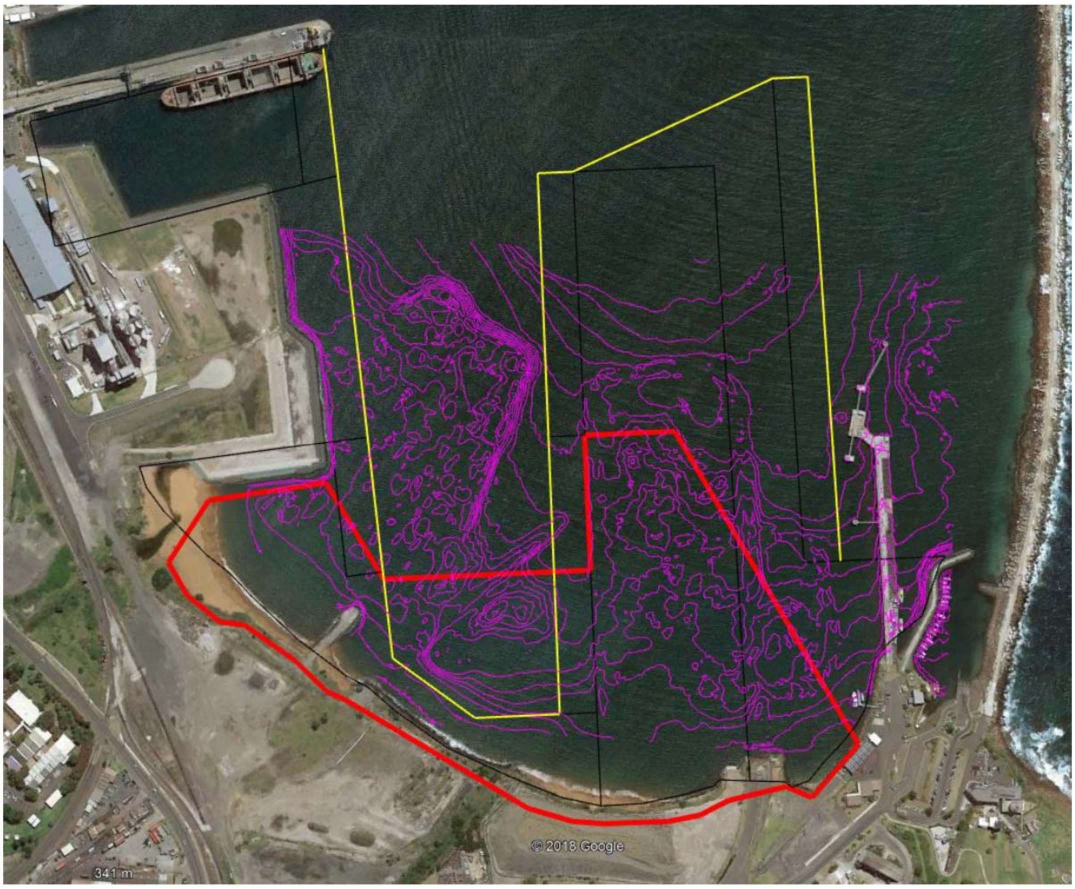

Figure 12-11 Proposed Outer Harbour disposal footprint (Advisian, 2018)

Given the departure from the previously approved footprint, additional numerical modelling investigations have been undertaken using the Mike21 BW software in order to characterise any potential changes to the previously assessed impacts. A copy of the numerical modelling report is provided in Appendix F and a summary of the key results and conclusions relating to potential impacts during operations is provided below.

Figure 12-12 demonstrates that the revised disposal footprint is expected to increase long wave heights at select locations within the Outer Harbour. The model predicts that long wave heights could increase by up to 13cm (wave disturbance coefficient of 0.37) at the southern end of the proposed Outer Harbour western berths. The model also predicts that long wave heights will increase in the vicinity of the existing Berth 201, adjacent to the Northern Breakwater by up to 5cm (wave disturbance coefficient of 0.15).

These predicted impacts will require consideration by NSW Ports during the design development of the berthing and mooring infrastructure associated with the proposed Outer Harbour Development. Consideration of the impact upon the existing mooring infrastructure and operations at Berth 201 will also be required by NSW Ports. No impacts to long waves are predicted within the Inner Harbour.

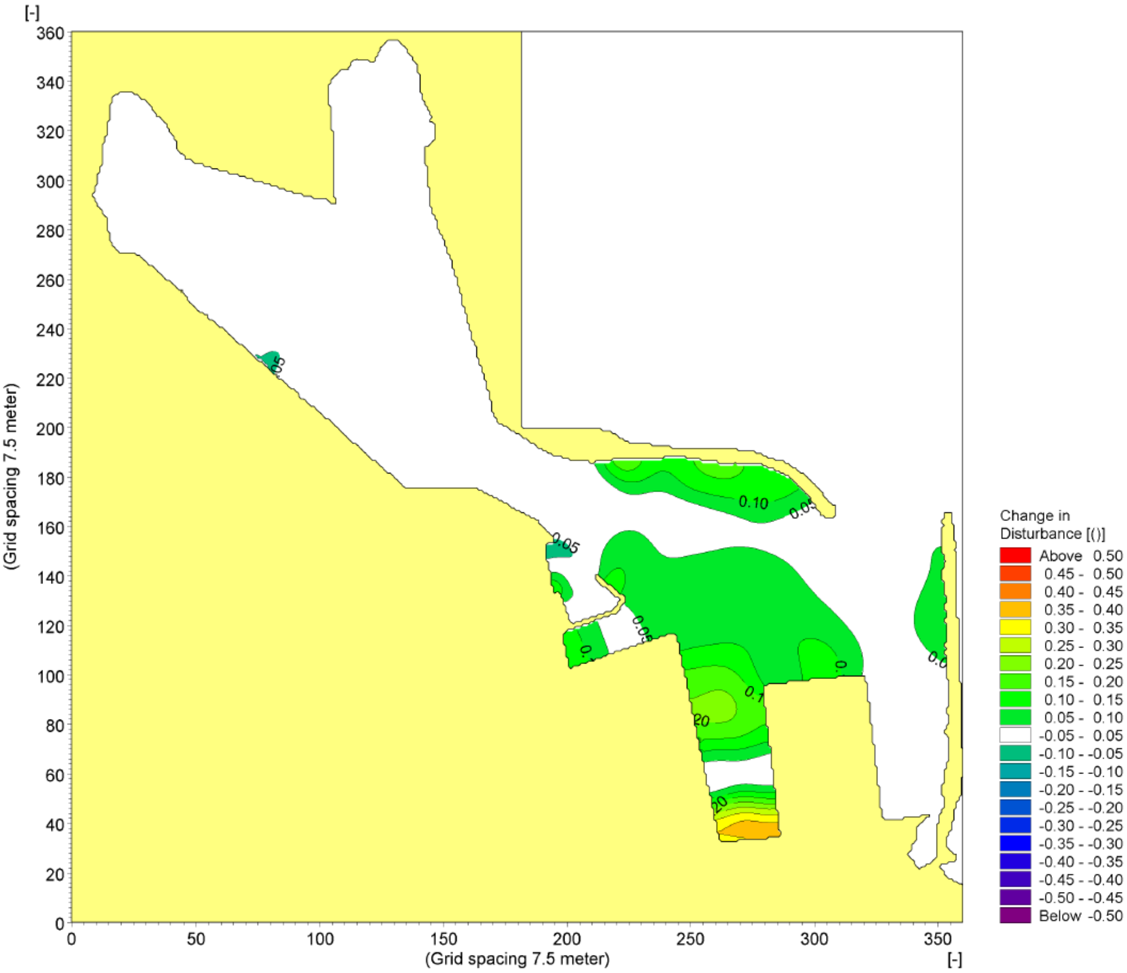

Figure 12-12 Modelled change in long wave disturbance coefficients (Cardno, 2018)

In addition to the assessment of long wave impacts, the hydrodynamic assessment report (Appendix F) describes the potential impacts to hydrodynamic processes associated with the proposed dredging and disposal activities. In particular, the report concludes that given the very small scale of the FSRU berth dredging, no substantial impacts are envisaged to the overall tidal flushing of the port.

The previous assessment of the proposed Outer Harbour Development concluded that the proposed reclamation was expected to reduce the tidal prism of the Outer Harbour which would generate improved flushing characteristics within the port as a whole. Given that the revised footprint further reduces the tidal prism of the Outer Harbour, the current project proposed is expected to offer further improvements to tidal flushing within the port.

Flooding hydrology assessment

Potential impacts to hydrology are primarily associated with the alteration of local creeks and drains due to the reclamation of land within the Outer Harbour as assessed in the 2010 Environmental Assessment undertaken on behalf of PKPC (Aecom 2010).

The previously approved Outer Harbour Development proposed that Salty Creek and the Darcy Road Drain would be redirected and extended as required to convey current and future flood flows through the reclamation area. The 2010 EA identified that this approach was expected to change the current Salty Creek Estuary from an Intermittently Closed or Open Lake or Lagoon (ICOLL) to a system permanently open to the Outer Harbour. This was expected to provide benefits with respect to upstream flooding, tidal flushing and water quality however it was also noted that the stabilisation of salinity and water levels within the estuary could lead to potential impacts on aquatic flora and fauna, including impacts to fish passage between the estuary and the Outer Harbour. The assessment concluded that the proposed works were not likely to have significant impacts on the aquatic ecology of the Outer Harbour.

Previously proposed mitigations measures included the introduction of light to the Salty Creek drainage tunnel, however these are not relevant to the currently proposed reclamation activities since the extension of Salty Creek will remain open to natural light.

The gas pipeline will be installed below ground and will be installed by directional drilling beneath both Gurungaty Waterway and Allans Creek. There will be no changes to flow paths or flood storage due to the installation of the pipeline and no alteration in the potential for flooding of the waterways during flood events.

Stormwater and spill management

Given the relatively small onshore footprint and nature of the proposed operations, the risk of stormwater related issues during operations is relatively low. Nevertheless, foreshore industrial operations have the potential to release litter, sediment, fuel, oil, grease, wash water, debris, detergent, paint, etc. into the harbour.

Where possible, surfaces would remain unsealed and be landscaped to assist in control of stormwater related issues. Design would be undertaken in accordance with emergency spill plans and the objectives and development criteria outlined in the Port Kembla Development Code (NSW Ports 2016).

Operational management plans and emergency response plans would be prepared in order to ensure the facility is operated in an environmentally sensitive manner and in accordance with all relevant approvals, licences and industry guidelines.

12.4 Management measures

Table 12-3 Management measures for water resources

ID	Issue	Measure	Timing
W1	Water quality and hydrodynamics	The location of the proposed terminal berth has been refined through navigation simulations to be located as close possible to the existing turning basin. This approach minimises hydrodynamic impacts and reduces dredging and disposal volumes as far as possible.	Design
W2	Flooding	The proposed pipeline between the terminal and the existing east coast gas transmission network at Cringila has been designed such that the pipeline will be below existing ground levels.	Design
W3	Hydrology	The western extent of the reclamation footprint has been limited to ensure Salty Creek remains open to the Outer Harbour without the need for enclosed culverts, thereby minimising the impacts to fish passage.	Design
W4	Water quality and hydrodynamics	The footprint of the Outer Harbour placement area has been minimised by raising the proposed fill height to include emergent reclamation. This approach minimises the quantity of material to be bottom dumped and thereby reduces the potential for generation of turbid plumes and mobilisation of sediments.	Design
W5	Water Quality	Preparation of a Construction Environmental Management Plan (CEMP) including specific dredge management plan to provide a framework for the environmental management of construction activities to minimise the environmental risks to a level that is as low as practically possible for this project.	Construction
W6	Water Quality	Design and implementation of a Water Quality Monitoring Program to ensure construction works do not cause exceedance of the marine water quality criterion of background plus 50 mg/L of suspended sediment, in accordance with recent Environmental Protection Licences (EPL) for similar activities within Port Kembla such as the Berth 103 Stage 2 Dredging & Spoil Disposal EPL20563). Continuous turbidity monitoring would be undertaken using a series of monitoring buoys to provide impact and background data (turbidity (NTU), pH, temperature). Prior to	Construction

ID	Issue	Measure	Timing
		commencement of the dredging works, buoys would be deployed for an agreed period of time to confirm background conditions in the vicinity of the monitoring points. Data would be logged and transmitted to an onshore recording station where it would be processed to allow automated comparison of median turbidity levels to a series of green, amber and red trigger levels. When exceeded, an alarm would be triggered, automated email and SMS alerts sent and agreed the procedures implemented. Such procedures may include hand held monitoring to verify readings, reduction in the rate of dredging, relocation of dredging activities or cessation of turbidity generating works until turbidity readings reach acceptable levels. Daily visual observations would be undertaken during dredging operations to monitor the potential release of oil or grease. Collection of water samples and laboratory analysis for an agreed set of contaminants would be undertaken on a weekly basis during dredging operations. The WQMP would include regular reporting, evaluation and revision where required to ensure the project objectives and approval conditions are achieved.	
W7	Water Quality	Silt curtains would be installed prior to commencement of the works in order to minimise the spread of any sediments entrained within the water column during dredging and disposal operations. Silt curtains are available in a range of designs and would be provided by the successful Contractor. It is envisaged that the silt curtain would comprise a geocomposite material consisting of a non-woven geotextile sewn to a woven geotextile, which would provide the required filtering capacity and rigidity respectively. Vessel access would be via gated or overlapped curtains or through installation of a bubble curtain. The top of the curtain would be supported by a floating boom, whilst the lower portion of the curtain would be weighted with appropriate ballasting (eg. bars or chains) to ensure that the full length if the curtain is maintained at all times. The curtain would be	Construction

ID	Issue	Measure	Timing
		anchored or fixed to existing structures as necessary.	
W8	Water Quality	Subaqueous sediment removal would be undertaken using a backhoe dredge. The use of mechanical dredging (rather than hydraulic dredging) ensures that sediments are removed, transported and placed as close to their insitu density as possible. Thereby minimising the suspension and mobilisation of sediments at the dredge and disposal sites. Method statements would be prepared by the contractor to ensure that loading of dredged materials into the hopper barges is undertaken in a manner that reduces spillage and avoids overfilling barges.	Construction
W9	Water Quality	A perimeter bund would be constructed within the Outer Harbour placement area to ensure long term stability of dredged materials and to minimise sediment migration during placement.	Construction
W10	Water Quality	A site specific erosion and sediment control plan (ESCP) will be prepared as part of the CEMP to provide control of all land based excavation and stockpiling requirements. All erosion and sediment control measures shall be designed, implemented and maintained in accordance with 'Managing Urban Stormwater: Soil and Construction Volume 1' (Landcom 2004) ('the Blue Book).	Construction
W11	Water quality, chemical and fuel impacts on flora and fauna	A site specific emergency spill plan will be developed, and will include spill management measures in accordance relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Roads and Maritime and EPA officers)	Construction
W12	Water quality, chemical and fuel impacts on flora and fauna	An emergency spill kit will be kept on site at all times. All staff will be made aware of the location of the spill kit and trained in its use.	Construction
W13	Water quality, chemical and fuel impacts on flora and fauna	Machinery will be checked daily to ensure there is no oil, fuel or other liquids leaking from the machinery. All staff will be appropriately trained through toolbox talks for the minimisation and management of accidental spills.	Construction

ID	Issue	Measure	Timing
W14	Water Quality	Prior to re-releasing the seawater back into the surrounding area, the operators of the vessel will aim to match the profile of the discharged water, as close as possible, to the pre-discharge profile and well below agreed thresholds for residual concentrations of sodium hypochlorite. Changing the profile of the discharge water will be done by modifying the frequency of production and the concentration of sodium hypochlorite produced on-board from the intake of sea water.	Operations
W15	Water Quality	A stormwater management system would be designed and constructed to control discharges from the import terminal site, including traps and filters where required. Design would be undertaken in accordance with emergency spill plans and the objectives and development criteria outlined in the Port Kembla Development Code (NSW Ports 2016).	Operations
W16	Water Quality	A site specific emergency spill plan will be developed, and will include spill management measures in accordance relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Roads and Maritime and EPA officers). An emergency spill kit will be kept on site at all times. All staff will be made aware of the location of the spill kit and trained in its use	Operations

13. Marine ecology

13.1 Overview

This chapter describes marine ecology matters relevant to the construction and operation of the project. It summarises the more detailed Marine Ecology Impact Assessment (MEIA) in Appendix G.

The assessment has been prepared with reference to and in accordance with the Secretary's Environmental Assessment Requirements (SEARs).

The scope broadly includes:

- A description of the existing marine environment within the project study area and the likelihood of any threatened biota and their habitats occurring in the project area. This assessment included database searches, review of existing studies and review of other Environmental Impact Statements (EISs). Matters of National Environmental Significance (MNES) under the Environment Protection Biodiversity Conservation Act 1999 (EPBC Act), and threatened marine fauna species listed under the NSW Fisheries Management Act (FM Act), and the NSW Biodiversity Conservation Act 2016 (BC Act), known or predicted to occur within the project site were also described.
- A field validation exercise to confirm that marine ecology within the Inner Harbour (inclusive of Berth 101) and Outer Harbour is consistent with observations historically made within these areas. Use of both field and historical data to describe the extant conditions.
- Assessment of potential construction and operational impacts on marine ecology (directly and indirectly) from project activities.
- Provision of mitigation and management measures, to avoid and minimise impacts to the marine ecology values, where relevant.

Refer to Appendix G for detail on the assessment methodology and assumptions. The terrestrial biodiversity report is provided in Appendix H and Chapter 14 of this EIS, which assesses terrestrial biodiversity issues under the BC Act, the FM Act and EPBC Act. No referrals was required under the EPBC Act for biodiversity matters.

13.2 The project and marine environment

The project has potential to impact upon the marine environment during both construction and operation.

Construction activities have the potential to directly disturb biofouling and benthic communities through activities such as:

- Removal of the existing Berth 101 infrastructure (including removal of the piles and quay wall)
- Pile driving
- Dredging of the seabed
- Development of the perimeter bund
- Placement of the dredged material within the disposal area

- Placement / anchoring of construction vessels
- Construction activities will also have the potential to impact marine ecology as a result of:
- Deterioration of water quality through increased turbidity and mobilisation of contaminated sediments
- Noise generation through activities such as pile driving and rock armouring
- Artificial lighting from construction vessel and site lighting

Operational activities with the potential to impact upon the marine environment include:

- Impacts to water quality from discharges to the Inner Harbour including cold water and residual sodium hypochlorite
- The movement of LNG carriers between port environments
- Lights installed as part of the new berth and LNG carrier infrastructure

Refer to Section 13.4 for the assessment of construction and operational activities upon marine ecology at Port Kembla.

13.3 Existing environment

13.3.1 Marine habitat

A description of the existing marine habitat at Port Kembla, including biofouling community, benthic communities and fish habitats, is provided in the section below.

Biofouling community

Hard substrate habitat within Port Kembla consists of infrastructure such as breakwalls, piles and quay walls around the perimeter of the port. Such hard substrate presents ideal habitat for biofouling communities within the sheltered environment. Assemblages around the Inner Harbour have been described by previous studies as sparse with community structures reflective of the highly disturbed environment; species noted within these communities are polychaete worms, bryozoans, barnacles and ascidians (Worsley Parsons, 2012). Comparatively, a higher diversity and abundance of sessile invertebrates has previously been reported in the Outer Harbour (Worsley Parsons, 2012).

Surveys of the berth piles undertaken in 2012 identified the Sydney rock oyster (*Saccostrea glomerata*) dominating the intertidal zone while oyster limpets (*Patelloida mimula*) were common and sea squirts (*Cunjevoi pyura*) were occasionally present (Worley Parsons, 2012). The subtidal zone (down to 2 metre depth) consisted of a mixture of encrusting bryozoan (*Watersipora subtorquata*), polychaete tubeworms (predominantly *Hydroides elegans*), compound ascidians (*Botrylloides leachii*), solitary ascidians (*Styela plicata*) and blue mussels (*Mytilus galloprovincialis*) (Worley Parsons, 2012). Large hydroids, arborescent bryozoans (*Bugula flabellata* and *Bugula stolonifera*), small sponges and barnacles were also common in this zone. Beyond 2 metres depth, encrusting communities were smothered by silt inhibiting identification of taxa (Worley Parsons, 2012). Introduced species accounted for 50 % of the coverage of the hard substrate assemblages within Port Kembla (Johnston, 2006).

Biofouling communities identified during the 2018 field investigation were generally consistent with those recorded during the 2012 survey, refer to Figure 13-1. Oysters and gastropods dominated the intertidal zone with compound ascidians, tubeworms and bryozoans present in the subtidal zone. A differentiator with the previous survey was the presence of the brown algae

Dictyota dichotoma at the shallow sub-tidal zone. This difference is potentially a result of seasonal variation.

Figure 13-1 Biofouling communities on Berth 101 piles

Benthic communities

The seabed within the Inner Harbour has previously been described as consisting of fine, unconsolidated silt expanses with large decapod burrows (Worley Parsons, 2012). This was also confirmed during the 2018 field investigation via the underwater video footage, refer to Figure 13-2.

Historically the seagrass species *Halophila ovalis* has been recorded within the Inner Harbour benthos (Pollard and Pethebridge, 2002; EcoLogical Australia, 2003). More recently this species has not been detected. Surveys in 2012 and 2018 confirm the persistent absence of any seagrasses from the Inner Harbour dredge footprint (Worley Parsons, 2012; current survey results). Furthermore, no seagrass was recorded in the Outer Harbour reclamation area during the conduct of the geochemical assessment in 2018. There are no known mapped seagrass communities adjacent to the project.

Macroalgae has been known to occur in sparse distributions across soft sediments habitats within both the Inner Harbour and Outer Harbour. The diversity and abundance has been considered to be higher in the Outer Harbour compared to the Inner Harbour, with 26 and 15 species recorded, respectively (Pollard and Pethebridge, 2002). The dominant forms of macroalgae were encrusting and turfing algae present across areas surveyed in the Outer Harbour at depths greater than 10 metres (AECOM, 2010). Although macroalgae have been previously observed in the Inner Harbour, 2018 investigations identified none are present within the proposed dredge footprint, other than those described along the berth piles (refer to biofouling community section above).

Figure 13-2 Benthic communities within the proposed dredging footprint

Fish communities

The different habitats within the Inner Harbour and Outer Harbour have been found to support varying diversities in fish assemblages and compositions. The higher diversity within the Outer Harbour as observed during the 1999, 2002 and 2009 surveys may have reflected the use of the area, including macroalgal habitat and breakwater, as nursery for juvenile species (AWT, 1999; AECOM, 2010). The eastern breakwater environments also provided niche habitat for species including mado (*Atypichthys strigatus*), yellowtail (*Trachurus novaezelandiae*) and moon-wrasse (*Thalassoma lunare*) (AECOM, 2010). Whereas other species such as the red morwong (*Cheilodactylus fuscus*) was the only species observed in deeper soft sediment habitat (AECOM, 2010). In contrast the highly utilised and developed Inner Harbour is not known to support as many species. Those that occur are typical of inshore habitats being glass perchlet (*Ambassis jacksoniensis*) and Japanese striped goby (*Tridentiger trigonocephalus*) AWT, 1999; Pollard & Pethebridge, 2002; UNSW, 2009). Fish assemblages identified as part of these studies are common across the region and did not include any threatened species.

13.3.2 Marine fauna

A search was undertaken to identify MNES under the EPBC Act 1999, and threatened marine fauna listed under the FM Act and the BC Act. Under the EPBC Act 1999, the MNES were identified using a point taken between the Inner and Outer Harbour (including a 5 kilometre buffer area) in the protected matters search tool (PMST). The following relevant matters were identified:

- No Wetlands of International Significance
- No Commonwealth Marine Areas
- 69 Listed Threatened Species (marine species excluding marine birds)
- 56 Listed Migratory Species (marine species excluding marine birds)
- 83 Listed Marine Species
- 12 Whales and other Cetaceans

- Habitat requirements and species distributions of the species identified from searches were reviewed in order to determine the likelihood of occurrence in the project area. A full list of the listed species and their likelihood of occurrence are provided in Appendix G. Those species which may occur and are likely to occur in the project area are provided in Table 13-1,Table 13-2, Table 13-3, and Table 13-4 below.

Table 13-1 Potential for species listed under the EPBC Act 1999 to occur at the project site

Species	Scientific name	EPBC Act status	Likelihood of occurrence
Listed threatened species			
Black rockcod, Black cod, Saddled rockcod	*Epinephelus daemelii*	Vulnerable	**May occur** - Species likely to use habitat within Port as shelter.
Southern right whale	*Eubalaena australis*	Endangered, Migratory Listed marine species Whales and Cetaceans	**Likely to occur** - Records of sightings within Outer Harbour.
Humpback whale	*Megaptera novaeangliae*	Vulnerable, Migratory Listed marine species Whales and Cetaceans	**Likely to occur** - Records of sightings within Outer Harbour.
Grey nurse shark (east coast population)	*Charcharias taurus*	Critically Endangered	**May occur** - Individuals may transit the area during migrations between aggregation areas.
Listed marine species (not previously listed)			
Long-nosed fur seal, New Zealand fur seal	*Arctocephalus forsteri*	Listed marine species	**Likely to occur** - Potential haul-out site at Five Islands.
Australian fur seal, Australo-african fur-seal	*Arctocephalus pusillus*	Listed marine species	**Likely to occur** - Known haul-out site at Five Islands.
Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphi	*Tursiops aduncus*	Listed marine species Whales and Cetaceans	**Likely to occur** - Species known throughout NSW and habitat occurs in Port area.
Bottlenose dolphin	*Tursiops truncates s. str.*	Listed marine species Whales and Cetaceans	**Likely to occur** - Species known throughout NSW and habitat occurs in Port area.

Species	Scientific name	EPBC Act status	Likelihood of occurrence
Syngnathids 21 species (i.e. seahorses, seadragons, pipefish and pipehorses)		Listed marine species	**May occur** - Habitat may be suitable for species.
Listed bird species			
Bar-tailed godwit (bauera), western Alaskan bar-tailed godwit	Limosa lapponica baueri	Vulnerable	**May occur** - The project area is highly modified and is not considered to support foraging and roosting for this species. This species may fly over the region during annual migrations.
Curlew sandpiper	Calidris ferruginea	Critically Endangered, Migratory	**May occur** - The project area is highly modified and is not considered to support foraging and roosting for this species. This species may overfly the region during annual migrations.
Eastern curlew, far eastern curlew	Numenius madagascariensis	Critically Endangered, Migratory	**May occur** - The project area is highly modified and is not considered to support foraging and roosting for this species. This species may overfly the region during annual migrations.
Gould's petrel, Australian Gould's petrel	Pterodroma leucoptera leucoptera	Endangered	**May occur** - No critical habitat for this species known to occur within the project area. This species may fly over or forage in the surrounding area.
Northern giant-petrel	Macronectes halli	Vulnerable, Migratory	**May occur** - The project area is highly modified and is not considered to support foraging and roosting for this species. This species may overfly the region during annual migrations.

Species	Scientific name	EPBC Act status	Likelihood of occurrence
Orange-bellied parrot	Neophema chrysogaster	Critically Endangered	**May occur** - This species may overfly the region during annual migrations.
Red knot, knot	Calidris canutus	Endangered, Migratory	**May occur** - The project area is highly modified and is not considered to support foraging and roosting for this species. This species may overfly the region during annual migrations.
Southern giant-petrel	Macronectes giganteus	Endangered, Migratory	**May occur** - The project area is highly modified and is not considered to support foraging and roosting for this species. This species may overfly the region during annual migrations.
Swift parrot	Lathamus discolor	Critically Endangered	**May occur** - This species may fly over the area during migration.
Wandering albatross	Diomedea exulans	Vulnerable, Migratory	**May occur** - This species may fly over the area during migration.

Table 13-2 Potential for migratory bird species listed under the EPBC Act 1999 to occur at the project site

Name	Scientific name	Description	Likelihood of occurrence
Bar-tailed godwit	*Limosa lapponica*	A wading bird that occurs in coastal habitats and brackish wetlands. Forages in sheltered intertidal areas, including beaches. Roosts on sandy beaches, sandbars and spits (Marchant and Higgins, 1990).	**May occur** - Core habitat for this species not known within the project area. This species may overfly the region during annual migrations.
Fork-tailed swift	*Apus pacificus*	Non-breeding visitor to all states and territories of Australia (Higgins, 1999) and is almost exclusively aerial and mainly occur over foothills an in coastal areas in Australia. Widespread across most areas of Australia, they have been recorded in NSW (DoEE, 2018).	**May occur** - Core habitat for this species not known within the project area. This species may overfly the region during annual migrations.

Name	Scientific name	Description	Likelihood of occurrence
Little tern	*Sternula albifrons*	A small, slight tern with gregarious behaviour. Australian population consists of several sub-populations, with the eastern population's distribution covering the east coast of Australia. This species generally occurs along sandy coastlines and mangrove mudflats (DoEE, 2018).	**May occur** - Core habitat for this species not known within the project area. This species may overfly the region during annual migrations.
Wedge-tailed Shearwater	*Ardenna pacifica*	A marine, pelagic shearwater. This species breeds on the east and west coasts of Australia and on off-shore islands. The species is common in the Indian Ocean, the Coral Sea and the Tasman Sea (Lindsey 1986). In tropical zones the species may feed over cool nutrient-rich waters. The species has been recorded in offshore waters of eastern Victoria and southern NSW, mostly over continental slope.	**May occur** - Core habitat for this species not known within the project area. This species may overfly the region during annual migrations.

Table 13-3 Potential for species listed under the FM Act 1994 to occur at the project site

Species	Scientific name	FM Act status	Likelihood of occurrence
Grey nurse shark	*Carcharias taurus*	Critically Endangered	**May occur -** Species may transit the area during migrations.
Black rockcod	*Epinephelus daemelii*	Vulnerable	**May occur -** Species may use habitat within Port as shelter.

Table 13-4 Potential for species listed under the BC Act 2016 to occur at the project site

Species	Scientific name	BC Act status	Likelihood of occurrence
Southern right whale	*Eubalaena australis*	Endangered	**Likely to occur -** Records of sightings for the Outer Harbour.
Long-nosed fur seal, New Zealand fur seal	*Arctocephalus forsteri*	Vulnerable	**Likely to occur -** Known haul-out site near Port Kembla.
Australian fur seal, Australo-african fur-seal	*Arctocephalus pusillus*	Vulnerable	**Likely to occur -** Known haul-out site near Port Kembla.

13.3.3 Introduced marine species

A comprehensive survey of pest species in Port Kembla was conducted in May 2000. This identified 35 introduced species and 14 cryptogenic species (Pollard & Pethebridge, 2002), including:

- Two dinoflagellates (*Alexandrium sp*. (catenella type) and *Alexandrium ostenfeldii / peruvianum)*
- One hydrozoan (*Halecium delicatulum*)
- Four species of polychaetes (*Boccardia chilensis, Boccardia proboscidea, Hydroides dirampha, and Hydroidesezoensis*)
- Eight species of crustaceans (*Megabalanus rosa, Cirolana harfordi, Paracerceis sculpta, Sphaeroma walkeri, Corophium acutum, Paradexamine pacifica, Liljeborgia c.f. dellavallei* and *Elasmopus rapax*)
- 15 species of broyzoa (A*mathia sp., Bowerbankia sp., Bugula dentata, Bugula flabellata, Bugula neritina, Bugula stolonifera, Cryptosula pallasiana, Schizoporella errata, Schizoporella sp. A, Schizoporella sp. B, Schizoporella sp. C, Schizoporella unicornis, Tricellaria occidentalis, Watersipora arcuata* and *Watersipora subtorquata*)
- Three species of ascidian (*Botryllus schlosseri, Ciona intestinalis* and *Styela plicata).*
- A number of smaller surveys conducted in 1991, 2000 and 2006 also identified additional introduced species (Pollard & Pethebridge, 2002; Johnston, 2006), including:
- Two fish species (*Acanthogobius flavimanus* and *Tridentiger trigonocephalus)*
- Three invertebrate species (the bivalve *Theora lubrica*, and the colonial ascidians *Botrylloides leachii* and *Perophora japonica)*
- Seven additional unidentified cryptogenic species

As evidenced by the extensive list of species recorded during previous surveys, introduced marine species accounted for 50 % of the coverage of the hard substrate assemblages within Port Kembla with more pest species and higher abundances of pest species present in the Outer Harbour compared to the Inner Harbour (Johnston, 2006).

Of the species recorded within Port Kembla, *Alexandrium spp*. dinoflagellates are listed as High National Priority Pests while the ascidians *Ciona intestinalis* and *Styela clava* and bryozoan *Schizoporella errata* are classified as Medium National Priority Pests (Hayes *et al.*, 2005).

Some toxic dinoflagellate species such as *Alexandrium spp.* can form dormant sedentary cysts that accumulate in bottom sediments. Under favourable conditions, these cysts can germinate, triggering blooms which deplete dissolved oxygen and produce toxins, causing environmental damage including fish kills. The toxins produced by *Alexandrium catenella* are known to bioaccumulate in fish, molluscs, crustaceans, polychaetes and some echinoderms with consumers of contaminated organisms suffering from paralytic shellfish poisoning; there is also evidence of direct toxicity to fish (NIMPIS, 2018).

Whilst the toxic dinoflagellate species *Alexandrium catenella* were recorded during surveys conducted in 2002 and 2009 within the port (Pollard & Pethebridge, 2002; AECOM, 2010), none were found during the later 2011 survey (Worley Parsons, 2012). In addition, no toxic dinoflagellate blooms have been recorded within Port Kembla. However the risk of blooms remain given the historical records of toxic dinoflagellate species at the port.

13.3.4 Water quality

Land use in the immediate vicinity of Port Kembla contributes to the ambient marine water quality within the port. The creeks and waterways that drain industrial, coal and iron ore stockpile areas (Figure 13-3) include:

- Allans Creek, Gurungaty Waterway and No. 1 Products Berth within the Inner Harbour
- The Cut passage which connects the Inner and Outer Harbours
- Darcy Road Drain within the Outer Harbour
- In addition, the ambient marine water quality within Port Kembla is also subject to tidal influences from the Port Kembla entrance (Figure 13-3).

Paper Size ISO A4

0 250 500 750 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Australian Industrial Energy
Port Kembla Gas Terminal

Marine ecological habitat surrounding the project site

Project No. 21-27477
Revision No. -
Date 31/10/2018

FIGURE 13-3

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Historically water quality within the Inner and Outer Harbours has been impacted by urban and industrial discharges as well as port activities as described in Chapter 12. Water quality monitoring within Port Kembla has indicated concentrations of metals (aluminium, cadmium, copper, lead, zinc, tin and arsenic) exceeded the ANZECC (2000) 95 % trigger values for protection of marine waters. These exceedances were generally highest in the vicinity of the creeks and waterways draining into the harbour from surrounding industrial catchments. Average total suspended solids were found to be higher within the Inner Harbour (5.9 milligram per litre) than the Outer Harbour (3.2 milligram per litre). pH levels were generally lower in the Inner Harbour than the Outer Harbour, indicating freshwater discharge influences from the existing waterways within the Inner Harbour.

Water temperatures within Port Kembla are generally higher than those measured offshore due to slower tidal flushing patterns and existing industrial thermal discharges (hot water discharge within Allans Creek) to the Inner Harbour. As a result, water temperatures within the Inner Harbour are generally one to two degrees warmer than temperatures beyond the entrance to the port. The Outer Harbour benefits from greater tidal flushing and is generally less than 0.25 degrees warmer than water temperatures beyond the entrance to the port (AECOM, 2010).

Additional information is provided in Chapter 12 Water Resources, of this EIS.

13.3.5 Sediment quality

Marine sediments within Port Kembla are generally characterised as soft silty clays dominating the surface sediments with an underlying layer of stiff clay. Metals (arsenic, cadmium, chromium, copper, manganese, mercury, lead, vanadium and zinc), Polycyclic Aromatic hydrocarbons (PAH), dioxins and Tributyltin (TBT) have been recorded within these sediments across the Inner Harbour exceeding the screening levels for ocean and land disposal (National Assessment Guideline for Disposal – NAGD, and National Environment Protection Measures – NEPM) (WorleyParsons, 2012; Geochemical Assessments, 2013). Further, bioavailability investigations also found concentrations of cadmium, copper, lead and zinc exceeded NAGD screening level in many samples (Geochemical Assessments, 2013).

Recent investigations undertaken as part of the EIS have indicated the presence of contaminated sediments within the proposed dredging and disposal areas and were generally consistent with previous investigations. Concentrations of contaminants of concern were largely consistent across the dredging and disposal areas, with the primary contaminants of concern including heavy metals, PAH, dioxins and TBT at concentrations above the nominated screening levels as outlined in Chapter 11 and Appendix E3.

13.4 Potential impacts

13.4.1 Overview

Planned project activities outlined in Section 13.2 have the potential to cause the following impacts:

- Disturbance of the biofouling and benthic communities
- Deterioration of water quality
- Noise pollution
- Artificial light emissions

Unplanned events from project activities have the potential to impact the marine environment, these include:

- Pest introduction and proliferation
- Marine fauna collisions
- Accidental release of solid waste
- Accidental release of hydrocarbon, chemicals and other liquid waste
- Damaged fuel tank associated with vessel collision

The impact assessment from planned and unplanned activities during construction and operation are provided below. Management measures recommended to reduce/ eliminate the impacts are provided in Section 13.5.

13.4.2 Biofouling and benthic community disturbance

Potential impacts upon biofouling and benthic communities are primarily associated with direct removal of habitat during construction and potential impacts to water quality during both construction and operation as discussed in Section 13.4.3.

Removal of the existing infrastructure, including extraction of the piles, will lead to the removal of the biofouling communities associated with the berth infrastructure. This will also lead to temporary loss of biodiversity from the project site, and the likely avoidance of/displacement from the area by associated mobile fauna. Slow moving or semi-sedentary mobile fauna may suffer mortality if located on the piles at the time of removal. This may include small, slow moving fishes such as Syngnathids.

Removal of the biofouling communities will not permanently affect the biodiversity of the project footprint. Recolonisation of the new piles is expected to commence immediately following installation, followed by a long-term natural recruitment succession process. It is expected that a mature level biofouling community, comparable to that currently present will be achieved within a few years (Hamer and Mills, 2015). The assemblages that occur on that infrastructure supports species which are more likely to be non-native and represented on other subtidal hard substrates within the Inner and Outer Harbour areas.

Piling activities have potential to generate turbid plumes, however these effects are expected to be localised to the immediate project area and wider impacts are unlikely to extend beyond the Outer Harbour. The area of disturbance due to pile driving activity is expected to be small and any sediment generated during works is predicted to have little impact.

Dredging activities have the potential to impact directly on biofouling and benthic communities through direct removal of the substrate from the environment, and indirectly through generation of turbid plumes that will lead to suspension of sediment, affecting filter feeding organisms (UNEP, 2013). The dredged areas within Berth 101 will eventually be covered with fine layers of silt from the vessel propeller wash, and will be colonised with similar benthic communities from surrounding areas within the Inner Harbour.

Development of the perimeter bund and disposal of the dredged sediment will directly impact on existing benthic communities within the Outer Harbour disposal area through smothering and burial of epibenthic fauna. These Outer Harbour benthic communities have been previously subject to six dredged material disposal campaigns. The construction of the perimeter bund and subsequent dredged sediment disposal is expected to permanently remove a maximum 16.5 hectares of benthic habitat and associated benthic communities from the Outer Harbour area. This however will be offset by the creation of the reclamation area infrastructure providing new surface for colonisation by biofouling communities.

The impacts to benthic infauna associated with the Inner Harbour are not expected to be permanent. Migration and recolonisation into the disturbed footprint from adjacent soft sediment environments will begin immediately following construction and occur over subsequent weeks and months.

13.4.3 Water quality

Activities potentially leading to a deterioration in water quality and associated impacts upon marine ecology are primarily associated with dredging and placement activities during construction and the discharge of cold seawater containing residual sodium hypochlorite used as heating in the regasification process during operation of the FSRU.

Turbidity

Numerical modelling undertaken has defined the potential impacts associated with sediment plume dispersion (Chapter 12 and Appendix F). The removal and placement of the sediment from Berth 101 area was identified as the activity with the greatest potential to impact upon turbidity levels. Model scenarios were developed to assess the impacts to total suspended solids (TSS) and sediment deposition associated with the dredging and disposal of sediments within the Inner and Outer Harbours..

Modelling predicts that the extent of the dredge plume will be confined to Port Kembla with significant total suspended solids (TSS) concentrations confined to the vicinity of the dredging and disposal areas.

Turbidity has the potential to impact fish feeding ability, with piscivorous fish being affected to a greater extent than planktivorous fish due to the requirement of visually identifying prey over greater distances (de Robertis *et al.* 2003). In extreme cases, high levels of suspended sediments can also cause gill damage in fish (Au *et al*. 2004; Wong *et al*. 2013).

The increase in turbidity and TSS may also affect the feeding and respiratory organs of filter-feeding organisms (Airoldi 2003; Maldonado *et al.* 2008). However, it is likely that such organisms are already established within a marine environment prone to large spikes in turbidity following rainfall events and historically exposed to numerous dredging and disposal campaigns within Port Kembla, these species will be resilient to any short-term increases in suspended solids resulting from dredging and disposal activities.

Mobilisation of contaminants

Sediment sampling and analysis conducted for the EIS has confirmed the presence of contaminated sediments within the proposed dredging and disposal areas. Handling of Berth 101 sediment through dredging and disposal has the potential to cause mobilisation of some of these identified contaminants into the water column.

Release of pollutants such as heavy metals, metalloids, TBT and PAHs into the water column can result in toxic effects on sessile invertebrates. Resuspension of contaminated sediment has also been identified as a driver for the establishment of tolerant invasive species as well as in reducing recruitment of dominant species such as barnacles and polychaetes (Piola & Johnston 2007; Knott *et al.* 2009).

Fish of Port Kembla have also historically been found to have elevated metal and PCB concentrations in their tissues (He & Morrison, 2001). Whilst there is generally no recreational /

commercial fishing or aquaculture within Port Kembla, some recreational fishing occurs within the Outer Harbour (Worley Parsons, 2012). Hedge & Knott (2009) found that metal concentrations were lower in the oyster tissues located in the Outer Harbour; however the risk to human health from contaminant exposure through ingesting fish from the Outer Harbour still remains as fish move freely between the Inner and Outer Harbours.

High-level contaminant exposure has been linked to various toxic effects including immune system depression, disease breakouts, reproductive effects and endocrine disruption in marine mammals (Vos *et al.* 2003).

The release of contaminants is likely to be localised within the Port Kembla environment and medium-term in nature as described in detail in Chapter 12. Suspended sediments will be confined within silt curtains at the berth while dredge material will be confined within the perimeter bund at the Outer Harbour to minimise the migration of sediment and contaminants during disposal. The duration of exposure to toxicants are considered to be short in duration while long-term toxic effects are considered unlikely.

Dinoflagellate cyst

The toxic dinoflagellate species *Alexandrium catenella* has been previously recorded in 2002 and 2009, however no toxic dinoflagellate blooms have been historically observed within Port Kembla or associated with historical dredging campaigns. Dredging of sediments with potential dinoflagellate cyst may cause the cysts to germinate triggering blooms when conditions are favourable. Blooms of the toxic dinoflagellate may deplete dissolved oxygen and produce toxins, causing environmental damage including fish kills.

The risk of blooms is considered to remain given the historical records of toxic dinoflagellate species at Port Kembla, however the likelihood of a bloom occurring is considered to be low.

Thermal water

Numerical modelling has been undertaken for this EIS to assess the behaviour and extent of the thermal discharge plume in light of the existing intakes and outlets operated by BlueScope Steel which currently discharge warm water into the Inner Harbour.

Modelling indicates that the release of cold water from the project will only have minor impacts on seawater temperatures, expected to be confined to within the limits of Port Kembla. Modelling also shows that the existing warm water discharges from BlueScope Steel have a significant influence on water temperatures within the Inner Harbour; these will be reduced by the proposed release of cold water within the Inner Harbour.

Differential plots of predicted seawater temperatures produced show that predicted reductions in temperature are greatest during winter when BlueScope warm water discharges are reduced. The model predicts that initial near field mixing will reduce the 5th percentile temperature differential to one degree at each end of the proposed berth. On average, temperatures within the port are generally expected to decrease by 0.1 to 0.2 degrees, which is unlikely to impact upon marine ecology. .

The FSRU will operate with an automated marine growth protection system (MGPS).The MGPS takes seawater from the surrounding area, uses its natural salts to produce a solution of sodium hypochlorite, which acts as a natural biocide that is used on-board to ensure all the systems remain free of marine growths. Sodium hypochlorite degrades naturally and so most of the created solution will be used within the vessel well before the water is ready for re-release.

However, some excess sodium hypochlorite is expected to remain prior to discharge and dilution within the Inner Harbour.

Prior to re-releasing the seawater back into the surrounding area, the operators of the vessel will aim to match the profile of the discharged water, as close as possible, to the pre-discharge profile and will ensure that free chlorine (total residual oxidant in estuarine/marine water) concentrations remain below 0.2 ppm. The discharge plume is predicted to have diluted by a factor of four by the time the plume reaches the floor of the Inner Harbour and a dilution factor of 30 at a distance of 400m from the discharge point. Residual chlorine is expected to be primarily restricted to the Inner Harbour environment and is not expected to extend beyond the Outer Harbour.

It is expected that the marine communities in close proximity to the discharge point will be adversely affected by the decrease in temperature/presence of residual chlorine. This is likely to include the biofouling communities at adjacent pylons, the benthic community immediately under and adjacent to the FSRU and benthic/pelagic fish passing through the plume area. Potential impacts to these communities will vary depending on species, life history and stage, and season. Decreases in temperature and the presence of residual chlorine could lead to the avoidance of the area by mobile species, and the inhibition of growth, spawning or larval settlement of sessile organisms.

Artificial noise emissions

Piling and dredging activities associated with Berth 101 redevelopment will generate underwater noise. Noise has the potential to displace fauna from the area, resulting in a temporary reduced diversity. Construction noise also has potential to cause a temporary or permanent threshold shift (TTS or PTS) in the hearing ability of sensitive fauna that use acoustic means of navigation or communication.

The South Australian Department of Planning, Transport and Infrastructure (DPTI) *Underwater Piling Noise Guidelines* (2012) provides relevant behavioural and physiological noise criteria for some species of megafauna as shown in Table 13-5.

Table 13-5 Behavioural and physiological noise criteria for some megafauna

Species	Impact	Noise exposure criteria for impact piling
Cetaceans and pinnipeds	Behavioural	SPL 160 dB re: 1µPa
Low frequency cetaceans (All baleen whales, including southern right whale and humpback whale)	Physiological (TTS)	Peak 224 dB re: 1µPa SEL 183 dB (Mlf) re: 1µPa2-s
	Physiological (PTS)	Peak 230 dB re: 1µPa SEL 198 dB (Mmf) re: 1µPa2-s
Mid frequency cetaceans (Majority of toothed whales including dolphins and killer whale)	Physiological (TTS)	Peak 224 dB re: 1µPa SEL 183 dB (Mmf) re: 1µPa2-s
	Physiological (PTS)	Peak 230 dB re: 1µPa SEL 198 dB (Mmf) re: 1µPa2-s
High frequency cetaceans (Other toothed whales)	Physiological (TTS)	Peak 224 dB re: 1µPa SEL 183 dB (Mhf) re: 1µPa2-s
	Physiological (PTS)	Peak 230 dB re: 1µPa SEL 198 dB (Mhf) re: 1µPa2-s
Pinnipeds (seals and sea lions including Australian fur seal)	Physiological (TTS)	Peak 212 dB re: 1µPa SEL 171 dB (Mpw) re: 1µPa2-s
	Physiological (PTS)	Peak 218 dB re: 1µPa SEL 186 dB (Mpw) re: 1µPa2-s

Based on the noise exposure criteria presented above, dredging operations are likely to cause a temporary behavioral shift as marine fauna avoid the area immediately in the vicinity of dredging. Dredging activities also have the potential to result in temporary threshold shifts (TTS) for cetaceans (e.g. Dolphins, Southern right whale) and pinnipeds (e.g. Australian fur seal and Long-nosed fur seal) if these mammals are present during dredging activities.

Observed responses from cetaceans to artificially generated sound include changes in swimming direction, increases in swimming speed and marked 'shocked' reactions. Animals are expected to avoid areas where noise is being generated and return to the area following the cessation of construction works. Any displacement is expected to be temporary and will support mitigation of risk of impact upon the animals.

While animals are expected to move out of the zone of impact/influence of any noise generated during construction, pile driving works and rock placement are expected to generate noise thresholds that give potential to cause a temporary or permanent hearing shift in animals such as dolphins and seals. Appropriate management is required to minimise risk during key noise generating activities such as piling and rock placement.

Rays, skates and sharks utilise low frequency sound to detect prey and may exhibit avoidance of the source of acoustic disturbance. Review of the habitat and distribution of the grey nurse shark and white shark identified that the species are unlikely to occur in the project area, although may transit the wider region during movements between aggregation sites. It is therefore considered that the species are unlikely to be impacted by noise and frequencies generated during the project works.

The ability of fish to withstand underwater noise and their sensitivity to it varies widely across species. Impacts to fish from construction noise will be limited to behavioural response such as avoidance of the area and such actions would be temporary in nature and localised.

A variety of migratory and local shorebirds may occur in the region, with bird numbers and species being highly dependent upon the time of year. Pile driving and other construction activities may cause a local reduction in shorebird use of the project area during construction.

Artificial light emissions

Artificial lighting has the potential to affect fauna by altering use of visual cues for orientation, navigation or other purposes, resulting in behavioural responses, which can alter foraging and breeding activity in marine turtles, cephalopods, birds, fish, dolphins, and other pelagic species. Continuous lighting in the same location for an extended period may result in disturbance to marine fauna including:

- Fish and other pelagic species (e.g. zooplankton, squid, and larval fish) may be attracted to lights either directly or indirectly. This can in turn, alter predatory fish behaviour.
- Turtles can be attracted to lights (note turtles are unlikely to be present within the project area due to a lack of foraging and nesting habitat).

Berth 101 and surrounding areas within the Inner Harbour are currently lit at night, therefore it is assumed that marine fauna species using the project area will be habituated to extant light conditions. The project will contribute to but not elevate or increase the existing landscape lighting profile. As such, construction based lighting is not predicted to result in any change in migratory behaviours of birds that use the area and are already habituated to current light conditions.

Pest introduction and proliferation

Proposed activities may support spread, dispersal or expansion of existing marine pest populations within the project area. LNG carriers carrying invasive marine pests may unintentionally introduce new species to the region where the activity is occurring or carry pests from the region to other areas.

Marine pests may be carried within the external biological fouling on the LNG carrier hull, within seawater pipes (e.g. cooling water) and associated infrastructure or on submersible marine instruments and equipment. Ballast water exchange may also allow for the transportation and proliferation of marine pests within the area of activity.

Before vessels can proceed to the project site, quarantine obligations will have to be fulfilled by all vessels. For vessels sourced from high risk or international destinations, ballast water exchange record requirements will need to be complied with, including possession of relevant state and national documentation such as the Australian Quarantine and Inspection Service (AQIS) clearance documentation in order to verify compliance with ballast water and biofouling management measures.

Marine fauna collision/interaction

Interaction with marine fauna can potentially occur during the dredging and disposal activities or LNG carrier movements. There is potential for interactions with marine fauna during rock armour placement on the perimeter bund. The consequences of such collisions between marine fauna and vessels or construction materials for the marine organisms range from changes to fauna behavioural patterns to injury or death of the organism due to a direct collision.

The risk of potential vessel strike is considered low for all marine species likely to occur in the project area, including cetaceans, sharks and fish. This risk accounts for works being concentrated within a small area of the Inner and Outer Harbour limited by the port boundaries, and being undertaken at relatively low vessel speeds.

The risk of interaction between marine fauna and construction materials during rock armouring of the bund wall is low, as fauna would need to be directly in the path of the rock placement activities.

Accidental release of solid wastes

A variety of hazardous and non-hazardous solid waste may be potentially released unintentionally into the environment from overfull and / or uncovered bins or if blown off the deck of a vessel. Accidental spillage during transfers of waste from vessel to shore, and incorrectly disposed items may also cause the unintentional release of solid waste into the surrounding environment.

Non-hazardous solid waste includes plastics, packaging and paper materials and products while examples of hazardous solid wastes include oily and contaminated wastes, aerosol products, fluorescent tubes, batteries and medical waste.

There is capacity for non-hazardous solid waste such as plastic bags to affect the environment and cause entanglement or ingestion by fauna. The ingestion of solid wastes like plastic bags can consequently result in internal tissue damage, prevention of normal feeding behaviours and potentially death of the affected fauna.

The pollution of the immediate environment with the release of hazardous solid waste has the likely consequence of negatively affecting the health of marine ecology within the area. Particularly fish and cetaceans are susceptible to chemical impacts, including disease or physical injury after ingesting or absorbing the waste.

Accidental release of hydrocarbons, chemicals and other liquid waste

Vessels require a wide variety of liquids, chemicals and hydrocarbon compounds to operate and to be maintained. Vessel engines and equipment such as cranes, pile drivers and heavy machinery operate on diesel fuel while hydraulic and lubricating oils are required for the operation and continual maintenance of mechanical components. Fuel drums may also be retained in dedicated storage areas while some vessel engines adopt independent storage tanks. Examples of hazardous liquids include corrosion inhibitors, biocide and miscellaneous chemicals like cleaning agents and lubricating oils.

In addition, other liquid wastes such as sewage and food waste will be generated during construction. There are various scenarios that may result in accidental release of liquid waste, including tank failure, pipework failure or inadequate bunding.

If refuelling is required during the proposed activity, then refuelling events have the potential to cause environmental impacts through reduction in water quality and / or contamination of marine ecology. Spills during refuelling can occur through several pathways, including fuel hose breaks, coupling failure or tank overfilling.

There are no releases planned during the construction of the project. Rather, all liquid waste will be stored for discharge to an appropriate onshore facility. There is potential that a leak or spill of hydrocarbons or other liquids (including environmentally hazardous wastes and non-hazardous substances) may occur at the site. Such an occurrence would result in the localised reductions in water quality and contamination of nearby marine receiving environment.

Damaged fuel tank associated with vessel or plant collision

There is potential for vessels or plant to collide. The rupture of a vessel's fuel tank is the predominant risk. The significance of the risk is attributed to the release of diesel into the environment from the damaged fuel tank. In the event of a tank rupture from vessel collision, a standard tank is expected to empty into the environment within hours.

An oil spill within Port Kembla due to vessel / plant collision and rupturing of a fuel tank may result in confined impacts upon a wide variety of organisms inhabiting the port environment depending upon the nature and extent of the oil spill. An oil spill occurred outside Port Kembla, impacts could extend to sensitive receptors such as rocky habitat (Red Point headland, Tom Thumb Islands and Five Islands Nature Reserve) and sandy beaches (Wollongong City Beach, Fisherman's Beach or North Beach) around Port Kembla, refer to Figure 13-3.

13.5 Management measures

Table 18-12 provides a summary of the management measures to address the marine ecology impacts of the project. All management measures would be collated in management plans prepared for construction and operation of the project.

Table 13-6 Management measures for marine ecology

ID	Issue	Measure	Timing
ME1	Biofouling and benthic community disturbance	Works to remove the current quay wall and piles will commence after a visual inspection for protected mobile fauna (e.g. Syngnathids). If present, these will be relocated to adjacent habitats, outside the zone of influence by the proposed works, where feasible. Dredging will be carried out using mechanical backhoe dredge, split barges and supporting tug vessels, as opposed to suction-style dredging, to minimise the potential mobilisation of sediments within the Inner Harbour. Disposal of the dredged material will be limited to the Outer Harbour disposal area within the perimeter bund.	Construction
ME2	Water quality and marine ecology impacts from resuspension of sediments	The following controls should be implemented prior to dredge activities: • Physical controls such as installation of silt curtains prior to commencement of construction works would be adequate in minimising the spread of any sediments within the water column at the dredging and disposal locations. • Dredging techniques that minimise sediment resuspension during excavation and disposal (such as using mechanical methods over hydraulic methods) should be implemented	Construction

ID	Issue	Measure	Timing
		throughout the project. Barge loads will also be controlled such that overflow of barge loads is avoided. • Screening technologies will be implemented to ensure that any contaminated sediments are disposed of responsibly. Contaminated dredge material will be placed such that it may be capped by uncontaminated material in accordance with a dredge management plan. • Implementation of a water quality monitoring program to ensure construction works do not exceed the project's agreed marine water quality criteria. • Daily visual observations of any potential toxic dinoflagellate blooms within the Inner Harbour.	
ME3	Water quality and marine ecology impacts from resuspension of sediments	Implementation of a water temperature monitoring program to document natural variations in water temperature and the extent of temperature differences and dispersion pathways of the cold water discharge plume.	Operation
ME4	Impact of artificial noise emissions on marine fauna	During piling activities the following standard operational procedures are to be implemented (DPTI, 2012): • Pre-start procedure – The presence of marine mammals should be visually monitored by a suitably trained crew member for at least 30 minutes before the commencement of the soft start procedure. Particular focus should be put on the shut-down zone but the observation zone should be inspected as well, for the full extent where visibility allows. Observations should be made from the piling rig or a better vantage point if possible. • Soft start procedure – If marine mammals have not been sighted within or are likely to enter the shut down zone during the pre-start procedure, the soft start procedure may commence in which the piling impact energy is gradually increased over a 10-minute period. The soft start procedure should also be used after long breaks of more than 30 minutes in piling activity. Visual observations of marine mammals within the safety zones should be maintained by trained crew throughout soft starts. The soft start procedure may alert marine mammals to the presence of the piling	Construction

ID	Issue	Measure	Timing
		rig and enable animals to move away to distances where injury is unlikely. • Normal operation procedure – If marine mammals have not been sighted within or are not likely to enter the shut down or observation zone during the soft start procedure, piling may start at full impact energy. Trained crew should continuously undertake visual observations during piling activities and shut-down periods. After long breaks in piling activity or when visual observations ceased or were hampered by poor visibility, the pre-start procedure should be used. Night-time or low visibility operations may proceed provided that no more than three shut-downs occurred during the preceding 24 hour period. • Stand-by operations procedure – If a marine mammal is sighted within the observation zone during the soft start or normal operation procedures, the operator of the piling rig should be placed on stand-by to shut-down the piling rig. An additional trained crew member should continuously monitor the marine mammal in sight. • Shut-down procedure – If a marine mammal is sighted within or about to enter the shutdown zone, the piling activity should be stopped immediately. If a shut-down procedure occurred and marine mammals have been observed to move outside the shut-down zone, or 30 minutes have lapsed since the last marine mammal sighting, then piling activities should recommence using the soft start procedure. If marine mammals are detected the shut-down zone during poor visibility, operations should stop until visibility improves.	
ME5	Impact of artificial noise emissions on marine fauna	Vessel and heavy machinery should be maintained in accordance with the manufacturer specifications to reduce noise emissions.	Construction
ME6	Impact of on marine fauna through artificial noise or collision	The interaction of all vessels with cetaceans and pinnipeds will be compliant with Part 8 of the Environment Protection and Biodiversity Conservation (EPBC) Regulations (2000). The Australian Guidelines for Whale and Dolphin Watching (DoEE, 2017) for sea-faring activities will be implemented across the entire project.	Construction

ID	Issue	Measure	Timing
		This includes the implementation of the following guidelines: • Caution zone (300 m either side of whales and 150 m either side of dolphins) –vessels must operate at no wake speed in this zone. • Caution zone must not be entered when calf (whale or dolphin) is present • No approach zone (100 m either side of whales and 50 m either side of dolphins) – vessels should not enter this zone and should not wait in front of the direction of travel or an animal or pod, or follow directly behind • If there is a need to stop, reduce speed gradually • Do not encourage bow riding • If animals are bow riding, do not change course or speed suddenly.	
ME7	The impact of artificial light emissions	Light spill from the nearshore vessel operations will be minimised where possible using directional lighting.	Construction Operation
ME8	The impact of artificial light emissions	Lighting on vessel decks or the berth construction area will be managed to reduce direct light spill onto marine waters or surrounding landscape, unless such actions do not comply with site safety or navigation and vessel safety standards (AMSA Marine Orders Part 30: Prevention of Collisions; AMSA Marine Orders Part 21: Safety of Navigation and Emergency Procedures).	Construction
ME9	Pest introduction and proliferation	Locally sourced vessels (within NSW waters) to complete the construction works, where possible International vessels to empty ballast water in accordance with the latest version of the Australian Ballast Water Management Requirements (DAWR, 2017) If an IMP is identified or suspected, then the contractor is obliged to immediately (within 24 hours) notify the NSW Department of Primary Industries Aquatic Biosecurity Unit hotline on (02) 4916 3877 Project activities to adhere to the National System for the Prevention and Management of Marine Pest Incursions (National System) and NSW requirements for IMP identification and management.	Construction Operation

ID	Issue	Measure	Timing
ME10	Accidental release of solid waste	Appropriate waste containment facilities will be included on site and managed to avoid overflow or accidental release to the environment. No waste materials will be disposed of overboard of vessels, all non-biodegradable and hazardous wastes will be collected, stored, processed and disposed of in accordance with the vessel's Garbage Management Plan as required under Regulation 9 of MARPOL Annex V. All marine vessels will be operated and maintained in accordance with the South Australian Government's Code of practice for vessel and facility management (marine and inland waters) 2008. Hazardous wastes will be separated, labelled and retained in storage onboard within secondary containment (e.g. bin located in a bund). All recyclable and general wastes to be collected in labelled, covered bins (and compacted where possible) for appropriate disposal at a regulated waste facility. Solid non-biodegradable and hazardous wastes will be collected and disposed of onshore at a suitable waste facility.	Construction Operation
ME11	Accidental release of hydrocarbons, chemicals and other liquid waste	All liquid waste to be stored for discharge to an appropriate onshore facility Chemicals and hydrocarbons will be packaged, marked, labelled and stowed in accordance with MARPOL Annex I, II and III regulations. These include provisions for all chemicals (environmentally hazardous) and hydrocarbons to be stored in closed, secure and appropriately bunded areas. A Materials Safety Data Sheet (MSDS) will be available for chemicals and hydrocarbons in locations nearby to where the chemicals / wastes are stored Vessel operators will have an up to date Shipboard Oil Pollution Emergency Plan (SOPEP) and Shipboard Marine Pollution Emergency Plan (SMPEP). All shipboard chemical and hydrocarbon spills will be managed in accordance with these plans by trains and competent crew. Any contaminated material collected will be contained for appropriate onshore disposal	Construction Operation

ID	Issue	Measure	Timing
		Any equipment or machinery with the potential to leak oil will be enclosed in continuous bunding or will have drip trays in place where appropriate Following rainfall events, bunded areas on open decks of the vessels or within any construction laydown areas will be cleared of rainwater All hoses for pumping and transfers will be maintained and checked as per the PMS	
ME12	Damaged fuel tank associated with vessel or plant collision	Visual observations will be maintained by watch keepers on all vessels and plant/moving machinery. All vessels must comply with relevant marine navigation and safety standards. Marine diesel oil compliant with MARPOL Annex VI Regulation 14.2 (i.e. sulphur content of less than 3.50% m/m) is the only diesel engine fuel to be used by the vessels Oil spill responses will be executed in accordance with the vessel's SOPEP, as required under MARPOL Emergency spill response procedures would be developed and implemented when required.	

14. Terrestrial biodiversity

14.1 Overview

This chapter describes terrestrial biodiversity matters relevant to the construction and operation of the project. It summarises the more detailed Biodiversity Development Assessment Report (BDAR) in Appendix H.

The assessment has been prepared with reference to and in accordance with the Secretary's Environmental Assessment Requirements (SEARs) and the NSW Biodiversity Assessment Method (BAM). BAM is the assessment manual that outlines how an accredited person assesses impacts on biodiversity at development sites and stewardship sites. The scope of the BDAR broadly includes:

- A description of the existing environment from a desktop study to describe the landscape features of the study area and a field survey in accordance with the BAM to describe the biodiversity values of the project site. This included identification of flora and fauna species, mapping of vegetation communities and assessment of terrestrial and aquatic habitats in the study area and to determine the likelihood of threatened biota listed under the NSW Biodiversity Conservation Act 2016 (BC Act) and their habitats occurring in the study area or being affected by the project.
- A description of the conservation significance of the study area to identify the Matters of National Environmental Significance (MNES) listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) known or predicted to occur, and that will be potentially affected by the project.
- An assessment of the impacts from the project on freshwater fish habitat, key fish habitat, and threatened freshwater biota listed under the NSW Fisheries Management Act (FM Act).
- Presentation of the data used to perform the BAM calculations in order to quantify the residual biodiversity impacts of the project and to determine the ecosystem and species credits required to offset these impacts.
- Consideration of whether any additional assessment, approval or biodiversity offsets would be required under the FM Act or EPBC Act
- Identification of measures undertaken to avoid and minimise impact to biodiversity values.

Refer to Appendix H for the assessment methodology and assumptions.

14.2 Existing environment

14.2.1 Landscape features

Overall, the site is highly modified and disturbed, as much of it is located within the existing Port Kembla Coal Terminal (PKCT), NSW Ports land, BlueScope Steelworks and road reserves. A small patch of modified native vegetation occurs in the site west of Springhill Road. Some larger fragmented patches of native vegetation occur east of Springhill Road, however these will be avoided through the use of directional drilling. Landscape features in the study area relevant to the BAM calculations are summarised in Table 14-8.

Table 14-1 Summary of landscape features present within the study area

Landscape feature	Study area
Interim Biogeographic regionalisation of Australia (IBRA) bioregion	The Sydney Basin Bioregion lies on the central east coast of NSW and covers an area of about 3,624,008 hectares which includes about 4.53 % of NSW. The bioregion extends from north of Batemans Bay to Nelson Bay, west to Mudgee and includes a significant proportion of the catchments of the Hawkesbury-Nepean, Hunter and Shoalhaven river systems.
IBRA subregion	The study area occurs mainly within the Illawarra IBRA. The Illawarra subregion includes vegetated cliff faces on coastal escarpments and barrier systems.
NSW landscape region	The study area is mapped predominantly within the 'Lake Illawarra Barrier' Mitchell Landscape. Small portions in the north-west and west of the study area are mapped within the 'Dapto-Wollongong Coastal Slopes', 'Kiama Coastal Slopes' and 'Lake Illawarra Alluvial Plains' (DECC, 2008a). Based on the native vegetation and geomorphology of the study area, Lake Illawarra Alluvial Plains is the Mitchell Landscape where most of the impacts occur.
% native vegetation	Calculated as 5.7 % within the 500 metre buffer area surrounding the centre line of the linear pipeline and berth.
Rivers, streams and estuaries	The project crosses Allans Creek and Gurungaty Waterway. Both flow into the Inner Harbour of Port Kembla and through highly disturbed land. However, the Allans Creek catchment includes natural areas of the Illawarra Escarpment. Allans Creek, Gurungaty Waterway and the Inner Harbour are mapped as key fish habitat by DPI (2007).
Wetlands	There are no Coastal Management SEPP wetlands or proximity area, nationally important wetlands or internationally important wetlands within the site or the buffer area. A small swamp is located between the rail corridor and Springhill Road in the 'horse paddock', located to the east of the project
Connectivity features	The study area is located with the industrial complex at Port Kembla Harbour. It is surrounded by urban development of Wollongong and Port Kembla. There is minimal connectivity with large areas of native vegetation.
Areas of geological significance or soil hazard features	Soil landscapes for the study area and surrounding buffer area are highly modified, and are subject to contamination from various sources. The project is located entirely within lands identified as Disturbed Terrain. Landfill in areas of Disturbed Terrain may include soil, rock, building and waste material (Hazelton and Tille 1990). Landscaped areas comprise revegetation upon substrates of dumped and formed steel slag (GHD 2018c) and may be subject to legacy soil contamination associated with industrial use, land reclamation and filling. Inner Harbour seabed materials comprise soft silty clay with potential contaminants including heavy metals, tributyltin (TBT) and polycyclic aromatic hydrocarbons (PAH) (GHD 2018a). Estuarine sediments within the harbour and are mapped as high probability of being acid sulphate soils (GHD 2018b). There are no karst, caves, crevices, cliffs or other areas of geological significance located within the study area or buffer area surrounding the site.

14.2.1 Non-native vegetation

Vegetation throughout the majority of the project site has been classified as non-native vegetation in accordance with the BAM. This comprises mixed landscape plantings of native and non-native over-storey, over mown groundcover dominated by exotic plant species. No naturally regenerating canopy species, hollow-bearing trees, nor fallen woody debris occur within areas of non-native vegetation.

Typically, native over-storey plantings comprise *Casuarina glauca* (Swamp Oak), *Eucalyptus tereticornis* (Forest Red Gum), *E. botryoides* (Bangalay), *Melaleuca linariifolia* (Flax-leaved Paperbark), *M. styphelioides* (Prickly-leaved Tea Tree), and two species not endemic to the region - *Ficus microcarpa* var. *hillii* (Hill's Weeping Fig – Queensland) and *Lophostemon confertus* (Brushbox – northern New South Wales / Queensland).

Exotic over-storey planting within the project site include *Harpephyllum caffrum* (Kaffir Plum), *Schinus molle* var. *areira* (Peppercorn tree), *Jacaranda mimosifolia* (Jacaranda), *Triadica sebifera* (Chinese Tallowwood), *Gleditsia triacanthos* (Honey Locust Bean), *Erythrina* x *sykesii* (Indian Coral Tree), *Cinnamomum camphora* (Camphor Laurel) and *Lagunaria patersonii* (Norfolk Island Hibiscus). A range of other planted over- and mid-storey species are also scattered throughout the project site as well as numerous invasive woody weed species.

Common species within mown and predominantly exotic understorey include *Axonopus fissifolius* (Narrow-leaved Carpet Grass), *Bromus catharticus* (Prairie Grass), *Chloris gayana* (Rhodes Grass), *Cynodon dactylon* (Couch), *Ehrharta erecta* (Panic Veldtgrass), *Pennisetum clandestinum* (Kikuyu), *Paspalum dilatatum* (Paspalum) and *Sporobolus africanus* (Parramatta Grass). Isolated small patches of naturally established native grasses occur within the north of the project site, including *Bothriochloa decipiens* (Pitted Bluegrass), *Chloris truncata* (Windmill grass) and *Microlaena stipoides* (Weeping Grass).

Vegetation within these areas is classified as 'non-native' because it is mainly composed of exotic plant species cover, provides limited habitat resources for native fauna and does not form a functioning or potentially self-sustaining ecosystem. No natural regeneration of overstorey species was observed and there was minimal recruitment of native understorey plants. These areas are managed as open recreational and operational land including through period slashing, which would further limit any potential for the establishment of a functional native plant community.

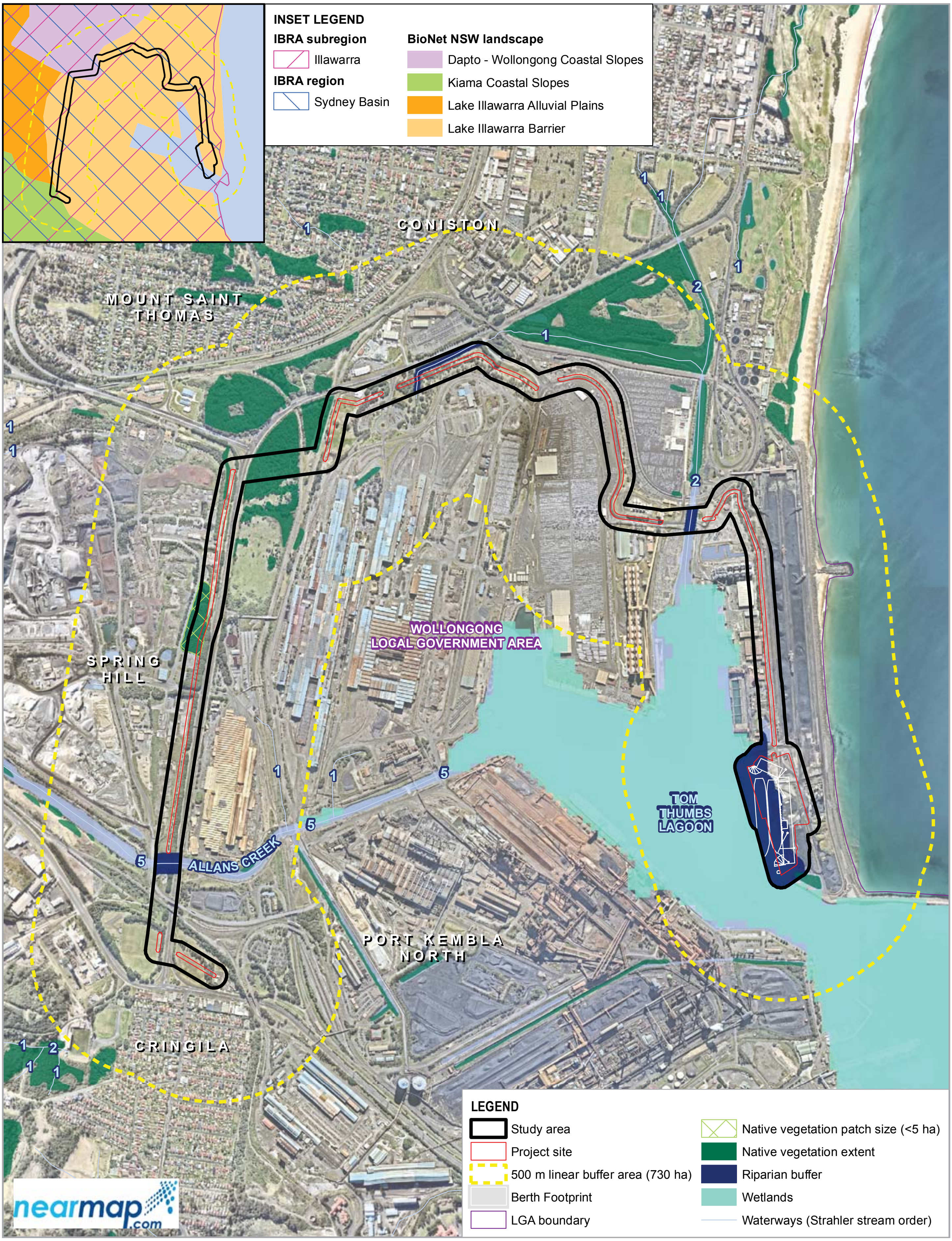
With the exception of an area of remnant woodland to the north of the western alignment, which will be avoided through directional drilling, the Wollongong City Council 2014 update of National Parks and Wildlife Service (NPWS) (2002) native vegetation mapping classifies vegetation throughout the study area as 'Disturbed landscapes' – 'Weeds and Exotics', 'Cleared lands' or 'Modified lands'.

14.2.2 Native vegetation and habitat

Native vegetation cover

A total of 41.30 hectares of native vegetation occurs within the 729.53 hectares landscape buffer area (comprising 5.7 % of the landscape buffer area) as shown on .

A total of 0.25 hectares of native vegetation occurs within the 14.55 hectares of the project site (comprising 0.02 % of the project site), entirely associated with a single, discrete patch of a single plant community type (PCT) covering an area of approximately two hectares.



Paper Size ISO A4

0 400 800

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Australian Industrial Energy
Port Kembla Gas Terminal

Native vegetation and landscape features

Project No. 21-27477
Revision No. -
Date 31/10/2018

FIGURE 14-1

G:\21\27477\GIS\Maps\Deliverables\Ecology\21_27477_Z001_BDAR_SiteLocation.mxd

Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018 & 19/07/2018, date extracted 01/08/2018 & 12/10/2018) & sixmaps 2018 ; General topo - NSW LPI DTDB 2017, 2015 & 2015; IBRA, IBRA subregion, BioNet NSW Landscapes, wetlands, vegetation - OEH; Berth footprint - Australian Industrial Energy. Created by: afoddy

Flora species

A total of 26 flora species from 18 families were recorded within native vegetation at the project site, comprising 13 native and 13 exotic species. The Asteraceae (daisies, 5 species, 1 native) and Poaceae (grasses, 4 species, 3 native) were the most diverse families recorded. A full list of flora species recorded within native vegetation is provided in Appendix H.

Native vegetation zones

Native vegetation and original substrates have been almost entirely removed from the study area, with no remnant native vegetation or natural substrates occurring within the project site.

Field surveys confirmed the presence of a single patch of native vegetation, comprising a small area of dense revegetation on modified/cleared lands at the approximate mid-point of the western pipeline alignment, within the project site. The vegetation is composed of a native canopy monoculture with a small number of native species regenerating in the understorey, amongst dense exotic species cover. The patch of native vegetation has been assigned to a PCT based on the classification of surrounding remnant vegetation (NPWS 2002), and likely substrates and landscape position in the area prior to their excavation and redevelopment (see Table 14-2). The vegetation zone at the project site is summarised in Table 14-2 and shown in Photograph 14-1

Table 14-2 Vegetation zones

Zone no.	Vegetation zone	PCT ID[1]	PCT Common Name	Condition	Patch size (ha)	Area (ha)	VIS2	Conservation significance
1	1326_Moderate-good (Woollybutt – White Stringybark – Forest Red Gum grassy woodland)	1326	Woollybutt – White Stringybark – Forest Red Gum grassy woodland on coastal lowlands	Moderate-good	2	0.25	18.2	Does not comprise an occurrence of any listed TEC
Total area						**0.25**		

Notes: 1) the closest matching PCT has been assigned to planted native vegetation within cleared and modified lands.

2) VIS = vegetation integrity score

Photograph 14-1 Woollybutt White Stringybark – Forest Red Gum grassy woodland on coastal lowlands

An additional small area of natural regeneration in a man-made drain was also recorded within the study area to the north of the western portion of the pipeline alignment (see Figure 2-1). Native vegetation within the man-made drain is most closely aligned with PCT 1071 *Phragmites australis* & *Typha orientalis* on coastal freshwater wetlands, although native vegetation within the study area does not comprise an occurrence of a listed threatened ecological community.

Groundwater dependent ecosystems

Table 14-3 shows a number of potential terrestrial Groundwater Dependent Ecosystems (GDE) in the study area (BOM, 2018). No aquatic GDEs are mapped in the study area.

Table 14-3 Potential Groundwater Dependent Ecosystems in the study area

Type of GDE	Location
Low potential GDE	The majority of Gurungaty Waterway and Allans Creek (to be underbored by the project)
Moderate potential GDE	Small vegetated areas along Gurungaty Waterway and Allans Creek (to be underbored by the project) Areas of native vegetation present at the northern end of Springhill Road (to be underbored by the project)
High potential GDE	Areas of native vegetation present at the northern end of Springhill Road (to be underbored by the project)

Fauna species

The field survey identified 25 fauna species in the project area and surrounds, comprising 23 bird species, one mammal species and one frog species. No threatened or migratory species were recorded during site investigations.

Habitat resources

The following specific geographic and habitat features were identified within the project site and indicate the potential presence of threatened species that could contribute to the credit calculations:

- Semi-permanent/ephemeral wet areas.
- Land within one kilometre of wet areas/swamps.
- Land containing swamps.
- Swamp margins or creek edges.
- Land within 500 metres of swamps.

Fauna habitats associated with native and non-native vegetation in the study area

Habitats for fauna associated with native vegetation are limited in the study area due to the history of industrial development at the site. A small patch of planted native vegetation dominated by Swamp Oak is located west of Springhill Road. A small drain with emergent vegetation is also located adjacent to Springhill Road. Swamp Oak revegetation and Typha wetland within the study area are shown in Photograph 14-2 and described in Table 14-4.

Potential fauna habitats associated with non-native vegetation in the study area predominantly comprise areas of sediment ponds planted vegetation, mown lawns and areas of weeds as described in Table 14-5. Non-native vegetation and constructed habitat features within the study area are shown in Photograph 14-3 and Photograph 14-4.

Photograph 14-2 Left: Swamp oak revegetation Right: Typha wetland

Photograph 14-3 Left: planted trees and shrubs Right: exotic shrub

Photograph 14-4 Left: Mown lawns (exotic grassland) Right: Sediment ponds

Table 14-4 Fauna habitats associated with native vegetation

Swamp oak revegetation		Typha wetland
Description	This area comprises a weed infested semi-mature, planted monoculture of Swamp Oak. A small number of bird-dispersed native species are beginning to establish within the revegetation area. No hollow-bearing trees are present.	There is a narrow drain with emergent, naturally regenerating *Typha orientalis* vegetation located near the intersection of Springhill Road and Masters Road. It runs alongside a mown lawn associated with the electricity easement and has high levels of weeds present. No large areas of open water are present.
Typical fauna species recorded	A small number of nectarivorous bird species were observed foraging within the planted trees and shrubs including the White-plumed Honeyeater (*Lichenostomus penicillatus*), Rainbow Lorikeet (*Trichoglossus haematodus*) and Red Wattlebird (*Anthochaera carunculata*). Insectivores including the Noisy Miner (*Manorina melanocephala*), Willie Wagtail (*Rhipidura leucophrys*) and Australian Magpie (*Cracticus tibicen*) were also observed.	This drain is likely to provide habitat for common frog species such as the Common Eastern Froglet (*Crinia signifera*)
Threatened fauna species recorded or likely to occur	No threatened species are likely to depend on the habitats present in this vegetation. Mobile threatened species such as woodland birds and microchiropteran bats may forage in these habitats on occasion while moving between better quality areas of habitat.	This drain may provide habitat for the Green and Golden Bell Frog. Given its small size and location adjacent to a busy road, it is more likely to be used transiently as foraging or basking habitat by individuals moving between areas of better quality habitat. Given the absence of open water and nearby shelter, breeding is highly unlikely at this location.
Migratory fauna species recorded	No migratory species are likely to depend on this habitat type. Species such as the Rufous Fantail or Satin Flycatcher could occur transiently while moving between better quality areas of habitat.	Migratory waders are unlikely to utilise this habitat frequently or for extended periods.

Table 14-5 Fauna habitats associated with non-native vegetation

Planted trees and shrubs		Exotic scrub
Description	Planted trees and shrubs occur within narrow linear plantings alongside the access road to the berth, in the northern portion of BlueScope Steel land, and planted figs along Springhill Road. No hollow-bearing trees were observed in this habitat type, although some small hollows may occur. Planted *Eucalyptus* and *Ficus* species provide foraging and shelter resources for a range of birds and mammals of urban environments that are tolerant of regular disturbance from traffic and noise impacts. Foraging resources include seasonal nectar resources, seeds and insects. Woody debris is generally absent from this broad habitat type, however some leaf litter is present where canopy species are present. Fallen timber and leaf litter provides shelter substrate for small reptiles, snakes and small mammals.	Exotic scrub is present along the rail corridor. Exotic scrub is dominated by dense midstorey vegetation of variable structural complexity and include Lantana. These areas were once cleared, but have not been regularly maintained and have since become overgrown. Exotic scrub within the study area provide potential foraging habitat for a range of common bird and mammal species. Exotic scrub also provides good refuge habitat for many small insectivorous and nectarivorous birds.
Typical fauna species recorded	A small number of nectarivorous bird species were observed foraging within the planted trees and shrubs and included the White-plumed Honeyeater, Rainbow Lorikeet and Little Wattlebird. Insectivores including the Noisy Miner, Willie Wagtail and Australian Magpie were also observed.	Small birds such as the Red-browed Finch (*Neochmia temporalis*), Superb Fairy-wren (*Malurus suberbus*) and New Holland Honeyeater (*Phylidonyris novaehollandiae*) were observed foraging. Native mammals including the Common Ring-tailed Possum (*Pseudocheirus peregrinus*) and small introduced mammals such as Black Rats (*Rattus rattus*) may den and forage in the dense midstorey of exotic scrub, although none were recorded.
Threatened fauna species recorded or likely to occur	The Grey-headed Flying-fox (*Pteropus poliocephalus*) is likely to forage in large Ficus individuals adjacent to Springhill Road and in planted eucalypts. No breeding camps are present. Other mobile threatened fauna (woodland birds or microchiropteran bats) could occur on occasion, but would not depend on the habitat for their survival in the locality.	Exotic scrub is unlikely to provide suitable habitat for threatened fauna species.
Migratory fauna species recorded	No migratory species are likely to depend on this habitat type. Rufous Fantail or Satin Flycatcher could occur transiently while moving between better areas of habitat.	No migratory species are likely to depend on this habitat type. Species such as the Rufous Fantail or Satin Flycatcher could occur transiently while moving between better quality areas of habitat.
Introduced species	Spotted Turtle-dove (*Streptopelia chinensis*)	Common Myna (*Sturnus tristis*); Red-whiskered Bulbul (*Pycnonotus jocosus*)

Table 14-6 Fauna habitats associated with non-native vegetation (continued)

Exotic grassland		Hardstand and sediment ponds
Description	Exotic grassland is present within parts of Bluescope Steel and along Springhill Road and the rail corridor. Exotic grassland is interspersed with ballast, bare ground and other artificial substrate. These areas would have historically supported native vegetation but have been extensively modified by previous clearing and land reclamation. These areas are devoid of shrubs and trees. Exotic grassland contains few habitat resources of relevance to most native species due to its low structural and floristic diversity. Exotic grasses and herbs would provide foraging resources for relatively mobile and opportunistic native fauna species.	Areas of hardstand (roads, pavements, and berths) and constructed sediment ponds are located throughout the coal terminal and Bluescope Steel land. These areas provide limited habitat for fauna species.
Typical fauna species recorded	Bird species commonly recorded include the Crested Pigeon (*Ocyphaps lophotes*), Welcome Swallow (*Hirundo neoxena*), Magpie-lark (*Grallina cyanoleuca*), and Willie Wagtail. These species are insectivorous and were observed foraging within mown portions of the grassland. Small, common lizards such as the Dark-flecked Garden Sunskink *(Lampropholis delicata*) are likely to occur, particularly in areas where shelter such as ballast or woody debris is present.	A tern (*Sternula sp.*) was observed resting on the edge of the berth. The Australian Raven (*Corvus coronoides*) was also observed foraging on the ground.
Threatened fauna species	No threatened species are likely to rely on this habitat. Microchiropteran bats such as the Eastern Bentwing Bat may forage above the grassland on occasion. There is potential for the green and Golden Bell Frog to occur in these areas on rare occasions when moving between areas of better quality habitat.	Hardstand areas and artificial sediment ponds provided minimal habitat for threatened species. The Green and Golden Bell Frog has, however, been recorded in these habitats in the study area previously and this species is known to occur in highly disturbed environments including those with moderate surface water contamination. It is likely that the species would only use these habitats temporarily while moving between areas of better condition habitat.
Migratory fauna	No migratory fauna are likely to occur in these areas.	No migratory waders are likely to utilise artificial sediment ponds within the study area except on rare occasions.
Introduced species	Spotted Turtle Dove	Rock Dove (*Columba livia*)

Connectivity

Native vegetation in the study area and surrounding buffer area is extensively fragmented by clearing for existing industrial development. Limited connectivity for fauna movement is present in the study area. The main fauna corridor is located along Springhill Road, where planted trees provide habitat for birds. Areas of weedy vegetation are also present along the rail corridor and would provide habitat for birds, small mammals, reptiles and frogs.

Movement habitat of the key population of the Green and Golden Bell Frog at Port Kembla is generally typified by wet areas such as creek lines, drains, periodically damp areas, connecting or partially connecting vegetation, easements, laneways and even open areas that do not restrict movement (DEC, 2007). This species may on occasion use disturbed habitats in the study area to move between other areas of habitat.

Aquatic habitat

Allans Creek and Gurungaty Waterway are highly disturbed aquatic habitats as shown in Photograph 14-1 and described in Table 14-7.

Photograph 14-1 Left: Allans Creek within Bluescope Steel land Right: Gurungaty Waterway upstream of the project site

Table 14-7 Fauna habitats: Aquatic habitat

Aquatic habitat	
Description	Allans Creek and Gurungaty Waterway are crossed by the pipeline alignment. The pipeline would be underbored beneath both creeks. Allans Creek, Gurungaty Waterway and the Inner Harbour are mapped as key fish habitat by DPI (2007). Allans Creek has modified banks along much of the reach within the study area. A number of pipelines are located alongside the creek. The creek is also crossed by various bridges. Limited riparian vegetation is present. A number of planted figs are located on the banks near Springhill Road. No emergent vegetation was observed. Gurungaty Waterway is also highly modified due to its location in an industrial area. It is crossed by various roads and rail lines before entering the Inner Harbour. It contains areas of saltmarsh and mangroves, which comprise 'marine vegetation' under the FM Act. These occur upstream of the project site and would not be directly impacted by the project.
Typical fauna species	Given their estuarine nature, a number of saltwater fish species are likely to occur in these creeks. Further detail is provided in the marine ecology report (Appendix G).
Threatened species	Allans Creek and Gurungaty Waterway are unlikely to provide habitat for any threatened freshwater fish species (DPI, 2018a).
Migratory fauna species	Migratory waders may occur on occasions along small areas of mudflats on Gurungaty Waterway and the remnant of Tom Thumb Lagoon.

14.2.3 Conservation significance

This section describes the conservation significance of the study area in terms of threatened biota and their habitats, and MNES that are known or predicted to occur.

Identification of threatened species under the BAM

Predicted threatened species

Based on the vegetation types and habitat resources present within the site, the BAM calculator generates a list of threatened fauna species that are predicted to utilise the study area. The list was refined based on the habitat assessment and field surveys conducted. The suite of threatened species associated with ecosystem credits required for the study area are listed in Table 14-8. For each predicted threatened species, a sensitivity class rating and vegetation zones they are predicted to be associated with are also provided. Targeted surveys are not required for these species.

Table 14-8 Habitat for predicted threatened species

Common Name	Scientific Name	BC Act	EPBC Act	Sensitivity class1	Habitat present
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	Vulnerable		High	Yes – likely to forage above the project site
Eastern Freetail-bat	*Mormopterus norfolkensis*	Vulnerable		High	Yes – may forage on occasion at the project site
Flame Robin	*Petroica phoenicea*	Vulnerable		Moderate	Yes – may forage on site on occasion
Gang-gang Cockatoo	*Callocephalon fimbriatum*	Vulnerable		Moderate	Yes – may forage on site on occasion
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	Vulnerable		High	Yes – may forage on site on occasion
Grey-headed Flying-fox	*Pteropus poliocephalus*	Vulnerable	Vulnerable	High	Yes – may forage on occasion at the project site
Little Bentwing-bat	*Miniopterus australis*	Vulnerable		High	Yes – may forage on occasion at the project site
Little Eagle	*Hieraaetus morphnoides*	Vulnerable		Moderate	Yes – may forage on site on occasion
Little Lorikeet	*Glossopsitta pusilla*	Vulnerable		High	Yes – may forage on site on occasion
Masked Owl	*Tyto novaehollandiae*	Vulnerable		High	Yes – may forage on site on occasion
Powerful Owl	*Ninox strenua*	Vulnerable		High	Yes – may forage on site on occasion
Scarlet Robin	*Petroica boodang*	Vulnerable		Moderate	Yes – may forage on site on occasion
Square-tailed Kite	*Lophoictinia isura*	Vulnerable		Moderate	Yes – may forage on site on occasion
Varied Sittella	*Daphoenositta chrysoptera*	Vulnerable		Moderate	Yes – may forage on site on occasion
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	Vulnerable		High	Yes – may forage on occasion at the project site

Species credit species

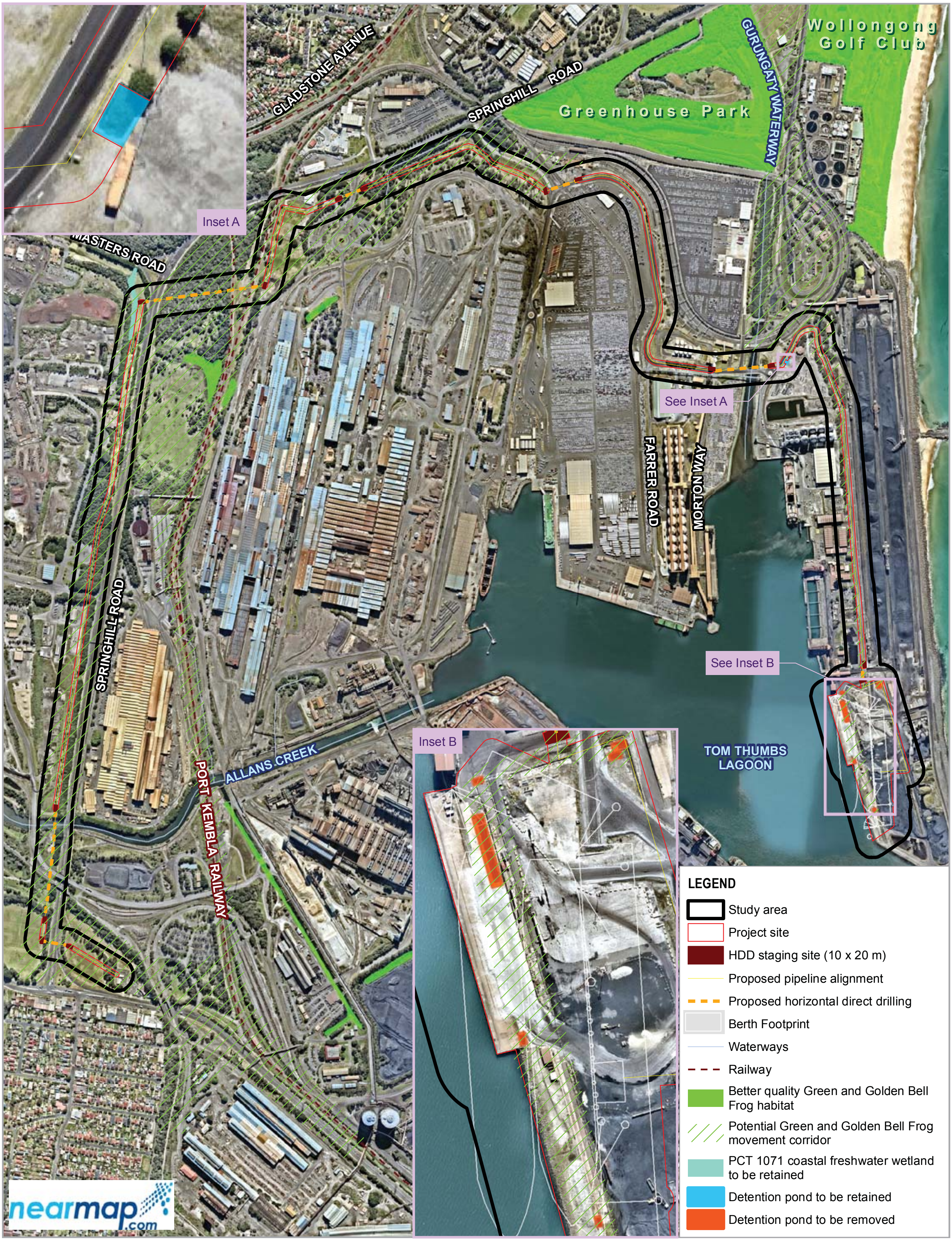
Species credit refers to the class of biodiversity credit created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Species Profile Database (OEH, 2018). Given the highly disturbed and modified nature of the study area, no suitable habitat for candidate species credit species occurs within the project site. No species credit species were opportunistically recorded in the study area during the GHD surveys.

Dispersal habitat and artificial refuge habitat for the Green and Golden Bell Frog is assumed to be present based on recent records in the area, however this is not associated with any PCTs in the project site.

The North Port Kembla sub-population of the Green and Golden Bell Frog is likely to extend across much of the industrial lands in and around the Port Kembla Steelworks and a range of constructed habitats have been established in order to protect and encourage the remaining population. They are believed to utilise drainage features, rail easements, roads, culverts and other low lying features and associated vegetation as habitat. The use of these habitat features may be transient, intermittent and dependent on suitable weather conditions (DEC, 2007).

Constructed habitat for Green and Golden Bell Frog is located to the north of the site in the south-east corner of Greenhouse Park. No individuals of Green and Golden Bell Frog have been recorded at the Greenhouse Park habitat over the last five years (Gaby Kirwood, Jen Byrne, pers. com. 2017), and the numbers recorded in the Inner Harbour have also decreased significantly in recent years. However, Bluescope Steel noted that a number of individuals were observed in constructed habitat in March 2017, after there being no significant sightings of the species for about seven years at this location (BlueScope, 2017).

The project site covers an area that is a potential movement corridor of the Green and Golden Bell Frog. Connections between the Tom Thumb Lagoon population to the north of the study area and other populations are exceedingly tenuous and would only be possible along rail easements, and creek and drainage lines (including Allans Creek) in the vicinity of the BlueScope steelworks complex. Connectivity between the North Port Kembla population (to the south of the study area) and the sub-populations further to the south is also likely to be tenuous (DEC, 2007).



Paper Size ISO A4

0 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Australian Industrial Energy
Port Kembla Gas Terminal

Green and Golden Bell Frog Habitat

Project No. **21-27477**
Revision No. **-**
Date **31/10/2018**

FIGURE 14-2

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Vegetation mapping - GHD & OEH (NPWS 2002, edited by WCC 2014); Berth footprint - Australian Industrial Energy. Created by: afoddy

Threatened survey results

No threatened flora species were recorded during surveys. Given the highly disturbed nature of the study area and especially the absence of natural soil profiles, no threatened flora species are likely to occur.

No threatened fauna were recorded during field surveys.

The Port Kembla key population of the Green and Golden Bell Frog is known to be associated with unnatural habitats in the local area. Breeding habitat used on occasion by the key population includes domestic swimming pools, ponds, drainage depressions, culverts and possibly grassy swale areas (DEC, 2007). Foraging habitat includes areas of native or introduced grasses, tussock vegetation and emergent sedges and reeds bordering water features (DEC, 2007). Green and Golden Bell Frogs have previously been recorded in highly disturbed and modified habitats within the coal terminal, including artificial ponds.

No threatened ecological communities occur within the project site or will be impacted by the project.

A single patch of native vegetation, comprising a small area of planted native species within heavily modified and degraded land, has been assigned to PCT 1326 (Woollybutt – White Stringybark – Forest Red Gum grassy woodland on coastal lowlands) as the most likely PCT to have occurred in the area prior to clearance and development. PCT 1326 may in appropriate condition states and landscape positions comprise an occurrence Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion, which is listed as an endangered ecological community (EEC) under the BC Act, and the related critically endangered ecological community (CEEC) listed under the EPBC Act. However, native vegetation within vegetation zone 1 does not comprise an occurrence of Illawarra Lowlands Grassy Woodland. This assessment is based primarily upon the absence of appropriate substrates, characteristic tree species and woodland structure.

A small patch of remnant PCT 694 (Blackbutt – Turpentine – Bangalay moist open forest) intergrading to PCT 1326 (Woollybutt – White Stringybark – Forest Red Gum grassy woodland) occurs within the north-west of the study area (NPWS, 2002). This remnant patch of PCT 1326 comprises an occurrence of the TEC Illawarra Lowland Grassy Woodland, however, this vegetation will not be impacted by the project.

Matters of National Environmental Significance

No threatened ecological communities or threatened flora species were recorded or are likely to occur within the project site.

The Grey-headed Flying-fox may forage in planted figs and eucalypts, but no breeding colony is present. The habitat present would make up a negligible area of foraging habitat for the local population.

The Green and Golden Bell Frog is known to occur in the area. It has been known to utilise artificial sediment ponds on occasion, and move through drainage depressions and cleared land.

With regards to migratory biota, in particular shorebirds, Chafer (1997) recorded a range of native fauna which utilise the remnant of Tom Thumb Lagoon north of the project site, including 45 bird species, of which 9 are listed as migratory species under the EPBC Act (see Chafer 1997 and Woods 2006).

Small areas of mudflats are located along Gurungaty Waterway upstream of the project site. There are no wetlands, mudflats or sandflats that represent important habitat for migratory shorebirds present in the project site.

Small areas of planted trees and exotic vegetation that occur in the project area are unlikely to support an ecologically significant proportion of terrestrial migratory species, and no important breeding habitat is present.

14.3 Potential impacts

This section describes the biodiversity impacts of relevance to the project area and how impacts will be avoided.

14.3.1 Overview

The project would result in direct impacts on cleared and disturbed land, including a small area of planted native vegetation, within the 14.55 hectare project site. Planted native vegetation within the project site is likely to provide marginal potential habitat for threatened species. No hollow-bearing trees suitable for use by breeding owls or cockatoos would be removed. No raptor nests would be removed. Construction would remove four small detention ponds that could be used on occasion as a refuge by the Green and Golden Bell Frog, and trenching would temporarily impact a movement corridor for this species. Groundcover would be restored following construction of the project. Residual impacts on native vegetation are assessed in Section 14.3.3.

14.3.2 Avoidance of impacts

The location of the project in a highly disturbed and modified industrial site, allows for avoidance of many impacts as compared to a project in a predominantly greenfield location. Minimal native vegetation and associated habitat for threatened species is present. Potential impacts upon native vegetation and fauna habitat have been further avoided by the use directional drilling of the pipeline (in particularly to avoid areas of Illawarra Lowlands Grassy Woodland and natural swamp areas that intersect the proposed alignment), with trenching being used in previously disturbed areas only. The construction corridor has been reduced in some locations to minimise impacts on potential Green and Golden Bell Frog habitat. Following construction, groundcover would be re-established, minimising impacts in the long-term.

14.3.3 Residual impacts

Construction phase

Clearing of native vegetation

The project site contains cleared land comprising exotic grass species, planted native/exotic flora in varying states of maturity and environmental weeds. Only a small area of native vegetation occurs within the project site that will be impacted by the project. Trenching for pipeline installation would mainly involve a temporary disturbance of ground-cover species, and disturbed areas would be stabilised and revegetated following construction. Some removal of shrubs and trees would be required and for the purposes of this assessment, it is assumed that all vegetation within the project site will be removed during construction of the project.

The vegetation that will be removed provides habitat resources for common native fauna typical of fragmented urban bushland remnants and parks and gardens. Directional drilling would be undertaken to avoid impacts on native vegetation present within the study area where possible. Drill sites and laydown areas will be located in predominantly cleared areas.

Direct impacts upon native vegetation that would occur as a result of the project are shown in Table 14-9.

Table 14-9 Proposed impacts within the project site

Zone no.	Vegetation zone	Conservation significance	VIS*	Area w/in project site (ha)
1	1326_Moderate-good (Woollybutt – White Stringybark – Forest Red Gum grassy woodland)	Does not comprise an occurrence of a listed TEC	18.2	0.25
n/a	Non-native vegetation	n/a	n/a	14.30
Total area (project site - trenching including HDD staging sites)				14.55

*VIS = vegetation integrity score

Removal of non-native vegetation

In addition to clearance of a 0.25 hectares of native vegetation, 14.30 hectares of non-native vegetation comprising planted native/exotic flora in varying states of maturity and environmental weeds will be removed within the remainder of the project site. The vegetation provides limited potential habitat resources for native fauna species. No hollow-bearing trees will be removed that are likely to provide habitat for large forest owls, cockatoos or the Large-footed Myotis.

There will be no impacts on bridges that could provide roosting habitat for the Large-footed Myotis.

The project site includes potential habitat and movement corridors for the Green and Golden Bell Frog (see Figure 14-2).Small artificial detention ponds (around 0.02 hectares in total) will be removed from the proposed berth area which are potential temporary habitat for the threatened Green and Golden Bell Frog. No emergent vegetation is present, and no shelter habitat is present in or adjoining these ponds.

There would be temporary disturbance of the potential movement corridor for the species during construction. Following construction the ground surface would be stabilised and planted with groundcover, and could continue to be utilized by the species. Mitigation measures are recommended to minimise potential injury or mortality of Green and Golden Bell Frog individuals during removal of the artificial pond (see Table 14-10).

Fauna injury and mortality

The project site provides a variety of habitat resources for native fauna species, including foraging, roosting and shelter resources for threatened species as well as common native fauna. Groundcover vegetation, leaf litter and woody debris provide shelter and foraging substrate for reptiles, frogs and invertebrates. Construction has potential to result in the injury or mortality of some individuals of these less mobile fauna species and other small terrestrial fauna that may be sheltering in vegetation within the subject site during clearing activities. Mitigation measures are recommended to minimise potential injury or mortality of native fauna and especially Green and Golden Bell Frog individuals, , pre-clearing surveys, use of frog-proof fencing near construction sites and management of the trench (see Table 14-10).

Habitat fragmentation

The study area traverses mostly cleared or otherwise disturbed and/or modified land, with small patches of planted vegetation. The project would predominantly impact exotic species-dominated groundcover, with only limited shrubs or trees removed andis unlikely to directly isolate or fragment any areas of habitat. The majority of the vegetation in the study area comprises exotic groundcover plants that have very little value as fauna movement habitat. Fauna movement, pollination and seed fall of plants and other ecological processes would continue to occur through the study area. The vegetation in the construction corridor does not comprise important shelter or movement habitat for most native fauna.

The majority of the project site is associated with the pipeline alignment and would not comprise any above-ground barriers to fauna movement.

There may be temporary impacts on the movement corridor of the Green and Golden Bell Frog. A range of mitigation measures are recommended to minimise the risk of impacts on dispersing individuals (see Table 14-10).

Weed invasion and edge effects

'Edge effects' refers to increased noise and light or erosion and sedimentation at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to vegetation structure and condition, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna.

Weed invasion and edge effects are already present throughout the study area, given the location of the project within a heavily cleared industrial landscape. The potential for the project to exacerbate existing edge effects and weed invasion would be limited, given the extent of modification within the study area.

There is some potential for additional impacts on native vegetation in the study area through dispersal of weed propagules on vehicles or equipment and through disturbance of vegetation and surface soil, which may provide increased opportunities for recruitment of new weed species.

Environmental safeguards, including weed control and minimising impacts on native vegetation are proposed in Table 14-10 to minimise the spread of weeds and edge effects.

Soil and water pollution

Construction of the project has the potential to result in sedimentation, pollution, contaminated runoff or erosion within the construction corridor and adjoining native vegetation and aquatic habitats, through soil disturbance and construction activities. Potential sources of soil and water pollution include:

- Soil disturbance during excavation and construction works.
- Inappropriate management of soil and material stockpiles.
- Hydrocarbon leaks or spills from vehicles or equipment used in construction.
- Increased sediment transfer and erosion potential in areas cleared of vegetation.

Mitigation measures to reduce the potential for such pollution are described in Table 14-10, and include minimising the disturbance area, construction staging, erosion and sediment control devices and rehabilitation or landscaping of disturbed areas.

Introduction of pests and pathogens

The project would not involve the transport of any animals or any other activities that are likely to directly contribute to the introduction of pest fauna species.

Construction activities have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangelii*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) throughout the study area through vegetation disturbance and increased visitation. Phytophthora and Myrtle Rust may result in the dieback or modification of native vegetation and damage to fauna habitats. Chytrid fungus affects both tadpoles and adult frogs and can lead to the extinction of local populations once introduced into an area.

The potential for impacts associated with these pathogens is low, given the existing modified nature of the landscape, high visitation rates to the study area, limited intact native vegetation and habitats within the project site and impact mitigation measures including exclusion of access to retained native vegetation adjoining the project site.

Noise and vibration

The construction corridor is located near busy roads with relatively high traffic volumes, as well as industrial areas. Habitats adjacent to the project therefore already experience high noise, light and vibration disturbance. There would be additional temporary noise and vibration as a result of construction. Most of the species that are likely to nest or roost in the study area are common species typical of predominantly cleared landscapes and would be habituated to noise to a large extent. Most mobile species such as common birds would move out of the area during construction.

Operation phase

The project would include installation of underground services that would be located in an area that is already developed and includes similar infrastructure. The pipelines would require periodic maintenance, involving associated vehicle traffic and potential excavation to access the pipelines if required. Given the modified nature of the revised construction corridor and in the context of other day to day activities occurring in the study area, this would have a negligible impact on the natural environment.

The project would be undertaken on land which has been extensively modified by existing, approved developments. It contains a relatively small total area of vegetation, minimal habitat resources for native fauna and has limited value as a movement corridor. Impacts on native flora and fauna are substantially less than would be associated with an undisturbed 'green field' site. After construction, the disturbed construction corridor would be stabilised and revegetated and would contain environments equivalent to those currently present.

14.3.4 Impacts on aquatic habitats and key fish habitat

Impacts on freshwater aquatic habitats and key fish habitats are likely to be negligible. Construction may temporarily disturb small roadside drains and remove artificial ponds. The gas pipeline will be directionally drilled beneath local waterways and there would be no direct impacts on key fish habitat within Allans Creek or Gurangaty Waterway. Indirect impacts from construction include soil and water pollution during trenching and directional drilling and are described above. Mitigation measures to reduce the potential for such pollution are described in Table 14-10. As there would be no removal of marine vegetation and no impacts on fish passage, offsets in accordance with DPI (2013) are not required.

Further details on the potential impacts upon marine ecology in the Inner and Outer Harbour is included in Chapter 13 and Appendix G.

14.3.5 Consideration of MNES

An assessment of significance for the Green and Golden Bell Frog is provided in Appendix C of the BDAR (see Appendix H). The project is unlikely to have a significant impact on this species given:

- There would be no impact on any good quality breeding habitat of the key population.
- The project has been designed and refined to avoid impacts on natural swamp areas that may represent breeding habitat and roadside drains with emergent vegetation that represent refuge habitat
- Direct impacts are limited to the removal of small artificial detention ponds from within the highly modified coal loading facility. The value of potential habitats to be removed is considered to be very low.
- Trenching works would only temporarily impact a movement corridor. The intensity and duration of trenching activities will be minor and short term.
- Mitigation measures are proposed to minimise impacts on dispersing individuals and any individuals that may occur in roadside drains or detention ponds
- Following construction the alignment would be rehabilitated.
- There would be no permanent fragmentation or isolation of habitat, and dispersal of the species would not be disrupted.

Given the results of the assessment of significance and the nature of the project, and with regards to the significant impact thresholds for the species (DEWHA, 2009) a referral is not considered necessary.

No threatened ecological communities listed under the EPBC Act are present in the project site and no threatened flora species are likely to occur. The removal of a very small area of planted vegetation from within an industrial area is unlikely to impact habitat for any other threatened fauna species. No important habitat for migratory species is likely to be impacted. No other assessments of significance are considered necessary.

Given that the project is unlikely to result in any significant impacts on MNES, no offsets in accordance with DSEWPaC (2012) are necessary.

14.4 Offset requirements

This section describes the offset requirements for the project. Refer to Appendix H for detail on the BDAR credit calculations, including BAM data utilised for this assessment, and data and assumptions used to generate the credit calculations.

14.4.1 Assessment of biodiversity impacts requiring offset

The construction phase of the project will result in the removal of 0.25 hectares of PCT 1326 within a single vegetation zone that forms potential threatened species habitat (for predicted threatened species identified within Table 14-8 and has a vegetation integrity score of 18.2. In accordance with section 10.2.1.1 (b) of the BAM, offsets are required for impacts upon a vegetation zone that has a vegetation integrity score of ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits). At total of three ecosystem credits are required to offset residual impacts of the project upon potential threatened species habitat.

No biota identified as have the potential to be impacted the project were identified as being a candidate serious and irreversible impact (SAII) entity.

14.4.2 Assessment of biodiversity impacts not requiring offset

The construction phase of the project will result in the removal of 0.25 hectares of PCT 1326 within a single vegetation zone that is not a TEC, and which has a vegetation integrity score of 18.2. In accordance with section 10.2.1.1 (c) of the BAM (2017), offsets are not required for impacts upon native vegetation that is not representative of a TEC or associated with threatened species habitat, where that vegetation zone has a vegetation integrity score of <20.

14.4.3 Areas not requiring assessment

The project site includes 14.30 hectares of non-native vegetation, comprising exotic grass species, planted native/exotic flora in varying states of maturity and environmental weeds within previously cleared, degraded and modified lands.

In accordance with section 5.1.1.5 of the BAM, areas of non-native vegetation do not require assessment under Stage 2 of the BAM. The removal of non-native vegetation that comprises threatened species habitat has been assessed as a prescribed impact in accordance with section 9.2 of the BAM.

14.5 Management measures

Table 14-10 provides a summary of the management measures, including the offset obligations, recommended to address the terrestrial biodiversity impacts of the project. All management measures would be collated in management plans prepared for construction and operation of the project.

Table 14-10 Management measures for terrestrial biodiversity

ID	Issue	Measure	Timing
TB1	Offset obligations	In accordance with the offset rules established by the *Biodiversity Conservation Regulation 2017* there are various means by which the offset obligations can be met. The following is recommended: • Secure and retire appropriate credits from stewardship site/s that fit within the trading rules of the BOS in accordance with the 'like-for-like' report generated by the BAM calculator. If the required credits are unavailable, source credits in accordance with the 'variation report' generated by the BAM calculator. • Only consider a payment to the Biodiversity Conservation Fund if a suitable number and type of biodiversity	Pre-construction

ID	Issue	Measure	Timing
		credits cannot be secured from third parties.	
TB2	Loss of native vegetation and fauna habitat	Staff will be inducted and informed of the limits of clearing and the areas of vegetation to be retained.	Construction
TB3	Fauna protection	A trained ecologist is to be present for construction activities that may impact frog habitat which includes dewatering / removal of detention basins and trenching immediately adjacent to Typha drainage line (west of Springhill Road) Temporary frog-proof fencing should be installed around drill sites, road side drains and detention ponds near the project site to be retained to prevent frogs from being injured or killed by equipment The trench is to be covered at night to prevent fauna from falling in An inspection is to be conducted each morning to check the trench for frogs Any frogs identified will only be handled by an ecologist or wildlife rescue representative Any Green and Golden Bell Frogs or other resident frogs are to be handled in accordance with the Chytrid fungus hygiene protocols (DECC 2008c) and released into the most appropriate nearby habitat area	Construction
TB4	Spread of weeds	Priority weed control measures will be implemented as part of the CEMP to prevent their spread in the study area.	Pre-construction
TB5	Spread of weeds	Declared priority weeds will be managed according to requirements of the NSW *Biosecurity Act* 2015 Soil material and stripped groundcover vegetation with the potential to contain priority weeds will not be removed from the project site Soil disturbance will be avoided as much as possible to minimise the potential for spreading weeds.	Construction and operation
TB6	Sedimentation	A site specific erosion and sediment control plan will be prepared as part of the CEMP. All erosion and sediment control measures shall be designed, implemented and maintained in	Pre-construction

ID	Issue	Measure	Timing
		accordance with relevant sections of 'Managing Urban Stormwater: Soil and Construction Volume 1' (Landcom 2004) ('the Blue Book) (particularly section 2.2) and 'Managing Urban Stormwater: Soil and Construction Volume 2A – Installation of Services' (DECC 2008b). The erosion and sediment control plan will include stockpiles, stormwater runoff, trees, site boundaries, site access and storage areas.	
TB7	Sedimentation	Areas disturbed during the works will be rehabilitated, including stabilising disturbed soils to resist erosion and weed invasion via establishment of with a suitable turf species such as a native Couch or repaving roads and sealed surfaces. Stabilisation activities will be carried out progressively to limit the time disturbed areas are exposed to erosion processes Activities with a risk of soil erosion such as earthworks will not be undertaken immediately before or during high rainfall or wind events.	Construction
TB8	Water quality, chemical and fuel impacts on flora and fauna	A site specific emergency spill plan will be developed, and will include spill management measures in accordance relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Roads and Maritime and EPA officers)	Pre-construction
TB9	Water quality, chemical and fuel impacts on flora and fauna	An emergency spill kit will be kept on site at all times. All staff will be made aware of the location of the spill kit and trained in its use	Construction
TB10	Water quality, chemical and fuel impacts on flora and fauna	Any herbicides used for weed control will be applied to the manufacturer's specifications and as outlined in the manufacturer's Material Safety Data Sheet	Construction

ID	Issue	Measure	Timing
TB11	Water quality, chemical and fuel impacts on flora and fauna	Machinery will be checked daily to ensure there is no oil, fuel or other liquids leaking from the machinery. All staff will be appropriately trained through toolbox talks for the minimisation and management of accidental spills.	Construction
TB12	Pathogen spread and establishment	Vehicle wash down facilities will be provided should evidence of pathogens or fungus such as Phytophthora or Chytrid be found.	Construction

15. Heritage

15.1 Overview

This chapter describes heritage matters relevant to the construction and operation of the project. It provides an overview of the key findings of the more detailed heritage assessments included in Appendix I and Appendix J.

The heritage assessments were based primarily upon a due diligence approach including reviews of databases and mapping, prior assessments and research, and historical mapping and imagery. The heritage assessments also involved site surveys to further identify and characterise heritage values in consultation with the Illawarra Local Aboriginal Land Council.

The heritage assessment identified areas of potential Aboriginal and historic heritage significance, including potential for archaeological deposits, around Spring Hill just west of Port Kembla.

The project is not anticipated to directly impact the identified areas of potential Aboriginal and historic heritage significance. The design of the project has been undertaken to ensure the gas pipeline alignment will avoid identified areas of heritage significance.

A number of management measures are proposed to address the residual risk of encountering previously unknown heritage values. These include inductions for the project workforce to be able to recognise heritage values and procedures to be followed in the event of an encounter.

15.2 Methodology

15.2.1 Aboriginal heritage

The Aboriginal heritage assessment involved a desktop assessment to identify areas of potential Aboriginal heritage significance. The desktop assessment included a review of sources including:

- Geological and landscape system mapping
- Prior Aboriginal heritage research and assessments
- Historical mapping and imagery of the Port Kembla area
- Aboriginal heritage information management system (AHIMS)

Following the desktop assessment, a site survey was undertaken that targeted areas of potential Aboriginal heritage significance. The site survey involved visual inspection of these areas.

The Aboriginal heritage assessment was prepared in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (NSW Office of Environment and Heritage 2010). Consultation was undertaken with the Illawarra Local Aboriginal Land Council and included participation of representatives of the council in the site survey.

15.2.2 Historic heritage

The historic heritage assessment involved a desktop assessment to identify areas of potential historic heritage significance. The desktop assessment included a review of sources including

- Prior historic heritage research and assessments
- Historical mapping and imagery of the Port Kembla area

- Records on the state, local and Commonwealth heritage registers
- Historical places under the State Environmental Planning Policy (Three Ports) 2013
- Following the desktop assessment, a site survey was undertaken that targeted areas of potential historic heritage significance. The site survey involved visual inspection of these areas.

15.3 Existing environment

15.3.1 Aboriginal heritage

The assessment found that the vast majority of the site of the project has been heavily modified for port development and other industrial development including large-scale reclamation.

Environmental setting

Prior to industrial development, the project site was characterised by Tom Thumb Lagoon and surrounding land. The lagoon was a large estuarine waterbody covering about 500 hectares, comprising an estuarine channel, saltmarsh and tidal mudflats with a sand body at the mouth to the east and sloping banks around Spring Hill to the west. The lagoon now consists of modified straight, formalised estuarine channels that do not reflect its original form.

Soil profiles are predominantly mapped as disturbed terrain, however it is likely that original soil profiles at Spring Hill and gentle slopes west of Tom Thumb Lagoon, associated with the Fairy Meadow soil landscape are less disturbed. The Fairy Meadow soil landscape is associated with floodplains and consist of alluvial soils overlying Quaternary deposits.

Although heavily altered by urban development, the former landscape of the study area would originally have consisted of wetlands, saltmarsh, coastal scrub, hilly forest and forested plains with some rainforest elements. The landscape would have provided a resource rich environment for Aboriginal people in the past. Aboriginal people would have had access to molluscs, fish, birds, macropods and a range of flora species, particularly around the margins of the former Tom Thumb Lagoon.

Ethnohistory

The site of the project is located within the traditional lands of the Wodi Wodi, part of the wider Dharawal language group. Early settlers recorded gatherings of Aboriginal people near site of the project including at Tom Thumb Lagoon and Spring Hill. Settlers recorded Aboriginal people camping and fishing around the shores of the lagoon and an estimate 100 people gathering for a corroboree at Spring Hill.

Aboriginal camps around the lagoon were documented to have continued until 1914, when Aboriginal people were forced to relocate to Hill 60 to make way for industrial redevelopment (DEC, 2005). The Hill 60 camps were located to the south of Port Kembla, but Aboriginal people continued resource gathering at Tom Thumb Lagoon for many years after.

Port Kembla has remained a place of residence for many local Aboriginal families to the current day. Aboriginal commercial fishing continued in the area up until the World War II, however many Aboriginal people also took up employment in local industries and associated service jobs (DEC, 2005). The combination of local housing and local employment meant that the local Aboriginal community has retained a strong connection to the local area.

Industrialisation in the study area predominantly occurred from the 1920s onwards, with the bulk of the port and steel mill development works occurring in the 1950s and 1960s.

Development at the port is ongoing in accordance with the NSW Ports 30 Year Master Plan. Tom Thumb Lagoon has been heavily modified for port development and other industrial development including large-scale reclamation of land over the lagoon and dredging of formalised channels. Spring Hill, west of the former Tom Thumb Lagoon, included some areas that were relatively undisturbed but had historically been used for industrial purposes and commons recreation.

While access over much of the study area has been restricted due to industrialisation and port controls, the local Aboriginal community does have recreational access to Spring Hill on the western side of Springhill Road. Fig trees at the site are culturally important to the local Aboriginal people, being traditional meeting places and having associations with woman's business.

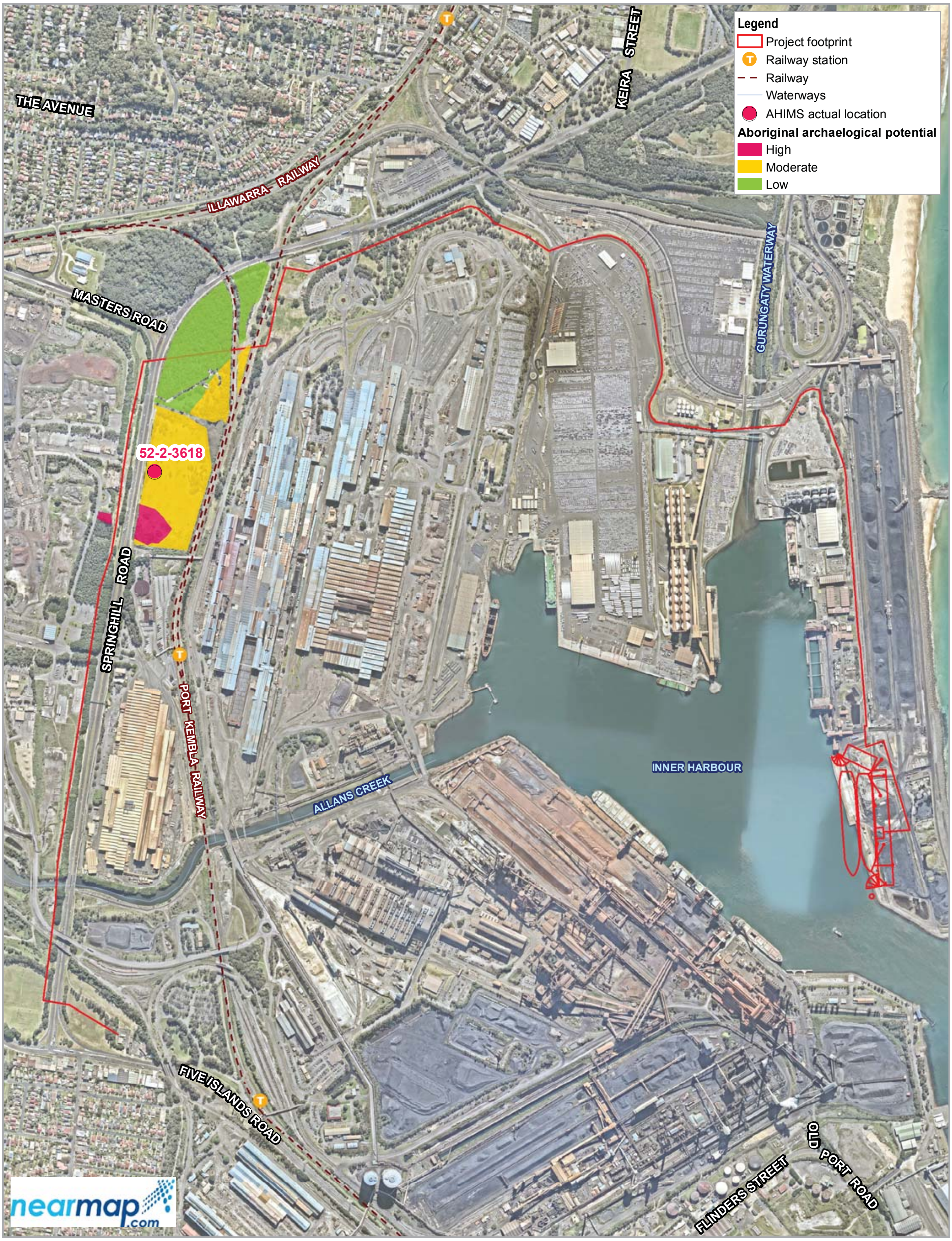
The area immediately surrounding two large fig trees was converted into a recreational reserve in 2007 and 2008. Works included landscaping, revegetation and erection of a shelter and the reserve is frequently visited by the local Aboriginal community and includes memorials to deceased community members.

Heritage significance

The main areas of potential Aboriginal heritage significance were around Spring Hill in areas that had not been subject to previous disturbance associated with industrial development. These included an area known as The Horse Paddock, an area of Crown land and areas of land in the reserve along Springhill road that were considered to be remnant landforms at the margins of the former Tom Thumb Lagoon as shown on Figure 15-1. Surviving land surfaces are likely to have potential for Aboriginal cultural material, likely be in the form of middens, stone artefacts, and scarred trees (where mature native vegetation has survived).

An extensive search of the AHIMS identified one recorded Aboriginal site in the vicinity of Spring Hill comprising an open camp site consisting of two flaked stone artefacts located on the crest of a hill in disturbed context. The AHIMS coordinates place the site on the western side of Springhill Road, however a detailed review of the OEH site card and mapping indicate the site is located within the horse paddock to the east of Springhill Road as shown on .Figure 15-1.

Undisturbed areas around the mature fig trees at Spring Hill were also identified to have archaeological potential and hold both tangible and intangible cultural heritage values. While the Fig trees themselves hold important cultural values, the reserve is of wider social importance to the Aboriginal community as a place for social gatherings and remembrance.



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Australian Industrial Energy
Port Kembla Gas Terminal

Aboriginal Heritage

Project No. 21-27477
Revision No. A
Date 31 Oct 2018

Figure 15-1

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy; Aboriginal heritage - GHD 2018. Created by: afoddy

15.3.2 Historic heritage

The historic heritage assessment found that the site of the project had been subject to a number of past land uses through the 1800s including land grants for cedar cutting, farming and cattle breeding, hotel and estate development and uses for a race course and recreational commons.

Early industrialisation began in the late 1800s including establishment of a jetty and railway for the transport of coal. Coal port operations expanded through to the early 1900s including the construction of breakwaters near the mouth of Tom Thumb Lagoon.

Over the following decades more land was acquired for port development. Port Kembla Rail Line was constructed in 1916 along the western boundary of Tom Thumb Lagoon. Spring Hill Road was also formalised at around this time. Dredging and reclamation occurred in the 1930s and 1940s with further work for construction of the Inner Harbour in the 1950s and 1960s.

By about 1975 the vast major of the site of the project had heavily modified for port development and other industrial development including large-scale reclamation. Industrialisation of the Inner Harbour continued well into the 1980s and 1990s through to the present day.

Prior archaeological studies of the site of the project found evidence of earlier rural land uses and settlements was increasingly rare as industrial and residential development is ongoing.

Nonetheless, a number of historical places are listed in the general area under the *State Environmental Planning Policy (Three Ports) 2013* as shown in Figure 15-2 and include:

- Mobile Block Setting Steam Crane
- Hill 60, Illowra Battery
- Brick Chimney, Port Kembla Copper
- Office and House, Port Kembla Copper
- Commonwealth Rolling Mill Plant and Gardens

The vast majority of the site of the project has been heavily modified for port development and other industrial development including large-scale reclamation. Some areas around Spring Hill including The Horse Paddock, an area of Crown Land and areas in the reserve along Spring Hill Road have been less heavily modified. There is potential for archaeological deposits to occur in and around these areas from earlier rural land uses and settlements. These include potential remains of house and outbuilding foundations, early private roads and rural domestic dumps. These areas of archaeological potential are shown in Figure 15-2.

It was also noted that Port Kembla Steel Works included built infrastructure and other industrial items dating from the 1950s and 1960s on display. While of historical interest these items are not recorded on the *State Environmental Planning Policy (Three Ports) 2013*.

Paper Size ISO A4

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Australian Industrial Energy
Port Kembla Gas Terminal

Project No. 21-27477
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Historic Heritage

Figure 15-2

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy; Aboriginal heritage - GHD 2018. Created by: afoddy

15.4 Potential impacts

15.4.1 Construction

The construction of the project is not expected to disturb any of the identified Aboriginal heritage values or areas of potential Aboriginal heritage significance as shown in Figure 15-1. Construction of the gas pipeline would avoid The Horse Paddock entirely and would utilise horizontal drilling techniques beneath the area of Crown land at a depth sufficient to avoid potential archaeological deposits. The alignment of the gas pipeline has been designed to avoid the fig trees and artefacts recorded on the Aboriginal heritage information management system discussed in 15.3.1.

The construction of the project is also not expected to disturb any of the identified historic heritage values or areas of potential historic heritage significance.

The construction of the project would have the potential to encounter previously unknown Aboriginal or historic heritage values. Measures to address such unexpected finds are provided in Table 15-1.

15.4.2 Operation

The operation of the project would not result in any additional disturbance than construction. The operation of the project would therefore not create an impact on Aboriginal and historic heritage.

15.5 Management measures

Table 18-12 outlines the management measures that are proposed to address the potential impacts of the project on heritage matters. All management measures would be collated in management plans prepared for construction and operation of the project.

Table 15-1 Management measures for heritage

ID	Issue	Measure	Timing
H1	Unexpected finds	The construction workforce would be given a heritage induction and supporting material to be able to identify materials of potential heritage value and how to respond.	Pre-construction
H2	Unexpected finds	A protocol to be followed in the event of an unexpected find would be developed and would include clear lines of communication and stop work procedures to be followed.	Construction

16. Traffic and access

16.1 Overview

This chapter describes traffic and access matters relevant to the construction and operation of the project. It provides an overview of the key findings of the more detailed assessment in Appendix K.

The assessment was prepared with reference to the relevant guidelines including NSW Roads and Maritime Services Guide to Traffic Generating Developments (2002). The existing road network and traffic and access conditions were determined based on site inspections and traffic counts at key roads and intersections.

The assessment found that existing traffic volumes generally fell well within the capacity of the existing road network based on the functional classification of the roads. The main exception was Springhill Road, which was found to be nearing capacity based on morning peak hour traffic counts. A review of historic traffic data indicated that there had been a slight decline in traffic in the area since 2016.

The assessment found that construction would generate additional light and heavy vehicle movements on the road network mainly associated with the mobilisation of the workforce, the transport of excavated and dredged material and additional general heavy vehicle movements. Traffic volumes were predicted to remain within the capacity of the existing road network and that key intersections would continue to operate to an acceptable level of service.

The assessment found that operation of the project would generate significantly less traffic than construction and would consequently have minimal impacts on existing traffic and access.

A number of management measures are proposed to mitigate the potential impacts of traffic generated by the construction and operation of the project. The proposed measures include the development and implementation of a Construction Traffic Management Plan.

16.2 Methodology

The assessment was prepared with reference to the relevant guidelines including *Guide to Traffic Generating Developments* (RMS 2002).

The existing road network and traffic and access conditions were determined based on site inspections, traffic counts at key roads and intersections and publically available traffic data. The site inspections and traffic counts for the project were undertaken in September 2018. Additional traffic count data was procured from NSW Roads and Maritime Services and Wollongong City Council.

The performance of the existing road network including the potential impacts of the project were assessed to determine the impact upon the safety and capacity of the road network including both intersection capacity and mid-block assessment criteria.

16.2.1 Intersection assessment criteria

The performance of the existing road network is largely dependent on the operating performance of key intersections, which are critical capacity control points on the road network. SIDRA intersection modelling software was used to assess the proposed peak hour operating performance of intersections on the surrounding road network.

The criteria for evaluating the operational performance of intersections is provided by the *Guide to Traffic Generating Developments* (Roads and Maritime Services, 2002) and reproduced in Table 16-1. The criteria for evaluating the operational performance of intersections is based on a qualitative measure being Level of Service (LOS) which is applied to each band of average vehicle delay.

Table 16-1 Level of service criteria for intersections

LOS	Average Delay per Vehicle (seconds/veh)	Traffic Signals, Roundabouts	Give Way & Stop Signs
A	< 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays Roundabouts require other control modes	At capacity, requires other control mode
F	> 70	Over Capacity Unstable operation	Over Capacity Unstable operation

Source: Guide to Traffic Generating Developments (Roads and Maritime Services 2002)

16.2.2 Midblock assessment criteria

According to *Austroads Guide to Traffic Management, Part 3: Traffic Studies and Analysis, Section 5.2.1*, the one-way mid-block capacity of an urban arterial road with interrupted flow varies depending on the type of lane. The typical mid-block capacity for urban roads with interrupted flow is outlined in Table 4.3.

An interrupted flow facility road is one in which traffic flow conditions are subject to the influence of fixed elements such as traffic signals, stop signs, give-way signs, roundabouts or other controls which cause traffic to stop periodically, irrespective of the total amount of traffic; examples include urban streets, unsignalised and signalised intersections.

Table 4.3 Typical mid-block capacity for urban roads with interrupted flow

Type of lane	One-way mid-block capacity (pc/h)
Median or inner lane	
Divided road	1000
Undivided road	
Middle lane (of a 3 lane carriageway)	900
Divided road	900
Undivided road	1000
Kerb lane	
Adjacent to parking lane	900
Occasional parked vehicles	600
Clearway conditions	900

Source: Table 5.1 in Austroads *Note: pc/h = passenger cars per hour*

Austroads Guide to Traffic Management Part 3 – Traffic Studies, Section 5.2.1 outlines however that:

> *Peak period mid-block traffic volumes may increase to 1200 to 1400 pc/h/lane on any approach road when the following conditions exist or can be implemented:*
>
> – *Adequate flaring at major upstream intersections*
> – *Uninterrupted flow from a wider carriageway upstream of an intersection approach and flowing at capacity*
> – *Control or absence of crossing or entering traffic at minor intersections by major road priority controls*
> – *Control or absence of parking*
> – *Control or absence of right turns by banning turning at difficult intersections high volume flows of traffic from upstream intersections during more than one phase of a signal cycle*
> – *Good co-ordination of traffic signals along the route.*

For the purposes of this assessment:

- A one-way mid-block capacity of 1,200 pc/h/lane has been adopted for arterial roads in the study area, including Springhill Road, Five Islands Road and Masters Road.
- A one-way mid-block capacity of 900 pc/h/lane has been adopted for other roads in the study area, including Port Kembla Road, Flinders Street, Old Port Road, Darcy Street and Foreshore Road.

This is in keeping with the Austroads special conditions which are reflective on the existing conditions for roads in the study area. This capacity is used to assess the Volume Capacity Ratio (VCR) of a particular road.

The VCR is a measure of the level of congestion on a road given the traffic volume and road capacity. When the VCR reaches 1, this indicates that the road is operating at 100 percent capacity.

16.3 Existing environment

16.3.1 Road network

The key roads that were assessed in and around the site of the project were as follows:

- Princes Motorway
- Springhill Road
- Five Islands Road
- Masters Road
- Port Kembla Road
- Flinders Street
- Old Port Road / Darcy Road
- Foreshore Road

These key roads are shown in relation to the project in Figure 16-1 and described below.

M1 Princes Motorway

The M1 Princes Motorway is a State Highway, which provides a link towards Sydney in the north to the Victorian Boarder via the Princes Highway. It carries approximately 66,000 vehicles per day (based on average daily traffic volumes of approximately 33,000 vehicles in the northbound direction, provided from the Roads and Maritime Traffic Volume Viewer website – count station ID 07594).

To the west of Port Kembla, grade separated interchanges are provided with Five Islands Road and Masters Road. No northbound access to Masters Road is provided from The M1 Princes Motorway. It has generally three traffic lanes in each direction and has a signposted speed limit of 100 km/h in the vicinity of the Five Islands Road interchange.

Springhill Road

Springhill Road is a state arterial road that provides access to Port Kembla. It has a sealed carriageway with three lanes in each direction. In the vicinity of Port Kembla, Springhill Road has a sign posted speed limit of 80 kilometres per hour. Springhill Road is part of state significant route B65 that connects Bulli to Shellharbour via Wollongong.

Five Islands Road

Five Islands Road is a state road that provides access toward the southern part of Port Kembla. Its main characteristics are that it has a sealed carriageway with three lanes in each direction. In the vicinity of Port Kembla, Five Islands Road has a sign posted speed limit of 60 kilometres per hour. Five Islands Road is also part of state significant route B65.

Masters Road

Masters Road is a state road connecting Princes Motorway and Springhill Road. Its main characteristics are that is has a sealed carriage way with three lands in each direction. In the vicinity of Port Kembla it has a sign posted speed limit of 80 kilometres per hour.

Port Kembla Road

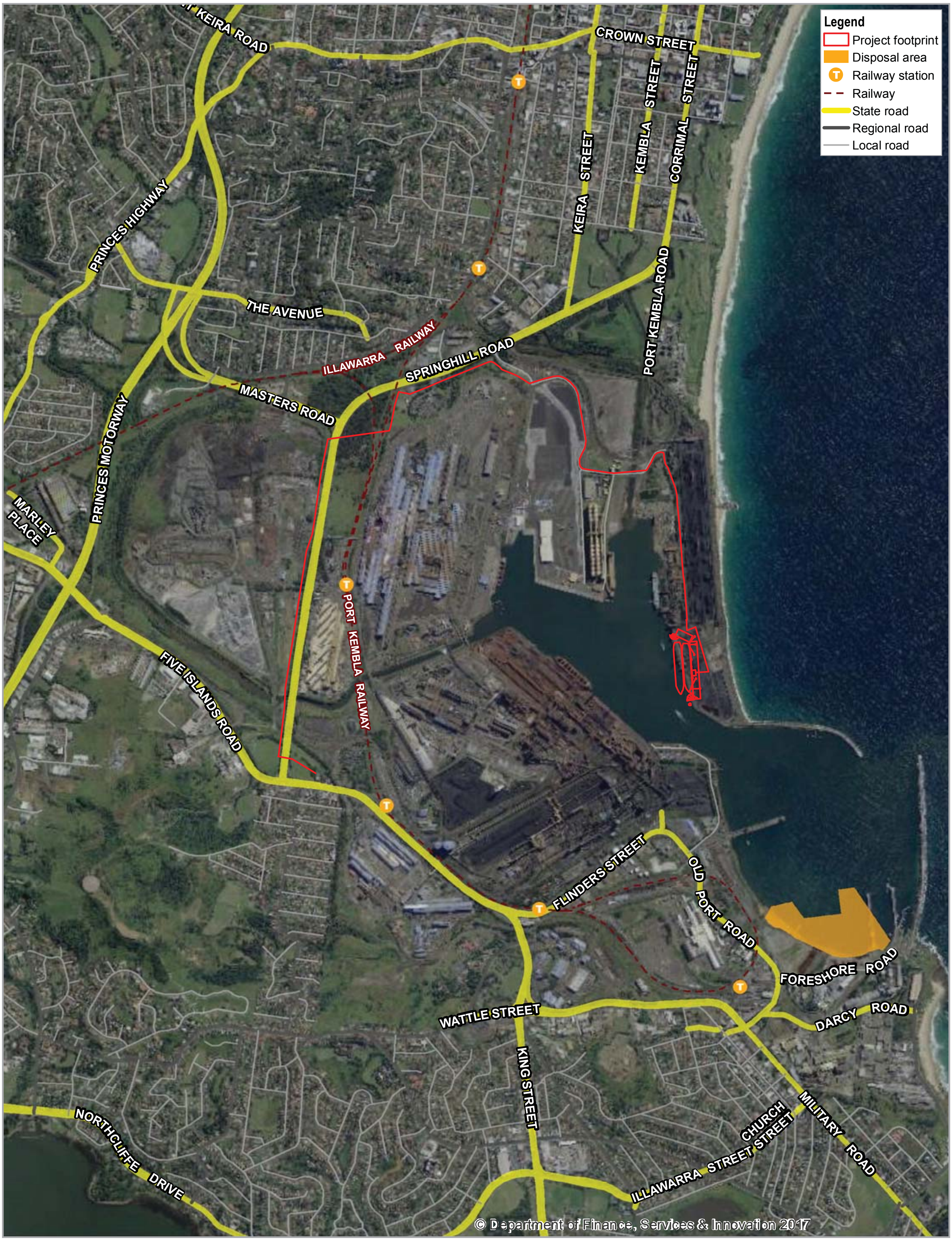
Port Kembla Road is a state road that provides access to the northern part of Port Kembla toward Berth 101. Its main characteristics are that is has a sealed carriageway with one lane in each direction. Port Kembla Road has a 50 kilometre per hour speed limit.

Flinders Street

Flinders Street is a state road that provides access to the southern part of Port Kembla toward the Outer Harbour. Its main characteristics are that is has a sealed carriageway with one lane in each direction. Flinders Street has a 60 kilometre per hour speed limit.

Old Port Road

Old Port Road is a state road that provides access to the southern part of Port Kembla toward the Outer Harbour. Its main characteristics are that it has a sealed carriageway with one line in each direction. It also includes a roundabout intersection with Foreshore Road and a controlled intersection with Five Islands Road. Old Port Road becomes Darcy Road to the south. Old Port Road and Darcy Road have a 60 kilometre per hour speed limit.



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Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Australian Industrial Energy
Port Kembla Gas Terminal

Project No. 21-27477
Revision No. A
Date 31 Oct 2018

Existing road network

Figure 16-1

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy; Aboriginal heritage - GHD 2018. Created by: afoddy

Foreshore Road

Foreshore Road is a local road that provides access from Old Port Road to the eastern side of the Inner Harbour. Its main characteristics are that it is a sealed road with one lane in each direction. Foreshore Road has a 50 kilometre per hour speed limit.

16.3.2 Traffic volumes

Existing traffic volumes on the road network were determined through traffic counts undertaken for the project during morning and afternoon peak hours. The results of the traffic counts for the morning and afternoon peak hours are summarised in Table 16-2.

Existing traffic volumes were generally within the capacity of the existing road network based on their functional classification. Roads that were closest to approaching capacity included Springhill Road, reaching up to about 94% capacity in some sections during the morning and about 63% capacity in some sections during the afternoon. Masters Road and Five Islands Road also reached about 63% and 78% capacity in the afternoon respectively.

An analysis of historic traffic data from Roads and Maritime Services indicated that the traffic volumes in the area may have declined over recent years. The data showed average weekday traffic volumes at Five Islands Road east of Springhill Road were around 45,000 movements in 2014, 2015 and 2016 but had reduced to around 41,000 movements in 2017 and 2018.

16.3.3 Road safety

A review of Transport for NSW road safety data returned a total of 220 accidents occurring in the area between the period 2013 to 2017. Of those recorded, 128 accidents did not cause any injuries, 91 accidents caused some kind of injury and 1 accident caused a fatality.

The majority of the accidents occurred on Springhill Road, totalling 133 accidents, while 78 were recorded on Five Islands Road, 6 on Flinders Street and 3 on Foreshore Road.

16.3.4 Public transport

A number of bus services were identified in the area of the project including

- Route 43 that runs around Port Kembla to the station near the Outer Harbour
- Route 51 Shellharbour to Wollongong, including Five Islands Road and Spring Hill Road
- Route 53 Shellharbour to Wollongong, including Five Islands Road and Spring Hill Road
- Route 65 North Wollongong to Port Kembla, including along Spring Hill Road
- Route 27SC train replacement bus Wollongong to Port Kembla, via all stations.

In addition to the public transport network, active transport options in the area were identified that included bicycle and pedestrian pathways along parts of Port Kembla Road, Springhill Road, Five Islands Road and Old Port Road as well as a bicycle route on Flinders Street.

Table 16-2 Existing peak hour traffic volumes

Road name	Count location	Traffic direction	Road capacity (per lane)	Number of lanes	Morning peak Volume	Morning peak Ratio	Afternoon peak Volume	Afternoon peak Ratio
Darcy Road	East of Five Islands Road / Military Road	Eastbound	900	1	167	19%	108	12%
		Westbound	900	1	107	12%	223	25%
Five Islands Road	West of Springhill Road	Eastbound	1,200	3	1,631	45%	2,798	78%
		Westbound	1,200	3	934	26%	1,222	34%
Five Islands Road	Northwest of Flinders Street	Northbound	1,200	3	2,346	65%	1,963	55%
		Southbound	1,200	3	1,723	48%	2,380	66%
Five Islands Road	Northwest of Darcy Road	Northbound	1,200	2	289	12%	302	13%
		Southbound	1,200	2	232	10%	312	13%
Flinders Street	East of Five Islands Road	Eastbound	900	1	232	26%	128	14%
		Westbound	900	1	160	18%	344	38%
Foreshore Road	East of Old Port Road	Eastbound	900	1	53	6%	66	7%
		Westbound	900	1	47	5%	75	8%
Masters Road	West of Springhill Road	Eastbound	1,200	4	1,609	34%	1,071	22%
		Westbound	1,200	3	1,313	36%	2,268	63%
Old Port Road	North of Darcy Road	Northbound	900	1	91	10%	96	11%
		Southbound	900	1	87	10%	127	14%
Port Kembla Road	South of Springhill Road	Eastbound	900	1	39	4%	27	3%
		Westbound	900	1	31	3%	70	8%
Springhill Road	Southwest of Port Kembla Road	Northbound	1,200	2	1392	58%	673	28%
		Southbound	1,200	2	571	24%	793	33%
Springhill Road	North of Masters Road	Northbound	1,200	3	3,192	89%	1501	42%
		Southbound	1,200	3	1,149	32%	2,211	61%
Springhill Road	South of Masters Road	Northbound	1,200	3	3,378	94%	2,268	63%
		Southbound	1,200	3	1,632	45%	1,782	49%
Tom Thumb Road	South of Springhill Road	Northbound	900	1	118	13%	47	5%
		Southbound	900	1	90	10%	140	16%

16.4 Potential impacts

16.4.1 Construction

Traffic volumes

Construction of the project would generate light and heavy vehicle movements as described in Chapter 5. Light vehicle movements would mainly be due to the transport of the construction workforce to and from construction sites. Heavy vehicle movements would mainly be due to the transport of excavated material from berth and wharf facilities to the disposal area.

The predicted additional daily light and heavy vehicle traffic volumes on the road network during construction are summarised in Table 16-3. The traffic volumes are based on predicted routes to and from the berth and wharf facilities, the disposal area and the gas pipeline route.

The predicted additional light and heavy vehicle traffic volumes represent some 'worst case' conditions including the maximum predicted construction workforce at 150 workers; simultaneous construction activities at the berth and wharf facilities, disposal area and gas pipeline; and the maximum predicted volume of excavated material to be transported by road at 720,000 m^3.

Table 16-3 Predicted daily traffic volumes

Road name	Location	Traffic direction	Additional daily traffic			
			Light	Heavy	Heavy[a]	Total
Five Islands Road	West of Springhill Road	Eastbound	38	10	0	48
		Westbound	38	10	0	48
Five Islands Road	Northwest of Flinders Street	Northbound	38	3	112	153
		Southbound	38	3	112	153
Flinders Street	East of Five Islands Road	Eastbound	38	3	112	153
		Westbound	38	3	112	153
Foreshore Road	East of Old Port Road	Eastbound	38	3	112	153
		Westbound	38	3	112	153
Masters Road	West of Springhill Road	Eastbound	76	7	0	83
		Westbound	74	13	0	87
Old Port Road	North of Darcy Road	Northbound	38	3	112	153
		Southbound	38	3	112	153
Port Kembla Road	South of Springhill Road	Eastbound	114	13	112	239
		Westbound	114	13	112	239

Road name	Location	Traffic direction	Additional daily traffic			
			Light	Heavy	Heavy[a]	Total
Springhill Road	Southwest of Port Kembla Road	Northbound	114	13	112	239
		Southbound	114	13	112	239
Springhill Road	North of Masters Road	Northbound	114	13	112	239
		Southbound	114	13	112	239
Springhill Road	South of Masters Road	Northbound	57	7	112	176
		Southbound	19	7	112	138
Tom Thumb Road / Port Kembla Road[b]	Various as construction progresses	Northbound or westbound	38	3	0	41
		Southbound or eastbound	38	3	0	41

[a] Heavy vehicles for transport of excavated material from Inner Harbour to Outer Harbour

[b] May include and Bluescope Northgate and BlueScope Western access as required

The predicted additional hourly light and heavy vehicle traffic volumes are presented in addition to the existing peak hour traffic volumes in Table 16-4. This is considered to be a 'worst case' scenario, as traffic management planning for the project would generally seek to avoid vehicle movements during peak hours, particularly on roads subject to congestion.

The assessment demonstrates that the peak hour traffic volumes would remain within the capacity of the existing road network based on their functional classification.

As with the existing traffic volumes discussed in Section 16.3, roads closest to approaching capacity included Springhill Road, in some sections reaching up to about 96% capacity in the morning and about 65% capacity in the afternoon. Masters Road and Five Islands Road also reached about 65% and 78% capacity in the afternoon respectively. The additional peak hour traffic on these roads as a proportion of their capacity represented about a 2% change.

The largest changes in peak hour traffic on the road network as a proportion of capacity was predicted on those roads with lower existing traffic volumes such as Port Kembla Road or Old Port Road. Even in this case the predicted increase was in the order of 7% to 12% of capacity.

Impacts on Princes Motorway would be negligible given the capacity of the motorway and volume of existing traffic in the order of 66,000 vehicles per day as discussed in Section 16.3.

Table 16-4 Predicted peak hour traffic volumes

Road name	Location	Traffic direction	Road capacity (per lane)	Number of lanes	Morning peak		Afternoon peak	
					Volume	Ratio	Volume	Ratio
Darcy Road	East of Five Islands Road / Military Road	Eastbound	900	1	167	19%	108	12%
		Westbound	900	1	107	12%	223	25%
Five Islands Road	West of Springhill Road	Eastbound	1,200	3	1,655	46%	2,822	78%
		Westbound	1,200	3	974	27%	1,262	35%
Five Islands Road	Northwest of Flinders Street	Northbound	1,200	3	2,411	67%	2,028	56%
		Southbound	1,200	3	1,788	50%	2,445	68%
Five Islands Road	Northwest of Darcy Road	Northbound	1,200	2	289	12%	302	13%
		Southbound	1,200	2	232	10%	312	13%
Flinders Street	East of Five Islands Road	Eastbound	900	1	297	33%	193	21%
		Westbound	900	1	225	25%	409	45%
Foreshore Road	East of Old Port Road	Eastbound	900	1	118	13%	131	15%
		Westbound	900	1	112	12%	140	16%
Masters Road	West of Springhill Road	Eastbound	1,200	4	1,648	34%	1,110	23%
		Westbound	1,200	3	1,374	38%	2,329	65%
Old Port Road	North of Darcy Road	Northbound	900	1	156	17%	161	18%
		Southbound	900	1	152	17%	192	21%
Port Kembla Road	South of Springhill Road	Eastbound	900	1	144	16%	132	15%
		Westbound	900	1	136	15%	175	19%
Springhill Road	Southwest of Port Kembla Road	Northbound	1,200	2	1,497	62%	778	32%
		Southbound	1,200	2	676	28%	898	37%
Springhill Road	North of Masters Road	Northbound	1,200	3	3,297	92%	1,606	45%
		Southbound	1,200	3	1,254	35%	2,316	64%
Springhill Road	South of Masters Road	Northbound	1,200	3	3,443	96%	2,333	65%
		Southbound	1,200	3	1,707	47%	1,857	52%
Tom Thumb Road	South of Springhill Road	Northbound	900	1	139	15%	68	8%
		Southbound	900	1	111	12%	161	18%

Intersection performance

Key intersections that would be utilised by traffic generated by the project have been modelled to determine their performance. The intersections that have been modelled include:

- A — Port Kembla Road / Springhill Road;
- B — Flinders Street / Five Islands Road; and
- C — Old Port Road / Foreshore Road.

A summary of the modelling results is shown in Table 16-5 including the existing performance based on traffic surveys and modelled performance with the addition of traffic from construction of the project. The model results indicate that the intersections would remain in good operation and retain an A rating during peak hour traffic, consistent with existing conditions.

Table 16-5 Intersection performance

Intersection	Existing morning		Modelled morning		Existing afternoon		Modelled afternoon	
	Delay[a]	LOS	Delay	LOS	Delay	LOS	Delay	LOS
A	8.0 s	A	13.4 s	A	5.5 s	A	11.0 s	A
B	10.6 s	A	11.5 s	A	10.1 s	A	10.8 s	A
C	9.5 s	A	10.0 s	A	9.5 s	A	9.5 s	A

[a]Average delay per vehicle measured in seconds

Public transport

Given the assessment of traffic volumes and intersection performance, construction of the project would be expected to have minor or negligible impacts on public transport as well as the identified active transport infrastructure discussed in Section 16.3.4.

16.4.2 Operation

As discussed in Chapter 5, operation of the project would generate far fewer vehicle movements than construction. Light vehicle movements would be mainly due to the transport of the operation workforce to and from the berth and wharf facilities. Heavy vehicle movements would generally be limited to occasional deliveries or waste services for the operation of the FSRU.

The operational workforce is predicted to be in the order of 40–50 personnel, with 20–25 on board the FSRU. Heavy vehicle movements would conservatively be in the order of 1 vehicle per day to and from the FSRU although this is likely to be an overestimate. The addition of in the order of 50 light vehicles and 1 heavy vehicle on the road network in and around Port Kembla would have a negligible impact on traffic volumes.

16.5 Management measures

Table 18-12 outlines the management measures that are proposed to address the potential traffic and access impacts of the project. All management measures would be collated in management plans prepared for construction and operation of the project.

Table 16-6 Management measures for traffic and access

ID	Issue	Measure	Timing
T1	General	A Construction Traffic Management Plan be prepared prior to the commencement of works with site induction for construction personnel being undertaken to outline the requirements of the CTMP. The aim of the CTMP is to maintain the safety of all workers and road users within the vicinity site including but not limited to: • site access routes • construction parking arrangement • traffic management • pedestrian and bicycle rider management • roadside hazards.	Preconstruction Construction
T2	Traffic management	A traffic control plan would be developed in accordance with the NSW Roads and Maritime Services *Traffic control at work sites* and *AS1742.3 – Traffic control devices for works on roads*.	Preconstruction Construction
T2	Traffic volumes	Traffic management planning would seek to minimise traffic movements where possible during the morning and afternoon peak hours.	Preconstruction Construction
T3	Traffic volumes	Construction workers would be encouraged to car pool or utilise public transport where practicable.	Preconstruction Construction

17. Noise and vibration

17.1 Introduction

17.1.1 Overview

This chapter describes the existing noise environment of the area and the potential noise and vibration impacts during the construction and operation of the project. This chapter provides an overview of the key findings of the detailed noise and vibration impact assessment included in Appendix L.

The assessment has been prepared in accordance with the documents:

- *Assessing Vibration: A Technical Guideline* (DEC, 2006)
- *BS 6472 – 1992, Guide to Evaluation of Human Exposure to Vibration in Buildings* (1 Hz to 80 Hz) (British Standard, 1992)
- *DIN 4150, Part 3: Structural Vibration in Buildings – Effects on Structures* (German Standard, 1999).
- *Interim Construction Noise Guideline* (ICNG) (DECC, 2009)
- *Noise Policy for Industry* (NPI) (EPA, 2017)
- *Road Noise Policy* (RNP) (DECCW, 2011)
- *Underwater Piling Noise Guidelines* (Government of South Australia, 2012)

Full details of the methodology and noise compliance criteria for construction and operation applied in the assessment are provided in Appendix L.

The scope broadly includes:

- Identification of the existing noise levels in the project study area
- Review of the proposed construction methodology, identification of potential construction equipment,
- Review of the proposed operations and identification of source noise levels of the operational equipment
- Assessment of the potential construction noise and vibration, including potential underwater construction noise impacts,
- Assessment of the potential operational noise and road traffic noise impacts
- Provision of mitigation and management measures where suitable

17.1.2 Project noise and vibration

Construction

The construction phase is anticipated to take 10 to 12 months. Construction works would be conducted during both standard construction hours (Monday to Friday: 7 am to 6 pm; Saturday: 8 am to 1 pm; and Sunday/public holiday: no work) and outside standard hours where construction activities are not anticipated to affect nearby residential receivers.

The construction methodology comprises two stages or programs. Construction Stage 1 (CS1) includes the pipeline construction which is expected to take around 6 months and Construction

Stage 2 (CS2) includes demolition, dredging, excavation, disposal and berth construction which is expected to take around 10 to 12 months. The two construction stages will be undertaken concurrently and encompass a series of scenarios which will potentially result in increased noise and vibration, as outlined in Table 17-1. These scenarios have been modelled for the assessment to predict noise levels and identify potential noise impacts during construction works. Refer to Appendix L for a full list of noise modelling parameters and assumptions.

Table 17-1 Construction methodology and scenarios

Scenario	Stage	Description
Pipeline construction		
CS1.1	Site establishment	Establish construction compounds Vegetation removal (where required)
CS1.2	Compound operations	Personnel movements, material deliveries, stockpiling
CS1.3	Trenching works	Excavations along pipeline route
CS1.4	Directional drilling works	Underground excavation along pipeline route
CS1.5	Pipe set down	Rehabilitation works
CS1.6	Rehabilitation works	Removal of compounds, transport of material
Demolition, dredging and construction		
CS2.1	Dredging works	Removal of sediment from seabed
CS2.2	Enabling works for excavation	Demolish existing Berth 101 Remove and stockpile existing rock revetment Excavate fill layer across site Transport of excavated material to stockpile sites
CS2.3	Excavation	Excavation of insitu material
CS2.4	Perimeter bund	Construction of the perimeter bund at the disposal site Dredging of soft sediments
CS2.5	Bottom dump	Disposal of dredged material using a split hopper barge
CS2.6	Material transport	Transport stockpiled material to disposal site
CS2.7	Berth and mooring facilities	Installation of mooring facilities, construction of quay wall, berth and an onshore receiving facility
CS2.8	Material deliveries	Delivery of piles and concrete truck movements

The plant and equipment likely to be required for each construction scenario are provided in Table 17-2 and Table 17-3 with details of sound power levels and operating assumptions included in Appendix L.

Other equipment may be used, however, it is anticipated that they would produce similar net noise emissions when used concurrently with the equipment listed.

Table 17-2 Construction equipment used for CS1 scenarios

Equipment	Pipeline construction					
	CS1.1	CS1.2	CS1.3	CS1.4	CS1.5	CS1.6
CAT 988 Loader	1	1	-	-	-	-
CAT 773 Dump truck	-	1	-	-	-	-
Excavator (40 tonne)	1	1	-	-	-	1
Komatsu 110 Long Reach Excavator	-	-	1	-	1	-
Road trucks/trailers	2	-	-	-	-	2
Crane (30 tonne to 150 tonne)	1	-	-	-	-	-
Trencher	-	-	1	-	-	-
Drill rig (directional drill)	-	-	-	1	-	-
Mud pump	-	-	-	1	-	-
Pipe laying machine	-	-	-	-	1	-

Table 17-3 Construction equipment used for CS2 scenarios

Equipment	Dredging, excavation and disposal							
	CS2.1	CS2.2	CS2.3	CS2.4	CS2.5	CS2.6	CS2.7	CS2.8
Backhoe dredger	1	-	-	1	-	-	-	-
Tug boat	2	-	-	2	-	-	-	-
Survey / Service Tug	1	-	-	1	-	-	-	-
Split hopper barge	2	-	-	2	2	-	-	-
CAT 988 Loader	-	2	1	-	1	2	-	-
CAT D8 Dozer	-	1	-	-	1	1	-	-
Komatsu Excavator (90 tonne)	-	5	-	-	1	1	-	-
CAT 773 Dump truck	-	4	-	-	2	2	-	-
Excavator (40 tonne)	-	-	3	-	-	3	-	-
Komatsu 110 Long Reach Excavator	-	-	1	-	-	1	-	-
Road trucks/trailers	-	4	10	-	-	10	2	-
Hydraulic hammer	1	-	-	-	-	-	1	-
Vibro hammer	-	-	-	-	-	-	2	-
Impact hammer (7 tonne – 16 tonne)	-	-	-	-	-	-	3	-
Crane (30 tonne to 150 tonne)	-	3	-	-	-	-	6	-

Equipment	Dredging, excavation and disposal							
	CS2.1	CS2.2	CS2.3	CS2.4	CS2.5	CS2.6	CS2.7	CS2.8
Piling rig	-	-	-	-	-	-	4	-
Crane (150 tonne to 300 tonne)	-	-	-	-	-	-	4	-
Directional Drilling machine (90 tonne)	-	-	-	-	-	-	3	-
Telehandler	-	-	-	-	-	-	2	-
Concrete truck	-	-	-	-	-	-	-	4
Semi-trailer	-	-	-	-	-	-	-	3

Construction of the project will also involve the use of the following vibration generating equipment:

- Hydraulic hammer
- Vibro hammer
- Impact hammer
- Piling rig

The construction traffic routes are detailed in Table 17-4. Access to the project site would be off Springhill Road, Five Islands Road, Flinders Street, Princes Motorway, Port Kembla Road, Masters Road and Old Port Road.

Construction vehicle movements would consist of heavy vehicles associated with plant and material delivery and light vehicles used for staff movements.

Table 17-4 Construction traffic route segments

ID	From	To	1	2	3	4	5	6
A	Wollongong	Port Kembla (Wharf)	Princes Motorway	Masters Road	Springhill Road	Port Kembla Road	Unnamed Road	—
B	Port Kembla (Wharf)	Wollongong	Unnamed Road	Port Kembla Road	Springhill Road	Masters Road	Princes Motorway	—
C	Wollongong	Port Kembla (Reclamation)	Princes Motorway	Masters Road	Springhill Road	Five Islands Road	Flinders Street	Old Port Road
D	Port Kembla (Reclamation)	Wollongong	Old Port Road	Flinders Street	Five Islands Road	Springhill Road	Masters Road	Princes Motorway
E	Port Kembla (Wharf)	Port Kembla (Reclamation)	Unnamed Road	Port Kembla Road	Springhill Road	Five Islands Road	Flinders Street	Old Port Road
F	Port Kembla (Reclamation)	Port Kembla (Wharf)	Old Port Road	Flinders Street	Five Islands Road	Springhill Road	Port Kembla Road	Unnamed Road
G	Wollongong	Bluescope (pipeline)	Princes Motorway	Masters Road	Springhill Road	Bluescope	—	—
H	Bluescope (pipeline)	Wollongong	Bluescope	Springhill Road	Masters Road	Princes Motorway	—	—

Operation

During operation, two noise emissions scenarios are anticipated as described in Table 17-5. These scenarios have been modelled for the assessment to predict noise levels and identify potential noise impacts during operation. Refer to Appendix L for a full list of noise modelling parameters and assumptions.

Table 17-5 Operational noise scenarios

Scenario	Stage	Description
OS1	Liquid natural gas (LNG) carrier berthing	Four tug boats would be used to moor and unmoor the LNG carrier from its berthing location beside the floating storage regasification unit (FSRU)
OS2	FSRU operation	Transfer of LNG from the LNG carrier to the FSRU Regasification of the LNG

The sound power levels of the operational equipment expected on site are provided in Table 17-6. The locations of the operational noise equipment are based off information provided by Australian Industrial Energy (AIE).

The following equipment will also be operational however they are expected to be housed within shielded structures on the FSRU. Noise emissions from these equipment would be considered negligible as they are shielded from direct emission to the surrounding environment.

- Mechanical plant in the air conditioning unit room
- Generators to support utilities, controls and electricity
- Gas compressors to vaporise the LNG.

Table 17-6 Equipment sound power levels, dBA

Source	Source height (m)	Octave band centre frequency, Hz										Reference
		31.5	63	125	250	500	1000	2000	4000	8000	Total	
Wärtsilä Engine W 8L50DF FSRU engine room LNG Carrier engine room 3rd and 4th deck 40 dBA reduction assumed	10	-	45	59	70	78	78	77	75	64	83	Wärtsilä datasheet
Wärtsilä Exhaust W 8L50DF FSRU funnel LNG Carrier funnel 35 dBA exhaust silencer fitted	45	83	72	77	75	85	91	89	74	-	94	Wärtsilä datasheet
Regasification boiler FSRU engine room 3rd and 4th deck	10	-	49	64	71	82	85	86	71	69	90	Noise Emission from Industrial Facilities VDI2571
Regasification booster pump **Sea water pump** FSRU main deck	30	-	103	93	89	84	87	87	85	81	104	Based on diesel pump
Loading arm FSRU main deck	30	-	96	99	96	90	94	94	83	74	105	Based on a crane
Tugboat	1.5	-	78	87	94	100	103	104	104	102	110	Based on a diesel engine

17.2 Existing environment

17.2.1 Overview

Overall, the existing noise environment is dominated by industrial noise from premises in Port Kembla, road traffic and rail noise.

At Port Kembla, there are a total of 18 berths with services ranging from motor vehicle imports, grain and coal exports, general cargo facilities, dry bulk and break bulk facilities and bulk liquid facilities. Land use surrounding Berth 101 is predominantly heavy industrial or special uses associated with port operations. Wollongong Sewage Treatment Plant is located to the north of the coal export facility. The closest residential properties to Berth 101 are located approximately 2 kilometres to the north in Coniston, to the west in Cringila and to the south at Port Kembla and Warrawong.

The pipeline to connect the FSRU with the existing gas transportation network at Cringila passes through a predominantly industrial setting around the outskirts of Port Kembla.

Springhill Road and Masters Roads are the two main vehicular traffic routes connecting Port Kembla to the regional road network including the M1 Princes Motorway. Tom Thumb, Springhill and Masters Roads all carry a high level of heavy vehicle traffic due to their direct link to and from Port Kembla. Tom Thumb Road services the existing port facilities including the PKCT.

The rail network within the port precinct consists of rail lines, sidings and loops. The Port Kembla rail network links to the Illawarra and Moss Vale-Unanderra rail line, managed by the NSW Government and Australian Rail Track Corporation (ARTC) respectively. The Illawarra Line is a shared passenger and freight rail line. Unattended background noise monitoring using noise loggers was undertaken for a period of 13 days (11 September to 24 September 2018) at two locations (refer to Figure 17-1) to quantify the existing noise environment surrounding the project site. The included:

- Location 1: Background noise monitoring location about 340 metres north of the proposed pipeline alignment and 2.5 kilometres north-west of Berth 101. This residential receiver is set-back at a similar distance to the closest sensitive receivers and is considered representative of the reasonably most-affected residences. Noise at this location is influenced by industrial noise from Port Kembla to the north-west, road traffic noise from Gladstone Avenue and rail operations located 20 metres to the south.
- Location 2: Background noise monitoring location about 170 metres south of the proposed pipeline alignment and 2.2 kilometres west of Berth 101. This residential receiver is set-back at a similar distance to the closest sensitive receivers and is considered representative of the reasonably most-affected residences. Noise at this location is influenced by industrial noise from Port Kembla to the north-west and road traffic noise from Five Islands Road located 60 metres to the north.

17.2.2 Noise monitoring

Results showed that the evening background noise levels are greater than the day-time background noise levels at location 1. The night-time levels are higher than the day and evening background noise levels at location 2. This is likely to be attributed to existing industrial noise in the area, noting that the evening period has fewer sample points, which inherently makes it more susceptible to variance using the NPI 90th percentile method.

Table 17-7 Summary of measured noise levels, dBA

Location	Rating background level, L_{A90}			Ambient level, L_{Aeq}		
	Day	Evening	Night	Day	Evening	Night
Location 1	39	40	39	52	50	50
Location 2	43	42	45	51	49	50

17.2.3 Sensitive receivers

Noise catchment areas (NCA) are used to represent areas with similar noise environments. Two NCAs have been identified for this assessment and are detailed in Table 17-8. NCA01 comprises a mix of residential, commercial and industrial sensitive receivers located to the north of the project and NCA02 comprises the same mix of sensitive receivers, however these are located to the south of the project.

Table 17-8 Noise catchment areas

NCA	Distances to construction area (closest construction area)	Distances to operational areas
NCA01	250 metres - 900 metres (gas pipeline construction)	2.5 kilometres – 3.5 kilometres
NCA02	100 metres – 900 metres (gas pipeline construction)	2.0 kilometres – 3.0 kilometres

The representative sensitive receivers used for modelling and assessment purposes are shown in Figure 17-1 (refer to Appendix L for a detailed list). Representative sensitive receivers were modelled at the most affected point located within 30 metres of the building in accordance with the NPI.

Paper Size ISO A4

0 260 520 780 1,040

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

GHD

Australian Industrial Energy
Port Kembla Gas Terminal

Project No. 21-27477
Revision No. A
Date 31 Oct 2018

Representative sensitive receivers, noise monitoring locations and land use map

Figure 17-1

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Print date: 31 Oct 2018 - 16:40 (SMA record: 2) (SMA record: 21)

Data source: ; (c) Department of Finance, Services and Innovation 2015; (c) Department of Finance, Services and Innovation 2012; (c) Forest Corporation of NSW 2017; (c) State of New South Wales and Office of Environment and Heritage; NSW Crown Copyright - Department of Planning and Environment; (c) Commonwealth of Australia (Department of the Environment) 2013; (c) Commonwealth of Australia (Department of the Environment) 2014. Created by: afoddy

17.3 Noise and vibration criteria

Noise and vibration compliance criteria for the project were established in accordance with the relevant guidelines. The following section provides a summary of these construction and operational noise criteria adopted for the assessment.

17.3.1 Construction noise criteria

Construction noise management levels

Construction noise management levels for residential premises and other sensitive land uses are based on the Interim Construction Noise Guideline (ICNG). The method to determine the noise management levels in accordance with the ICNG is outlined in Table 17-9.

Table 17-9 Noise management levels for residential receivers

Time of day	Noise management level, $L_{Aeq(15\ min)}$	Application notes
Recommended standard hours	Noise affected: RBL + 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise. • where the predicted or measured LAeq(15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • the proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected: 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected: RBL + 5 dBA	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level.

Time of day	Noise management level, $L_{Aeq(15\ min)}$	Application notes
		Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community.

Noise management levels for other sensitive land uses are provided in Table 17-10 and only apply when the properties are in use.

Table 17-10 Noise management levels for other sensitive land uses

Land use	Noise management level, $L_{Aeq(15\ min)}$
Classrooms Hospital wards and operating theatres Places of worship	45 dBA (internal)
Active recreation areas	65 dBA (external)
Passive recreation areas	60 dBA (external)
Commercial premises	70 dBA (external)
Industrial premises	75 dBA (external)

Sleep disturbance

The ICNG recommends that maximum noise level events and the frequency of maximum noise level events exceeding the RBL should be assessed where construction works are planned to extend over two or more consecutive nights.

The NPI provides the most updated guidance for the assessment of sleep disturbance. The NPI recommends a maximum noise level assessment to assess the potential for sleep disturbance impacts which include awakenings and disturbance to sleep stages. An initial screening test for the maximum noise levels events should be assessed to the following levels.

- $L_{Aeq(15\ min)}$ 40 dBA or the prevailing RBL plus 5 dB, whichever is greater; and/or
- L_{AFmax} 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

If the screening test indicates there is a potential for sleep disturbance then a detailed maximum noise level assessment should be undertaken. The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

Project construction noise management levels

A summary of the project construction noise management levels for residential receivers in the area is provided in

Table 17-11. The noise management levels at non-residential receivers are as per Table 17-10.

Table 17-11 Project construction noise management levels, dBA

Receiver type	Construction noise management levels, $L_{Aeq(15\ min)}$				
	Standard construction hours		Outside standard construction hours[1]		
	Noise affected	Highly noise affected	Day	Evening	Night
Residential NCA01	49	75	44	44[2]	44 54 L_{AFmax}
Residential NCA02	53	75	48	47	47[3] 57 L_{AFmax}

Note 1: The *Noise Policy for Industry* (EPA, 2017) defines day, evening and night time periods as:

- Day: the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays.
- Evening: the period from 6 pm to 10 pm.
- Night: the remaining periods.
- Note 2: Measured background levels during the day were used as the measured evening levels were higher than the measured day-time levels.
- Note 3: Measured background levels during the evening were used as the measured night-time levels were higher than the measured evening levels.

17.3.2 Construction vibration criteria

Construction vibration criteria were established for human comfort as well as for structural damage.

Vibration criteria have been set with consideration to *Assessing Vibration: a technical guideline* (DEC, 2006). British Standard *BS 6472 – 1992, Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)* which is recognised as the preferred standard for assessing the ‘human comfort criteria’.

Typically, construction activities generate ground vibration of an intermittent nature. Intermittent vibration is assessed using the vibration dose value. Acceptable values of vibration dose are presented in Table 17-12 for sensitive receivers.

Whilst the assessment of response to vibration in *BS 6472-1:1992* is based on vibration dose value (refer to Table 17-12) and weighted acceleration. For construction related vibration, it is considered more appropriate to provide guidance in terms of a peak value, since this parameter is likely to be more routinely measured based on the more usual concern over potential building damage.

Table 17-12 Human comfort intermittent vibration limits (BS 6472-1992)

Receiver type	Period	Intermittent vibration dose value ($m/s^{1.75}$)	
		Preferred value	Maximum value
Residential	Day (7 am and 10 pm)	0.2	0.4
	Night (10 pm and 7 am)	0.13	0.26
Offices, schools, educational institutes and places of worship	When in use	0.4	0.8

The degrees of perception for humans are suggested by the vibration level categories given in BS 5228.2 – 2009, Code of Practice for noise and vibration on construction and open sites – Part 2: Vibration, as shown in Table 17-13.

Table 17-13 Guidance on effects of vibration levels for human comfort (BS 5228.2-2009)

Vibration level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration at this level in residential environments will cause complaints, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure.

Two guidelines were applied to establish vibration criteria for the project: DIN 4150-3 Structural vibration – effects of vibration on structures (1999). The guideline values are shown in Table 17-14.

Table 17-14 Guideline values for short term vibration on structures

Line	Type of structure	Guideline values for velocity (mm/s)		
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[1]
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10

[1] At frequencies above 100 Hz the values given in this column may be used as minimum values

17.3.3 Operational noise criteria

Project noise trigger levels

The NPI provides guidance on the assessment of operational noise impacts and was used to establish operational noise criteria for the project. Operational noise levels are distinguished between intrusiveness noise and amenity noise. The intrusiveness noise level refers to the relative audibility of operational noise compared to the background level at residential receivers. The amenity noise level refers to the total level of extraneous noise for all receiver types.

The project noise trigger level is the lower value of the intrusiveness noise level and the amenity noise level. The intrusiveness noise aims to protect against significant changes in noise levels and the amenity noise level aims to protect against cumulative noise impacts from existing industry. The project noise trigger levels that would be used to assess operational noise impacts are provided in Table 17-15.

The NPI states that *"To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows:*

Project amenity noise level for industrial developments = Recommended amenity noise level (Table 2.2) minus 5 dB(A)"

As the project is in an existing industrial cluster and the development constitutes a single premises addition to the existing cluster, the project amenity noise level has been calculated by reducing the NPI amenity noise levels by 5 dBA.

Table 17-15 Project noise trigger levels, dBA

Receiver	Time period	Intrusiveness noise level $L_{Aeq(15\ min)}$	Project amenity noise level, $L_{Aeq(15\ min)}$[1,2,3]	Maximum noise level events	Project noise trigger level, dBA
Residential NCA01 suburban	Day	44	58	-	**44** $L_{Aeq(15\ min)}$
	Evening	44[4]	48	-	**44** $L_{Aeq(15\ min)}$
	Night	44	43	54 L_{Amax}	**43** $L_{Aeq(15\ min)}$ **54** L_{Amax}
Residential NCA02 suburban	Day	48	58	-	**48** $L_{Aeq(15\ min)}$
	Evening	47	48	-	**47** $L_{Aeq(15\ min)}$
	Night	47[5]	43		**43** $L_{Aeq(15\ min)}$
Commercial	All		63	-	**63** $L_{Aeq(15\ min)}$
Industrial	All		68	-	**68** $L_{Aeq(15\ min)}$

Note 1: The project amenity noise levels have been calculated by subtracting 5 dBA from the recommended amenity noise levels as the project constitutes a single premises addition to an existing industrial area.

Note 2: The NPI recommends applies a 3 dBA addition to the $L_{Aeq(period)}$ noise level to convert the amenity noise level to a $L_{Aeq(15\ min)}$.

Note 3: Receivers are located in an industrial interface. A 5 dBA addition has been applied to the residential recommended amenity levels as existing industrial noise levels are above the suburban recommended amenity level.

Note 4: The NPI recommends that evening intrusiveness levels should be no greater than the day-time intrusiveness level. Therefore the day-time background noise level has been used to calculate the project intrusiveness noise level for the evening period.

Note 5: The NPI recommends that night-time intrusiveness levels should be no greater than the evening intrusiveness level. Therefore the evening background noise level has been used to calculate the project intrusiveness noise level for the night-time period.

17.3.4 Traffic noise criteria

The RNP provides traffic noise criteria for residential receivers in the vicinity of existing roads (Table 17-16). The criteria is applied to operational and construction traffic on public roads to identify potential road traffic impacts and the requirement for feasible and reasonable mitigation measures.

The RNP application notes state that *"for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion."*

If road traffic noise increases during operation are within 2 dBA of current levels then the objectives of the RNP are met and no specific mitigation measures are required.

Table 17-16 Road traffic noise criteria, $L_{Aeq(period)}$, dBA

Type of development	Day 7 am to 10 pm	Night 10 pm to 7 am
Existing residence affected by additional traffic on arterial roads generated by land use developments	60 $L_{eq(15\ hour)}$	55 $L_{eq(9\ hour)}$
Existing residence affected by additional traffic on local roads generated by land use developments	55 $L_{eq(1\ hour)}$	50 $L_{eq(1\ hour)}$

17.4 Potential impacts

17.4.1 Construction

The assessment of noise during construction includes air-borne noise impacts, traffic impacts, and vibration impacts. Management measures identified as a result of the construction assessment are provided in Section 17.5

Air-borne noise impacts

The magnitude of off-site noise impacts associated with construction is dependent upon a number of factors:

- the intensity and location of construction activities
- the type of equipment used
- existing background noise levels
- intervening terrain and structures
- the prevailing weather conditions.

Noise modelling was undertaken to predict the noise levels during construction at the identified sensitive receivers. The predicted noise levels were based on the equipment (refer to Table 17-2 and Table 17-3) operating at maximum capacity in the worst-case sensitive receiver area. In practice, noise levels would fluctuate based on the nature of construction works occurring in proximity to the sensitive receiver. Therefore, the assessment was considered to be conservative and representative of the worst case scenario for each receiver.

Outputs from the noise model include the predicted noise levels for the construction scenarios including pipeline construction and demoltion, dredging and berth construction as outlined in Table 17-1. Refer to Appendix L for the construction noise contours for each modelled scenario. A summary of the number of exceedances of the NMLs for the modelled representative sensitive receivers are presented in Table 17-17 and Table 17-18 for residential receivers.

During pipeline construction activities, predicted noise level modelling results show the following exceedances:

- Minor exceedances of the NML (≤ 10 dBA) are predicted in NCA01 during standard and outside of standard construction hours. This would be limited to residential receivers within 300 metres of the pipeline alignment along Gladstone Avenue; and
- Minor (≤ 10 dBA) to moderate exceedances of the NML (10 – 22 dBA) are predicted in NCA 02 during standard and outside of standard construction hours. This would be limited to residential receivers within 300 metres of the pipeline alignment along Five Islands Road. Impacts at these sensitive receivers would be partially shielded due to the

row of industrial and commercial premises directly facing the pipeline construction route on Five Islands Road.

- The impacts from pipeline construction activities would be intermittent in duration as the works would progress sequentially along the construction corridor. The entire pipeline is anticipated to be constructed in six months. Therefore, predicted worst-case impacts at any one receiver would be expected to be short term (less than 2-3 weeks) in duration.

During demolition, dredging and berth construction activities, predicted noise level modelling results show the following exceedances:

- No exceedances of the NML are predicted in NCA01 during all construction time periods. This is due to the intervening shielding and distances between these receivers and the fixed construction activities; and
- Minor (≤ 10 dBA) exceedances of the NML are predicted in NCA02 during standard and outside of standard construction hours. The worst impacted residential receivers are isolated residences along Flinders Street and residential blocks adjacent to Five Islands Road and Wentworth Street. These receivers would be subject to existing ambient rail traffic noise and industrial noise from port area.

Exceedances of the construction noise management levels are typical for construction projects of this scale. The noise impacts would be limited to the construction period only and can be managed via a number of best-practice activities.

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Table 17-17 Residential exceedance summary – NCA 1

Time period	Summary	Construction scenario CS1.1	CS1.2	CS1.3	CS1.4	CS1.5	CS1.6	CS2.1	CS2.2	CS2.3	CS2.4	CS2.5	CS2.6	CS2.7	CS2.8
Standard construction hours	Number of exceedances	3	1	0	0	0	2	0	0	0	0	0	0	0	0
	Highest noise level, dB(A)	55	55	46	48	48	53	37	41	37	27	30	44	41	44
	Highest exceedance, dB	2	2	-	-	-	0	-	-	-	-	-	-	-	-
	Worst affected receiver	R028	R028	R028	R028	R028	R028	R040	R043	R043	R032, R046	R043, R051, R056	R042	R040	R042
Outside standard construction hours (day)	Number of exceedances	23	19	0	1	2	13	0	0	0	0	0	0	0	0
	Highest noise level, dB(A)	55	55	46	48	48	53	37	41	37	27	30	44	41	44
	Highest exceedance, dB	7	7	-	0	0	5	-	-	-	-	-	-	-	-
	Worst affected receiver	R028	R028	R028	R028	R028	R028	R040	R043	R043	R032, R046	R043, R051, R056	R042	R040	R042
Outside standard construction hours (evening and night)	Number of exceedances	25	23	0	1	2	19	0	0	0	0	0	0	0	0
	Highest noise level, dB(A)	55	55	46	48	48	53	37	41	37	27	30	44	41	44
	Highest exceedance, dB	8	8	-	1	1	6	-	-	-	-	-	-	-	-
	Worst affected receiver	R028	R028	R028	R028	R028	R028	R040	R043	R043	R032, R046	R043, R051, R056	R042	R040	R042

Table 17-18 Residential exceedance summary – NCA 2

Time period	Summary	Construction scenario CS1.1	CS1.2	CS1.3	CS1.4	CS1.5	CS1.6	CS2.1	CS2.2	CS2.3	CS2.4	CS2.5	CS2.6	CS2.7	CS2.8
Standard construction hours	Number of exceedances	13	9	1	2	1	8	0	1	0	2	2	0	1	0
	Highest noise level, dB(A)	66	54	56	52	58	63	48	51	47	52	52	48	52	39
	Highest exceedance, dB	17	5	7	3	9	14	-	2	-	3	3	-	3	-
	Worst affected receiver	R065	R065	R065	R065	R065	R065	R076	R076, R078	R076, R078	R080	R079	R076	R076	R076
Outside standard construction hours (day, evening and night)	Number of exceedances	19	15	4	4	8	15	1	1	1	2	2	3	2	0
	Highest noise level, dB(A)	66	54	56	52	58	63	48	51	47	52	52	48	52	39
	Highest exceedance, dB	22	10	12	8	14	19	4	7	3	8	8	4	8	-
	Worst affected receiver	R065	R065	R065	R065	R065	R065	R076	R076, R078	R076, R078	R080	R079	R076	R076	R076

Sleep disturbance impacts

Construction activities are expected outside standard construction hours to achieve the required construction program and minimise disruption to local transport networks. Residential receivers located within 300 metres of the pipeline construction alignment have the potential to be impacted.

A detailed maximum noise level assessment was undertaken using adopted criteria from the RNP of sleep disturbance impacts on residential receivers in NCA01 and NCA02 from construction activities outside of standard construction hours.

Results showed that assuming a 10 dBA reduction through an open window, predicted maximum internal noise levels would be below 55 dBA. Therefore, awakening events and sleep disturbance impacts are not anticipated as a result of construction.

Construction traffic impacts

An assessment was undertaken, against adopted criteria, of the noise impacts from project construction traffic along road routes which have residential receivers within the vicinity. The construction traffic route roads included routes A and B: Princes Motorway and Masters Road; Routes C and D: Princes Motorway, Masters Road and Five Islands Road; Routes E and F: Five Islands Road; and Routes G and H: Princes Motorway and Masters Road as shown in Table 17-4.

The worst case construction traffic movements would occur during wharf demolition and construction, dredging and reclamation. It is estimated that, on average, 225 light vehicle and 236 heavy vehicle construction vehicle movements would occur daily.

Assessment results showed that a significant increase in traffic volumes would be needed to increase road traffic noise by 2 dBA (as an example a doubling in traffic corresponds to an approximate 3 dBA increase).

The construction traffic movements will be on arterial roads with significant existing daily traffic volumes. The additional heavy and light vehicles movements associated with the project are unlikely to be significant when compared with the existing vehicle numbers in the area. As a result, no noise impacts from construction traffic movements are expected.

Construction vibration impacts

An assessment was undertaken, against adopted criteria, of the vibration impacts from project construction plant and equipment on residential receivers within the vicinity.

The nearest residential sensitive receivers are located over 300 metres from the proposed pipeline construction area and 2 kilometres from the dredging works area. Non-residential structures are located over 40 metres from the project construction areas.

Assessment results showed that no vibration impacts are predicted from construction of the project due to the large distances between the construction area and the nearest residential receivers and structures.

Underwater noise impacts

An assessment was undertaken, against adopted criteria, of the underwater noise impacts on marine fauna that may occur during piling and dredging activities associated with the construction of the quay wall.

Underwater noise levels associated with dredging will depend on the dredge type (e.g. hydraulic pipeline cutterhead dredges, bucket dredges or hopper dredges) utilised for construction.

A review of available scientific literature by the U.S. Army Corps of Engineers (2015) indicates that *"it is unlikely that underwater sound from conventional dredging operations can cause physical injury to fish species"* and "the area of influence was limited to less than 100 metres from the source". However, dredging operations are likely to cause a temporary behavioural shift as marine fauna avoid the area immediately in the vicinity of dredging.

Assessment results showed that underwater noise impacts from dredging are not anticipated to cause irreversible auditory damage to marine fauna in the area. Behaviour patterns are likely to be temporarily altered as marine fauna seek to avoid the immediate dredging area.

Underwater noise levels associated with piling will depend on the number of pile strikes and relative water depth. Against adopted criteria, two rates of distance attenuation of noise were calculated for unattenuated piles and observation zone distances were calculated for multiple strikes and a single pile strike.

Results showed that a 109 metre observation zone is recommended around the piling area to permit up to 30 minutes of continuous piling. If marine species are sighted within the observation zone or about to enter the observation zone, piling would be stopped until the marine species moves outside the observation zone or 30 minutes have passed since the last sighting.

17.4.2 Operation

For operation, the assessment includes noise impacts from the two operational scenarios (refer to Table 17-5) and operational traffic impacts. These are detailed below. No management measures were identified as a result of the operational assessment.

Operational noise impacts

Noise modelling was undertaken to predict the noise levels during operation. Results showed that noise levels during the worst-case 15 minute assessment period are expected to be the same across the day, evening and night-time assessment periods as the FSRU and associated infrastructure would be in constant operation.

A summary of the maximum predicted noise levels in each NCA for residential receivers and for each non-residential receiver type is provided in Table 17-19.

Assessment results showed that the predicted noise levels during operation of the FSRU is expected to be below the project noise trigger levels during all time periods. No sleep disturbance impacts are anticipated as the operational noise sources are constant and do not have impulsive noise characteristics.

Table 17-19 Most affected receivers

Receiver type		Operational scenario		
		OS1	OS2	OS1 and OS2 (cumulative)
Residential – NCA01	Highest noise level	16	25	26
	Worst affected receiver	R043	R042	R042
Residential – NCA02	Highest noise level	26	32	33
	Worst affected receiver	R080	R076	R076
Commercial	Highest noise level	24	24	27
	Worst affected receiver	R081	R041	R081
Industrial	Highest noise level	29	30	32
	Worst affected receiver	R078	R078	R078
Place of worship	Highest noise level	16	22	23
	Worst affected receiver	R074	R074	R074
Active recreation	Highest noise level	12	20	20
	Worst affected receiver	R007	R007	R007

Operational traffic impacts

The project would generate traffic along Springhill Road from light vehicle movements associated with staff. Staff movements would be limited as a proportion of the FSRU staff are expected to be based permanently on-board.

Road traffic impacts due to heavy vehicle movements is not anticipated. The access routes to the site were previously used for coal delivery with a high volume of daily truck movements. A significant number of truck movements from the project are not anticipated as material delivery trucks would not be required to transport gas which is transferred through the pipeline to connect to the existing network.

The objectives of the RNP would be met during operation if the road traffic noise increase due to operational changes is limited to 2 dBA above existing levels. The existing traffic along Springhill Road would be required to increase by approximately 58 % in order for noise levels to increase by 2 dBA.

No operational road traffic noise impacts are expected as existing traffic volumes are not anticipated to increase by over 58 %.

17.5 Management measures

All management measures would be collated in management plans prepared for construction and operation of the project. Table 17-20 outlines the management measures that are proposed to address the noise and vibration impacts from the construction of the project. Operational noise levels are expected to comply with the operational noise criteria at the worst affected receiver. No specific operational mitigation measures are recommended.

Table 17-20 Management measures for noise and vibration

ID	Issue	Measure	Timing
NV1	Management of airborne noise through site inductions	Provide site inductions to all employees, contractors and subcontractors. The induction must at least include: • All relevant project specific and standard noise and vibration mitigation measures • Relevant licence and approval conditions • Permissible hours of work • Any limitations on noise generating activities with special audible characteristics • Location of nearest sensitive receivers • Construction employee parking areas • Designated loading/unloading areas and procedures • Site opening/closing times (including deliveries) • Environmental incident procedures.	Pre-construction
NV2	Airborne noise from transport	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.	Pre-construction
NV3	Management of sensitive receivers from airborne noise	• Notify the affected receivers detailing the construction activities, time periods over which they would occur and the duration of works. • Provide contact details to the affected receivers. If noise complaints are received, they should be recorded and attended noise monitoring should be conducted to assess compliance with the predicted construction noise levels.	Pre-construction
NV4	Airborne noise and general construction methods	Quieter construction methods should be used where feasible.	Construction
NV5	Airborne noise from pipeline construction	Minimise pipeline construction activities near sensitive receivers during more sensitive time periods (evening, night).	Construction
NV6	Airborne noise from equipment	Turn off equipment after use.	Construction

ID	Issue	Measure	Timing
NV7	Airborne noise from behavioural practices	• No swearing or unnecessary shouting or loud stereos/radios on site. • No dropping of materials from height, throwing of metal items and slamming of doors. • No excessive revving of plant and vehicle engines. • Controlled release of compressed air.	Construction
NV8	Updating the Construction Environmental Management Plan (CEMP)	The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies.	Construction
NV9	Airborne noise from use and siting of plant	• Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be avoided. • The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers.	Construction
NV10	Airborne noise from vehicles	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work, including delivery vehicles.	Construction
NV11	Airborne noise from delivery of goods to construction sites	• Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. • Select site access points and roads as far as possible away from sensitive receivers. • Dedicated loading/unloading areas to be shielded if close to sensitive receivers. • Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.	Construction
NV12	Airborne noise from mobile plant	Where possible reduce noise from mobile plant through additional fittings including residential grade mufflers.	Construction
NV13	Airborne noise from prefabrication of materials	Where practicable, pre-fabricate and/or prepare materials off-site to reduce noise with special audible characteristics occurring on site. Materials can then be delivered to site for installation.	Construction
NV14	Airborne noise from stationary noise sources	Stationary noise sources, such as pumps, should be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained. Appendix F of AS 2436:1981 lists materials suitable for shielding	Construction

ID	Issue	Measure	Timing
NV15	Noisy activity impacts on sensitive receivers	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.	Construction
NV16	Impacts from underwater noise	It is recommended than a 109 metre observation zone be established around the underwater piling zone. The 109 metre observation zone would permit up to 30 minutes of continuous piling. Larger observation zones can permit longer durations of piling.	Construction
NV17	Impacts from underwater noise	The *Underwater Piling Noise Guidelines* (2012) recommends the following standard management and mitigation procedures with respect to underwater piling operations: • Avoid conducting piling activities during times when marine mammals are likely to be breeding, calving, feeding, migrating or resting in biologically important habitats located within the potential noise impact footprint. • Use low noise piling methods, instead of impact piling, where possible. • Presence of marine mammals should be visually monitored by a suitably trained crew member for at least 30 minutes before the commencement of the piling procedure. • If no marine mammals are nearby, a soft-start piling procedure should be used. This involves gradually increasing the piling impact energy over a 10 minute time period. Visual observations of marine mammals within the safety zone should be maintained by trained crew throughout the start period. • If a marine mammal is sighted within the observation zone during the soft start of normal operation procedures, the operator of the piling rig should be placed on stand-by to shut down the piling rig. • A record of procedures employed during the operations should be maintained by the piling contractor.	Construction

18. Air quality

18.1 Introduction

18.1.1 Overview

This chapter describes the existing air quality and meteorology of the project area and the potential air quality impacts during the construction and operation of the project. This chapter provides an overview of the key findings of the detailed Air Quality Impact Assessment (AQIA) included in Appendix M.

The assessment has been prepared in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (Approved Methods) (NSW EPA, 2016).

The scope broadly includes:

- Desktop review of site plans, aerial photographs and topographic maps to gain an understanding of the existing environment in terms of local terrain, proposed operations and sensitive receptors within the study area.
- Review of available ambient air quality monitoring data, to gain an understanding of existing air quality within the vicinity of the project site. Ambient pollutant levels were sourced from data recorded from Office of Environment and Heritage (OEH) ambient monitoring stations located in the local area.
- Outline the applicable air quality criteria with consideration to the Approved Methods (EPA, 2016).
- An emissions inventory was created to include the terminal and tankers using client supplied data, allowable United States Environmental Protection Agency (US EPA) emission limits and national pollution inventory emission factors.
- Undertake meteorological modelling to gain an understanding of the local wind climate and use as model input for conducting atmospheric dispersion modelling.
- Dispersion modelling to predict construction and operational impacts at nearby receptors was conducted using CALPUFF.
- Recommended in management measures to reduce impacts and, if warranted, recommend air quality monitoring programmes.

Refer to Appendix M for full details of the assessment methodology for construction and operation, including air quality compliance criteria.

18.1.2 Project emissions

Air quality may be impacted by a number of pollutants during construction and operation of the project, each of which have different emission sources and effects on human health and the environment. The assessment focuses on the highest-risk impacts with the potential to occur during construction and operation.

Construction

Construction of the project is expected to take 10 to 12 months with completion due in early 2020. Construction works would be conducted during both standard construction hours

(Monday to Friday: 7 am to 6 pm; Saturday: 8 am to 1 pm; and Sunday/public holiday: no work). The construction methodology comprises two stages or programs which will be undertaken concurrently. Construction Stage 1 (CS1) includes the pipeline construction which is expected to take around 6 months and Construction Stage 2 (CS2) includes demolition, dredging, excavation, disposal and berth construction which is expected to take around 10 to 12 months. Table 18-1 outlines the types of works for each stage.

Table 18-1 Construction staging

Stage	Description	Timeframe	Type of works
CS1	Pipeline construction	6 months	Trenching works through the industrial port precinct Transport of material Pipe laying Rehabilitation works
CS2	Dredging, excavation and disposal	10 – 12 months	Construction of berth Excavation and dredging for quay wall construction Transport of material Installation of mooring facilities

For the construction assessment, the two construction stages or programs along with the emissions inventory have been modelled to predict emissions and identify potential air quality impacts during construction works.

The potential emissions during construction will occur primarily during pipeline construction activities associated with CS1. Earthworks are expected to be completed using a trencher and excavator with sections of horizontal directional drilling. Relatively small volumes of soil will be disturbed associated with the pipeline installation and standard construction management measures will adequately control dust generation.

During dredging, excavation and disposal activities associated with CS2, all material dredged and excavated from the ocean floor will have a high moisture content. Due to the high moisture content, minimal dust will be released during the handling and transfer of the material and no significant dust impacts are anticipated. The distance to sensitive receivers will also limit the potential for impacts associated with berth construction.

Emissions inventory

The potential impacts of construction were conservatively assessed based on a 20 metre wide easement undergoing earthworks with earth movements related to activities typical of pipeline construction.

Dust emissions for each construction area have been calculated using generic emission factors based on a range of typical construction activities. The derived emission rates were characterised using generic emission factors published in the *Western Regional Air Partnership Fugitive Dust Handbook* (WRAP) (Countess Environmental, 2006).

Fine particle emissions associated with exhausts from vehicles and plant used during construction activities are accounted for in the emission factors for earthmoving and handling used in the assessment. Exhaust emissions during construction are expected to be discontinuous, transient, and mobile.

Total suspended particles and dust deposition is usually assessed against annual criteria however, these criteria are less relevant to the Project as construction works would be transient. The primary emission of concern during the construction phase was found to be dust as PM_{10}. As a result, for this Project, air quality was assessed in terms of distances at which the relevant criteria are achieved at any time.

The dust emission factors used in the construction assessment are provided in Table 18-2. The emission factors have been sourced directly from literature where applicable, however where TSP and $PM_{2.5}$ emission factors were not provided, the following assumptions were made:

- TSP/PM_{10} ratio assumed to be a factor of 2
- $PM_{2.5}$/PM_{10} ratio assumed to be 0.1.

Table 18-2 Dust emission factors for construction activities

Construction activity	Particle size emission factors (g/m^2/s)			Source
	PM_{10}	Total suspended particles (TSP)	$PM_{2.5}$	
General and fixed construction activities	3.63238E-05	7.26477E-05	3.63238E-06	WRAP – Recommended PM10 emission factors for construction operations Level 1 (Worst-case conditions).

Refer to Appendix M for detail on the modelling methodology, including the source of dust emissions factors, how emissions rates were calculated, and applied assumptions.

Operation

During operation, the primary emission source associated with the project are the engines on board the FSRU and LNG carrier, which are released via a stack on each vessel. It is understood that the FSRU and the LNG carrier can be operated using gas (LNG) or liquid fuel (MGO). It is AIE's intention to primarily operate the both the FSRU and LNG carrier using boil off gas (LNG) as an energy source.

The emergency generator and auxiliary boiler on board the FSRU have the potential to produce emissions. AIE have stated that the auxiliary boilers are not expected to operate as recovered heat from the main engines will be used. Additionally it was mentioned that the emergency generator will be operated for 30 minutes every week for test purposes only. It is assumed that the generator will not be tested while the LNG carrier is docked. The emissions from these sources are not considered significant as they are not intended to be used during everyday operations and are not expected to exceed emissions from the assessed scenarios in this assessment (refer to Section 18.4.2).

To account for any operational scenario, the air quality emissions for the number of engines operating from the FSRU and LNG carrier while operating on gas and liquid, were modelled for the assessment. Modelling has predicted the emissions and identified potential air quality impacts during operation. Refer to Appendix M for detail on the modelling methodology, including air quality modelling parameters, the source of emissions factors, the methodology adopted for calculating the emissions rates, and applied assumptions.

FSRU emissions

The FSRU is to be powered using four WARTSILA 8L50DF engines. Only two are required to operate while moored and to power the regasification process. All four engines are required when on the open ocean. The two engines operating while moored have been assumed to operate continuously at 100 % capacity. For a summary of engine specifications, refer to Appendix M. The emissions to air for the gas fuelled FSRU scenario and the emissions to air for the liquid fuelled FSRU scenario are presented in Table 18-3 and Table 18-4 respectively.

Table 18-3 FSRU emissions (gas fuelled)

Pollutant	Engine number and emission rate (g/s)			
	1	2	3	4
Particles (PM_{10})	0.14	0.14	0.14	0.14
NO_x	2.60	2.60	2.60	2.60
CO	1.95	1.95	1.95	1.95
SO_2	0.0023	0.0023	0.0023	0.0023
Benzene	0.0042	0.0042	0.0042	0.0042
Formaldehyde	0.5	0.5	0.5	0.5
PAH	0.0000016	0.0000016	0.0000016	0.0000016

Table 18-4 FSRU emissions (liquid fuelled)

Pollutant	Engine number and emission rate (g/s)			
	1	2	3	4
PM_{10}	0.91	0.91	0.91	0.91
$PM_{2.5}$	0.50	0.50	0.50	0.50
NO_x	22.68	22.7	22.7	22.7
CO	10.83	10.8	10.8	10.8
SO_2	3.74	3.7	3.7	3.7
VOCs	4.33	4.33	4.33	4.33
Benzene	0.043	0.043	0.043	0.043
Formaldehyde	0.0043	0.0043	0.0043	0.0043
PAH	0.00000063	0.00000063	0.00000063	0.00000063

LNG carrier emissions

The LNG carrier will dock against the FSRU temporarily while the LNG carrier is unloading LNG to the FSRU. The LNG carrier is to be powered by three WARTSILA 8L50DF engines and one WARTSILA 6L50DF. A maximum of two engines are required to be operational to power the LNG carrier during docking and while the carrier is docked. This assessment assumed engines 1 and 2 of the LNG carrier will operate at 100 % capacity during docking and while docked. For a summary of engine specifications, refer to Appendix M.

The emissions to air for the gas fuelled LNG carrier scenario and the emissions to air for the liquid fuelled LNG carrier scenario are presented in Table 18-5 and Table 18-6 respectively

Table 18-5 LNG carrier emissions (gas fuelled)

Pollutant	Engine number and emission rate (g/s)			
	1	2	3	4
Particles (PM_{10})	0.14	0.14	0.14	0.10
NOx	2.60	2.60	2.60	1.95
CO	1.95	1.95	1.95	1.46
SO_2	0.0023	0.0023	0.0023	0.0017
Benzene	0.0042	0.0042	0.0042	0.0031
Formaldehyde	0.50	0.50	0.50	0.37
PAH	0.0000016	0.0000016	0.0000016	0.0000012

Table 18-6 LNG carrier emissions (liquid fuelled)

Pollutant	Engine number and emission rate (g/s)			
	1	2	3	4
PM_{10}	0.91	0.91	0.91	0.68
$PM_{2.5}$	0.50	0.50	0.50	0.37
NO_x	22.68	22.68	22.68	17.01
CO	10.83	10.83	10.83	8.13
SO_2	3.74	3.74	3.74	2.80
VOCs	4.33	4.33	4.33	3.25
Benzene	0.043	0.043	0.043	0.033
Formaldehyde	0.0043	0.0043	0.0043	0.0033
PAH	0.00000063	0.00000063	0.00000063	0.00000048

18.2 Existing environment

18.2.1 Overview

At Port Kembla, there are a total of 18 berths with services ranging from motor vehicle imports, grain and coal exports, general cargo facilities, dry bulk and break bulk facilities and bulk liquid facilities. Land use surrounding Berth 101 is predominantly heavy industrial or special uses associated with port operations. Wollongong Sewage Treatment Plant is located to the north of the coal export facility. The closest residential properties to Berth 101 are located approximately 2 kilometres to the north in Coniston, to the west in Cringila and to the south at Port Kembla and Warrawong.

The pipeline to connect the FSRU with the existing gas transportation network at Cringila passes through a predominantly industrial setting around the outskirts of Port Kembla.

18.2.2 Air quality monitoring

Ambient air quality daily concentrations for the project area have been estimated using the NSW OEH ambient air quality monitoring stations, which are located in selected areas around NSW. The nearest station to the site is Kembla Grange, however Wollongong has been included as it contains background data for sulfur dioxide (SO_2), $PM_{2.5}$ and carbon monoxide (CO). Daily pollutant average and maximum ambient concentrations for the modelled year (2014) are presented in Table 18-7.

Table 18-7 Ambient air quality daily concentrations (2014)

Pollutant		OEH monitoring site	
		Wollongong	Kembla grange
SO_2	Average (µg/m^3)	2.0	-
	Maximum (µg/m^3)	13.1	-
NO	Average (µg/m^3)	5.9	2.1
	Maximum (µg/m^3)	57.8	20.9
NO_2	Average (µg/m^3)	14.8	0.0
	Maximum (µg/m^3)	37.6	30.1
CO	Average (µg/m^3)	253.4	-
	Maximum (µg/m^3)	575.0	-
PM_{10}	Average (µg/m^3)	17.7	17.3
	Maximum (µg/m^3)	45.3	99.2
	70th percentile (µg/m^3)	20.2	20.3
$PM_{2.5}$	Average (µg/m^3)	7.0	-
	Maximum (µg/m^3)	17.3	-
	70th percentile (µg/m^3)	8.2	

'-' denotes data not sampled at the site

The top 10 measured $PM_{2.5}$ levels (from Wollongong) and PM_{10} concentrations (from Kembla Grange) are provided below in Table 18-8. These are used for a contemporaneous assessment of operational particulate impacts.

Table 18-8 Top ranked PM_{10} and $PM_{2.5}$ concentrations

Rank	PM_{10} concentration (Kembla Grange)	$PM_{2.5}$ concentration (Wollongong)
1	99.2	17.3
2	43.6	16.8
3	42.2	16.1
4	41.5	15.8
5	40.8	15.5
6	37.8	15.2
7	37	14.9
8	36.8	14.8
9	36.8	14.4
10	36.2	14.3

18.2.3 Meteorology

The local meteorology largely determines the pattern of off-site air quality impact on receptors (houses, businesses and industry). The effect of wind on dispersion patterns can be examined using the wind and stability class distributions at the site. The winds at the site are visually shown through wind rose diagrams, giving the distribution of winds and the wind speeds from these directions and used in the dispersion modelling.

The features of particular interest in this assessment are: (i) the dominant wind directions and (ii) the relative incidence of stable light wind conditions that yield minimal mixing (defines peak impacts from ground-based sources).

Modelling results showed that the average wind rose diagrams produced for the entire data period taken at the project site shows the following features:

- The predominant annual average wind directions are from the west and northeast.
- The average wind speed measured was 3.94 metres per second.
- Calms (winds speeds less than 0.5 metres per second) occurred 0.82 % of the time

The seasonal wind rose diagrams produced for 2014 show that:

- During summer the predominant wind direction is from the northeast.
- During winter, westerly and south westerly winds are the most dominant.
- Autumn and spring are transitional periods. During these seasons both summer and winter patterns are observed. Autumn wind patterns are characteristically similar to winter, generally consisting of westerly winds. Spring displays a higher percentile of northeast winds.

Atmospheric stability substantially affects the capacity of a pollutant such as gas, particulate matter or odour to disperse into the surrounding atmosphere upon discharge and is a measure of the amount of turbulent energy in the atmosphere. Stability classes are defined by a series of categories (A to F), each with assigned wind speed range criteria and associated stability characteristics as defined in Appendix M.

Stability modelling results showed:

- Stable atmosphere conditions are the dominant stability state of the atmosphere occurring 40 % of the time.
- Neutral stability occurs 29 % of the time.
- Unstable atmospheres occur about 31 % of the time.
- Refer to Appendix M for a visual representation of the modelling outputs (wind rose diagrams showing annual wind pattern and seasonal variation in wind pattern at the project site) and associated stability.

18.2.4 Sensitive receptors

Sensitive receptors are locations where people are likely to work or reside and may include a dwelling, school, hospital, office or recreation area (EPA, 2016). Representative sensitive receptors used for the assessment are shown in Figure 18-1 (refer to Appendix M for a detailed list). These comprise a mix of residential sites and buildings including commercial, industrial and other types such as Port Kembla Station and Breakwater attery Museum.

Paper Size ISO A4

0 260 520 780 1,040

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

Australian Industrial Energy
Port Kembla Gas Terminal

Project No. **21-27477**
Revision No. **A**
Date **31 Oct 2018**

Site and sensitive receptor Location

Figure 18-1

G:\21\27477\GIS\Maps\Deliverables\EIS\21_27477_EIS_Z010_NoiseSMA.mxd
Print date: 31 Oct 2018 - 15:49 (SMA record: 2) (SMA record: 38)

Data source: ; (c) Department of Finance, Services and Innovation 2015; (c) Department of Finance, Services and Innovation 2012; (c) Forest Corporation of NSW 2017; (c) State of New South Wales and Office of Environment and Heritage; NSW Crown Copyright - Department of Planning and Environment; (c) Commonwealth of Australia (Department of the Environment) 2013; (c) Commonwealth of Australia (Department of the Environment) 2014. Created by: afoddy

18.3 Air quality criteria

Air quality criteria adopted for the assessment has been taken from the Approved Methods (NSW EPA, 2016). To ensure that environmental outcomes are achieved, the emissions impact from the project must be assessed against the assessment criteria shown in Table 18-9.

The values of some of these pollutants have been converted from mg to µg in order to be consistent. Impact assessment criteria included in the assessment are based on the pollutants listed in the supplied engine data from AIE.

Table 18-9 Air quality assessment criteria

Pollutant	Averaging period	Percentile	Assessment criteria (µg/m³)
TSP (total suspended particulates)	Annual	100th	90
PM_{10}	24 hour	100th	50
	Annual	100th	25
$PM_{2.5}$	24 hour	100th	25
	Annual	100th	8
CO	1 hour	100th	30000
	8 hour	100th	10000
NO_2	1 hour	100th	246
	Annual	100th	62
SO_2	1 hour	100th	570
	24 hour	100th	228
	Annual	100th	60
Benzene	1 hour	99.9th	29
Formaldehyde	1 hour	99.9th	20
Total PAHs (polycyclic aromatic hydrocarbons)	1 hour	99.9th	0.4

18.4 Potential impacts

For the air quality assessment, the CALPUFF dispersion model was used to predict ground-level concentrations of pollutants from the project.

18.4.1 Construction

For the construction, a screening level air quality assessment was undertaken. The modelled scenario carried out assumes construction works occurring along the pipeline easement. The results for scenario 1 are shown in Figure 18-2 (daily) and Figure 18-3 (annual) respectively. For general construction activities, the results indicate the following:

- The daily PM_{10} criteria and $PM_{2.5}$ criteria are met at 80 metre and 10 metre from the construction area
- The annual TSP, PM_{10} and $PM_{2.5}$ criteria are met at 20 metre, 70 metre and 60 metre from the construction area.

The nearest sensitive receptor from the easement has been identified as over 100 metre from the easement. Hence, the dust criteria will not be exceeded at any sensitive receptor in the study area during general construction operations within the easement.

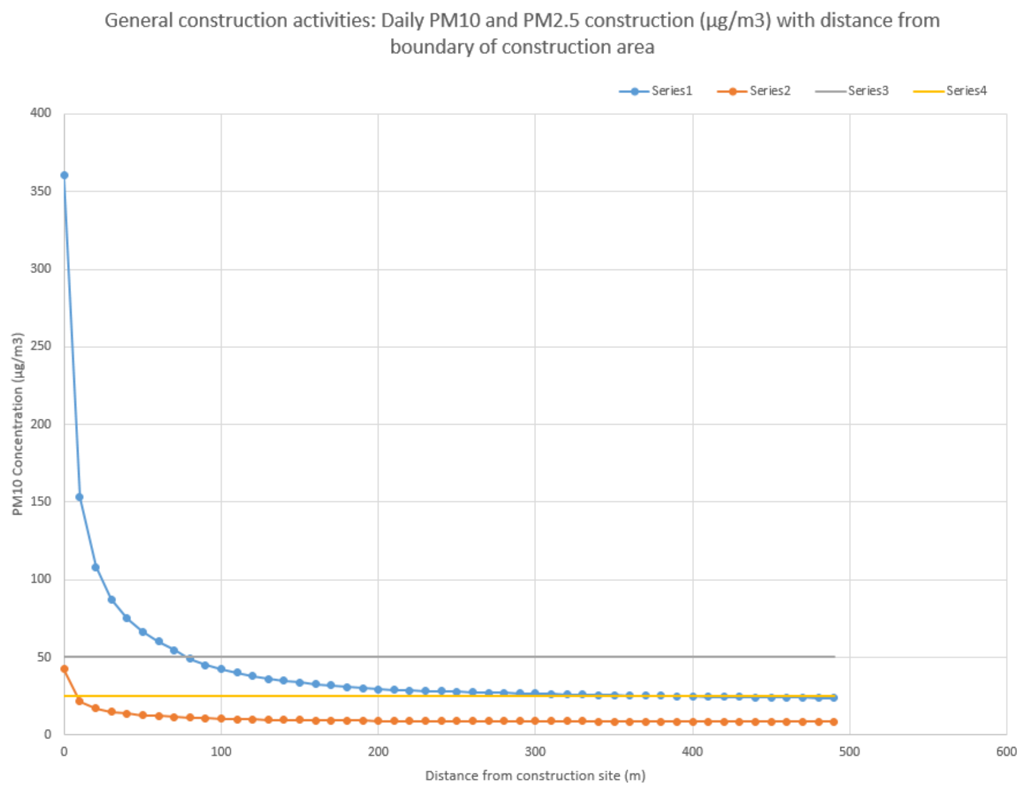


Figure 18-2 Scenario 1: Daily PM_{10} and $PM_{2.5}$ concentrations with distance from boundary of construction area (including background)

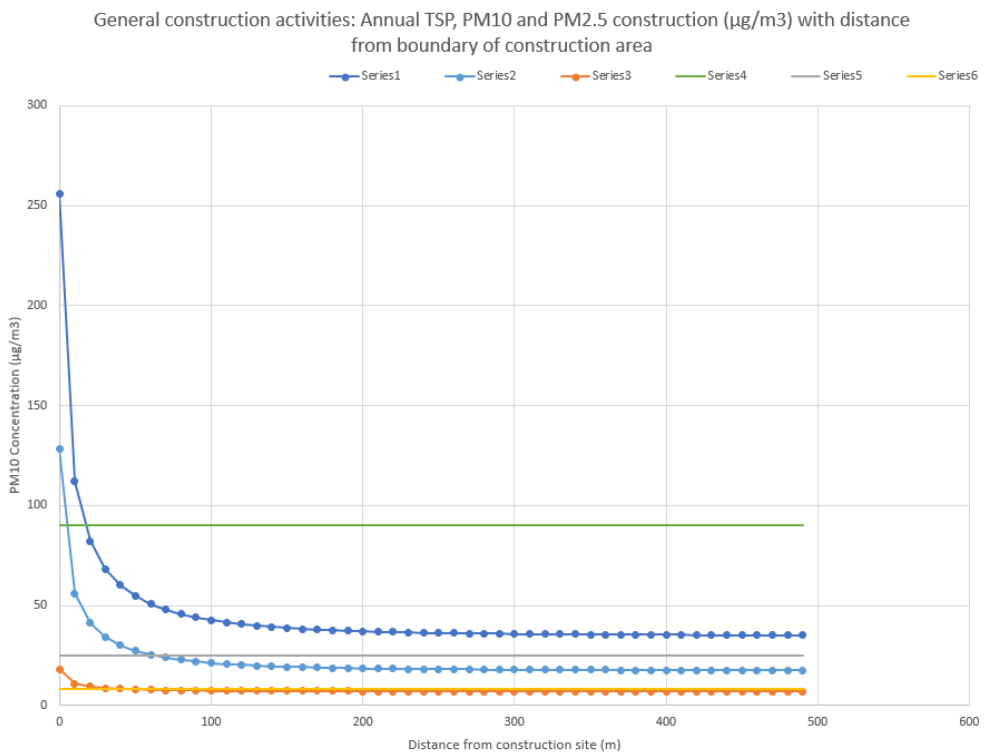


Figure 18-3 Scenario 1: Annual PM_{10}, $PM_{2.5}$ and TSP concentrations with distance from boundary of construction area (including background)

18.4.2 Operation

The LNG carrier will only be docked temporarily while LNG is unloaded to the FSRU. To conservatively assess the impact from the project, the FSRU and LNG carrier have been modelled together to account for worst case emissions. During docking and while the LNG carrier is docked, only two engines on board the LNG carrier will be operational. Only two engines on board the FSRU are required to be operational continuously during regasification operations.

The FSRU and LNG carrier can be operated using gas (LNG) or liquid (MGO). AIE has advised that the FSRU and LNG carrier will likely consume gas as their primary energy source. However it is possible that gas or liquid fuel may be used on either vessel.

The operational assessment modelled six potential operating scenarios. To account for all possible air borne emissions, the following scenarios have been modelled (all scenarios assumed two engines are active on board the FSRU and two engines are active on board the LNG carrier):

- Scenario 1: gas fuelled FSRU and liquid fuelled LNG carrier (possible operating scenario)
- Scenario 2: liquid fuelled FSRU and liquid fuelled LNG carrier (possible operating scenario)
- Scenario 3: gas fuelled FSRU and gas fuelled LNG carrier (likely operating scenario)

Additional modelling was undertaken to ensure compliance in the unlikely event that all four engines are required to be operational onboard the FSRU. The following scenarios have been modelled (all scenarios assumed four engines are active on board the FSRU and two engines are active onboard the LNG carrier:

- Scenario 4: gas fuelled FSRU and liquid fuelled LNG carrier (unlikely operating scenario)
- Scenario 5: liquid fuelled FSRU and liquid fuelled LNG carrier (unlikely operating scenario)
- Scenario 6: gas fuelled FSRU and gas fuelled LNG carrier (possible operating scenario)

Results for scenarios 1, 2 and 3 are presented in Table 18-10 and results for scenarios 4, 5 and 6 are presented in Table 18-11.

Overall, results show that there are no predicted exceedances of the assessment criteria during normal operations, which consists of two gas engines operating on the FSRU and two gas fuelled engines on the LNG carrier.

Table 18-10 Scenarios 1, 2 and 3 predicted pollutant concentrations ($\mu g/m^3$)

Receptor	Predicted pollutant concentrations ($\mu g/m^3$)									
	PM_{10}		$PM_{2.5}$		NO_2	CO	SO_2	Benzene	Formaldehyde	PAH
	24 hour	Annual	24 hour	Annual	1 hour	1 hour	1 hour	1 hour	1 hour	1 hour
Criteria	50	25	25	8	246	30000	570	29	20	0.4
Scenario 1										
R01	1.3	0.08	0.60	0.04	85	123	36	0.3	3	0.00002
R02	1.7	0.09	0.83	0.04	105	226	59	0.4	4	0.00004
R03	1.1	0.10	0.50	0.05	101	98	29	0.3	3	0.00002
R04	2.1	0.14	0.98	0.07	129	192	50	0.3	4	0.00004
R05	1.3	0.10	0.62	0.05	102	216	57	0.3	3	0.00004
R06	1.0	0.06	0.50	0.03	82	167	44	0.2	3	0.00002
R07	0.9	0.17	0.43	0.08	86	80	23	0.2	3	0.00002
R08	1.0	0.17	0.50	0.08	105	141	44	0.2	3	0.00003
R09	0.9	0.07	0.46	0.03	153	176	57	0.3	4	0.00004
R10	1.4	0.15	0.65	0.07	102	139	40	0.3	4	0.00003
R11	1.5	0.12	0.72	0.06	103	195	58	0.4	4	0.00004
Scenario 2										
R01	2	0.1	1.2	0.07	91	192	66	0.5	0.05	0.00001
R02	3	0.2	1.5	0.08	127	400	125	0.7	0.07	0.00001
R03	2	0.2	1.0	0.09	117	172	59	0.5	0.05	0.00001
R04	4	0.2	2.0	0.13	140	296	88	0.5	0.05	0.00001
R05	2	0.2	1.1	0.09	109	341	107	0.6	0.06	0.00001
R06	1	0.1	0.7	0.06	103	197	59	0.4	0.04	0.00001
R07	2	0.3	0.9	0.16	103	135	46	0.4	0.04	0.00001
R08	2	0.3	1.0	0.16	154	218	75	0.4	0.04	0.00001
R09	2	0.1	1.0	0.07	161	346	119	0.5	0.05	0.00001
R10	2	0.3	1.3	0.14	116	236	82	0.6	0.06	0.00001
R11	3	0.2	1.4	0.11	112	341	117	0.7	0.07	0.00001

Receptor	Predicted pollutant concentrations (µg/m³)									
	PM_{10}		$PM_{2.5}$		NO_2	CO	SO_2	Benzene	Formaldehyde	PAH
	24 hour	Annual	24 hour	Annual	1 hour	1 hour	1 hour	1 hour	1 hour	1 hour
Scenario 3										
R01	0.35	0.02	-	-	58	38	0.04	0.05	6	0.00002
R02	0.42	0.02	-	-	59	74	0.08	0.06	8	0.00002
R03	0.30	0.03	-	-	58	39	0.04	0.05	5	0.00002
R04	0.65	0.04	-	-	70	65	0.07	0.06	7	0.00002
R05	0.31	0.03	-	-	58	65	0.07	0.05	7	0.00002
R06	0.22	0.02	-	-	58	42	0.04	0.04	5	0.00002
R07	0.28	0.05	-	-	63	28	0.03	0.04	5	0.00001
R08	0.29	0.05	-	-	63	56	0.07	0.04	5	0.00002
R09	0.36	0.02	-	-	80	98	0.12	0.05	6	0.00002
R10	0.44	0.04	-	-	58	47	0.05	0.06	7	0.00002
R11	0.46	0.03	-	-	58	88	0.10	0.07	8	0.00003

Table 18-11 Scenarios 4, 5 and 6 predicted pollutant concentrations (µg/m³)

Receptor	Predicted pollutant concentrations (µg/m³)									
	PM_{10}		$PM_{2.5}$		NO_2	CO	SO_2	Benzene	Formaldehyde	PAH
	24 hour	Annual	24 hour	Annual	1 hour	1 hour	1 hour	1 hour	1 hour	1 hour
Criteria	50	25	25	8	246	30000	570	29	20	0.4
Scenario 4										
R01	1.4	0.1	0.60	0.04	86	140	36	0.3	6.0	0.00002
R02	1.9	0.1	0.83	0.04	108	264	59	0.4	7.3	0.00003
R03	1.2	0.1	0.50	0.05	103	110	29	0.3	5.9	0.00002
R04	2.5	0.2	0.98	0.07	131	227	50	0.3	7.6	0.00003
R05	1.4	0.1	0.62	0.05	105	248	57	0.3	6.6	0.00003
R06	1.1	0.1	0.50	0.03	89	183	44	0.2	5.0	0.00002
R07	1.1	0.2	0.43	0.08	87	94	23	0.2	5.0	0.00002
R08	1.2	0.2	0.50	0.08	113	152	44	0.2	5.5	0.00002
R09	1.1	0.1	0.46	0.03	154	185	57	0.3	7.0	0.00003

Receptor	Predicted pollutant concentrations (µg/m³)									
	PM_{10}		$PM_{2.5}$		NO_2	CO	SO_2	Benzene	Formaldehyde	PAH
	24 hour	Annual	24 hour	Annual	1 hour	1 hour	1 hour	1 hour	1 hour	1 hour
R10	1.6	0.2	0.65	0.07	104	162	40	0.4	7.5	0.00003
R11	1.7	0.1	0.72	0.06	104	225	58	0.4	7.6	0.00003
Scenario 5										
R01	3.3	0.2	1.8	0.1	102	295	101	0.7	0.1	0.00001
R02	4.0	0.2	2.2	0.1	166	607	191	1.0	0.1	0.00001
R03	2.9	0.3	1.6	0.1	133	242	84	0.7	0.1	0.00001
R04	6.4	0.4	3.5	0.2	161	543	174	0.9	0.1	0.00001
R05	2.8	0.2	1.6	0.1	152	547	171	0.9	0.1	0.00001
R06	1.9	0.2	1.1	0.1	129	323	101	0.6	0.1	0.00001
R07	2.6	0.5	1.4	0.2	143	228	77	0.6	0.1	0.00001
R08	2.8	0.5	1.6	0.3	162	379	131	0.6	0.1	0.00001
R09	3.1	0.2	1.7	0.1	174	619	214	0.8	0.1	0.00001
R10	4.1	0.4	2.2	0.2	131	373	129	0.9	0.1	0.00001
R11	3.9	0.3	2.1	0.2	127	542	178	1.0	0.1	0.00001
Scenario 6										
R01	0.51	0.03	-	-	58	53	0.1	0.07	8	0.00003
R02	0.62	0.04	-	-	85	109	0.1	0.10	11	0.00004
R03	0.44	0.04	-	-	62	44	0.1	0.07	9	0.00003
R04	0.99	0.06	-	-	73	98	0.1	0.09	10	0.00003
R05	0.43	0.04	-	-	65	99	0.1	0.08	10	0.00003
R06	0.29	0.02	-	-	58	58	0.1	0.06	7	0.00002
R07	0.40	0.07	-	-	68	41	0.0	0.06	7	0.00002
R08	0.44	0.07	-	-	73	68	0.1	0.06	7	0.00002
R09	0.48	0.03	-	-	85	112	0.1	0.08	10	0.00003
R10	0.63	0.06	-	-	72	67	0.1	0.09	11	0.00003
R11	0.60	0.05	-	-	64	98	0.1	0.09	11	0.00004

The assessment identified the potential for elevated formaldehyde concentrations during Scenario 6. Scenario 6 assumed four gas fuelled engines are active on the FSRU and two gas fuelled engines are active on the LNG carrier. This scenario is unlikely to occur as only two engines are required on the FSRU during regasification operations. Four engines are only required when travelling a maximum speed on the open seas.

Formaldehyde emissions for Scenario 6 meet the criteria at all assessed sensitive receptors. However, the contour plot in Figure 18-4 shows that there are areas where the 99.9th percentile ground level concentrations exceed the criteria (orange areas). These locations are located principally over the Inner Harbour and near The Cut and will occur only during worse case dispersion conditions under Scenario 6, equating to approximately 0.03% of the time. These potential formaldehyde exceedances are not considered significant and will not impact sensitive receptors in the Port Kembla region.

Figure 18-4 Formaldehyde assessment criteria exceedance locations (Scenario 6)

Based on assumptions as (refer to Appendix M), the predicted pollutant emissions from the construction and operation of the project are expected to comply with the relevant criteria when assessed in accordance with the Approved Methods (NSW EPA, 2016). The application of standard dust mitigation measures will assist to minimise potential impacts from construction of the project. Compliance with International Maritime Organization (IMO) legislation and guidelines will minimise the impacts from the operations of the project.

18.5 Management measures

All management measures would be collated in management plans prepared for construction and operation of the project. Table 18-12 outlines the management measures that are proposed to address the air quality impacts from the construction of the project. These measures will assist in reducing impact on all areas off-site during construction activities. Operational air quality impacts are not anticipated and no specific mitigation is provided. It is recommended that the projected remains compliant with IMO legislation and guidelines to ensure future operations comply with air quality standards.

Table 18-12 Management measures for air quality

ID	Issue	Measure	Timing
AQ1	Fugitive dust emissions	Water material prior to it being loaded for on-site haulage, where appropriate.	Construction
AQ2	Fugitive dust emissions	Aim to minimise the size of storage piles where possible.	Construction
AQ3	Fugitive dust emissions	Limit cleared areas of land and clear only when necessary to reduce fugitive dust emissions.	Construction
AQ4	Vehicle emissions	Control on-site traffic by designating specific routes for haulage and access and limiting vehicle speeds to below 25 km/hr.	Construction
AQ5	Fugitive dust emissions	All trucks hauling material will be covered on the way to the site and maintain a reasonable amount of vertical space between the top of the load and top of the trailer.	Construction
AQ6	Fugitive dust emissions	Operations conducted in areas of low moisture content material should be suspended during high wind speed events or water sprays should be used.	Construction

19. Landscape and visual

19.1 Introduction

19.1.1 Overview

This chapter describes landscape and visual character of the area surrounding the Port Kembla Gas Terminal and the potential impacts during the construction and operation of the project. This section provides an overview of the key findings of the detailed landscape and visual impact assessment (LVIA) included in Appendix N.

The assessment has been prepared in accordance with the approach developed by NSW Roads and Maritime Services as set out in the *Environmental Impact Assessment Guidance Note - Guidelines for landscape character and visual impact assessment (EIA-N04)*, Version 2 (Roads and Maritime, 2013) and also the *Guidelines for Landscape and Visual* Impact *Assessment,* 3rd Edition (Landscape Institute and Institute of Environmental Management & Assessment, 2013) with full details of the methodology included in Appendix N.

The LVIA assesses the landscape character and visual impacts of the project, with particular consideration for sensitive landscape and visual receptors in the locality. The scope broadly includes:

- An understanding of the landscape and visual attributes of the study area
- Identification of sensitivities of landscape and visual receptors in the vicinity of the project
- Assessment of potential landscape and visual impacts associated with the project
- Provision of recommendations for managing identified landscape and visual impacts arising from the project.

19.1.2 Visual project components

Development of the LNG import terminal incorporates four key components with potential to result in impacts to landscape character or visual amenity. Each component is described in detail in Chapter 5 and outlined below to provide context for the landscape and visual assessment.

Floating storage and regasification unit (FSRU)

The FSRU is a vessel which will be moored at Berth 101 on the eastern side of the Inner Harbour at Port Kembla. The dimensions of the FSRU are as follows:

- Overall length of 294 metres
- Breadth of 46 metres
- Approximate overall height of 58 metres from base of vessel to top of bridge
- Approximate height from sea level of 45 metres to top of bridge

The typical colour scheme of the FSRU is a white deck and bridge and dark blue hull as shown on the cross section in Figure 19-1.

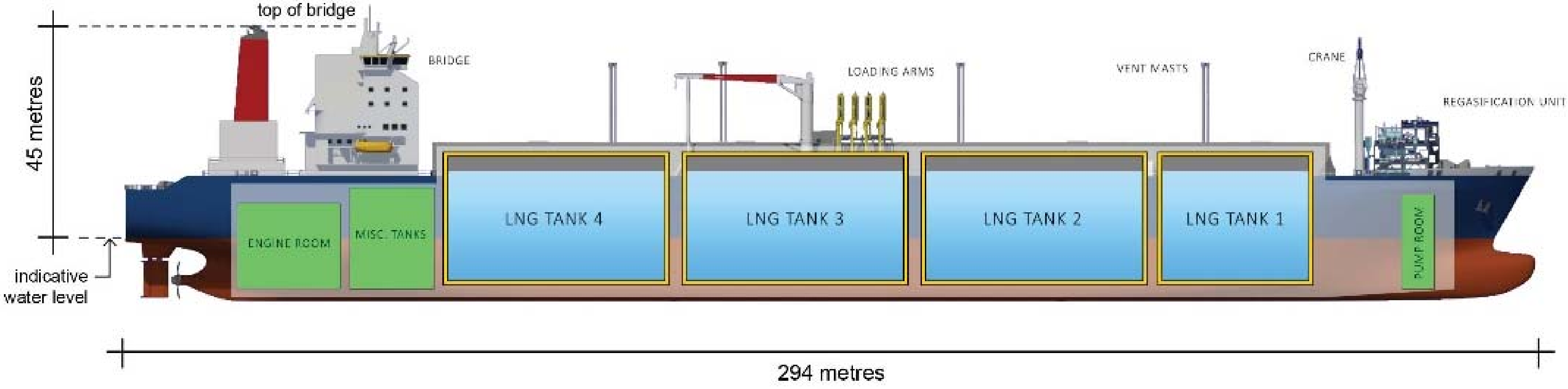


Figure 19-1 Sectional elevation of FSRU with indicative dimensions

Figure 19-2 Left: Model image of LNG carrier and FSRU

Figure 19-3 Right: Indicative lighting on FSRU

LNG carrier vessel

The LNG carrier (LNGC) vessel is similar in size and scale to the FSRU but tends to have either a flat deck or a series of spherical storage tanks (see Figure 19-2). An LNG carrier is expected to arrive at the harbour every two to three weeks, tether alongside the FSRU and unload its cargo into the FSRU as shown in Figure 19-2. Typical lighting for an FSRU is shown on Figure 19-3.

Wharf facilities

Wharf facilities include a new berth pocket at Berth 101 to accommodate the side by side mooring of the FSRU and the LNG carrier, as well as facilities required to connect the FSRU to the gas pipeline for gas transfer, such as loading arms or hoses.

The berth construction is likely to consist of a piled tubular steel wall tied back to a piled steel anchor wall with steel tie rods. This is a common method of wharf construction within Port Kembla. The pavement level of the proposed wharf will be approximately 5 metres above sea level.

Gas pipeline

A gas pipeline connection of around 6.3 kilometres in length will be constructed from Berth 101 to the existing east coast gas transmission network at Cringila. The pipeline will be installed underground and will result in no ongoing changes to landscape setting or visual amenity following the completion of construction.

19.2 Existing environment

19.2.1 Landscape baseline

For the purposes of this assessment, the study area is defined as land within ten kilometres of the project site. The study area has been determined based on a review of aerial photographs, topographic maps, a site inspection and analysis of the zone of theoretical visibility mapping.

The Illawarra Escarpment provides a natural visual catchment boundary to Wollongong and Port Kembla, and was therefore used to assist in defining the study area.

A range of land uses are present within the study area including Wollongong City Centre, surrounding residential areas, the Wollongong University, Port Kembla, Lake Illawarra, and the conservation areas of the Illawarra Escarpment.

Built form within the study area includes the industrial and port areas of Port Kembla and the area below the Illawarra Escarpment, with views towards the coast. Residential areas generally consist of detached single and double storey dwelling, contrasting with the multi-storey mixed use towers within the core of the city centre, reaching up to 16 storeys.

Mount Keira (height of 464 metres) and the Illawarra Escarpment are key topographic features within the region. The Illawarra Escarpment is characterised by its continuous elevated cliff line and plateau contrasting with the coastal plain below.

The hydrology within the region generally includes Lake Illawarra and a series of small creeks providing drainage from the escarpment to the coast, some of which form part of the Allans Creek catchment within the industrial Port Kembla harbour, and others entering the ocean at Fairy Creek at North Wollongong. The Illawarra Region is within the Sydney Basin Bioregion, supporting high levels of terrestrial and aquatic biodiversity.

19.2.2 Landscape character

Landscape Character Zones (LCZs) have been defined within the study area, which represent broadly homogenous characteristics and urban patterns. Six LCZs have been defined as shown on Figure 19-4 and described below.

LCZ 1: Industrial port

LCZ 1 includes the Port Kembla industrial port and the associated peripheral heavy and light industrial area between the Princes Highway and Princes Freeway. LCZ 1 is situated on the waterfront servicing the key regional industries of coal, grain, steel, bulk liquids as well as motor vehicle imports. More recently, cruise ships have occasionally docked in Port Kembla offering industrial, historical and other tours of interest in the local area. The topography of LCZ 1 is therefore flat, with a highly modified waterfront harbour. Key characteristics of LCZ 1 include the following:

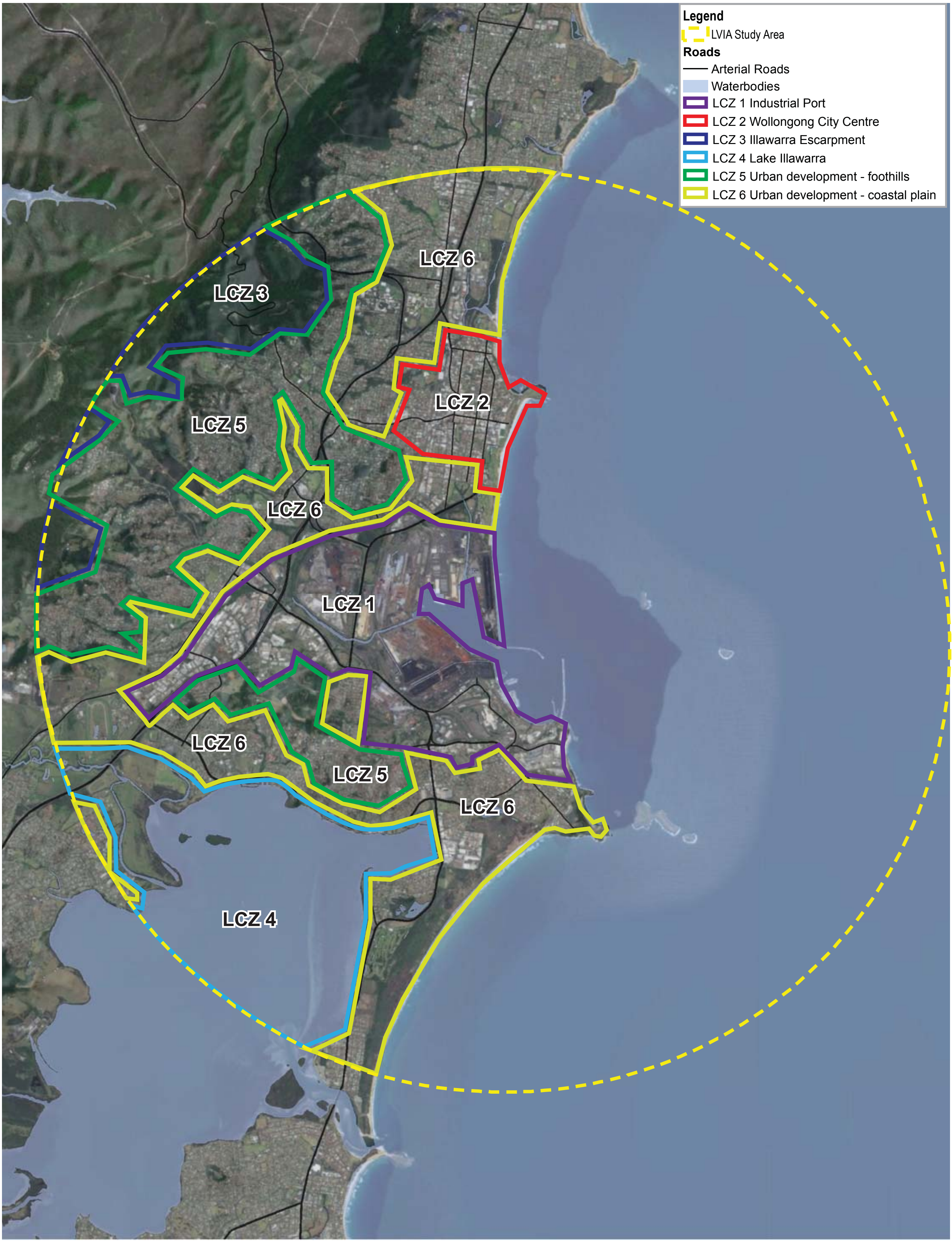
- Highly modified coastline and harbour, including purpose built terminals, silos, overland conveyor belts and towers, and long rocky breakwaters to the harbour opening
- Large scale built form of homogenous colour and industrial materiality, including long corrugated iron sheds, rusty steel chimneys and other infrastructure associated with the steelworks, silos for the storage of grain, bulk liquids and cranes for materials transfer
- Internal rail and road network for transport of materials
- Large open storage areas for materials such as coal and motor vehicles
- Views to the Illawarra Escarpment
- Limited vegetation, with buffer planting present to main public access roads, open spaces and car parking areas
- Port Kembla has a long history as a working industrial port and contributes to the historical development, visual and landscape character of the Wollongong region. A number of items within the port are recognised for their heritage significance, including a steam crane, a brick chimney, a house and office, and a rolling mill plant and gardens, however these are not located close to the project site.

LCZ 2: Wollongong City Centre

LCZ 2 includes the Wollongong City Centre precinct as defined in the Wollongong DCP. The city centre is situated on the coastal plain, and includes the commercial core, a mixed use area to the city edge, Wollongong train station, Wollongong beach and waterfront recreation areas, Flagstaff Park and headland, and peripheral residential areas. Key characteristics of LCZ 2 include the following:

- Multi-storey built form to the commercial core and mixed use area, up to 16 storeys
- Active street frontage to the commercial core and mixed use areas
- Strong urban grid pattern aligned to the foreshore
- Views to the Illawarra Escarpment aligned to the foreshore and escarpment
- Natural, historical and recreational destinations and features, such as the foreshore and beach, lighthouses and headland lookout, ocean baths, and WIN stadium

Typical urban street tree planting to the urban core, with cultural plantings of mature Norfolk Island Pines along Marine Drive, and open grassland to the headland park.



Paper Size ISO A4

0 2,000 4,000

Metres

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

GHD

Australian Industrial Energy
Port Kembla Gas Terminal

Project No. **21-27477**
Revision No. **A**
Date **01 Nov 2018**

Landscape Character Zones

Figure 19-4

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Data source: Basemaps - esri 2018; General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

The setting of the Wollongong City Centre between the coast and escarpment is a defining feature of the city, therefore views to the escarpment and ocean from the city and foreshore are recognised for their contribution to the character, amenity, and sense of place of the city. The lighthouses, particularly the Wollongong Head Lighthouse are also recognised as a positive significant visual built form element within the city.

The foreshore area is within a state significant heritage precinct, valued for its natural, cultural and industrial history. The Norfolk Island pines along Marine Drive are also valued for their local heritage significance, and many buildings of heritage significance are present within the city centre core.

LCZ 3: Illawarra Escarpment

LCZ 3 includes the national park and environmental conservation area associated with the Illawarra Escarpment within the study area. LCZ 3 include the topographic feature of Mount Keira. The escarpment forms a natural western barrier to the urban expansion of Wollongong, and is characterised by its continuous elevated cliff line and plateau contrasting with the coastal plain below.

Key characteristics of LCZ 3 include the following:

- Main escarpment formation of a continuous elevated cliff line and plateau, with Mount Keira a feature landform offset slightly from the main escarpment
- Steep cliffs and slopes have historically prevented urban development
- Predominantly sandstone geology, with shale, claystone and coal seam deposits on the lower slopes
- Topographic elevation ranging from a height of 464 metres at Mount Keira, to approximately 100 metres below
- Dense continuous natural eucalypt forest to the escarpment edges, and moist forest and rainforest to the escarpment slopes
- Urban development restricted to minimal roadways following the natural topography, the Mount Keira lookout and carpark, as well as a number of walking trials

LCZ 3 is situated within the local heritage precinct of the Illawarra Escarpment Landscape Conservation Area. Values associated with this include the scenic, ecological, historic and indigenous cultural, social, visual, and natural history. These include the combined dramatic effect of the geological formation of the escarpment with rich forests, and the narrow coastal plain below. The many vantage points to achieve extensive views and vistas into and out of the escarpment are also valued.

LCZ 4: Lake Illawarra

LCZ 4 includes Lake Illawarra and Mullet Creek, located to the south of Port Kembla. Key characteristics of LCZ 4 include the following:

- Large coastal open water wetland / estuary / lagoon with an open entrance to the ocean
- Shallow beds, with an average depth of 2 metres, with seagrass and salt marsh habitat present
- Gently sloping foreshore, with areas of public open space
- Facilities for water sports and recreational fishing such as ramps and jetties

Lake Illawarra is one of several nationally recognised wetlands in the region, also valued as a recreational and fishing resource.

LCZ 5: Urban development – foothills

LCZ 5 includes urban development to the escarpment foothills, including the suburbs of Mount Pleasant, West Wollongong, Mount Saint Thomas, Coniston, Mangerton, Figtree, and Cordeaux Heights to the escarpment foothills, as well as Cringila, Warrawong, and Lake Heights on the elevated terrain north of Lake Illawarra. Key characteristics of LCZ 5 include the following:

- Land uses are predominantly low density residential development, with rural areas close to the escarpment base, and public recreation typically associated with waterways
- Built form typically consists of single-storey detached residential dwellings, with weatherboard and fibro common in the suburbs north of Lake Illawarra. Houses conform to the topography, often elevated above the street oriented to enjoy coastal views
- Roads and urban patterns conform to the topographic landform and slopes
- Topography is undulating, ranging from approximately 50 to 100 metres
- The foothill suburbs are relatively leafy, with narrow corridors and pockets of mature vegetation
- Residential areas to the upper elevations have views towards the coast and port

Landscape values associated with LCZ 5 are not recognised under the Wollongong LEP, however the local residents are likely to value the low density leafy suburban setting between escarpment and coastline with easterly views towards the ocean.

LCZ 6: Urban development – coastal plains

LCZ 6 includes the lower lying urban areas with flatter terrain within the study area between the foothills and coastline. This includes North Wollongong, Wollongong University and Botanic Gardens, industrial and residential areas around Reidtown, Fairy Meadow and Towradgi. Also included are flatter areas between the foothills and the port, the city and the port, and urban development and parkland around Lake Illawarra. Key characteristics of LCZ 6 include the following:

- Flat to gently undulating topography at lower elevations of between approximately 5 to 50 metres
- Land uses range from environmental conservation, urban parkland, low to medium density residential, educational, and light industry. Built form varies according to land use type.
- Due to the flatter terrain, LCZ 6 has abundant recreational facilities including sports fields, ovals, golf courses, and foreshore reserves
- LCZ 6 includes foreshore areas including Fairy Meadow Beach Reserve, the Wollongong Golf Club and foreshore, Hill 60 rocky headland, Port Kembla Beach, and the Lake Illawarra foreshore
- Vegetation includes heathy natural coastal foreshore communities, urban street tree planting, cultural plantings within the botanic gardens and university

- Views experienced within LCZ 6 are across a relatively flat landscape, often intercepted by built form and vegetation, yet still allowing regular glimpses of the escarpment

Value associated with LCZ 6 includes conservation areas associated with the Fairy Meadow Beach Reserve and Port Kembla / Windang Beach foreshore. Part of the Hill 60 / Illowra Battery heritage conservation area is within LCZ 6, with state significance associated with the Aboriginal, Maritime and Military history, including views from Hill 60 lookout.

19.2.3 Visual baseline

Key views were found to be achieved from elevated locations within the study area, and headland locations with clear open views across the water. The most important of these are sensitive receptor locations such as tourist lookouts, as well as residential areas.

Of particular note are the following key viewing locations within the project viewshed:

- Mount Keira lookout
- Wollongong Head Lighthouse lookout
- Hill 60 Park lookout
- Heritage Park / Breakwater Battery Military Museum

Also of note are residential areas on elevated locations within the viewshed, on the foothills and to the south of the project. The elevated topography forms a visual 'bowl' within which the flat landscape of the project site lies. As the topography and vegetation decreases from the escarpment towards the coast, views open up from the foothills to the east, from elevated buildings and from roadways.

Port Kembla creates a defining characteristic skyline of the steel industry and port. Similarly, it is a significant feature to view from the surrounding residential areas, due to the contrast in scale within the urban fabric in a relatively confined space as shown on Figure 19-5.

Figure 19-5 Port skyline within the residential setting

19.3 Potential impacts

19.3.1 Landscape character

The project is primarily restricted to the LCZ 1: Industrial Port with a small section of the pipeline extending into LCZ 6: Urban Development.

The introduction of the gas import terminal will add new features and change the landscape within LCZ 1 for the period of the project.

The FSRU will be moored at Berth 101 in the Inner Harbour of Port Kembla, only needing to leave the port for scheduled dry docking, extended maintenance purposes or if directed by the Port Authority.

LNG carriers will be a regular feature at Berth 101, appearing every two to three weeks and tethering adjacent to the FSRU for a period of approximately 24 to 48 hours each visit, while their LNG cargoes are unloaded.

The wharf facilities will involve demolition of the existing Berth 101 and the construction of a new berth and wharf facilities to accommodate the proposed vessels in a side-by-side configuration.

The gas pipeline will be installed underground and pass through previously disturbed areas and road verges. Installation of the pipeline will take about six months and involve construction using traditional trenching methods, with directional drilling proposed at road and rail crossings to minimise disruption to the transport network. Pipeline construction will require the avoidance of biodiversity and culturally sensitive areas, however where traditional trenching methods are proposed will require the removal of above ground elements such as trees and landscaping within the industrial precinct.

While the FSRU and LNG carriers are of significant scale, they are not uncharacteristic of the existing landscape setting within the industrial port. Vessels of similar capacity regularly enter the Inner Harbour of Port Kembla and there are many other elements of significant scale present within the LCZ 1 including sheds, silos and stockpiles.

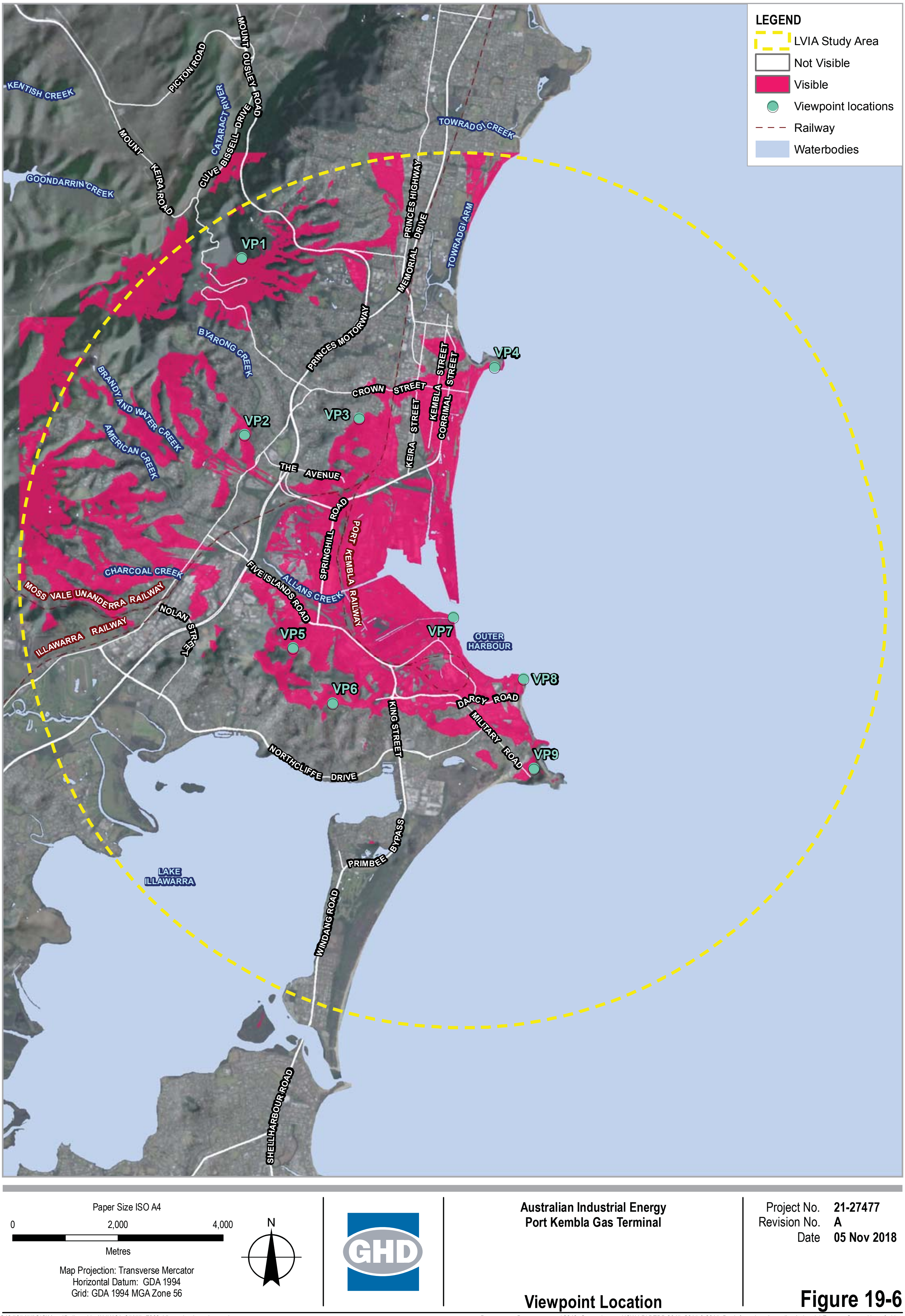
The standard colour palette of the vessels is consistent with that outlined in the Port Kembla Development Code, therefore the vessels fit within the desired built form objectives of the port precinct in relation to colour.

Tree removal will likely be limited to sections along road corridors often behind the existing primary buffer tree planting. Existing vegetation is likely to have been introduced with the port and road development and is not protected for its landscape value. The directional drilling approach proposed to road and rail crossings will result in the retention of existing trees in these locations.

19.3.2 Visual impacts

For the assessment of visual impacts, key viewpoints (VP) towards the project were identified. These were informed by desktop analysis, zone of theoretical visibility (ZTV) mapping and a site inspection. ZTV mapping is a computer-generated analysis which identifies land from which it is theoretically possible to view the components of the project based on topography or landform. ZTV mapping does not take into account landcover such as the presence of buildings or intervening vegetation.

The ZTV reveals the influence of the escarpment and foothill landforms on the theoretical visibility of the project as shown in Figure 19-6.



Australian Industrial Energy
Port Kembla Gas Terminal

Project No. 21-27477
Revision No. A
Date 05 Nov 2018

Viewpoint Location

Figure 19-6

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Data source: Basemaps - esri 2018; General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

Nine VP locations from the most sensitive visual receptors in the study area were identified for the visual assessment. These locations of these are shown in Figure 19-6 and outlined in Table 19-1.

Table 19-1 Viewpoint locations

Viewpoint	Location	Description
VP1	Mount Keira Lookout	This view represents visitors to Mount Keira Lookout.
VP2	Lewis Drive, Figtree	This view represents residents in elevated areas within Figtree.
VP3	Hilltop Avenue, Coniston	This view represents residents in elevated areas within Coniston.
VP4	Wollongong Head Lighthouse	This view represents visitors to Wollongong Head Lighthouse. This view would also be similar to the view experienced from Wollongong Beach.
VP5	Lackawanna Street, Cringila	This view represents residents in elevated areas in Cringila.
VP6	Flagstaff Road, Warrawong	This view represents residents in elevated areas within Warrawong.
VP7	Christy Drive, Port Kembla	This view represents visitors using the public carpark on Christy Drive, Port Kembla.
VP8	Port Kembla Heritage Park	This view represents visitors to Port Kembla Heritage Park.
VP9	Port Kembla Lookout Hill 60	This view represents visitors to Port Kembla Lookout Hill 60.

The assessment of visual impacts detailed below is based on the project in operation following the completion of construction and is based upon panoramas of existing views.

Viewpoint 1: Mount Keira Lookout

Criteria	Comments
Location	VP1 is located at Mount Keira Lookout, approximately 7 kilometres north-west of the project site and at an elevation of approximately 560 metres. Mount Keira Lookout includes a visitor carpark, lookout and walking track, and is within a national park.
View direction	South-east
Description of existing view	VP1 is representative of visitors to Mount Keira Lookout stopping to enjoy the views up and down the coastline. VP1 is a distant and expansive view towards the project site, capturing residential areas on the foothills, the Wollongong City Centre to the left, Port Kembla harbour to the centre, and Lake Illawarra to the distant right. The ocean and sky form a blue gradient on the horizon as the coastline forms a strong presence in the view. Built form types and scale variations are discernible between different uses such as the tower buildings in the city, finer grain suburban areas, and larger scale industry around the harbour.
Anticipated Change to View	The FSRU and LNG carrier vessels would appear in the view, partially obscured by the elevated white grain silos adjacent to Berth 104. The size of each vessel would be smaller but similar in scale to the silos (which measure approximately 400 metres in length), and similar in form and colouration.
Sensitivity to Change	The sensitivity to change is **High**. This is due to the high value placed on the view.
Magnitude of Change	The magnitude of change is **Negligible.** The project will be partially shielded by existing features in the view, is of similar scale and colour to surrounding features and not uncharacteristic in appearance.
Significance of Impact	**Negligible**

Viewpoint 2: Lewis Drive, Figtree

Criteria	Comments
Location	VP2 is located at the intersection of Lewis and Outlook Drives in the suburb of Figtree, approximately 3.7 kilometres north-west of the project and at an elevation of approximately 60 metres. Figtree is a low density leafy suburb on the escarpment foothills with elevated areas enjoying distant views.
View direction	South-east
Description of existing view	VP2 represents views experienced by local residents. The view consists of residential properties on Outlook Drive to the foreground, with vegetation and built form to the middle ground, including the well vegetated elevation of Mangerton residential area to the left of the view. Port Kembla industrial area can be seen in the distance to the centre of the view above the residential rooftops. The cluster of vertical chimneys associated with the steelworks dominates the built form in this portion of the view, grounded by the elongated large scale sheds associated with Bluescope Steel. The large-scale elevated silos are just visible to the left. The ocean can be seen above the storage sheds, creating a focal point to the view.
Anticipated Change to View	The FSRU and the LNG carrier would appear as new elements in the view, seen on the distant horizon to the right of the elevated silos. The project would appear to the front of a small portion of ocean, adding to the already existing industrial frame. The ocean horizon will still be seen above the top of the vessel within the view, retaining the sea horizon.
Sensitivity to Change	The sensitivity to change is **Moderate** as residents would experience long viewing periods at a distance from the project site.
Magnitude of Change	The magnitude of change is **Low** as the change is relatively minor in scale and not uncharacteristic within the view. A small portion of the ocean is likely to be removed from view.
Significance of Impact	**Moderate-Low**

Viewpoint 3: Hilltop Avenue, Coniston

Criteria	Comments
Location	VP3 is located at Hilltop Avenue, Coniston, approximately 3.6 kilometres north-west of the project site, and at an elevation of approximately 60 metres. Coniston is a leafy low to medium density residential suburb situated close to the city centre and Port Kembla Inner Harbour.
View direction	South-east
Description of existing view	VP3 represents views experienced by local residents. Rooftops of residential properties populate the lower half of the view. The Port Kembla industrial area features across the horizon to the centre right. Trees and roofs frame the view to the foreground. Hill 60 can just be seen in the far distance. The elevated grain terminal silos stand out amongst the muted urban context, creating a focal point to the view. The steelworks chimneys punctuate a generally strong horizon line to the distant right. The left portion of the horizon is made up of dense vegetation and a large portion of ocean view.
Anticipated Change to View	The project will be partially shielded by the elevated white silos associated with the grain terminal, as well as other port infrastructure in front. Up to half the length of the FSRU may be visible to the left of the silo building, extending to the location where the angled silo chute disappears behind existing built form.
Sensitivity to Change	The sensitivity to change is **Moderate** as residents would experience long viewing periods at a distance from the project site.
Magnitude of Change	The magnitude of change is **Low** as the new feature is likely to be visible yet will be nestled amongst existing infrastructure of a similar visual character.
Significance of Impact	**Moderate-Low**

Viewpoint 4: Wollongong Head Lighthouse

Criteria	Comments
Location	VP4 is located at the lookout above the carpark near the Wollongong Head Lighthouse, approximately 4.3 kilometres north of the project sites at an elevation of approximately 20 metres. The Wollongong Lighthouse and Flagstaff Hill Park forms part of a natural rocky headland adjacent to Wollongong city centre and beach, and is a popular tourist destination.
View direction	South
Description of existing view	VP4 represents views experienced by visitors to the Flagstaff Hill Park and Wollongong Head Lighthouse. VP4 is a long distant view south along the coastline towards Hill 60, which appears to the left on the horizon line. The foreground is dominated by the carpark. To the middle ground, the ocean and beach shoreline can be seen, with tall pine trees and multi-storey towers of Wollongong to the right. The port infrastructure appears to the centre of the view forming part of the distant horizon. The elevated grain silos built form dominates the view in this location due to its scale and form, and although the steelworks chimneys punctuate the horizon, most infrastructure appears below the escarpment horizon. The escarpment forms a continuous distant backdrop to the city and port.
Anticipated Change to View	The anticipated change to VP4 is the addition of the project to a relatively small portion of the view in the distance, to the left and front of the steelworks chimneys. Existing coal stockpiles and rock wall in the existing view will appear in front of the project. In this location, the colours appear relatively muted therefore although the project will appear behind existing elements, the scale of the FSRU (and LNG carrier) may provide contrast and attract the eye, as the white silos are currently doing.
Sensitivity to Change	The sensitivity of change is **High** as this is a major tourist lookout location adjacent to the Wollongong city centre.
Magnitude of Change	The magnitude of change is **Low** as the new feature in the view is minor, not uncharacteristic, although is likely to be noticeable.
Significance of Impact	**Moderate**

Viewpoint 5: Lackawanna Street, Cringila

Criteria	Comments
Location	VP5 is located at the intersection of Lackawanna Street and Jarvie Road in Cringila, approximately 3 kilometres south-west of the project site at an elevation of approximately 70 metres. Cringila is a residential suburb with single-storey dwellings on relatively undulating topography and extensive views to the steelworks at Port Kembla.
View direction	South-west
Description of existing view	VP5 represents views from nearby residential properties at a similar elevation. The view comprises Jarvie Road to the centre, with single-storey residential houses to the right and parkland to the left. The steelworks infrastructure of chimneys and sheds dominates the centre and left of the view extending across the horizon line, with steam billowing from a chimney to the right. A solid blue ocean horizon extends across the backdrop of the view over the steelworks and suburban area. Electrical poles are dominant vertical foreground elements in the view.
Anticipated Change to View	Only a small portion of the project is likely to be visible within VP5. This may appear to the left of the tallest steelworks element central to the view. The visible component is likely to be limited to the FSRU / LNG carrier. This may appear between existing chimneys already in the view.
Sensitivity to Change	The sensitivity to change is **Moderate** as residents would experience long viewing periods at a distance from the project site.
Magnitude of Change	The magnitude of change is **Negligible** as the project would not affect any change, it will only be a small component within the already relatively industrialised view.
Significance of Impact	**Negligible**

Viewpoint 6: Flagstaff Road, Warrawong

Criteria	Comments
Location	VP6 is located on a footpath within an open space area on Flagstaff Road Warrawong, approximately 3 kilometres south-west of the project site at an elevation of approximately 50 metres. Warrawong is a low to medium density residential development located between the industrial port and Lake Illawarra.
View direction	South-west
Description of existing view	VP6 represents views from nearby residences at a similar elevation. The view comprises Flagstaff Road residences to the right, sited at an elevation overlooking the open space area towards the port. The centre of the view to the fore and middle ground comprises low shrubs and grasses within the open space valley, exposing clear views towards the steelworks behind. Large scale vertical and horizontal sheds, chimneys and silos can be seen, with steam billowing into the skyline. The Illawarra Escarpment and ocean form a blue backdrop to the view.
Anticipated Change to View	Only a small portion of the project is likely to be visible within VP6. This may appear to the centre of the view to the left of the steelworks chimneys. The visible component is likely to be limited to the bridge element of the FSRU / LNG carrier. If visible, these components will appear behind the steelworks infrastructure.
Sensitivity to Change	The sensitivity to change is **Moderate** as residents would experience long viewing periods at a distance from the project site.
Magnitude of Change	The magnitude of change is **Negligible** as the project may not affect any change, it would only be a small project component within an existing industrial setting.
Significance of Impact	**Negligible**

Viewpoint 7: Christy Drive, Port Kembla

Criteria	Comments
Location	VP7 is located in the public carpark at Christy Drive in Port Kembla, approximately 500 metres south of the project site at an elevation of approximately 5 metres. This area is a publically accessible section of Port Kembla, located between the Inner and Outer Harbours, is possibly used by, visitors to the port, workers and anglers. A footpath and row of trees are present along the foreshore, as well as a memorial to those who died as a result of the sinking of the ship Gabriella.
View direction	North / north-west
Description of existing view	VP7 is representative of visitors, workers and anglers using the small foreshore area and carpark at Christy Drive. The view comprises an expanse of Inner Harbour water to the foreground, components of the Coal and Grain Terminals to the middle ground, and the Illawarra Escarpment and Mount Keira forming the backdrop. Key built elements include the elevated silos, the smaller silver silos, sheds and ships. Light poles and cranes are also relatively prominent across the view. The escarpment skyline is relatively continuous as most built elements appear below.
Anticipated Change to View	The FSRU and LNG carriers will be new features in the view, appearing to the centre, behind the rock revetment wall and to the front of the grain terminal infrastructure. Due to the angle of the view, the front of the vessels will be the most visible component. The FSRU will appear to the front of the silver silos, and the LNG carrier vessel, when berthed, will appear adjacent, extending across the view to the left to meet the elevated grain silos.
Sensitivity to Change	The sensitivity to change is **Low** as views will be experienced either by carpark users, anglers, and visitors within an interest in viewing the industrial port.
Magnitude of Change	The magnitude of change is **Low** as the new features will be visible however are within the existing characteristics of the view.
Significance of Impact	**Low**

Viewpoint 8: Port Kembla Heritage Park

Criteria	Comments
Location	VP8 is located to the outer edge of the Port Kembla Heritage Park, which is adjacent to the Breakwater Battery Museum approximately 2.2 kilometres south-east of the project site, at an elevation of approximately 8 metres. The park and museum are situated on a once natural rocky headland which now includes the eastern breakwater of the Port Kembla harbour. The site is part of the Hill 60 / Illowra Battery heritage precinct which has significance at both a state and local level. The site incorporates Maritime, Military and Aboriginal Heritage whilst also providing an outlook to the working port.
View direction	North-west
Description of existing view	VP8 is representative of visitors to Heritage Park. Similar views may also be experienced from within the museum, and from the Eastern Breakwater. VP8 comprises of the Breakwater Museum to the left, the Eastern Breakwater extending across the centre middle of the view, and the port infrastructure and escarpment to the background. The narrow opening between Inner and Outer Harbours can be seen to the centre left of view. Mount Keira provides a focal point on the horizon. Key built form infrastructure includes the museum, the breakwater, and the steelworks. The water and grassy slope dominates the foreground.
Anticipated Change to View	The FSRU and LNG carrier vessels would appear as new features in the view, located towards the centre to the front of the elevated grain silos. The vessels would extend from the vertical elements to the centre of the silos, to the left, close to the harbour opening. From this view direction, the appearance of the LNG carrier vessel when berthed will be largely obscured by the FSRU.
Sensitivity to Change	The sensitivity to change is **High** as the site is a heritage tourism location located on a natural headland, from which visitors enjoy the views of the surrounding area.
Magnitude of Change	**Low** as the project will be a minor addition to the view within the setting of the port with similar characteristics already present within the view.
Significance of Impact	**Moderate**

Viewpoint 9: Port Kembla Lookout Hill 60

Criteria	Comments
Location	VP9 is located at the lookout within Hill 60 Park, approximately 3.8 kilometres south-east of the project site, at an elevation of 70+ metres. The park and lookout are located above Fisherman's Beach, and the viewpoint is taken from the top level of the concrete military fortification adjacent to the Illowra Trig Station. VP9 is within the Hill 60 / Illowra Battery heritage precinct which has both state and local heritage significance. The site incorporates Maritime, Military and Aboriginal Heritage whilst also providing 360 degree views of the surrounding area including the port, coastline, lake and escarpment.
View direction	North / north-west
Description of existing view	VP9 is representative of visitors to Hill 60 Park and lookout. The view comprises coastal vegetation to the foreground, the port and coastline to the middle ground, and the escarpment to the background. The Illowra Trig point appears as a large feature central to the view, with a picnic setting behind. The steelworks chimneys and associated stream appear to the centre left of the view. Larger industrial sheds can be seen to the right of the Trig point, behind MM Beach. Port Kembla Public School can be seen immediately right of the Trig Point. The breakwater and central harbour passage can be seen, as well as the elevated grain silos, the city centre and Wollongong Head Lighthouse to the distant right. The escarpment is a continuous dominant feature in the view, characterised by the gently undulating horizon and features of Mount Keira and Mount Kembla.
Anticipated Change to View	The project will be a new feature in the view, appearing to the immediate right of the elevated silos building, partially obscured by the rocky landform of the coal terminal. Removed from the view will be a small portion of harbour water. The project is likely to appear relatively similar in scale and colour to the elevated silos building. The addition of the LNG carrier to the view when berthed will not be a noticeable addition as the vessel will appear largely behind the FSRU from this view direction.
Sensitivity to Change	**High** as visitors to this location are here specifically to experience extensive views of the surrounding urban and natural landscape.
Magnitude of Change	**Low** as the project is of similar scale and colour to surrounding features and not uncharacteristic within the view. The image is hazy due to the climatic conditions and time of day – during clearer conditions the project is likely to be more visually prominent than the image may suggest.
Significance of Impact	**Moderate**

19.4 Management measures

Table 19-2 outlines the management measures that are proposed to address the potential impacts of the project on landscape and visual amenity matters. All management measures would be collated in management plans prepared for construction and operation of the project.

Table 19-2 Management measures for landscape and visual matters

ID	Issue	Measure	Timing
LV1	Visual - wharf facilities	Ensure proposed wharf facilities conform to recommended design criteria within the *Port Kembla Development* Code. Specifically: • Ensure ancillary structures are highlighted through the innovative use of colour, structure, screening and material • Ensure materials used reinforce the industrial maritime character of the port precinct and are appropriate for the proposed use. Preferred materials include timber, brick, steel, corrugated metal, and other complementary materials	Design
LV2	Visual - gas pipeline	Ensure the gas pipeline alignment and associated six metre easement is located away from the existing established buffer tree planting along main public road corridors such as Springhill Road, to avoid unnecessary tree removal and ensure the functional integrity of the existing environmental and visual buffers as outlined in the *Port Kembla Development Code*. Obtain arboricultural advice regarding the opportunity to retain existing mature vegetation, and investigate design solutions to achieve this Where possible, incorporate replacement landscape planting to areas disturbed by construction work and to re-establish the landscape buffers to external roadways, intersections, and the Bluescope Oval recreation area, in accordance with the *Port Kembla Development Code* design criteria. Ensure tree species are selected to complement the existing landscape character of the immediate surrounding area.	Design

ID	Issue	Measure	Timing
LV3	Visual – operational lighting	In accordance with the *Port Kembla Development Code*, ensure that: • All external lighting provides a safe and attractive environment that meets the operational requirements of the Port • Light spill on the surrounding environment, community and operational activities of the waterways is minimised • Lighting levels are to be provided in a manner sufficient to meet operational requirements and to the relevant Australian Standards • Light spill outside the site boundary and sky lighting is to be avoided through the adoption of measures such as: – Focussing light downwards – Installing cut-offs or shields on lights – Minimising the light mast height – Using low mounting height poles to light non terminal operational areas, including access / egress routes.	Design / Operation
LV4	Visual – construction works	Temporary boardings, barriers, traffic management and signage would be removed when no longer required.	Construction
LV5	Visual - construction works	Materials and machinery would be stored neatly during construction works.	Construction
LV6	Visual - construction works	Roads providing access to the site and work areas would be maintained free of dust and mud as far as reasonably practicable.	Construction
LV7	Visual - construction works	Ensure temporary lighting required during the construction period is sited and designed to avoid light spill into the surrounding area.	Construction

20. Social and economic

20.1 Overview

This chapter describes the social and economic matters relevant to the construction and operation of the project. It provides an overview of the more detailed assessment in Appendix O.

The assessment was prepared with reference to relevant guidelines including the NSW Department of Environment and Planning *Social impact assessment guideline* (2017). The existing social and economic conditions were considered with reference to stakeholder feedback received during consultation as well as publicly available demographic and economic data from sources including the Australian Bureau of Statistics and Wollongong City Council.

Construction of the project is predicted to generate economic benefits directly through capital investment and job creation, and indirectly through industrial and supply chain effects such as the supply of goods and services to the construction workforce. It found that construction of the gas pipeline could lead to some temporary amenity impacts at nearby residences such as noise and dust from construction activities and equipment as well as additional road traffic.

Operation of the project would also generate economic benefits through job creation and the potential local supply of gas to industrial users that would support in the order of 15,000 gas dependent jobs in the region and over 300,000 jobs across NSW. It found that the ongoing operation of the project would not have any material impacts on amenity of nearby residences or the broader community.

A number of management measures are proposed to enhance the social and economic benefits and mitigate the potential social and economic impacts of the project. The proposed measures included development and implementation of continued stakeholder engagement, especially during construction, to provide information and a feedback mechanism to residents, and the implementation of noise and vibration, air quality and traffic management plans for management of those amenity issues during construction.

In addition, a contracting and procurement strategy, which seeks to maximise local content for both construction and operation, will support local employment and business opportunities. During operation the project will seek to work with interested local parties to support new qualification/certification pathways for some of the specialised roles on the FSRU, which is unique to Australia at this stage and is both a marine vessel and a regasification plant.

20.2 Methodology

The social and economic assessment involved five steps:

- determination of the social and economic area of influence
- description of existing social and economic conditions
- incorporation of feedback received during consultation
- identification of social and economic benefits and impacts
- development of measures to enhance benefits and mitigate impacts

The social and economic area of influence was defined as the areas that may be directly or indirectly affected by the project. This area of influence was defined at the local, district and regional scale. The local area of influence was defined as the suburb of Port Kembla including nearby residences that may have the potential to experience amenity impacts, especially from pipeline construction. The district area of influence was defined as Port Kembla and surrounding suburbs that were targeted as part of community consultation which included, among others, neighbouring suburbs of Mangerton, Mount St. Thomas, Figtree, Unanderra, Berkeley, Cringila, Lake Heights, and Warrawong. The regional area of influence was defined as the Wollongong City Council local government area.

Existing social and economic conditions were described with reference to community feedback received during consultation as well as publicly available demographic and economic data. This included a review of current census data from the Australian Bureau of Statistics and social and economic plans and policies administered by Wollongong City Council, as well as an audit of nearby community facilities with the potential to be affected by the project.

Stakeholder feedback received during consultation for the project was reviewed to develop an understanding of community values and issues of concern as well as the perceived potential benefits and impacts of the project. Consultation undertaken included meetings and workshops, presentations, phone calls and emails and community information sessions. Further consultation activities were undertaken specifically for the social and economic assessment and included meetings with Wollongong City Council and Illawarra Business Chamber.

Social and economic benefits and impacts were identified in line with established principles and guidelines and with consideration to the nature of the impact (positive, negative or neutral), the type of impact (direct or indirect), its duration (temporary, short, medium or long term) and degree of change compared to existing conditions (negligible, minor, medium or major). Measures to enhance benefits and mitigate impacts were then developed.

20.3 Existing environment

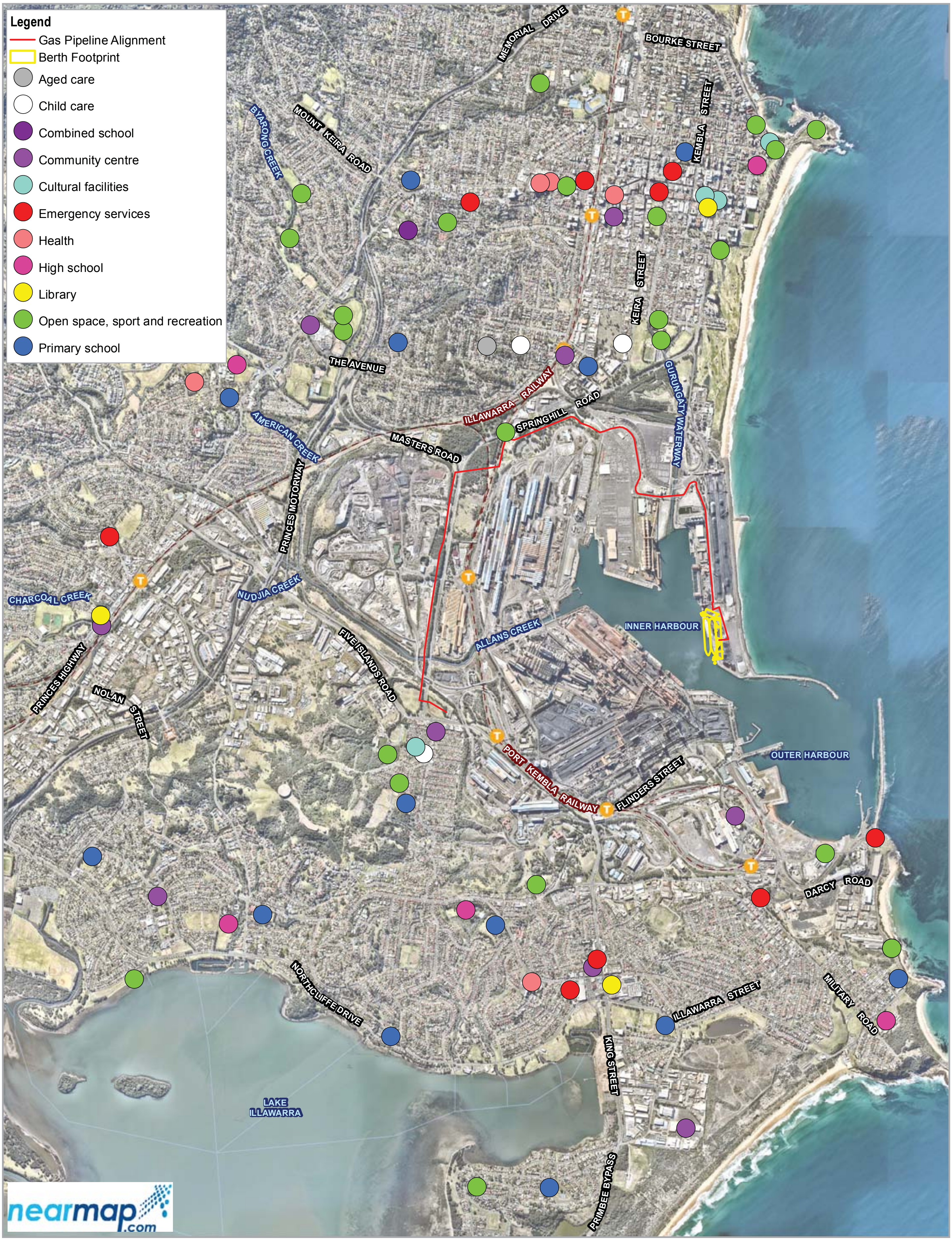
The existing environment in the area surrounding the project is shown in Figure 20-1. As shown Port Kembla is situated about two kilometres south of the centre of Wollongong with surrounding localities including Mangerton, Mount St. Thomas and Figtree to the north-west; Unanderra to the west; Berkeley to the south-west; and Cringila, Lake Heights, and Warrawong to the south. As shown in Figure 20-1 a range of social infrastructure has also been identified in the region including various schools, aged care, childcare, community, cultural and recreational facilities.

The assessment characterised the existing demography of the local, district and regional area. It found that the local area and district area particularly to the south of Port Kembla were characterised by a slightly larger population in the 50–85 years and above range, slightly larger proportion of culturally and linguistically diverse populations, and slightly larger proportion of lone-person households, single-parent families or people requiring care assistance. These areas also had higher proportions of the population working in jobs such as manufacturing and construction but also had higher rates of unemployment compared to the regional area.

The Australia Bureau of Statistics socio-economic index accordingly showed higher levels of socio-economic disadvantage in those areas immediately adjacent and to the south of Port Kembla compared to lower socio-economic disadvantage to the east and north.

The assessment found that Port Kembla was economically important at the local, district and regional scales sustaining over 3,800 jobs and contributing $839 million in economic output to the regional economy each year. It found while industrial activities associated with Port Kembla were an essential part of the regional economy there had also been a shift in employment toward other industry sectors including information technology, tourism, health and aged care, and education and research. However, there remained higher proportions of jobs in manufacturing, construction, technician and trade work, machinery operation and manual labour in the local and district areas surrounding Port Kembla than in the broader regional area.

Consultation undertaken for the project reflected the significance of Port Kembla and associated industrial activities to the local, district and regional economy. The project was generally seen as a suitable use of the industrial land at Port Kembla and interest was expressed in the potential utilisation of local workers and suppliers through the construction and operation of the project.



Paper Size ISO A4

0 250 500 750 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Australian Industrial Energy
Port Kembla Gas Terminal

Social Infrastructure

Project No. **21-27477**
Revision No. **A**
Date **31 Oct 2018**

Figure 20-1

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Data source: Aerial imagery - nearmap 2018 (image date 19/07/2018, date extracted 12/10/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

20.4 Potential impacts

Construction of the project is expected to take about 10–12 months. Construction of the pipeline will occur concurrently, but is expected to be completed in about 6 months. Construction of the project is expected to employ about 150 workers at its peak.

20.4.1 Construction phase

Construction investment and employment

Construction of the project is predicted to generate economic benefits directly through capital investment and employment, and indirectly through industrial and supply chain effects. Construction of the project would involve a capital investment of $200–250 million and is expected to employ about 150 workers at its peak. This investment and employment has the potential to generate economic benefits at the local, district and regional scale.

As discussed in Section 20.3, industrial activities associated with Port Kembla already support the regional economy through jobs in manufacturing, construction, technician and trade work, machinery operation and manual labour. The project would have the potential to provide more jobs of this kind that would be consistent with the skillsets of the workforce in the region.

Construction will also create opportunities for local suppliers of goods and services to the construction workforce or more generally in support of construction activities. Management measures to enhance these potential benefits are proposed in Section 16.5.

Population and demography

The scale and duration of construction, and the size of the construction workforce, means it is unlikely to lead to material changes to the local population or demography. As part of AIE's contracting procurement plans, all contractors will be required to outline their plans to maximise local content. This approach will support local employment meaning any changes to the local population or demography would be minimised.

Amenity and character

During construction there could be some temporarily amenity impacts at residences in close proximity to the gas pipeline route. This may include noise and dust from construction and additional road traffic noise and road traffic volumes on the road network.

In general, construction of the berth and wharf facilities would not lead to noise impacts given the distance to the nearest sensitive receiver, which is around 2 kilometres from the berth. Potential impacts of construction noise and are discussed in more detail in Chapter 17.

Construction would also have the potential to generate air emissions including dust from construction and excavation as well as exhaust from construction equipment and vehicles. Potential impacts of construction on air quality would be readily managed by implementation of standard control measures and are not expected to affect nearby residences or other sensitive receivers. Potential impacts of construction on air quality and proposed management measures are discussed in detail in the air quality assessment in Chapter 18.

Access and connectivity

Construction of the project would also generate road traffic on the road network including light vehicles for the transport of the construction workforce and heavy vehicles for the transport of construction equipment and materials. The light and heavy vehicle movements to and from as well as around Port Kembla between the Inner Harbour and Outer Harbour would be consistent with its existing use as a major port and industrial area as well as an employment hub.

Additional traffic is not expected to have substantial impacts on local or regional access or connectivity. Potential impacts of traffic are assessed in detail in Chapter 16.

20.4.2 Operational phase

Operational investment and employment

Operation of the project would generate economic benefits through some direct job creation and the potential supply of gas to industrial users that support in the order of 15,000 jobs in the region and over 300,000 jobs across NSW. The strategic benefits of the project for the local economy and NSW is described in further detail in Chapter 3.

Population and demography

During operation, the project is expected to support between 40–50 on-going roles. Of these roles, approximately 20–25 are expected to relate to the safe manning of the FSRU, which is both a marine vessel and a regasification plant. People fulfilling these roles will be housed on the FSRU and thus will not impact the supply or pricing of accommodation in the local area. On-board housing ensures the vessel is able to maintain its marine safety requirements, including being able to move out to sea at any stage. Given the project will be the first of its kind in NSW and probably the first of its kind in Australia, it is anticipated that many of the specialist FSRU roles and marine ticketed positions will need to be sourced from outside the local area. Nevertheless, wherever possible key support functions such as catering, cleaning, painting and other maintenance work will be sourced locally. In addition, the proponent will seek to work with local skills development agencies, such as TAFE NSW, to design and deliver certification/qualification pathways to support the development of relevant skills in the local area.

Given the relatively small size of the operational workforce, potential impacts on the surrounding area and facilities would be limited and would be mitigated through the implementation of the management measures proposed in Section 20.5.

Amenity and character

Although the project would potentially be visible from some locations in the vicinity of Port Kembla it would be consistent with the existing visual character or Port Kembla and surrounding industrial land. As such, it would not be expected to materially affect existing views from the community.

The operation of the project would not be expected to generate noise or air emissions to the extent they would materially reduce the amenity of the surrounding area. Detailed noise and air quality assessments of the operation of the project are provided in Chapter 17 and Chapter 18.

Access and connectivity

The operation of the project would generate a relatively small number of daily light vehicle movements for the transport of the operation workforce and infrequent vehicle movements for deliveries or waste transport to and from the FSRU. Traffic generated by the project would be relatively limited and is not expected to have a significant impact on traffic or access.

20.5 Management measures

Table 20-1 outlines the management measures that are proposed to address the potential impacts of the project on social and economic matters. All management measures would be collated in management plans prepared for construction and operation of the project.

Measures to address the potential traffic, noise and air quality are provided in the detailed assessments of those matters in Chapter 16, Chapter 17 and Chapter 18.

Table 20-1 Management measures for social and economic matters

ID	Issue	Measure	Timing
S1	Investment and employment	A contracting and procurement strategy focusing on maximising local content will be prepared to support local employment and business opportunities during construction. During operation, the project should seek to work with interested local parties to support new qualification/certification pathways for some of the specialised roles on the FSRU.	Pre-construction
S2	Other impacts	Stakeholder engagement would be carried out prior to and during construction with key stakeholders and the community to provide information about the project activities and provide a feedback mechanism for residents.	Pre-construction Construction

21. Waste management

21.1 Overview

This chapter describes waste management matters relevant to the construction and operation of the project. It identifies types of waste that may be generated by the construction and operation of the project and the quantities of waste that may be generated. It also proposes measures to manage waste in accordance with the *Waste Avoidance and Resource Recovery Act 2001*.

Construction of the project would have various waste streams including demolition and construction waste, excavated and dredged material and waste vegetation. The largest waste stream will be excavated and dredged sediment and soil material, which will primarily be placed at the disposal area in the Outer Harbour generally in line with NSW Ports reclamation plans.

Waste generated by the project during operation would largely be limited to the waste generated by the FSRU and the workforce stationed on board the vessel including the generation of sewage and other wastewater as well as general rubbish and food waste.

Waste generated by construction and operation would be managed in accordance with the waste hierarchy defined in the Waste Avoidance and Resource Recovery Act 2001 through separate waste management plans developed for construction and operation.

Waste in NSW is regulated under a number of laws including the *Protection of the Environment Operations Act 1997*, *Waste Avoidance and Resource Recovery Act 2001* and *Marine Pollution Act 2012*, which gives effect to the International Convention for the Prevention of Pollution from Ships. These and the other laws relevant to the project are described in Chapter 6.

In addition, as a marine vessel the FSRU is required to adhere to The International Convention for the Prevention of Pollution from Ships (MARPOL), which includes regulations aimed at preventing both accidental pollution and pollution from routine vessel operations.

MARPOL includes six technical annexes:

- Annex I: Regulations for the prevention of pollution by oil
- Annex II: Regulations for the control of pollution by noxious liquid substances in bulk
- Annex III: Regulations for the prevention of pollution by harmful substances carried by sea in packaged form
- Annex IV: Regulations for the prevention of pollution by sewage from ships
- Annex V: Regulations for the prevention of pollution by garbage from ships
- Annex VI: Regulations for the prevention of air pollution from ships

Australia implements MARPOL through the Commonwealth Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and Navigation Act 2012, and the NSW Marine Pollution Act.

MARPOL protocols prescribe procedures for minimizing, collecting, storing, recording, recycling, processing and/or disposing of waste, including from the crew and use of equipment on board.

These requirements include the maintenance of detailed waste management plans, protocols and record keeping such that every discharge to a port reception facility (for example) shall include date and time of discharge, port or facility or name of ship, categories of waste discharged, and the estimated amount discharged for each category in cubic metres.

21.2 Methodology

The following tasks were undertaken as part of the waste management assessment:

- Review proposed construction activities and materials to identify likely waste streams
- Review of proposed operational activities and materials to identify likely waste streams
- Identification of likely waste classifications of construction and operation waste streams
- Description of management measures for construction and operations waste streams

The review of proposed construction and operation activities and materials to identify likely waste streams included a review of the description of the project and its layout as well as the construction methodology and operational details. Waste classifications of the waste streams were determined with reference to the classification guidelines administered by the NSW EPA. Measures to manage waste were identified with reference to the *Waste Avoidance and Resource Recovery Act 2001* and the NSW Waste and Resource Recovery Strategy 2014-21.

It is noted that the statutory framework concerning waste management including the *Waste Avoidance and Resource Recovery Act 2001* is described in Chapter 6.

21.3 Waste generation

21.3.1 Construction

An inventory of estimated construction waste is provided in Table 21-1. The inventory is based on conservative or nominal estimates of the key waste streams and is not intended to be exhaustive. The identified waste streams, and any other waste streams that may occur during construction, would be managed appropriately and in accordance with the *Waste Avoidance and Resource Recovery* Act as discussed in Section 21.4.

Table 21-1 Construction waste inventory

Activity	Waste	Classification	Volume (m^3)
Demolition and clearing	Waste pavement[a]	General solid waste	2250[b]
	Construction and demolition waste[c]	General solid waste	1000
	Waste vegetation[d]	General solid waste	2000[d]
Excavation and dredging	Excavated and dredged material	General solid waste[e]	720000[f]
	Trenched material[g]	General solid waste	1250[g]
General construction	Surplus construction materials[h]	General solid waste	1000
	Construction packaging waste[i]	General solid waste	1000
	Other general waste[j]	General solid waste	Minimal
	Waste water[k]	Liquid waste	2000[l]

[a] Includes waste concrete, asphalt, gravel and other aggregates.

[b] Assumed as 15 hectares of pavement to a depth of 15 centimetres.

[c] Includes waste wood, metal, brick and other construction and demolition waste.

[d] Assumes an average 0.5 cubic metre per metre for about 4 kilometres of grassed or vegetated areas.

[e] There is potential for some excavated and dredged material to be contaminated (see Section 21.4).

[f] Estimated volume that would be transported from the berth and wharf facilities to the disposal area.

[g] Assumed as about 6.3 kilometres with a trench 1 metre wide and 1 metre deep with 20 percent surplus after backfill.

[h] Includes surplus building materials including wood, metal, brick, aggregates and offcuts such as excess pipeline.

[i] Includes wood pallets, metal straps, plastic packaging and other construction packaging.

[j] Includes general waste produced by the workforce such as food packaging.

[k] Includes sewage and grey water produced by the project workforce.

[l] Assumes about 1000 litres per person per month over one year.

21.3.2 Operation

An inventory of estimated operational waste is provided in Table 21-2.

The waste generated during operation and represented in Table 21-2 would largely be limited to the waste generated by the operation of the FSRU and the workforce stationed on board.

Similar wastes may be generated on board liquid natural gas carriers but have not been included in the monthly inventory as where and how the waste is managed would depend on the operator.

The management of waste from both vessels has been considered in Section 21.4.3.

Waste generated at berth and wharf facilities or the gas pipeline are anticipated to be minimal and would mainly be associated with occasional testing and maintenance activities.

The inventory is not intended to be exhaustive and some other waste streams may occur during operation but are expected to be minor in quantity.

Table 21-2 Operation waste inventory (monthly)

Activity	Waste	Classification	Volume (m^3)
FSRU	Grey water	Liquid waste	510
	Sewage	Liquid waste	60
	Bilge water	Liquid waste	310
	Rubbish[a]	General solid waste	8
	Food waste	General solid waste (putrescible)	0.4

[a] Includes waste paper, plastic, glass, metal and the like from packaging and other goods used on board the vessel

21.4 Waste management

21.4.1 Overview

The general approach to waste management for the project would be in line with the waste hierarchy defined in the *Waste Avoidance and Resource Recovery Act 2001*. In accordance with the hierarchy, waste would in the first instance be avoided through avoidance of unnecessary resource consumption. When waste is produced, options to recover the waste would be looked at including options for reuse, reprocessing, recycling and energy recovery. Waste would only be disposed of as a last resort where other options have been investigated and are not practicable.

21.4.2 Construction

Construction waste will be avoided in the first instance through detailed design and planning to avoid procurement of unnecessary or surplus construction materials. Waste that is generated during construction would be separated by waste type in stockpiles, skips or other types of waste receptacles. Colour coded bins would be established for separation of general waste produced by the workforce. Waste would be routinely collected by a suitably licensed waste contractor.

Waste materials that are capable of being readily reused, reprocessed, recycled or otherwise recovered such as wood, metal, brick, concrete, asphalt, gravel and other aggregates would be sent to suitably licensed facilities for those purposes as far as practicable. Remaining waste including waste vegetation, construction and demolition waste, construction packaging waste and other waste would be sent to suitably licensed facilities for recovery and/or disposal.

It is estimated that about 600,000 cubic metres of material would be excavated and dredged for the construction of berth and wharf facilities. Allowing for typical bulking factors, this volume would equate to about 720,000 cubic metres. The material would be deposited at a disposal area in the Outer Harbour as discussed in Chapter 5. As discussed in Chapter 11, some of the material may have the potential to be contaminated and/or acid forming.

The excavation and dredging as well as the placement of the material in the disposal area would be carried out in a manner such that higher risk material would be capped with lower risk material while potential acid sulphate soils will be placed at depth to prevent oxidation and acid formation. The potential impacts and management measures concerning excavated and dredged material that is potentially contaminated and/or acid forming material would include the development of specialist management plans that are discussed further in Chapter 11.

21.4.3 Operation

Operation waste will be avoided in the first instance through planning to avoid procurement of unnecessary or surplus materials. Waste generated on board the FSRU would be stored in bags, bin, tanks or other vessels as appropriate. Rubbish from living quarters would be compacted and stored in bags. Food waste would be kept frozen to prevent decay and odour.

Waste would be routinely collected by a suitably licensed waste contractor and transported to suitably licensed facilities for recovery and/or disposal as appropriate. Liquid waste including grey water, sewage, sludge and bilge water would be stored in holding tanks and periodically emptied and collected by a suitably licensed waste contractor and transported to suitably licensed facilities.

Similar arrangements would be put in place for the liquid natural gas carriers in the event that the operation of the vessel demands that waste should be offloaded at Port Kembla. That is, waste would be collected by suitably licensed contractors and transported to suitably licensed facilities.

21.4.4 Management measures

Table 18-12 outlines the management measures that are proposed manage waste generated during the construction and operation of the project. All management measures would be collated in a waste management plan prepared for construction and operation of the project.

Table 21-3 Management measures for waste

ID	Issue	Measure	Timing
W1	Construction waste	Develop and implement a waste management plan for construction that integrates all statutory requirements for waste in NSW and includes: • systems to sort and track the actual types and quantities of waste generated • measures for separating waste based on classification of management options including colour coded bins • options for offsite reuse, reprocessing, recycling and energy recovery of waste	Construction
W2	Operation waste	Develop and implement a waste management plan for operation that integrates all statutory requirements for waste in NSW, including under MARPOL, and includes: • systems to sort and track the actual types and quantities of waste generated • measures for separating waste based on classification of management options including colour coded bins • options for offsite reuse, reprocessing, recycling and energy recovery of waste	Operation

22. Greenhouse gas

22.1 Overview

This chapter describes greenhouse gas matters relevant to the construction and operation of the project. It summarises the more detailed assessment in Appendix P.

The greenhouse gas assessment was undertaken in accordance with the *National Greenhouse and Energy Reporting Act 2007* and *National Greenhouse and Energy Reporting (Measurement) Determination 2008* and supplementary documentation in line with good accounting practice.

The assessment estimated that greenhouse gas emissions would be about 8,314 t CO_2-e during construction, mainly due to diesel consumption, and 44,145 t CO_2-e each year during operation, mainly due to electricity generation on board the FSRU. During operation this would comprise about 0.03% of emissions in NSW and 0.01% of emissions in Australia.

A number of measures are proposed to avoid and mitigate potential greenhouse gas emissions during construction and operation of the project through procurement and operational efficiency.

22.2 Methodology

The greenhouse gas assessment was undertaken in accordance with the *National Greenhouse and Energy Reporting Act 2007* and *National Greenhouse and Energy Reporting (Measurement) Determination 2008*. Reference was also made to the American Petroleum Institute *Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Natural Gas Industry* (2009) where necessary to determine the appropriate emissions factors or other estimation techniques. The global warming potentials of various greenhouse gases were also determined with reference to the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* and the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (2007).

The greenhouse gas assessment was carried out by reviewing the project details including the types and quantities of plant, vehicles and equipment planned to be utilised during construction and operation. Potential sources of greenhouse gas emissions during construction and operation were then identified as well as the types of greenhouse gas that would be released such as carbon dioxide, methane and nitrous oxide. The quantities of emissions of each greenhouse gas were then calculated by applying relevant emissions factors or other estimation techniques. Quantities of emissions were expressed in terms of their equivalent in tonnes of carbon dioxide (t CO_2-e) to account for the varying global warming potential of each greenhouse gas as shown in Table 22-1.

Further detail on the methodology of the assessment including assumptions and estimation techniques for each potential source of greenhouse gas emissions is provided in Appendix P.

Table 22-1 Global warming potential

Greenhouse gas	Global warming potential
Carbon dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous oxide (N_2O)	298

22.3 Potential impacts

22.3.1 Construction

Greenhouse gas emissions during construction would be a relatively minor component of the overall greenhouse gas inventory for the project. The key activities that would be potential sources of greenhouse gas emissions during construction were found to be diesel consumption in plant, vehicles and equipment including construction machinery, dredging vessels, electricity generators and vehicles transporting the workforce. The total emissions from the fuel consumption were estimated to be about 8,314 t CO_2-e. This would be about 20% of the more substantial potential greenhouse gas emissions that would occur during operation discussed below in Section 22.3.2.

22.3.2 Operation

The key activities that would be potential sources of greenhouse gas emissions during operation include diesel consumption in vehicles and generators, LNG consumption on board the FSRU for electricity generation and other processes on board. The total emissions from those activities were estimated to be about 44,145 t CO_2-e each year of operation.

Under the *National Greenhouse and Energy Reporting Act 2007*, facilities with greenhouse gas emissions over 25,000 t CO_2-e each year are required to report on their annual emissions in the Clean Energy Regulator's Emissions and Energy Reporting System. Accordingly the project would be required to report on its annual emissions providing this remains in force.

The estimated greenhouse gas emissions during operation are compared to the published totals for NSW and Australia in Table 22-2. As shown the estimated greenhouse gas emissions during operation would comprise about 0.03% of emissions in NSW and 0.01% of emissions in Australia.

Table 22-2 Greenhouse gas emissions

Inventory	Total (t CO_2-e)
Project (annual operations)	44,145
NSW (2017)	131,600,000
Australia (2017)	533,700,000

22.4 Management measures

Table 18-12 outlines the management measures that are proposed to address the greenhouse gas emissions of the project. All management measures would be collated in management plans prepared for construction and operation of the project.

Table 22-3 Management measures for greenhouse gas

ID	Issue	Measure	Timing
G1	Greenhouse gas emissions	All plant and equipment used during the construction works shall be regularly maintained to comply with the relevant exhaust emission guidelines	Construction
G2	Greenhouse gas emissions	Sustainable procurement practices will be adopted where feasible.	Construction
G3	Greenhouse gas emissions	The following measures will be considered by contractor(s): • Construction materials sourced locally where possible • Construction materials that have minimal embodied energy be selected • Use of PVC plastic minimised • Construction materials that are low maintenance and durable • Plant and equipment will be switched off when not in constant use and not left idling • Plant and equipment brought onsite will be regularly serviced and energy efficient vehicles or equipment will be selected where available • Any plant and equipment that is not working efficiently (i.e. emitting excessive smoke) will be removed from site and replaced as soon as possible • Construction works will be planned to ensure minimal movement of plant and equipment, including barges	Construction
G4	Greenhouse gas emissions	The FSRU will obtain and maintain an International Energy Efficiency Certificate, and implement a Ship Energy Efficiency Management Plan.	Operation
G5	Greenhouse gas emissions	The engine types on the proposed FSRU are designed to use dual fuels, with LNG/NG as the main fuel, which is inherently less polluting than diesel or other fuels for power generation. The engines are designed for high efficiency and reliability, and low emissions.	Operation
G6	Greenhouse gas emissions	Boil of Gas (BOG, vaporized LNG) will be managed to avoid using the Gas Combustion Unit(GCU). BOG can be either used as fuel in the generators or sent back to LNG storage after repressurizing. Avoiding or reducing the need to use the GCU will minimise emissions..	Operation

ID	Issue	Measure	Timing
G7	Greenhouse gas emissions	The equipment will be maintained appropriately to minimise the risk of unintended leaks and unnecessary venting, for the FSRU and pipeline.	Operation
G8	Greenhouse gas emissions	The operations will comply with the general principles of the Green Port Guidelines (Sydney Ports Corporation, 2006)	Operation

23. Climate change risk assessment

23.1 Overview

This chapter provides an overview of the key findings of the preliminary climate change risk assessment included in Appendix Q.

The assessment is intended to inform the project proponent of potential vulnerabilities of the proposed asset from climate change and identify ways to address and minimise this vulnerability. It is intended to highlight areas which may be considered for future consideration and does not constitute a comprehensive climate change risk assessment.

The risk assessment has been prepared in accordance with Australian Standard 5334-2013 *Climate change adaptation for settlements and infrastructure – A risk based approach*.

The scope broadly includes:

- Review of publicly available Commonwealth Science and Industrial Research Organisation (CSIRO) and Bureau of Meteorology (BoM) climate data appropriate for the site to gather baseline data and projections to inform possible risks to proposed assets.
- Identification of the potential climatic events and hazards that could impact the proposed asset, based on its scale, location, asset components and design life.
- Assessment of climate change risk, likelihood and consequence under two timeframes and emission scenarios to provide a qualitative weighting of potential risks.
- Linking asset vulnerability associated with climate change to the design of the asset, and potential adaptation options to improve asset resilience.
- Providing some context for the asset within relevant Federal, State and Local government climate change assessment and adaptation policies and guidelines.
- Identification of potential adaptation and mitigation which are planned or may be considered in future stages of design or implementation of the project, including an indication of how these may reduce residual risk.

Refer to Appendix Q for the assessment methodology, assumptions and limitations of the risk assessment.

23.2 Climate context

There is a growing body of evidence that shows Australia's climate has changed and continues to change significantly, particularly driven by the work of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Bureau of Meteorology (BoM). This will continue to place property, communities and infrastructure assets under risk, which can manifest itself in a number of ways, affecting physical asset life, life-cycle maintenance costs, operating costs and/or revenue. To add to the uncertainty, potential impacts influenced by climate change could be realised in either the short term or decades from today.

Infrastructure is designed to function and perform within the environment that it exists, and to respond to the variable weather conditions for which it has been designed. State, national and international design standards and codes of practice exist to provide the parameters necessary to ensure the desired reliability and level of resilience of various infrastructure components to extreme conditions.

The proposed floating LNG facility asset is subject to climate change uncertainty, from the risks posed to physical asset by climate hazards under the influence of climate change. The NSW state government has a strong focus on research of climate change impacts broadly, and particularly regarding coastal impacts, with significant local climate change research projects being undertaken through the NSW Adaptation Research Hub. This research will inform risk assessments in the future, especially relating to the impact of rising sea level and climatological phenomena such as east coast lows, which have already been shown to impact large carrier vessels in NSW. For any asset to be resilient to the impacts of climate change, consideration must be made to the climate hazards which are applicable to the asset type and broader context, including regular review to incorporate the latest climate science. The results of a climate change risk assessment at any stage of a design promotes resilience and consideration of adaptation, either through designed adaptations or in allowance for future adaptive capacity.

23.3 The project

The risk assessment requires an understanding of the anticipated asset components of the project. These are provided in Table 23-1.

Table 23-1 Asset components

Component	Description
Floating storage regasification unit (FSRU)	Double hulled tanker that stores LNG
Berthing facility	Wharf facilities; quick release hooks, beam, mooring dolphins, fenders, quay wall
Gas transmission pipeline	Anticipated 18 inch diameter design in accordance with AS 2885 Australian Pipeline Code
Loading arms	Able to withstand -161 °C of LNG under high pressure
LNG carriers	Associated LNG carriers anticipated to arrive at 2-3 weekly intervals
Port access channel	Dredging of the port will allow access, managed by Ports NSW
Access roads	Design includes some allowance for access roads for staff, and fencing
Safety and communications infrastructure	At the current stage of design this infrastructure is anticipated to be largely placed within the FSRU

This system is designed to allow shipments of gas to meet market demand and the FSRU may be relocated if the facility is no longer required. The design life for this project is anticipated to be nominally 10 -15 years, with consideration for future extension subject to dry docking for vessel maintenance and market demand. Some asset components, such as the FSRU, have an asset life of 20 -30+ years, noting that FSRUs and carrier vessels may be sold and reused elsewhere beyond this project. In addition, the wharf infrastructure would typically be expected to have around a 25 year design life, extending beyond this particular operational use.

23.4 Assessment method

The method applied for the climate change risk assessment is consistent with 5334-2013 *Climate change adaptation for settlements and infrastructure – A risk based approach* which in turn follows the principles of AS/NZS ISO 31000 *Risk management – Principles and guidelines*

The methodology for the climate change risk assessment broadly included the following steps:

- Identification of anticipated asset components of the project potentially at risk from climate change (refer to Table 23-1)
- Collation of climate baseline data, for the relevant climate statistics, from the Bellambi weather station. This station represents the closest weather station in a comparable coastal location with a large range of climate statistics which have been tracked for approximately 20 years.
- Collation of climate projection data from the CSIRO and BoM *Climate Change in Australia Technical Report* in 2015 and based on the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report. Climate change projection scenarios are described as Representative Concentration Pathways (RCPs). RCPs are described according to atmospheric CO_2 concentration levels (in parts per million, ppm), and may also be described by anomalies in global mean surface air temperatures for the period 2081-2100 relative to the average period 1986-2005. Refer to Table 23-2 for the RCP scenarios.
- Risk analysis which involved estimating the likelihood and consequences associated with each of the described risks, with the overall risk level as a function of those two parameters. The risk matrix used for this assessment, including the descriptors for consequence and likelihood, comes from AS 5334. A workshop on the 5 October 2018, with members of the EIS team, provided the identification and evaluation of risks to the asset, considering the asset's proposed location, objectives and intended operations. The risk assessment was subsequently reviewed by a Principal Maritime Engineer who has previously designed berth facilities within Port Kembla Inner Harbour. Baseline climate and projection data (Table 23-3) were used to inform the assessment of likelihood and consequence for each impact.
- Adaptations are identified which have already been planned in reference design, or could potentially be adopted in future design or operation of the asset. Risks were reassessed in light of these planned and potential adaptations, to provide an indication of residual risk that may be achieved if these actions are performed. The adaptation options and residual risk provide additional information, however would need to be considered and implemented by the asset owner at future stages of the project, such as at detailed design and commencement of operations.

Refer to Appendix Q for detail.

Table 23-2 Climate change projection scenarios

Global climate response	RCP scenario	Projected increase in global surface temperature by 2081 – 2100
Strong immediate response, emissions peak by 2020, with rapid decline in emissions thereafter from global participation and application of technologies.	**RCP 2.6**, atmospheric concentration of CO_2 projected at approx. 420 ppm by 2100.	Mean projected increase **1.0°C** Anomaly range +0.3 – 1.7 °C
Slower response, emissions peak around 2040, then decline.	**RCP 4.5**, atmospheric concentration of CO_2 projected at approx. 540 ppm by 2100.	Mean projected increase **1.8 °C** Anomaly range +1.1 – 2.6 °C
Slow response, application of mitigation strategies and technologies.	**RCP 6.0**, atmospheric concentration of CO_2 projected at approx. 660 ppm by 2100.	Mean projected increase **2.2 °C** Anomaly range +1.4 – 3.1 °C
Little curbing of emissions, continuing rapid rise throughout the 21st century.	**RCP 8.5**, atmospheric concentration of CO_2 projected at approx. 940 ppm by 2100 and continuing to increase.	Mean projected increase **3.7 °C** Anomaly range +2.6 – 4.8 °C

23.5 Climate data

Table 23-3 provides a summary of the climate baseline and projection data used to inform the risk assessment of consequence and likelihood, as identified in Section 23.6.

Table 23-3 Climate baseline and projection data

Variable	Current Climate		Climate Change Projections	
Climate variable	*Annual Historical trend Bellambi AWS*	*Baseline period*	*Near term, moderate scenario 2030, RCP 4.5*	*Mid-term, extreme scenario 2050, RCP 8.5*
Mean maximum daily temperature (°C) - Annual	21.4	1997-2018	+0.7° (0.5 to 1.0)	+1.6° (1.2 to 2.0)
Mean maximum daily temperature (°C) - Summer (DJF)	24.6	1997-2018	+0.8° (0.5 to 1.3)	+1.7° (1.2 to 2.4)
Days p.a. over 35 °C	1.7	1997-2018	+0 to 3	n/a
Days p.a. over 40 °C	0.2	1997-2018	Substantial increase in warm spells	
Highest temperature for years 1997 to 2018 (°C)	43.7 1 Jan 2006	Discrete event	n/a	
Hottest day: Summer monthly maximum (DJF)	40.5	1997-2018	+1.2° (0.6 to 1.9)	+2.1° (1.0 to 2.9)
Mean daily solar exposure (MJ/(m*m))	15.5	2007-2018	+0.7% (-0.1 to 2.0)	+1.9% (+0.2 to 3.7)
Mean rainfall (mm) - annual	1123.8	1997-2018	-2% (-9 to 6)	-3.9% (-8.7 to 4.1)
Highest daily rainfall (mm) for years 1997 to 2018	240 18 Aug 1998	Discrete event	n/a	
Wettest day: monthly maximum 1-day rainfall event (mm) - Annual	122	1997-2018	+4.4% (-1.5 to 9.6)	+9.8% (-1.2 to 14.3)
Maximum 1 day rainfall for a 20 year ARI event	n/a		+6.7% (-2.1 to 16.4)	+10.1% (-2.2 to 22.8)
Drought	n/a		Increased time spent in drought	
Soil moisture	n/a		-2.3% (-4.2 to -0.4)	n/a
Climate variable	*Annual Historical trend Bellambi AWS*	*Baseline period*	*Near term, moderate scenario 2030, RCP 4.5*	*Mid-term, extreme scenario 2050, RCP 8.5*
Sea level rise	Refer baseline graph		+0.14 m (0.09 to 0.18)	+0.27 m (0.19 to 0.36)

Variable	Current Climate		Climate Change Projections	
Climate variable	*Annual Historical trend Bellambi AWS*	*Baseline period*	*Near term, moderate scenario 2030, RCP 4.5*	*Mid-term, extreme scenario 2050, RCP 8.5*
Storm surge	n/a		Storm surge in NSW often due to East Coast Low activity (refer below)	
Percentage exceedance for significant wave height (m) for Port Kembla, years 1974 to 2012	5.62	1974-2011	n/a	
Sea surface temperature	Approx 15 to 25°C	Mar-Oct 2018	Rise in sea surface temperature	
Avg. 9 am wind speed (km/h)	17.0	1997-2010	+0.4% (-2.0 to 1.3)	+0.9% (-1.9 to 2.5)
Avg. 3 pm wind speed (km/h)	23.3	1997-2010	+0.4% (-2.0 to 1.3)	+0.9% (-1.9 to 2.5)
Maximum wind gust for years 2003-2018 (km/h)	141 24 Aug 2003	Discrete event	n/a	
East Coast Lows	10 per year (Illawarra region)		Low/mid intensity ECL: -19% frequency in winter, +9% frequency in summer High intensity ECL: -6% frequency in winter, +28% frequency in summer	
Lightning	20-25 thunder days (Illawarra region)		+5-6% change per degree warming	
Hail	3 hailstorms per year (Illawarra region)		Hail projections unclear	

23.6 Coastal processes

Coastal processes which have the potential to impact the project include sea level rise and east coast lows. These are summarised below. The impacts of these have been assessed as part of the risk assessment in Section 23.7.

23.6.1 Sea level rise

Monthly sea level has been captured at Port Kembla as demonstrated in Figure 23-1, demonstrating the natural variability which exists.

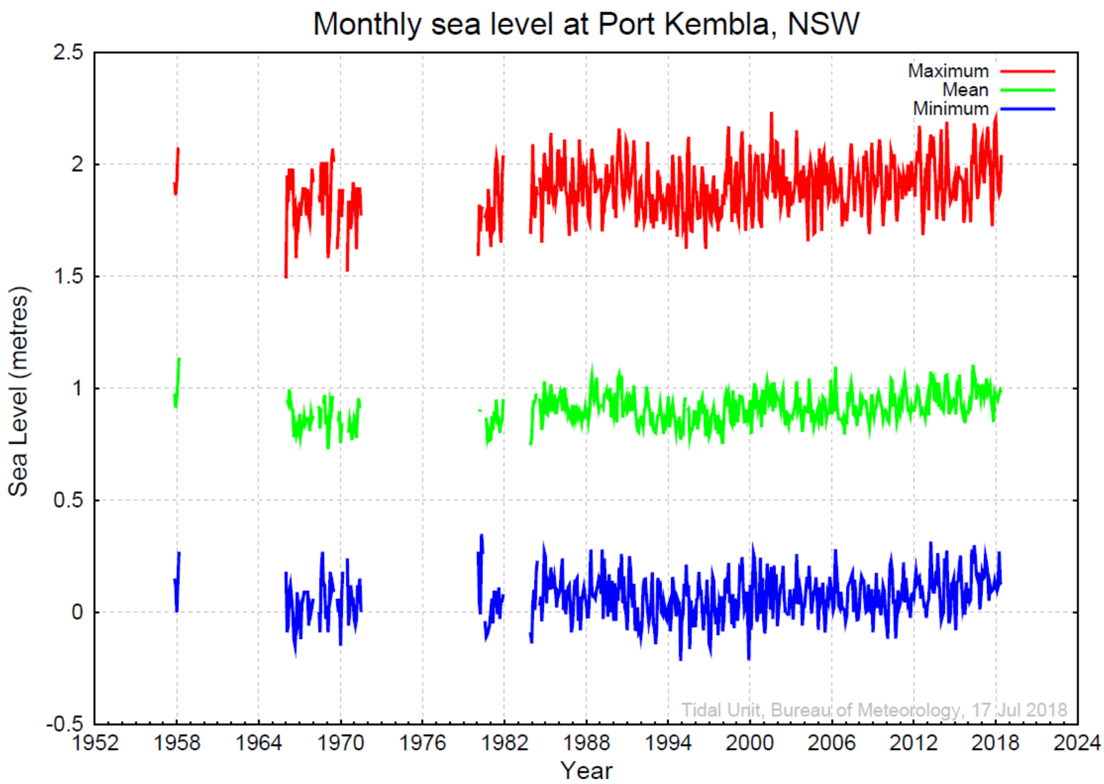


Figure 23-1 Monthly sea level at Port Kembla (BOM, July 2018)

Sea level rise will have implications for coastal erosion and inundation, and will increase the storm surge height. In addition, engineered controls in coastal areas may become less effective, increasing the vulnerability of physical assets in coastal areas. For example, storm surge which is projected to increase will be further exacerbated by rising sea levels. Astronomical tides, wind-waves and storm surges will all contribute to extreme sea level events.

23.6.2 East coast lows

Two notable examples exist when east coast lows have directly impacted carriers in NSW which serve to demonstrate the particular climate risks faced by this kind of asset:

- Bulk carrier Sygna drifted in extreme wind and swell conditions off the coast of Newcastle and grounded, causing a major pollution incident in 1974
- Bulk carrier Pasha was grounded new Newcastle, resulting in a three week salvage operation in 2007.

Significant work has been performed by the Eastern Seaboard Climate Change Initiative (ESCCI) regarding east coast lows and their potential change in the future climate. The ESCCI reclassified east coast lows from one type of event into five types of lows that may occur, three of which are applicable to Port Kembla;

- Southern secondary lows, typically arising all year, peaking in winter;
- Inland trough lows, most common in summer, spring and early autumn; and
- Continental lows, mostly occurring in May to September.

Analysis of past east coast lows indicated that between 1955 and 2012 the risk of coastal storm activities was low in the southern eastern seaboard compared to previous periods. There is significant variability in the magnitude of east coast lows and this research highlights that recent events may not be a good indicator of the scale of future events. Global climate models do not work at a scale which allows east coast lows to be captured, therefore significant work is required to improve the resolution of models to allow more accurate projections of east coast low activity in a changing climate. East coast lows are influenced by a variety of coastal climate events and as such are difficult to predict. Any future updates to this risk assessment should include consideration of new research regarding east coast lows, and risk should be assessed conservatively.

23.7 Risk assessment

This preliminary climate change risk assessment identified eleven risks which are applicable to the proposed FSRU and associated infrastructure. A summary of the climate change risks identified, including their ratings under the current baseline climate, in 2030 (under RCP 4.5) and 2050 (under RCP 8.5) is provided in Table 23-4. Additionally, adaptation options were identified and their effect on the residual risk assessed in light of these controls, which have been or may be adopted in the future.

An FSRU and associated wharf infrastructure may inherently be more resilient to the effects of climate than a fixed asset. An FSRU is a moveable, seaworthy vessel designed to operate in a wide variety of climates across the world, including particularly harsh climates which may be more extreme than Australia's under the effect of climate change for some variables. Given that FSRUs are also required and designed to travel across the sea in rough conditions, risks from storm surge and hail were assessed as low.

Typically impacts identified have consequences for the infrastructure service, causing delays or early renewal, and financial cost to the operation of the asset. In addition, some impacts were identified which may have consequences for the environment or social impact.

23.7.1 Sea level rise impacts

The most certain future climate risk to the proposed asset is posed by sea level rise which is projected with very high confidence. Sea level rise increases the chance of inundation to wharf infrastructure or stress from a comparative change in height between the FSRU and the dock for the loading arms. Sea level rise is projected to be 14 cm under RCP 4.5 and RCP 8.5 by 2030 for Wollongong LGA. The reference design for the wharf currently includes an allowance to account for this climate impact of 20 cm. This is appropriate for the maximum current intended life of the LNG facility, however in 2050 sea level is predicted to rise by 22 cm therefore any remaining or repurposed infrastructure will be at higher risk of disruption from sea level rise. The residual risk of sea level rise impacting on berthing facilities was assessed as insignificant due to the anticipated placement of critical infrastructure such as significant electrical, communication and safety infrastructure within the FSRU which, as a floating vessel, is not vulnerable to sea level rise or inundation.

23.7.2 East coast low impacts

East coast lows have been shown to previously impact bulk carriers in NSW, therefore the likelihood of the FSRU to break from the berth and run aground or cause damage was assessed as possible. The selection of the Inner Harbour for this floating LNG facility was made with consideration of extreme weather events, and this precise location means that the FSRU and berth will be somewhat protected from east coast low impacts. Therefore the residual likelihood for this impact has been assessed as unlikely, but the potential consequences include damage and disruption to infrastructure service and environmental damage.

23.7.3 Extreme wind impacts

Extreme winds are often associated with east coast low systems in the Illawarra region. Extreme winds were assessed as being the most likely residual risk to the asset, disrupting gas supply either by damage caused to the facility, or by the restricted safe movement of carriers causing delay to supply. There is high model agreement on little change in average wind speed for 2030 under RCP 4.5 for the Southern Slopes cluster, however there is little information regarding projections for extreme wind. It is unclear what implications the future climate will have for extreme wind, given the uncertainty of storm and east coast low projections. As the expected supply of LNG to the FSRU is anticipated to be on a 2-3 weekly basis, the adaptation measure identified for wind management is adaptive management of the asset, whereby managers may mitigate disruption to supply by timing delivery and scheduling of carriers appropriately. This would be the responsibility of management in conjunction with the Port Authority of NSW who are responsible for the management of shipping operations in Port Kembla, including the provision of Harbour Master functions, pilotage, navigation services and ship scheduling.

Table 23-4 Climate change risk assessment summary

Climate variable	Impact	Risk rating			Possible adaptations	Residual risk	
		Current	2030	2050		2030	2050
Extreme temperature	Extreme temperature causes FSRU to use more energy to re-gasify the LNG.	Low	Low	Low	Management response, detailed design to allow for operation within future climate scenarios.	Low	Low
	Extreme temperatures and increasing solar radiation cause localised extreme heat around FSRU which cause unworkable conditions for personnel or equipment causing disruption to service.	Low	Low	Low	No adaptation required, operating environment is anticipated to have high temperatures for FSRUs. Design of berthing facility equipment to account for potential extreme temperatures.	Low	Low
Sea level rise	Sea level rise causes a limit to the loading arms to safely connect to the gas pipeline from overextension, disrupting supply.	Low	Moderate	Moderate	Allowance of 14 cm extra height for berthing facility.	Low	Moderate
	Sea level rise inundates berthing facilities causing damage and disruption to business.	Low	Moderate	Moderate	Allowance of 14 cm extra height for berthing facility in design. Critical equipment vulnerable to sea water to be housed within FSRU.	Low	Low
Storm surge	Storm surge disrupts immediate operation and causes damage to the FSRU, interrupting supply.	Low	Low	Low	Hydrodynamic modelling undertaken to confirm that berthing is appropriate.	Low	Low
	Storm surge causes disturbance of sediment, cutting off channel allowing access to facility.	Low	Low	Low	Control of the channel and dredging is the responsibility of NSW Ports and regularly maintained.	Low	Low

Climate variable	Impact	Risk rating			Possible adaptations	Residual risk	
		Current	2030	2050		2030	2050
Sea water temperature	Sea level temperature rise allows more efficient heating of LNG from sea water.	Low	Low	Low	None identified at this stage of the project.	Low	Low
East Coast Lows	East coast lows cause extreme conditions which leads to the FSRU to break from the berth, causing environmental damage and damage to the FSRU.	Low	Moderate	Moderate	Detailed design to account for extreme weather events. Site of inner harbour selected to reduce the impact of extreme storms.	Moderate	Moderate
Hail	Hail causes damage to loading arms or berthing infrastructure.	Low	Low	Low	None identified at this stage of the project.	Low	Low
Extreme wind	Safe navigation of vessels within inner harbour limited by extreme wind conditions, causing delay and interruption to supply.	Moderate	Moderate	Moderate	Port protocols and scheduling of services to manage this risk.	Moderate	Moderate
	Extreme wind disrupt immediate operation and causes damage to the FSRU, interrupting supply.	Moderate	Moderate	Moderate	Port protocols and scheduling of services to manage this risk.	Moderate	Moderate

Further detail of the likelihood and consequence for each risk rating and the impact type used to determine consequence is provided in the full risk assessment table in Appendix Q.

23.8 Adaptation

The inevitability of climate change uncertainty impacts adaptation planning for climate risk, and it is recognised that decisions and planning processes should be flexible enough to cope with potential knowledge gaps. Accordingly, a key principle toward adapting to a future with an uncertain climate may be to adopt ‘adaptive management’, i.e. implementing incremental changes and adaptation measures based on climate and scientific monitoring and prescribed responses. Some adaptation options for infrastructure that may be deemed appropriate in response to the most extreme climate projections may require large-scale engineering or other works, the need for which will depend on the extent of climate change that actually transpires over time, as opposed to the conditions that were modelled.

Some adaptation measures have been planned for design as identified in Table 23-4 and will serve to make the LNG facility less vulnerable to the effects of climate change. The allowance of 20 cm for sea level rise is a key adaptation planned for design, which mitigates the effects of sea level rise for 2030. This is in accordance with the recommended allowance height suggested by the National Climate Change Adaptation Research Facility through the CoastAdapt projections for Wollongong Local Government Area.

Some of the potential adaptation responses identified in this risk assessment are management responses which would need to be implemented by the asset manager in conjunction with staff and wider stakeholders such as NSW Ports. Additional adaptation responses should be considered during detailed design and at future intervals of the project to ensure that climate risks are appropriately mitigated. Per AS 5334, continuous feedback loops of monitoring and review are required, as well as communication and consultation with relevant stakeholders, to continue to effectively manage risks.

Where risks are deemed to be a tolerable level, adaptation is not required, however this must be reassessed over the life of the proposed asset, particularly if climate projections are updated by CSIRO. Any future adaptation assessment should take into account factors such as the effectiveness, cost, duration and feasibility of the adaptation option, in addition to the impacts to greenhouse gas emissions, the social and environmental context and any implications for related risk profiles as a result of implementing the adaptation.

24. Cumulative impacts

24.1 Overview

This chapter describes the potential cumulative impacts of the project and other existing or proposed major projects. The cumulative impact assessment draws on the findings of other specialist assessments of the project contained throughout the EIS and publicly available assessment documentation on other existing or proposed major projects in the region.

The cumulative impact assessment has found that there is limited potential for cumulative impacts to occur. Based on the potential impacts of the project and the other existing or proposed major projects that were identified, the main areas where potential cumulative impacts could occur were considered to be hazard and risk, water resources, traffic and access, noise and vibration, air quality and visual impacts. The potential for cumulative impacts in each of these areas was considered limited, drawing on specialist assessments of the project and the other identified projects where relevant.

24.2 Methodology

The cumulative impact assessment involved the following tasks:

- definition of the region surrounding the project
- identification of existing or proposed projects
- identification of potential cumulative impacts
- assessment of significance of potential cumulative impacts
- identification of further management measures if necessary

The region surrounding the project for the purpose of cumulative impact assessment was defined as the Wollongong local government area. Existing or proposed projects in the region were identified through a search of the Department of Planning and Environment major project assessment database in the Wollongong local government area for projects with the status of State significant development or State significant infrastructure. Other existing industrial facilities known to be surrounding the project were also considered as part of the assessment.

Potential cumulative impacts were identified by considering the scale of identified projects and their distance from the project, as well as reviewing publicly available assessment documentation where necessary, and assessing whether or not there was potential for those potential impacts and the potential impacts of the project to occur at the same time and in the same area.

The significance of the potential cumulative impacts was considered and further mitigation measures were identified if considered necessary in addition to those already proposed.

24.3 Existing environment

The existing environment of the project is generally defined by a range of existing port and industrial uses in and around Port Kembla. Existing users of the berths at Port Kembla include Port Kembla Coal Terminal at Berth 101 and 102, general cargo facilities and Quattro Port grain facility at Inner Harbour Berths 103, 105, 106 and 107, GrainCorp grain terminal at Berth 104, and bulk liquids facilities operated by NSW Ports at Outer Harbour Berths 201 and 206.

In addition to operations at import and export berths, there are multiple other business, cargo, logistics, bulk goods and heavy industrial facilities in and around Port Kembla including Ceva Logistics, AutoNexus, PrixCar, Patrick Autocare, Linx, Qube Stevedores, BlueScope, Port Kembla Gateway, Svitzer, Cement Australia, NSW Ports Maritime Centre and Pacific National.

These existing facilities and their impacts on the surrounding environment have generally been captured in the analysis of the existing environment in the specialist assessments of the project contained throughout the EIS but are also considered further in Section 24.4 as appropriate.

In addition to the known existing and established facilities in and around Port Kembla, additional proposed major projects identified in the region have been identified, including the QT Holdings Port Kembla Bulk Liquids Terminal. The additional proposed major projects are outlined in Table 24-1 and Figure 24-1 and described in further detail in the following sections.

Table 24-1 Proposed major projects

Project	Type	Status	Distance
Port Kembla Outer Harbour Development	Reclamation and development of the Outer Harbour	Approved	0 km
Kembla Grange Waste Recovery Facility	Resource recovery of construction and demolition waste	Approved	8 km
Port Kembla Bulk Liquids Terminal	Fuel and ethanol import terminal	Approved	0.8 km
Bulli Hospital Aged Care Centre of Excellence	Aged care facility	Approved	13.5 km
University of Wollongong	Molecular and life sciences building	Approved	6 km
University of Wollongong	Arts and social sciences building	Approved	6 km
Port Kembla Resource Recovery Facility	Resource recovery of construction and demolition waste	SEARs Issued	2.2 km
Dendrobium Mine Extension Project	Coal mine	SEARs Issued	9 km
Hydromet Unanderra	Liquid waste treatment facility	SEARs Issued	4 km
Princes Highway Albion Park Rail Bypass	Road bypass	Approved	12 km
Port Kembla Biodiesel Facility	Soybean processing and biodiesel facility	Approved	0.8 km

24.3.1 Port Kembla Outer Harbour Development

The Port Kembla Outer Harbour Development received concurrent concept and project approval under Part 3A of the EP&A Act in March 2011. The development of the Outer Harbour was proposed to occur in stages over a relatively long period of time as described in Chapter 2.

The majority of dredged sediments and excavated material required for the establishment of a new berthing pocket at Berth 101 is proposed to be disposed within a 17 hectare disposal area within the Outer Harbour as part of the reclamation activities proposed as part of the development.

The disposal area has been developed through discussion with NSW Ports to accommodate the latest plans for redevelopment of the Outer Harbour. The disposal footprint falls predominantly within the approved development area for Stage 1 of the Outer Harbour Development Project, with a small portion of the disposal area extending beyond the approved footprint near the southern shoreline of the Outer Harbour.

24.3.2 Kembla Grange Waste Recovery Facility

Kembla Grange is an existing waste recovery facility about 8 kilometres west of the project. In 2016, approval was sought to expand the facility to provide for processing of up to 230,000 tonnes per annum of building and demolition waste. The expansion was scheduled to be constructed and commissioned by 2016.

24.3.3 Port Kembla Bulk Liquids Terminal

Port Kembla Bulk Liquids Terminal is a proposed fuel and ethanol import terminal at Berth 104 in the Inner Harbour of Port Kembla, about 0.8 kilometres to the north of the project berth and wharf facilities. The project was approved in September 2016 and was expected to be operational by 2018, however construction and operation have not yet commenced.

24.3.4 Bulli Hospital Aged Care Centre of Excellence

Bulli Hospital Aged Care Centre of Excellence is a proposed extension to Bulli Hospital about 13.5 kilometres north of the project. The extension involves construction of an aged care facility, ancillary facilities and associated car park. The project was approved in September 2017 and at the time of writing was under construction scheduled for completion in 2019.

24.3.5 University of Wollongong molecular and life sciences building

The University of Wollongong molecular and life sciences building is a proposed extension to the University of Wollongong about 6 kilometres north of the project. The extension involves the construction of a new five-storey building in the east precinct of the existing campus. The project was approved in December 2017 with construction commencing in July 2018 and scheduled for completion in 2019.

24.3.6 University of Wollongong arts and social sciences building

The University of Wollongong arts and social sciences building is a proposed extension to the University of Wollongong about 6 kilometres north of the project. The extension involves the construction of a new four-storey building in the west precinct of the existing campus. The extension was approved in December 2017. Construction of the extension has not yet started.

24.3.7 Port Kembla Resource Recovery Facility

Port Kembla Resource Recovery Facility is a proposed facility about 2.2 kilometres south of the project. The facility would involve processing including crushing, screening and separation of up to 400,000 tonnes of construction and demolition waste per annum. Environmental assessment requirements for the project were requested and provided in 2014, however the environmental impact assessment has not been published and the proposed facility has not been approved. The environmental assessment requirements are expected to have lapsed requiring reapplication.

24.3.8 Dendrobium Mine Extension Project

The Dendrobium Mine Extension Project is a proposed extension to the existing underground coal mine leased across a large area around Cordeaux. The mine pit top is about 9 kilometres west of the project. Environment assessment requirements were provided in February 2017, however the environmental impact assessment has not been produced. It is understood that continued long wall mining at the Dendrobium Coal Mine is already approved to be undertaken.

24.3.9 Hydromet Unanderra

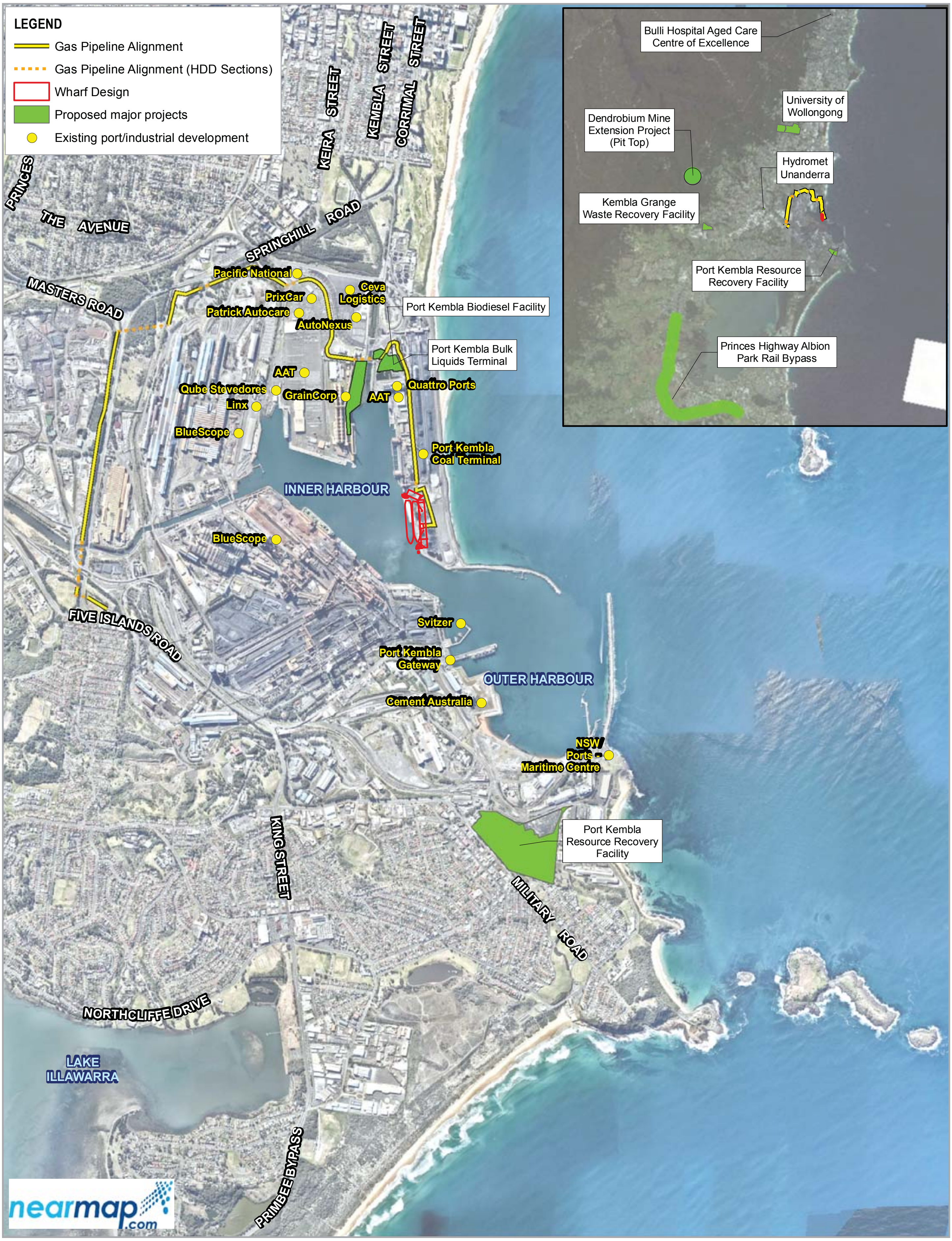
Hydromet Unanderra is a proposed extension to an existing waste treatment facility about 4 kilometres west of the project. The extension would process in the order of 6,500 tonnes of inorganic liquid waste per annum. Environmental assessment requirements for the project were provided in May 2018. It is expected that the environmental assessment for the facility is underway.

24.3.10 Princes Highway Albion Park Rail Bypass

Princes Highway Albion Park Rail Bypass is a proposed 10 kilometre extension of the M1 Princes Motorway between Yallah and Oaks Flats to bypass the Albion Park Rail, about 12 kilometres south west of the project. The extension was approved in January 2018. Construction is expected to start in early 2019.

24.3.11 Port Kembla Biodiesel Facility

The Port Kembla Biodiesel Facility is a proposed soybean processing and biodiesel facility about 0.8 kilometres north of the project in the same area as the proposed Port Kembla Bulk Liquids terminal. The most recent modification application to the project was made in 2015 and extended the approval lapse date to May 2016. It is understood that the facility has not been constructed and therefore it is considered that the approval for the facility has lapsed.



Paper Size ISO A4

0 1 2

Kilometers

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

GHD

Australian Industrial Energy
Port Kembla Gas Terminal

Project No.	21-27477
Revision No.	A
Date	30 Oct 2018

Existing or proposed major projects

Figure 24-1

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Data source: Aerial imagery - nearmap 2018 (image date 16/04/2018, date extracted 01/08/2018); General topo - NSW LPI DTDB 2017, 2015 & 2015; Berth footprint - Australian Industrial Energy. Created by: afoddy

24.4 Potential impacts

24.4.1 Overview

The sections below detail the potential cumulative impacts of the project and other existing or proposed major projects described in Section 24.3. Based on the potential impacts of the project and the other existing or proposed major projects that were identified, the main areas where potential cumulative impacts could occur were considered to be hazard and risk, water resources, traffic and access, noise and vibration, air quality and visual.

24.4.2 Hazard and risk

The potential for cumulative hazards and risks was assessed in accordance with propagation risk criteria under *Hazardous Industry Planning Advisory Paper No 4, Risk Criteria for Land Use Safety Planning*. The propagation risk criteria define the extent to which a hazardous event at one facility could trigger another hazardous event at an adjoining facility.

The potential for these cumulative impacts, or propagation risk, was assessed in detail in the preliminary hazard analysis in Appendix D, which was also summarised in Chapter 10.

The assessment found that the propagation risk from potential hazard events caused by the project, including the LNG carriers, FSRU, berth and wharf facilities, and gas pipeline, would not extend to adjacent industrial facilities including the proposed Port Kembla Bulk Liquids Terminal.

Further, a review of the available hazard assessments undertaken for adjacent industrial facilities including the proposed Port Kembla Bulk Liquids Terminal found that the propagation risk from potential hazard events from those facilities would similarly not extend to the project.

Accordingly, the potential for cumulative impacts between the two facilities was assessed to be very low, being less than 50 chances in 1 million as defined in the propagation risk criteria.

24.4.3 Water resources

The potential impacts of the project on water resources were assessed in detail in Appendix F and in Chapter 12. The assessment found that water quality within the Inner Harbour and Outer Harbour of Port Kembla has been historically affected by urban and industrial discharges as well as port activities, including contamination of groundwater and harbour waters.

Potential impacts during construction are primarily associated with water quality impacts generated during the removal, handling and placement of dredged sediments. In particular, dredging and reclamation activities may generate turbid plumes, mobilise contaminants and increase rates of sedimentation.

Port Kembla Harbour has been subject to several capital dredging campaigns, which have been undertaken to facilitate the development of shipping berths. Maintenance dredging activities are undertaken less frequently, with management of declared depths primarily managed through annual sweep dredging (i.e. bed levelling using a sweep bar). These operations result in repeated mobilisation of sediments from within the channel and berth areas. Potential impacts during dredging activities will be managed in accordance with established practices at the port and potential impacts will be commensurate with previous dredging campaigns.

The regasification process of the FSRU relies on the use of seawater extracted from the Inner Harbour to heat the gas. The seawater used in the regasification process will then be released back into the Inner Harbour at cooler temperatures than the ambient sea water temperature within the harbour. Modelling indicates that the release of cold water from the FSRU will only have minor impacts on seawater temperatures. These impacts are expected to be confined to within the port limits and will offset the warm industrial releases currently discharged from Allans Creek.

Of the additional major projects identified in the region of the project it was considered that Port Kembla Bulk Liquids Terminal and/or Port Kembla Biodiesel Facility would have the potential to have cumulative impacts on water resources. The remaining facilities were considered too remote from the project to have potential impacts on the same water resources. Assuming either facility is constructed and operational at the same time as the project, neither would involve significant releases to the Inner Harbour meaning cumulative impacts would be negligible.

24.4.4 Traffic and access

The potential impacts of the project on traffic and access were assessed in detail in Appendix K and in Chapter 16. The assessment found that peak hour traffic volumes during construction would remain within the capacity of the existing road network based on their functional classification. It found that traffic volumes during operation would be significantly lower than during construction and accordingly would have a negligible impact on traffic and access.

The assessment was informed by background traffic counts that were considered to represent background traffic generated by other existing port and industrial development. Accordingly, the assessment accounted for potential cumulative impacts with these existing developments.

Of the additional proposed major projects identified in the region, it was considered that Port Kembla Bulk Liquids Terminal, Port Kembla Resource Recovery Facility and/or Port Kembla Biodiesel Facility had the potential to generate traffic that could have cumulative impacts when assessed in combination with the project, especially during construction.

For cumulative traffic impacts to occur, the construction of those additional projects would need to occur during the same time as construction of the project. This was considered possible for Port Kembla Bulk Liquids Terminal given the project was relatively recently approved, but was considered to be unlikely for Port Kembla Resource Recovery Facility and Port Kembla Biodiesel Facility as the approval for these projects had not been granted or was assumed to have lapsed.

A review of the traffic assessment in the Port Kembla Bulk Liquids Terminal environmental impact assessment similarly indicated that construction would have potential to utilise some of the same roads as construction of the project, including Tom Thumb Road, Springhill Road, Masters Road, Princes Motorway and Five Islands Road. An analysis of the traffic modelling undertaken indicated the peak hour traffic generation during construction for these projects is not planned to occur at coinciding times and that the combination of traffic from both projects is not expected to have a significant impact on the surrounding road network. As such, even if construction periods overlap, it is not expected that significant cumulative impacts on traffic and access would occur. Measures are nonetheless proposed in Section 24.5 to ensure these potential impacts are monitored and managed during construction planning.

The construction of the Princes Highway Albion Park Rail Bypass would also have the potential to generate traffic that could have cumulative impacts when assessed in combination with the construction of the project, particularly along the M1 Princes Motorway. As discussed in the traffic and transport assessment the M1 Princes Motorway currently carries around 66,000 vehicles per day and is not expected to be significantly affected by the project. Accordingly, the potential for significant cumulative impacts is considered low.

It was considered that some other proposed projects could have potential to generate traffic however the potential for cumulative impacts was considered negligible due to their distance from the project and relatively low expected traffic generation. These included the Bulli Hospital Aged Care Centre of Excellence, University of Wollongong molecular and life sciences building and the University of Wollongong arts and social sciences building.

Traffic generation during operation of the project will not generate significant traffic movements with potential to cumulatively impact upon the road network.

24.4.5 Noise and vibration

The potential noise and vibration impacts of the project were assessed in detail in Appendix L and in Chapter 17. The assessment showed that there was potential for some minor noise impacts during construction activities that were typical of projects of that scale and would be readily managed through the implementation of standard noise mitigation measures. Vibration impacts were not predicted due to the distances to nearest residences and structures.

The assessment was informed by background noise monitoring that would include background noise from existing port and industrial development in the region. Accordingly, the assessment took into account the potential cumulative impacts of these existing developments and the project.

Of the additional proposed major projects identified in the region, it was considered that Port Kembla Bulk Liquids Terminal, Port Kembla Resource Recovery Facility and/or Port Kembla Biodiesel Facility had the potential to generate noise and vibration during construction that could have cumulative impacts when assessed in combination with the project. The remaining proposed major projects were too remote from the project to generate cumulative impacts.

For cumulative noise impacts to occur, the construction of those additional projects would need to occur during the same time as construction of the project. This was considered possible for Port Kembla Bulk Liquids Terminal given the project was relatively recently approved, but was considered to be unlikely for Port Kembla Resource Recovery Facility and Port Kembla Biodiesel Facility as the approval for these projects had not been granted or was assumed to have lapsed.

Construction noise from Port Kembla Bulk Liquids Terminal, in the event it occurred at the same time as construction of the project, would not be expected to result in a significant increase in noise exceedances at sensitive receivers.

The assessment found that the operation of the project would not lead to any exceedances of noise criteria at sensitive receivers during day or night periods. Accordingly, the project would not be expected to significantly contribute to cumulative noise impacts during operation.

24.4.6 Air quality

The potential air quality impacts of the project were assessed in detail in Appendix M and in Chapter 18. The assessment showed that the construction and operation of the project would not result in an exceedance of the air quality criteria at any of the identified sensitive receiver locations for relevant pollutants including particulate matter, nitrogen dioxide, carbon monoxide sulfur dioxide, benzene, formaldehyde and polycyclic aromatic hydrocarbons.

The assessment was informed by background air quality data considered representative of background emissions from existing port and industrial development in the region. Accordingly, the assessment took into account the potential cumulative impacts of these existing developments and the project. Of the proposed major projects identified in the region, it was considered that Port Kembla Bulk Liquids Terminal, Port Kembla Resource Recovery Facility and/or Port Kembla Biodiesel Facility had potential to generate emissions to air that could have cumulative impacts, when assessed in combination with the project. The remaining proposed major projects were considered too remote from the project and/or were not likely to generate sufficient additional emissions to air to generate cumulative impacts when assessed in combination with the project.

For cumulative impacts to occur during construction, construction of other projects would need to occur during the same period as construction of the project. This was considered possible for Port Kembla Bulk Liquids Terminal given the project was relatively recently approved, but was considered to be unlikely for Port Kembla Resource Recovery Facility and Port Kembla Biodiesel Facility as the approval for these projects had not been granted or was assumed to have lapsed.

The main area of potential exceedances of air quality criteria from construction of the project were residential receivers near the southern end of the gas pipeline around Cringila. None of the identified proposed major projects were in the vicinity of this part of the pipeline. Accordingly, the potential for cumulative impacts during construction was considered negligible.

The modelled concentrations of pollutants during operation of the project were all significantly below the relevant air quality criteria at all identified sensitive receivers. A review of the air quality assessment in the Port Kembla Bulk Liquids Terminal environmental impact assessment similarly indicated that modelled concentrations of pollutants would also be well below the criteria. Potential for cumulative impacts resulting in an exceedance of the criteria would accordingly be low.

24.4.7 Visual

The potential visual impacts of the project were assessed in detail in Appendix O and in Chapter 19. The project would also have limited impacts on landscape and visual amenity and would be consistent with the existing character of Port Kembla and surrounding industrial development, as would the additional proposed major projects in the vicinity such as the bulk liquids terminal.

24.5 Management measures

Table 22-3 outlines the management measures that are proposed to address the cumulative impacts of the project. All management measures would be collated in management plans prepared for construction and operation of the project.

Table 24-2 Management measures for cumulative impacts

ID	Issue	Measure	Timing
C1	Cumulative construction traffic impacts	Proponents of other projects identified in the region that could generate substantial additional traffic in the same areas of the road network at the same time as the project would be consulted during traffic management planning to minimise overlap and interaction of planned vehicle movements.	Preconstruction Construction

25. Environmental management

25.1 Overview

This chapter provides an overview of the environmental management plans that would be developed and implemented to avoid, mitigate and manage the potential environment impacts.

The plans to be developed and implemented would include a Construction Environmental Management Plan (CEMP) and Operation Environmental Management Plan (OEMP). Both plans may be organised by a number of issue- or activity-specific sub-plans where necessary.

The CEMP and OEMP would be living documents and would be reviewed and amended as necessary over the life of the project.

In addition to the OEMP a detailed safety case would be prepared under the *Work Health and Safety Act 2011*. The safety case would be developed in consultation with SafeWork NSW and would form the basis of ongoing safety management over the life of the project.

25.2 Requirements

The CEMP and OEMP would be developed in accordance with the commitments made in this EIS, the conditions of approval under the EP&A Act and any other statutory or licensing requirements that apply to the project at the time.

In addition to these requirements, the CEMP and OEMP would be developed to be consistent with any other overarching plans, policies or standards in place at the time, such as:

- ISO 14001 Environmental Management Systems
- NSW Guideline for the Preparation of EMPs
- NSW Ports Port Kembla Development Code
- NSW Ports Environmental Management Plan
- NSW Ports Sustainability Plan 2015

The CEMP and OEMP would also make reference to the relevant industry standard guidelines for specific issues and activities. For example, erosion and sedimentation would be managed in accordance with Managing Urban Stormwater Volume 1 (the Blue Book).

25.3 Structure

The CEMP and OEMP would follow a similar basic structure, which include:

- Background
- Environmental management
- Implementation
- Monitor and review

The background would include an overview of the project and the activities relevant to the project stage being construction or operation. It would provide the context for the plan, making reference to the relevant legislation, approvals, policies and so forth that frame the plan.

The environmental management section would describe the relevant corporate structure and the responsibilities of those personnel in implementing the plan as well as emergency contacts. It would specify requirements for any addition approvals, reporting and training for personnel.

The implementation section would include a risk assessment that would convey the main environmental risks associated with the project and the activities relevant to the project stage. It would specify the environmental management activities and controls that are required to be implemented including those in the EIS and required under the conditions of approval.

The implementation section would also include environmental schedules, such as checklists or report templates, as well as relevant mapping to assist in the implementation of the plan.

The monitor and review section would include requirements for environmental monitoring and auditing, corrective actions to be taken in the event of a noncompliance, and mechanisms to ensure the plans are reviewed and amended where necessary over the life of the project.

25.4 Sub-plans

The CEMP and OEMP may include a number of sub-plans targeted at specific issues or activities so specific management requirements can be communicated effectively.

Key sub-plans during construction may include sub-plans for erosion and sediment controls, acid sulphate soils, dredge management, traffic management, noise and vibration and waste management, as required.

Key sub-plans during operation may include sub-plans for port navigation and waste.

25.5 Decommission

In addition to the CEMP and OEMP, a plan would be required at the end of the project life to mitigate and manage the potential environmental impacts of decommissioning.

The activities involved in decommissioning would depend on the intended use of the land occupied by the project. It is expected the berth and wharf facilities would be retained for other port related uses. The gas pipeline and associated facilities would likely remain in situ subject to landholder agreements and either decommissioned completely or placed into care and maintenance arrangements (typically it is left in situ and filled with an inert gas such as Nitrogen). The FSRU is an ocean going vessel, which can simply sail away from port for other uses.

A detailed decommission plan for the entire project, including the pipeline, would be developed in consultation with relevant stakeholders including NSW Ports at the end of the project life.

25.6 Management measures

The management measures proposed throughout this EIS are listed in Table 25-1.

Table 25-1 Management measures

ID	Issue	Measure	Timing
PN1	Port navigation	Design measures as a result of the navigational simulations include: • The berth pocket has been moved north and rotated to align parallel with Berth 102. • The stern of the LNG carrier will be moved to a 40 metre offset from the turning basin. • The navigational lead light located at the north-western side of The Cut, south of Berth 101, will require relocation and/or raised to a new height to increase the visibility and avoid collision (Advisian, 2018). The final position to be confirmed with further consultation with the Port Authority of NSW.	Design
PN2	Port navigation	The movement of barges will be coordinated by the Port Authority VTIC. Adherence with existing Port Kembla navigational protocols through close liaison and compliance to directions of the Harbour Master (refer to Section 9.2.4).	Construction
PN3	Port navigation	Development of a construction marine traffic management plan for submission to the Harbour Master.	Construction
PN4	Port navigation	Barge operation will be controlled through a permit system under the control of the Harbour Master (through the VTIC) and Masters will be required to obtain Certificates of Local Knowledge as required by the Harbour Master and NSW Marine Safety Regulation 2016.	Construction
PN5	Port navigation	Permission of the Harbour Master will be sought for split hopper barges to be used at night. Construction will be coordinated so as to not impact other vessels and port navigation, with due regard to the port instructions and port protocols (Port Authority of NSW, 2015) (outlined in Section 9.2.4).	Construction
PN6	Port navigation	Monitoring of the depth of deposited dredged material from the seabed in the disposal area to ensure that the barges transferring dredged material are not at risk of grounding.	Construction
PN7	Port navigation	Adherence with the existing port instructions and port protocols (Port Authority of NSW, 2015) (refer to Section 9.2.4).	Operation

ID	Issue	Measure	Timing
PN8	Port navigation	The existing port wind limitation of 20 to 25 knots for the car carriers is not suitable for the LNG carriers. Reduced wind conditions of 15 to 20 knots will be implemented and will be reviewed by the Harbour Master as operations commence.	Operation
PN9	Port navigation	The use of three existing Port Kembla tugs and one additional tug of at least 75 tonne bollard pull and adequate sea-keeping ability. The additional tug will act as an escort tug. Pending the results of the passing vessel study, other vessel traffic may experience a reduction in speed when passing Berth 101, where additional tugs may be required to maintain vessel manoeuvrability	Operation
PN10	Port navigation	Two Pilots will be required for arrival and departure of the LNG carrier until the pilots are familiarised with the LNG carrier manoeuvring or as directed by the Harbour Master.	Operation
PN11	Port navigation	The Inner Harbour turning circle to be modified and appropriate monitoring contingencies will be implemented.	Operation
PN12	Port navigation	Ship-handling protocols will be developed by the Harbour Master to ensure adequate management measures are implemented for passing vessels which may cause interaction with vessels berthed at Berth 101 (LNG carrier's and FSRU) pending the results of a vessel passing study.	Operation
PN13	Port navigation	Modifications to the operating practices when turning other vessels in the Inner Harbour to maintain safe clearances will be determined by the Harbour Master and may include: • Extra Pilot training for the 40 metre offset from the turning basin. • Extra aids to navigation for Pilots including upgraded portable Pilot Unit computers using DGPS (navigational software) with the turning circle added • Extra monitoring by the VTIC. • Potential modification of port parameters for vessels using the turning basin in higher wind conditions, which may also involve extra tugs or reduced wind conditions, by the Harbour Master.	Operation
PN14	Port navigation	The risk of grounding will be analysed and mitigated by the Port Authority in upgrades to Port Parameters and Business Continuity Management Plans.	Operation

ID	Issue	Measure	Timing
PN15	Port navigation	As noted in the design measures above, the navigational lead light located at the north-western side of The Cut, south of Berth 101, will require relocation and/or raised to a new height to increase the visibility and avoid collision (Advisian, 2018). The final position to be confirmed with further consultation with the Port Authority of NSW.	Operation
H1	Safety	Hazard identification and design assurance process safety activities such as HAZID, HAZOP and LOPA shall continue in the detailed design phase to ensure that the health and safety risk is reduced to As Low As Reasonably Practicable (ALARP). Major Accident Hazard events and the associated safeguards will be further defined to allow the development of performance standards for safety critical systems and elements	Design
H2	Safety	A comprehensive safety management system would be developed in line with local standards and industry best practice for facilities handling LNG. The safety management system would address hazards to people and the environment in and around the project. The management system will define how the facility manages all aspects of personnel and process safety from the identification of hazards to the maintenance and testing of safety critical barriers, which either prevent or mitigate releases of LNG, and the emergency response to events from within or external to the project. The safety management system will interface with a computerised maintenance management system to manage facility maintenance of both safety critical and non-safety critical equipment.	Pre-operation
H3	Fire safety	The project would include safety systems including fire detection and firefighting systems in line with *AS 3846-2005 The handling and transport of dangerous cargoes in port areas*. A range of firefighting and protection systems will be installed on board the FSRU including gas detection, emergency shutdown and isolation, and firewater and suppression systems. The wharf area will also host gas detection and firefighting systems.	Pre-operation
C01	Contamination at Berth 101	One or more of the following is proposed for assessing the potential risk to human health the two BaP (TEQ) hotspots identified at GHB09 and GBH26: • Development of a human health risk assessment for BaP (TEQ), to further refine the potential risk posed by these contaminants to future construction workers. Given the short duration of the works relative to the standard exposure assumptions in a	Pre-construction

ID	Issue	Measure	Timing
		commercial/industrial scenario, it is likely that derived site specific target levels for BaP (TEQ) would be higher than adopted for this assessment. • Additional investigation to delineate the vertical and lateral extent of BaP (TEQ). The investigation would involve step out borehole locations which will target materials at depths between 4 m and 5 m, to assess if the contamination is isolated or widespread. • The source of BaP (TEQ) at GHB09 and GBH26 was not identified nor was there apparent evidence of this contamination present at the time of sampling. The contamination may be a characteristic of the fill material, meaning it could be randomly distributed throughout the fill matrix. Therefore, in addition to further investigation, bioavailability testing is also recommended so that the risk to human health is better understood and appropriate safety control measures can be adopted during construction. The laboratory is presently maintaining these samples pending further analysis.	
C02	Contamination at Berth 101	Removal of any remnant ACM fragments from the ground surface. The removal should be undertaken by a licenced removalist in accordance with relevant SafeWork NSW codes of practice. Following removal, a licenced asbestos assessor should inspect the site and provide a clearance certificate confirming removal of asbestos.	Construction
C03	Contamination at Berth 101	Inclusion of an unexpected finds protocol for contamination in the Construction Environmental Management Plan (CEMP) for the work associated with construction activities.	Construction
C04	Berth 101; Proposed pipeline alignment; Dredging area and disposal area	Preparation of an ASSMP by a consultant experienced in the identification and management of ASS. This will also include appropriate management and/or treatment of ASS. The ASSMP will be developed in line with the requirements of the Acid Sulphate Soils Management Advisory Committee Guidelines (ASSMAC, August 1998 and as updated). The ASSMP will be prepared to identify, manage and treat the ASS encountered during excavation and dredging to minimise the production of acid leachate.	Construction
C05	Proposed pipeline alignment	Preparation and implementation of a construction environmental management plan (CEMP) to include an unexpected finds protocol (UFP) to effectively manage the potential contamination issues identified from both a human health and environmental perspective. This would include	Construction

ID	Issue	Measure	Timing
		the assessment of materials to be disturbed across the site to inform appropriate management strategies	
C06	Proposed pipeline alignment	Assessment and classification of all material to be disposed of offsite as per NSW EPA (2014) Waste Classification Guidelines, Part 1: Classifying Waste and Part 4: Acid Sulfate Soils prior to off-site disposal.	Pre-construction
C07	Proposed pipeline alignment	If the proposed pipeline alignment is likely to intersect groundwater, assessment of groundwater quality in those sections should also be carried out to inform construction management of potential contamination issues.	Construction
C08	Dredging area and disposal area in the Outer Harbour	A dredge management plan will be prepared prior to the dredging of Berth 101, outlining the contamination management measures, including: • surface water monitoring, which will be implemented during the course of the works to minimise potential impacts to the receiving waters • use of a turbidity curtain to restrict the generation of turbidity plumes and localise any water quality issues	Construction
W1	Water quality and hydrodynamics	The location of the proposed terminal berth has been refined through navigation simulations to be located as close possible to the existing turning basin. This approach minimises hydrodynamic impacts and reduces dredging and disposal volumes as far as possible.	Design
W2	Flooding	The proposed pipeline between the terminal and the existing east coast gas transmission network at Cringila has been designed such that the pipeline will be below existing ground levels.	Design
W3	Hydrology	The western extent of the reclamation footprint has been limited to ensure Salty Creek remains open to the Outer Harbour without the need for enclosed culverts, thereby minimising the impacts to fish passage.	Design
W4	Water quality and hydrodynamics	The footprint of the Outer Harbour placement area has been minimised by raising the proposed fill height to include emergent reclamation. This approach minimises the quantity of material to be bottom dumped and thereby reduces the potential for generation of turbid plumes and mobilisation of sediments.	Design

ID	Issue	Measure	Timing
W5	Water Quality	Preparation of a Construction Environmental Management Plan (CEMP) including specific dredge management plan to provide a framework for the environmental management of construction activities to minimise the environmental risks to a level that is as low as practically possible for this project.	Construction
W6	Water Quality	• Design and implementation of a Water Quality Monitoring Program to ensure construction works do not cause exceedance of the marine water quality criterion of background plus 50 mg/L of suspended sediment, in accordance with recent Environmental Protection Licences (EPL) for similar activities within Port Kembla such as the Berth 103 Stage 2 Dredging & Spoil Disposal EPL20563). • Continuous turbidity monitoring would be undertaken using a series of monitoring buoys to provide impact and background data (turbidity (NTU), pH, temperature). Prior to commencement of the dredging works, buoys would be deployed for an agreed period of time to confirm background conditions in the vicinity of the monitoring points. Data would be logged and transmitted to an onshore recording station where it would be processed to allow automated comparison of median turbidity levels to a series of green, amber and red trigger levels. When exceeded, an alarm would be triggered, automated email and SMS alerts sent and agreed the procedures implemented. Such procedures may include hand held monitoring to verify readings, reduction in the rate of dredging, relocation of dredging activities or cessation of turbidity generating works until turbidity readings reach acceptable levels. • Daily visual observations would be undertaken during dredging operations to monitor the potential release of oil or grease. • Collection of water samples and laboratory analysis for an agreed set of contaminants would be undertaken on a weekly basis during dredging operations. The WQMP would include regular reporting, evaluation and revision where required to ensure the project objectives and approval conditions are achieved.	Construction

ID	Issue	Measure	Timing
W7	Water Quality	• Silt curtains would be installed prior to commencement of the works in order to minimise the spread of any sediments entrained within the water column during dredging and disposal operations. Silt curtains are available in a range of designs and would be provided by the successful Contractor. It is envisaged that the silt curtain would comprise a geocomposite material consisting of a non-woven geotextile sewn to a woven geotextile, which would provide the required filtering capacity and rigidity respectively. Vessel access would be via gated or overlapped curtains or through installation of a bubble curtain. The top of the curtain would be supported by a floating boom, whilst the lower portion of the curtain would be weighted with appropriate ballasting (eg. bars or chains) to ensure that the full length if the curtain is maintained at all times. The curtain would be anchored or fixed to existing structures as necessary.	Construction
W8	Water Quality	Subaqueous sediment removal would be undertaken using a backhoe dredge. The use of mechanical dredging (rather than hydraulic dredging) ensures that sediments are removed, transported and placed as close to their insitu density as possible. Thereby minimising the suspension and mobilisation of sediments at the dredge and disposal sites. Method statements would be prepared by the contractor to ensure that loading of dredged materials into the hopper barges is undertaken in a manner that reduces spillage and avoids overfilling barges.	Construction
W9	Water Quality	A perimeter bund would be constructed within the Outer Harbour placement area to ensure long term stability of dredged materials and to minimise sediment migration during placement.	Construction
W10	Water Quality	A site specific erosion and sediment control plan (ESCP) will be prepared as part of the CEMP to provide control of all land based excavation and stockpiling requirements. All erosion and sediment control measures shall be designed, implemented and maintained in accordance with 'Managing Urban Stormwater: Soil and Construction Volume 1' (Landcom 2004) ('the Blue Book).	Construction
W11	Water quality, chemical and fuel impacts on flora and fauna	A site specific emergency spill plan will be developed, and will include spill management measures in accordance relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Roads and Maritime and EPA officers)	Construction

ID	Issue	Measure	Timing
W12	Water quality, chemical and fuel impacts on flora and fauna	An emergency spill kit will be kept on site at all times. All staff will be made aware of the location of the spill kit and trained in its use.	Construction
W13	Water quality, chemical and fuel impacts on flora and fauna	Machinery will be checked daily to ensure there is no oil, fuel or other liquids leaking from the machinery. All staff will be appropriately trained through toolbox talks for the minimisation and management of accidental spills.	Construction
W14	Water Quality	Prior to re-releasing the seawater back into the surrounding area, the operators of the vessel will aim to match the profile of the discharged water, as close as possible, to the pre-discharge profile and well below agreed thresholds for residual concentrations of sodium hypochlorite. Changing the profile of the discharge water will be done by modifying the frequency of production and the concentration of sodium hypochlorite produced on-board from the intake of sea water.	Operations
W15	Water Quality	A stormwater management system would be designed and constructed to control discharges from the import terminal site, including traps and filters where required. Design would be undertaken in accordance with emergency spill plans and the objectives and development criteria outlined in the Port Kembla Development Code (NSW Ports 2016).	Operations
W16	Water Quality	A site specific emergency spill plan will be developed, and will include spill management measures in accordance relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Roads and Maritime and EPA officers). An emergency spill kit will be kept on site at all times. All staff will be made aware of the location of the spill kit and trained in its use	Operations

ID	Issue	Measure	Timing
ME1	Biofouling and benthic community disturbance	Works to remove the current quay wall and piles will commence after a visual inspection for protected mobile fauna (e.g. Syngnathids). If present, these will be relocated to adjacent habitats, outside the zone of influence by the proposed works, where feasible. Dredging will be carried out using mechanical backhoe dredge, split barges and supporting tug vessels, as opposed to suction-style dredging, to minimise the potential mobilisation of sediments within the Inner Harbour. Disposal of the dredged material will be limited to the Outer Harbour disposal area within the perimeter bund.	Construction
ME2	Water quality and marine ecology impacts from resuspension of sediments	The following controls should be implemented prior to dredge activities: Physical controls such as installation of silt curtains prior to commencement of construction works would be adequate in minimising the spread of any sediments within the water column at the dredging and disposal locations. Dredging techniques that minimise sediment resuspension during excavation and disposal (such as using mechanical methods over hydraulic methods) should be implemented throughout the project. Barge loads will also be controlled such that overflow of barge loads is avoided. Screening technologies will be implemented to ensure that any contaminated sediments are disposed of responsibly. Contaminated dredge material will be placed such that it may be capped by uncontaminated material in accordance with a dredge management plan. Implementation of a water quality monitoring program to ensure construction works do not exceed the project's agreed marine water quality criteria. Daily visual observations of any potential toxic dinoflagellate blooms within the Inner Harbour.	Construction
ME3	Water quality and marine ecology impacts from resuspension of sediments	Implementation of a water temperature monitoring program to document natural variations in water temperature and the extent of temperature differences and dispersion pathways of the cold water discharge plume.	Operation

ID	Issue	Measure	Timing
ME4	Impact of artificial noise emissions on marine fauna	During piling activities the following standard operational procedures are to be implemented (DPTI, 2012): Pre-start procedure – The presence of marine mammals should be visually monitored by a suitably trained crew member for at least 30 minutes before the commencement of the soft start procedure. Particular focus should be put on the shut-down zone but the observation zone should be inspected as well, for the full extent where visibility allows. Observations should be made from the piling rig or a better vantage point if possible. Soft start procedure – If marine mammals have not been sighted within or are likely to enter the shut down zone during the pre-start procedure, the soft start procedure may commence in which the piling impact energy is gradually increased over a 10-minute period. The soft start procedure should also be used after long breaks of more than 30 minutes in piling activity. Visual observations of marine mammals within the safety zones should be maintained by trained crew throughout soft starts. The soft start procedure may alert marine mammals to the presence of the piling rig and enable animals to move away to distances where injury is unlikely. Normal operation procedure – If marine mammals have not been sighted within or are not likely to enter the shut down or observation zone during the soft start procedure, piling may start at full impact energy. Trained crew should continuously undertake visual observations during piling activities and shut-down periods. After long breaks in piling activity or when visual observations ceased or were hampered by poor visibility, the pre-start procedure should be used. Night-time or low visibility operations may proceed provided that no more than three shut-downs occurred during the preceding 24 hour period. Stand-by operations procedure – If a marine mammal is sighted within the observation zone during the soft start or normal operation procedures, the operator of the piling rig should be placed on stand-by to shut-down the piling rig. An additional trained crew member should continuously monitor the marine mammal in sight. Shut-down procedure – If a marine mammal is sighted within or about to enter the shutdown zone, the piling activity should be stopped immediately. If a shut-down procedure occurred and marine mammals have been observed to move outside the shut-down zone, or 30 minutes	Construction

ID	Issue	Measure	Timing
		have lapsed since the last marine mammal sighting, then piling activities should recommence using the soft start procedure. If marine mammals are detected the shut-down zone during poor visibility, operations should stop until visibility improves.	
ME5	Impact of artificial noise emissions on marine fauna	Vessel and heavy machinery should be maintained in accordance with the manufacturer specifications to reduce noise emissions.	Construction
ME6	Impact of on marine fauna through artificial noise or collision	The interaction of all vessels with cetaceans and pinnipeds will be compliant with Part 8 of the Environment Protection and Biodiversity Conservation (EPBC) Regulations (2000). The Australian Guidelines for Whale and Dolphin Watching (DoEE, 2017) for sea-faring activities will be implemented across the entire project. This includes the implementation of the following guidelines: • Caution zone (300 m either side of whales and 150 m either side of dolphins) –vessels must operate at no wake speed in this zone. • Caution zone must not be entered when calf (whale or dolphin) is present • No approach zone (100 m either side of whales and 50 m either side of dolphins) – vessels should not enter this zone and should not wait in front of the direction of travel or an animal or pod, or follow directly behind • If there is a need to stop, reduce speed gradually • Do not encourage bow riding • If animals are bow riding, do not change course or speed suddenly.	Construction
ME7	The impact of artificial light emissions	Light spill from the nearshore vessel operations will be minimised where possible using directional lighting.	Construction Operation
ME8	The impact of artificial light emissions	Lighting on vessel decks or the berth construction area will be managed to reduce direct light spill onto marine waters or surrounding landscape, unless such actions do not comply with site safety or navigation and vessel safety standards (AMSA Marine Orders Part 30: Prevention of Collisions; AMSA Marine Orders Part 21: Safety of Navigation and Emergency Procedures).	Construction

ID	Issue	Measure	Timing
ME9	Pest introduction and proliferation	Locally sourced vessels (within NSW waters) to complete the construction works, where possible International vessels to empty ballast water in accordance with the latest version of the Australian Ballast Water Management Requirements (DAWR, 2017) If an IMP is identified or suspected, then the contractor is obliged to immediately (within 24 hours) notify the NSW Department of Primary Industries Aquatic Biosecurity Unit hotline on (02) 4916 3877 Project activities to adhere to the National System for the Prevention and Management of Marine Pest Incursions (National System) and NSW requirements for IMP identification and management.	Construction Operation
ME10	Accidental release of solid waste	Appropriate waste containment facilities will be included on site and managed to avoid overflow or accidental release to the environment. No waste materials will be disposed of overboard of vessels, all non-biodegradable and hazardous wastes will be collected, stored, processed and disposed of in accordance with the vessel's Garbage Management Plan as required under Regulation 9 of MARPOL Annex V. All marine vessels will be operated and maintained in accordance with the South Australian Government's Code of practice for vessel and facility management (marine and inland waters) 2008. Hazardous wastes will be separated, labelled and retained in storage onboard within secondary containment (e.g. bin located in a bund). All recyclable and general wastes to be collected in labelled, covered bins (and compacted where possible) for appropriate disposal at a regulated waste facility. Solid non-biodegradable and hazardous wastes will be collected and disposed of onshore at a suitable waste facility.	Construction Operation

ID	Issue	Measure	Timing
ME11	Accidental release of hydrocarbons, chemicals and other liquid waste	All liquid waste to be stored for discharge to an appropriate onshore facility Chemicals and hydrocarbons will be packaged, marked, labelled and stowed in accordance with MARPOL Annex I, II and III regulations. These include provisions for all chemicals (environmentally hazardous) and hydrocarbons to be stored in closed, secure and appropriately bunded areas. A Materials Safety Data Sheet (MSDS) will be available for chemicals and hydrocarbons in locations nearby to where the chemicals / wastes are stored Vessel operators will have an up to date Shipboard Oil Pollution Emergency Plan (SOPEP) and Shipboard Marine Pollution Emergency Plan (SMPEP). All shipboard chemical and hydrocarbon spills will be managed in accordance with these plans by trains and competent crew. Any contaminated material collected will be contained for appropriate onshore disposal Any equipment or machinery with the potential to leak oil will be enclosed in continuous bunding or will have drip trays in place where appropriate Following rainfall events, bunded areas on open decks of the vessels or within any construction laydown areas will be cleared of rainwater All hoses for pumping and transfers will be maintained and checked as per the PMS	Construction Operation
ME12	Damaged fuel tank associated with vessel or plant collision	Visual observations will be maintained by watch keepers on all vessels and plant/moving machinery. All vessels must comply with relevant marine navigation and safety standards. Marine diesel oil compliant with MARPOL Annex VI Regulation 14.2 (i.e. sulphur content of less than 3.50% m/m) is the only diesel engine fuel to be used by the vessels Oil spill responses will be executed in accordance with the vessel's SOPEP, as required under MARPOL Emergency spill response procedures would be developed and implemented when required.	

ID	Issue	Measure	Timing
TB1	Offset obligations	In accordance with the offset rules established by the Biodiversity Conservation Regulation 2017 there are various means by which the offset obligations can be met. The following is recommended: Secure and retire appropriate credits from stewardship site/s that fit within the trading rules of the BOS in accordance with the 'like-for-like' report generated by the BAM calculator. If the required credits are unavailable, source credits in accordance with the 'variation report' generated by the BAM calculator. Only consider a payment to the Biodiversity Conservation Fund if a suitable number and type of biodiversity credits cannot be secured from third parties.	Pre-construction
TB2	Loss of native vegetation and fauna habitat	Staff will be inducted and informed of the limits of clearing and the areas of vegetation to be retained.	Construction
TB3	Fauna protection	A trained ecologist is to be present for construction activities that may impact frog habitat which includes dewatering / removal of detention basins and trenching immediately adjacent to Typha drainage line (west of Springhill Road) Temporary frog-proof fencing should be installed around drill sites, road side drains and detention ponds near the project site to be retained to prevent frogs from being injured or killed by equipment The trench is to be covered at night to prevent fauna from falling in An inspection is to be conducted each morning to check the trench for frogs Any frogs identified will only be handled by an ecologist or wildlife rescue representative Any Green and Golden Bell Frogs or other resident frogs are to be handled in accordance with the Chytrid fungus hygiene protocols (DECC 2008c) and released into the most appropriate nearby habitat area	Construction
TB4	Spread of weeds	Priority weed control measures will be implemented as part of the CEMP to prevent their spread in the study area.	Pre-construction

ID	Issue	Measure	Timing
TB5	Spread of weeds	Declared priority weeds will be managed according to requirements of the NSW Biosecurity Act 2015 Soil material and stripped groundcover vegetation with the potential to contain priority weeds will not be removed from the project site Soil disturbance will be avoided as much as possible to minimise the potential for spreading weeds.	Construction and operation
TB6	Sedimentation	A site specific erosion and sediment control plan will be prepared as part of the CEMP. All erosion and sediment control measures shall be designed, implemented and maintained in accordance with relevant sections of 'Managing Urban Stormwater: Soil and Construction Volume 1' (Landcom 2004) ('the Blue Book) (particularly section 2.2) and 'Managing Urban Stormwater: Soil and Construction Volume 2A – Installation of Services' (DECC 2008b). The erosion and sediment control plan will include stockpiles, stormwater runoff, trees, site boundaries, site access and storage areas.	Pre-construction
TB7	Sedimentation	Areas disturbed during the works will be rehabilitated, including stabilising disturbed soils to resist erosion and weed invasion via establishment of with a suitable turf species such as a native Couch or repaving roads and sealed surfaces. Stabilisation activities will be carried out progressively to limit the time disturbed areas are exposed to erosion processes Activities with a risk of soil erosion such as earthworks will not be undertaken immediately before or during high rainfall or wind events.	Construction
TB8	Water quality, chemical and fuel impacts on flora and fauna	A site specific emergency spill plan will be developed, and will include spill management measures in accordance relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Roads and Maritime and EPA officers)	Pre-construction
TB9	Water quality, chemical and fuel impacts on flora and fauna	An emergency spill kit will be kept on site at all times. All staff will be made aware of the location of the spill kit and trained in its use	Construction

ID	Issue	Measure	Timing
TB10	Water quality, chemical and fuel impacts on flora and fauna	Any herbicides used for weed control will be applied to the manufacturer's specifications and as outlined in the manufacturer's Material Safety Data Sheet	Construction
TB11	Water quality, chemical and fuel impacts on flora and fauna	Machinery will be checked daily to ensure there is no oil, fuel or other liquids leaking from the machinery. All staff will be appropriately trained through toolbox talks for the minimisation and management of accidental spills.	Construction
TB12	Pathogen spread and establishment	Vehicle wash down facilities will be provided should evidence of pathogens or fungus such as Phytophthora or Chytrid be found.	Construction
H1	Unexpected finds	The construction workforce would be given a heritage induction and supporting material to be able to identify materials of potential heritage value and how to respond.	Pre-construction
H2	Unexpected finds	A protocol to be followed in the event of an unexpected find would be developed and would include clear lines of communication and stop work procedures to be followed.	Construction
T1	General	A Construction Traffic Management Plan be prepared prior to the commencement of works with site induction for construction personnel being undertaken to outline the requirements of the CTMP. The aim of the CTMP is to maintain the safety of all workers and road users within the vicinity site including but not limited to: • site access routes • construction parking arrangement • traffic management • pedestrian and bicycle rider management roadside hazards.	Preconstruction Construction
T2	Traffic management	A traffic control plan would be developed in accordance with the NSW Roads and Maritime Services *Traffic control at work sites* and *AS1742.3 – Traffic control devices for works on roads*.	Preconstruction Construction

ID	Issue	Measure	Timing
T2	Traffic volumes	Traffic management planning would seek to minimise traffic movements where possible during the morning and afternoon peak hours.	Preconstruction Construction
T3	Traffic volumes	Construction workers would be encouraged to car pool or utilise public transport where practicable.	Preconstruction Construction
NV1	Management of airborne noise through site inductions	Provide site inductions to all employees, contractors and subcontractors. The induction must at least include: • All relevant project specific and standard noise and vibration mitigation measures • Relevant licence and approval conditions • Permissible hours of work • Any limitations on noise generating activities with special audible characteristics • Location of nearest sensitive receivers • Construction employee parking areas • Designated loading/unloading areas and procedures • Site opening/closing times (including deliveries) • Environmental incident procedures.	Pre-construction
NV2	Airborne noise from transport	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.	Pre-construction
NV3	Management of sensitive receivers from airborne noise	Notify the affected receivers detailing the construction activities, time periods over which they would occur and the duration of works. Provide contact details to the affected receivers. If noise complaints are received, they should be recorded and attended noise monitoring should be conducted to assess compliance with the predicted construction noise levels.	Pre-construction
NV4	Airborne noise and general construction methods	Quieter construction methods should be used where feasible.	Construction

ID	Issue	Measure	Timing
NV5	Airborne noise from pipeline construction	Minimise pipeline construction activities near sensitive receivers during more sensitive time periods (evening, night).	Construction
NV6	Airborne noise from equipment	Turn off equipment after use.	Construction
NV7	Airborne noise from behavioural practices	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors. No excessive revving of plant and vehicle engines. Controlled release of compressed air.	Construction
NV8	Updating the Construction Environmental Management Plan (CEMP)	The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies.	Construction
NV9	Airborne noise from use and siting of plant	Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be avoided. The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers.	Construction
NV10	Airborne noise from vehicles	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work, including delivery vehicles.	Construction

ID	Issue	Measure	Timing
NV11	Airborne noise from delivery of goods to construction sites	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.	Construction
NV12	Airborne noise from mobile plant	Where possible reduce noise from mobile plant through additional fittings including residential grade mufflers.	Construction
NV13	Airborne noise from prefabrication of materials	Where practicable, pre-fabricate and/or prepare materials off-site to reduce noise with special audible characteristics occurring on site. Materials can then be delivered to site for installation.	Construction
NV14	Airborne noise from stationary noise sources	Stationary noise sources, such as pumps, should be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained. Appendix F of AS 2436:1981 lists materials suitable for shielding	Construction
NV15	Noisy activity impacts on sensitive receivers	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.	Construction
NV16	Impacts from underwater noise	It is recommended than a 109 metre observation zone be established around the underwater piling zone. The 100 metre observation zone would permit up to thirty minutes of continuous piling. Larger observation zones can permit longer durations of piling.	Construction
NV17	Impacts from underwater noise	The *Underwater Piling Noise Guidelines* (2012) recommends the following standard management and mitigation procedures with respect to underwater piling operations: • Avoid conducting piling activities during times when marine mammals are likely to be breeding, calving, feeding, migrating or resting in biologically important habitats located within the potential noise impact footprint. • Use low noise piling methods, instead of impact piling, where possible. • Presence of marine mammals should be visually monitored by a suitably trained crew member for at least 30 minutes before the commencement of the piling procedure.	Construction

ID	Issue	Measure	Timing
		• If no marine mammals are nearby, a soft-start piling procedure should be used. This involves gradually increasing the piling impact energy over a 10 minute time period. Visual observations of marine mammals within the safety zone should be maintained by trained crew throughout the start period. • If a marine mammal is sighted within the observation zone during the soft start of normal operation procedures, the operator of the piling rig should be placed on stand-by to shut down the piling rig. • A record of procedures employed during the operations should be maintained by the piling contractor.	
AQ1	Fugitive dust emissions	Water material prior to it being loaded for on-site haulage, where appropriate.	Construction
AQ2	Fugitive dust emissions	Aim to minimise the size of storage piles where possible.	Construction
AQ3	Fugitive dust emissions	Limit cleared areas of land and clear only when necessary to reduce fugitive dust emissions.	Construction
AQ4	Vehicle emissions	Control on-site traffic by designating specific routes for haulage and access and limiting vehicle speeds to below 25 km/hr.	Construction
AQ5	Fugitive dust emissions	All trucks hauling material will be covered on the way to the site and maintain a reasonable amount of vertical space between the top of the load and top of the trailer.	Construction
AQ6	Fugitive dust emissions	Operations conducted in areas of low moisture content material should be suspended during high wind speed events or water sprays should be used.	Construction

ID	Issue	Measure	Timing
LV1	Visual - wharf facilities	Ensure proposed wharf facilities conform to recommended design criteria within the *Port Kembla Development* Code. Specifically: Ensure ancillary structures are highlighted through the innovative use of colour, structure, screening and material Ensure materials used reinforce the industrial maritime character of the port precinct and are appropriate for the proposed use. Preferred materials include timber, brick, steel, corrugated metal, and other complementary materials	Design
LV2	Visual - gas pipeline	Ensure the gas pipeline alignment and associated six metre easement is located away from the existing established buffer tree planting along main public road corridors such as Springhill Road, to avoid unnecessary tree removal and ensure the functional integrity of the existing environmental and visual buffers as outlined in the Port Kembla Development Code. Obtain arboricultural advice regarding the opportunity to retain existing mature vegetation, and investigate design solutions to achieve this Where possible, incorporate replacement landscape planting to areas disturbed by construction work and to re-establish the landscape buffers to external roadways, intersections, and the Bluescope Oval recreation area, in accordance with the *Port Kembla Development Code* design criteria. Ensure tree species are selected to complement the existing landscape character of the immediate surrounding area.	Design
LV3	Visual – operational lighting	In accordance with the *Port Kembla Development Code*, ensure that: • All external lighting provides a safe and attractive environment that meets the operational requirements of the Port • Light spill on the surrounding environment, community and operational activities of the waterways is minimised • Lighting levels are to be provided in a manner sufficient to meet operational requirements and to the relevant Australian Standards • Light spill outside the site boundary and sky lighting is to be avoided through the adoption of measures such as: – Focussing light downwards	Design / Operation

ID	Issue	Measure	Timing
		– Installing cut-offs or shields on lights – Minimising the light mast height • Using low mounting height poles to light non terminal operational areas, including access / egress routes.	
LV4	Visual – construction works	Temporary boardings, barriers, traffic management and signage would be removed when no longer required.	Construction
LV5	Visual - construction works	Materials and machinery would be stored neatly during construction works.	Construction
LV6	Visual - construction works	Roads providing access to the site and work areas would be maintained free of dust and mud as far as reasonably practicable.	Construction
LV7	Visual - construction works	Ensure temporary lighting required during the construction period is sited and designed to avoid light spill into the surrounding area.	Construction
S1	Investment and employment	A contracting and procurement strategy focusing on maximising local content will be prepared to support local employment and business opportunities during construction. During operation, the project should seek to work with interested local parties to support new qualification/certification pathways for some of the specialised roles on the FSRU.	Pre-construction
S2	Other impacts	Stakeholder engagement would be carried out prior to and during construction with key stakeholders and the community to provide information about the project activities and provide a feedback mechanism for residents.	Pre-construction Construction
W1	Construction waste	Develop and implement a waste management plan for construction that integrates all statutory requirements for waste in NSW and includes: • systems to sort and track the actual types and quantities of waste generated • measures for separating waste based on classification of management options including colour coded bins options for offsite reuse, reprocessing, recycling and energy recovery of waste	Construction

ID	Issue	Measure	Timing
W2	Operation waste	Develop and implement a waste management plan for operation that integrates all statutory requirements for waste in NSW, including under MARPOL, and includes: • systems to sort and track the actual types and quantities of waste generated • measures for separating waste based on classification of management options including colour coded bins options for offsite reuse, reprocessing, recycling and energy recovery of waste	Operation
G1	Greenhouse gas emissions	All plant and equipment used during the construction works shall be regularly maintained to comply with the relevant exhaust emission guidelines	Construction
G2	Greenhouse gas emissions	Sustainable procurement practices will be adopted where feasible.	Construction
G3	Greenhouse gas emissions	The following measures will be considered by contractor(s): • Construction materials sourced locally where possible • Construction materials that have minimal embodied energy be selected • Use of PVC plastic minimised • Construction materials that are low maintenance and durable • Plant and equipment will be switched off when not in constant use and not left idling • Plant and equipment brought onsite will be regularly serviced and energy efficient vehicles or equipment will be selected where available • Any plant and equipment that is not working efficiently (i.e. emitting excessive smoke) will be removed from site and replaced as soon as possible Construction works will be planned to ensure minimal movement of plant and equipment, including barges	Construction
G4	Greenhouse gas emissions	The FSRU will obtain and maintain an International Energy Efficiency Certificate, and implement a Ship Energy Efficiency Management Plan.	Operation

ID	Issue	Measure	Timing
G5	Greenhouse gas emissions	The engine types on the proposed FSRU are designed to use dual fuels, with LNG/NG as the main fuel, which is inherently less polluting than diesel or other fuels for power generation. The engines are designed for high efficiency and reliability, and low emissions.	Operation
G6	Greenhouse gas emissions	Boil of Gas (BOG, vaporized LNG) will be managed to avoid using the Gas Combustion Unit(GCU). BOG can be either used as fuel in the generators or sent back to LNG storage after repressurizing. Avoiding or reducing the need to use the GCU will minimise emissions.	Operation
G7	Greenhouse gas emissions	The equipment will be maintained appropriately to minimise the risk of unintended leaks and unnecessary venting, for the FSRU and pipeline.	Operation
G8	Greenhouse gas emissions	The operations will comply with the general principles of the Green Port Guidelines (Sydney Ports Corporation, 2006)	Operation

26. Justification and conclusion

26.1 Overview

This chapter provides an evaluation of the project as a whole with regard to:

- the strategic need and justification for the project having regard to NSW legislation, which has deemed the project Critical State Significant Infrastructure and thus essential to NSW on social, environmental and/or economic grounds
- the objectives of the NSW Gas Plan, which is focused on gas security and reliability in NSW, as well as numerous other State, regional and local policies and plans
- the matters for consideration under the Environmental Planning and Assessment Act 1979 (EP&A Act), including the principles of ecologically sustainable development
- the biophysical, economic and social costs and benefits of the project.

26.2 Strategic need and justification

The strategic need for the project stems from the fact that NSW does not have its own material local gas supplies and relies on gas from other states like Queensland, Victoria and South Australia. In recent years, the development of a natural gas export market, increases in the cost of domestic gas production and relatively expensive onshore transmission costs have made it difficult for gas customers, particulary large industrial users, to source long-term, affordable gas supply contracts. Furthermore, the Australian Energy Market Operator forecasts that not only NSW but also the entire east coast gas market will become increasingly reliant on undeveloped, contingent or prospective sources of gas supply in order to meet demand.

Not only is the amount of gas able to be realised by these sources uncertain, it is likely to take many years for them to bring significant quantities of gas on line. In contrast, the project can deliver gas to market by 2020, subject to approval timeframes.

Gas is a critically important resource for households, businesses and industries in NSW and the east coast in general. As outlined in the NSW Gas Plan, about 500 heavy industries demand 75% of the State's gas supplies. Another 15% is used by 33,000 NSW businesses. Together these enterprises are estimated to support over 300,000 jobs across NSW. Natural gas also provides over 10% of NSW current electricity generation.

The project could alleviate pressure on gas supply and price by providing a virtual pipeline to gas supplies from around Australia and the world. The project has the potential to import approximately 100 petajoules of natural gas per annum into NSW. This equates to more than 70% of total gas demand in NSW, thereby providing an independent, secure source of gas and insulating NSW against potential disruptions to supply from other existing sources. Additionally the project can store enough natural gas to supply the entire state for 10–12 days,

Gas import terminals like the project are used around the world and have proven to be efficient and economical means by which to connect economies to global gas supplies at competitive prices.

26.2.1 NSW Gas Plan

NSW Government gas policy is put forward in the *NSW Gas Plan — Protecting what's valuable Securing our future*. The Plan outlines a strategic framework to secure "vital gas supplies for the State". It recognises that "without affordable and reliable gas supplies our manufacturers will struggle to compete and … households will pay higher prices". The Plan identifies five priority pathways, including a pathway dedicated to "securing NSW gas supply needs" which includes a range of measures to diversify supply sources and keep downward pressure on prices.

The project is consistent with the NSW Gas Plan as it contributes to a diversification of gas supply and an increase in competition in both the wholesale gas and the pipeline transmission markets, while also avoiding some of the concerns over potential impacts of on-shore gas field development on land valued for its agricultural, environmental, social or cultural heritage values.

The strategic context of the project is described in further detail in Chapter 3.

26.3 Matters for consideration under the EP&A Act

The project has been developed with consideration to objects and matters defined under the EP&A Act. The project has been declared CSSI in accordance with section 5.13 of the EP&A Act and Schedule 5 of the *State and Regional Development SEPP*.

The Project has been developed with consideration to the objects of the EP&A Act as follows.

a. to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources

b. to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment

c. to promote the orderly and economic use and development of land

d. to promote the delivery and maintenance of affordable housing

e. to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats

f. to promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage)

g. to promote good design and amenity of the built environment

h. to promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants

i. to promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State

j. to provide increased opportunity for community participation in environmental planning and assessment

The Project will promote the social and economic welfare of the Illawarra region and of NSW more broadly and involve the orderly and economic use of land consistent with NSW Ports 30 Year Master Plan. The Project will be undertaken in accordance with the principles of ecologically sustainable development and has been designed to protect the environment as far as practical and avoid areas of known ecological sensitivity or heritage significance.

The Project will be assessed as critical state significant infrastructure and involve input from all levels of government and the community in determining the application.

Further details on the applicable legislation and planning instruments are discussed in detail in Chapter 6.

26.3.1 Ecologically sustainable development

The principles of ecologically sustainable development are defined in the Environmental Planning and Assessment Regulation 2000 and include the following:

- the precautionary principle, namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:
  - careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
  - an assessment of the risk-weighted consequences of various options,
- inter-generational equity, namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations,
- conservation of biological diversity and ecological integrity, namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration,
- improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services, such as:
  - polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,
  - the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,
  - environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

The site of the project and the surrounding environment is largely characterised by existing port and industrial development. The vast majority of the site of the project has been heavily modified by historical development including large-scale reclamation and evidence of existing contamination of land and water. The potential impacts of the project on the environment have been considered in detail throughout the EIS and have been found to be very limited.

The overarching conclusion is that the project does not pose a threat of serious or irreversible environmental damage. Accordingly, it would not be expected that the project would negatively affect the health, diversity and productivity of the environment for current or future generations, nor would it undermine the conservation of biological diversity and ecological integrity.

With regard to pricing mechanisms, the project would be required to comply with the mechanisms under relevant legislation. For example, the project would require an environment protection licence under the *Protection of the Environment Operations Act 1997*. Further, the project would be required to offset impacts to plant communities in accordance with the *Biodiversity Conservation Act 2016*.

26.4 Biophysical, economic and social costs and benefits

The biophysical, economic and social costs and benefits of the project have been assessed in detail throughout the EIS. The biophysical impacts of the project are generally limited due to the disturbed nature of the existing environment and the relatively limited disturbance required.

The main waterbodies in and around the project include the Inner Harbour and Outer Harbour as well as Gurungaty Waterway, Allans Creek and Salty Creek. The hydrology and water quality of these waterbodies have been heavily modified by historic industrial and port development and continue to be influenced by industrial runoff and releases. Soil and water sampling undertaken for the EIS has confirmed the presence of contaminants consistent with prior studies.

The main potential impact of the construction of the project on hydrology and water quality has been assessed as excavation and dredging around Berth 101 at the Inner Harbour and disposal within the Outer Harbour. The excavation and dredging is predicted to have temporary impacts on water quality in the surrounding area typical of other port development. Disposal would be generally within the area already marked for future development of the Outer Harbour.

The main potential impact of the operation of the project on hydrology and water quality was assessed to be the release of cold seawater from the FSRU into the Inner Harbour. The cold seawater will be treated to comply with national and international regulations, while aiming to match the profile of the surrounding seawater as closely as possible. Plume modelling indicated the cold water would dilute in the surrounding seawater to an ambient temperature within the confines of the harbour.

The potential impacts of the project on biodiversity were assessed as being very limited as the site of the project is highly modified and predominantly cleared. The construction of the gas pipeline would involve the clearing of a small area of planted non-remnant vegetation. Potential impacts on vegetation along waterway corridors would be avoided entirely through horizontal directional drilling. Vegetation to be cleared was not considered a threatened community or habitat for threatened species.

The project was also expected to involve the removal of in the order of three artificial detention ponds around the existing coal terminal at Berth 101. The ponds have the potential to provide habitat for the threatened green and golden bell frog, most likely as they move between more suitable habitat. Given the low quality and highly disturbed nature of the habitat potential impacts were not considered significant.

The heritage values of the site of the project were limited to areas of potential Aboriginal and historic heritage significance, including potential for archaeological deposits, around Spring Hill just west of Port Kembla. These areas would be avoided due the design of the project and the implementation of horizontal directional drilling to avoid potentially sensitive areas.

The potential impacts of the project on amenity such as traffic, noise, vibration and air quality were also found to be very limited. Traffic generated by the project including light and heavy vehicles, would utilise the existing road network in and around Port Kembla, however those roads would remain within their capacity and intersections would continue to perform to an acceptable standard. Noise generated during construction had the potential to generate short-term noise impacts at a few locations that would be typical of large-scale construction projects, while noise during operation was not expected to exceed the relevant noise criteria at any of the identified residences or other noise sensitive receivers. Lastly, the assessment of air quality found the construction and operation of the project would not result in an exceedance of the air quality criteria at any of the identified sensitive receiver locations.

Overall, the potential impacts of the project on the environment were considered limited and would be readily managed with the implementation of the measures discussed through the EIS that would be collated in construction and operation environmental management plans. Those plans would include sub-plans targeted at specific issues including dredge management.

The project would involve a capital investment in the order of \$200–\$250 million. Construction of the project is expected to employ about 150 workers at its peak while operation is expected to create about 40–50 ongoing roles. Furthermore, the supply of gas created by the project would have the potential to support a much larger number of businesses and jobs across the state, and particularly those in heavy industry, which are very reliant on a stable and affordable supply of gas.

26.5 Conclusion

The project as a whole is considered to have a well-established strategic need and justification in that it responds to potential gas supply and price pressures in the east coast gas market and has been declared critical state significant infrastructure by the NSW government. The project has been designed and assessed with consideration to the matters for consideration under the EP&A Act, and is generally consistent with the principles of ecologically sustainable development. The biophysical, economic and social costs of the project are generally limited. The potential economic benefits of the project are potentially significant and wide reaching given the project has the capacity to deliver a new source of natural gas into the NSW and east coast gas market.

27. References

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