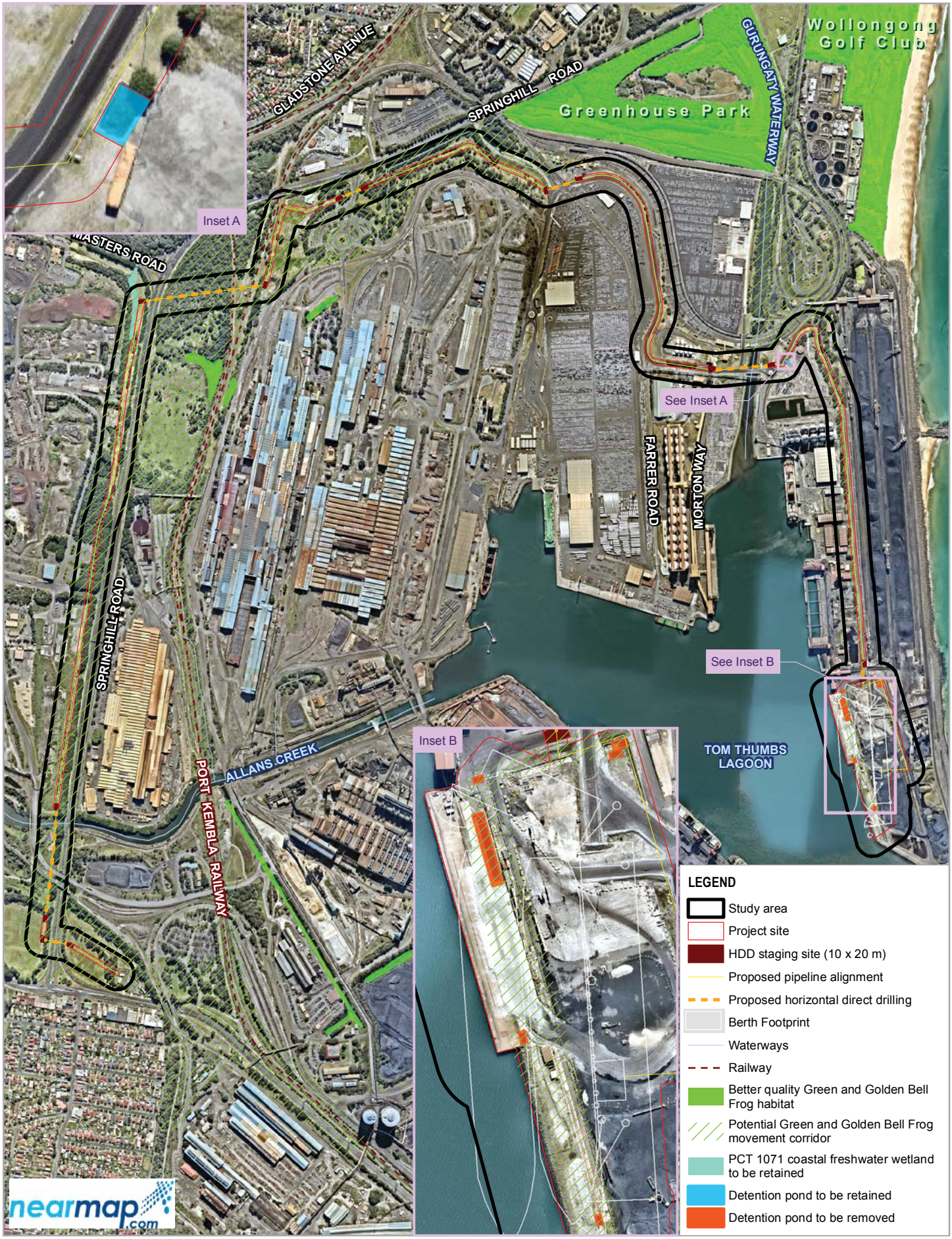

Paper Size ISO A4

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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**
Revision No. **-**
Date **31/10/2018**

Green and Golden Bell Frog Habitat

FIGURE 14-2

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

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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.

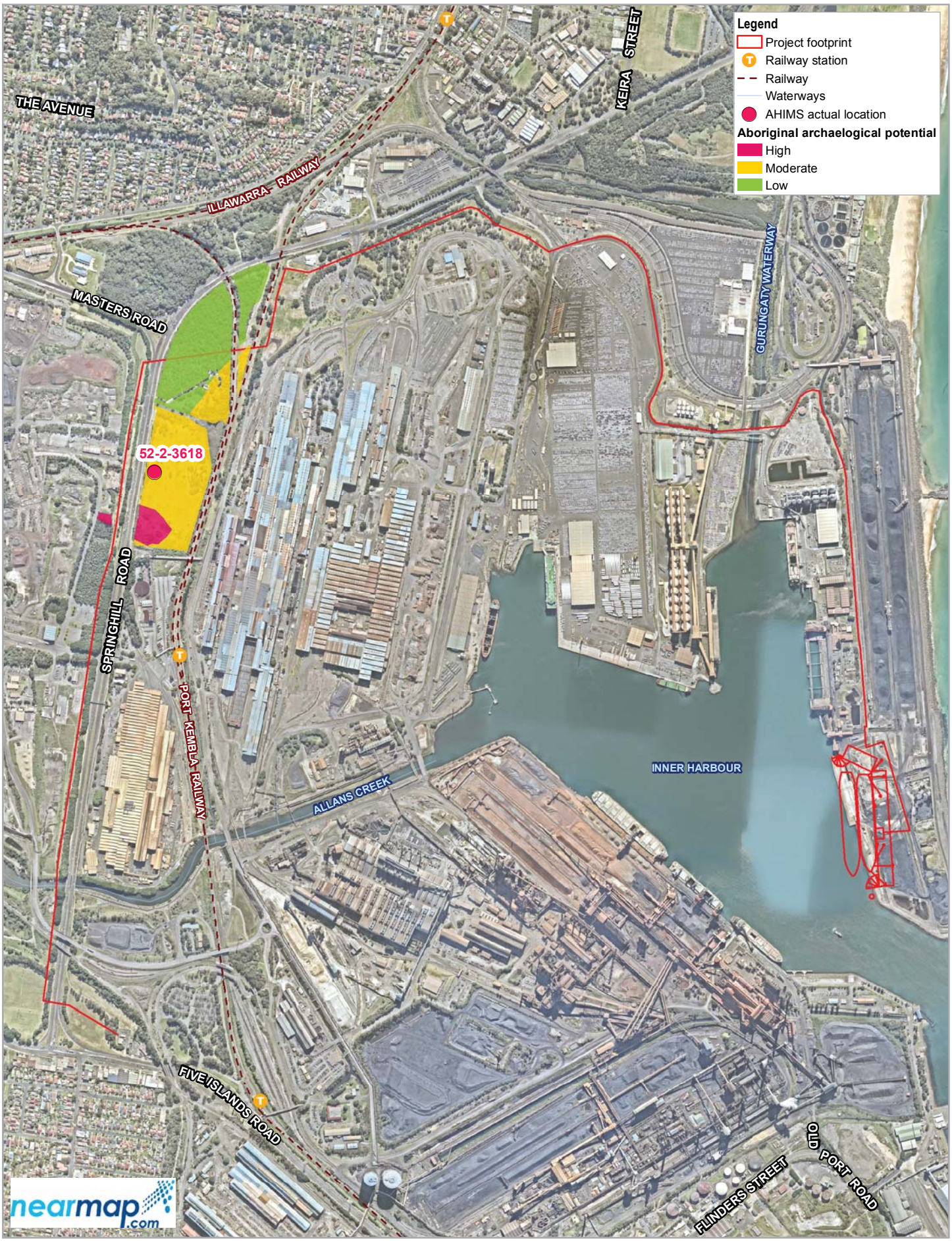
The area immediately surrounding two large fig trees was converted into a recreational reserve in 2007 and 2008. Works included landscaping, revegetation and erection of a shelter and the reserve is frequently visited by the local Aboriginal community and includes memorials to deceased community members.

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.



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**
Revision No. **A**
Date **31 Oct 2018**

Aboriginal Heritage

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*.

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Metres

Map Projection: Transverse Mercator
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Port Kembla Gas Terminal

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

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

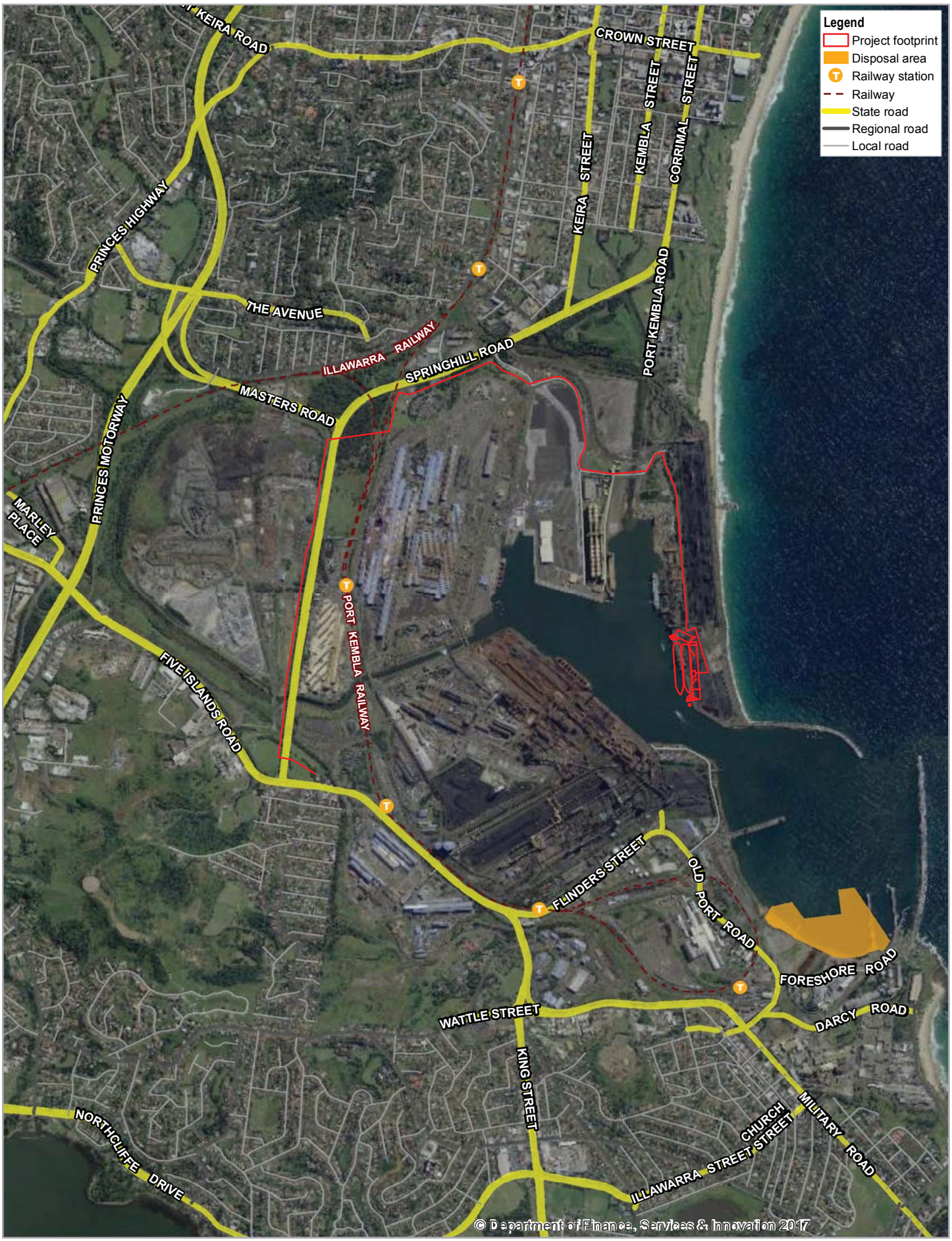
Port Kembla Road is a state road that provides access to the northern part of Port Kembla toward Berth 101. Its main characteristics are that is has a sealed carriageway with one lane in each direction. Port Kembla Road has a 50 kilometre per hour speed limit.

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.



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

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Australian Industrial Energy
Port Kembla Gas Terminal

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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		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	1,631	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

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

N

GHD

Australian Industrial Energy
Port Kembla Gas Terminal

Representative sensitive receivers, noise monitoring locations and land use map

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

Figure 17-1

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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	442	44 54 L_{AFmax}
Residential NCA02	53	75	48	47	473 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

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

N

GHD

Australian Industrial Energy
Port Kembla Gas Terminal

Site and sensitive receptor Location

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

Figure 18-1

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Print date: 31 Oct 2018 - 15:49 (SMA record: 2) (SMA record: 38)

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 ($\mu g/m^3$)
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.

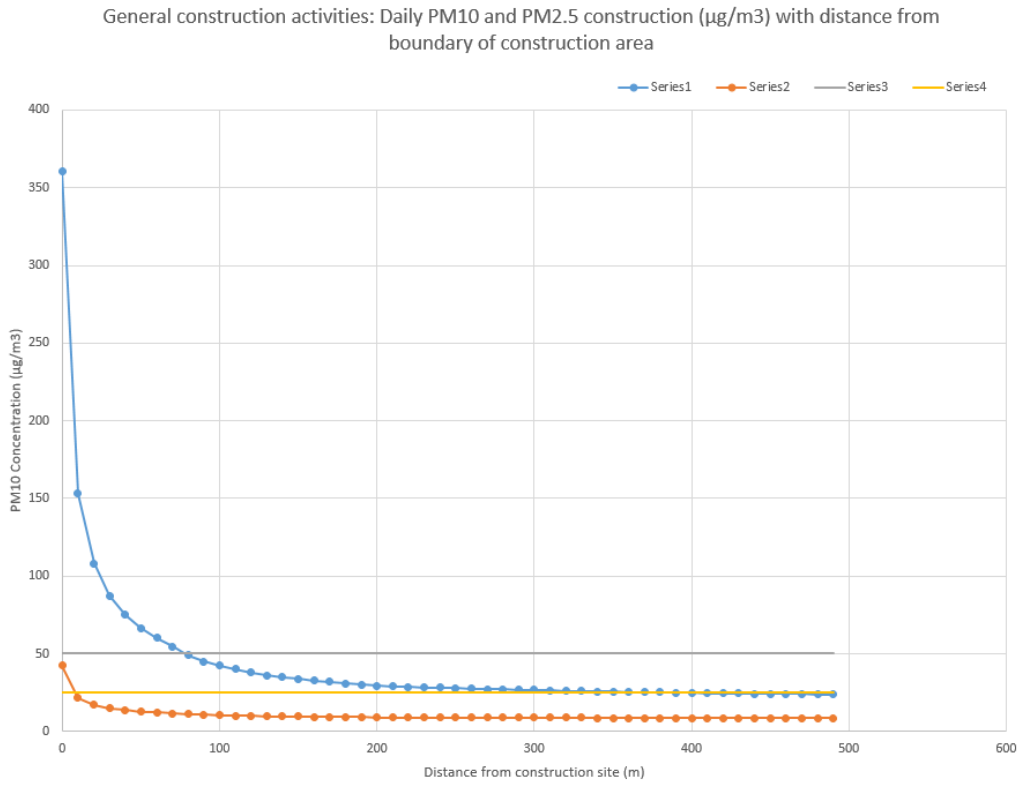


Figure 18-2 Scenario 1: Daily PM_{10} and $PM_{2.5}$ concentrations with distance from boundary of construction area (including background)

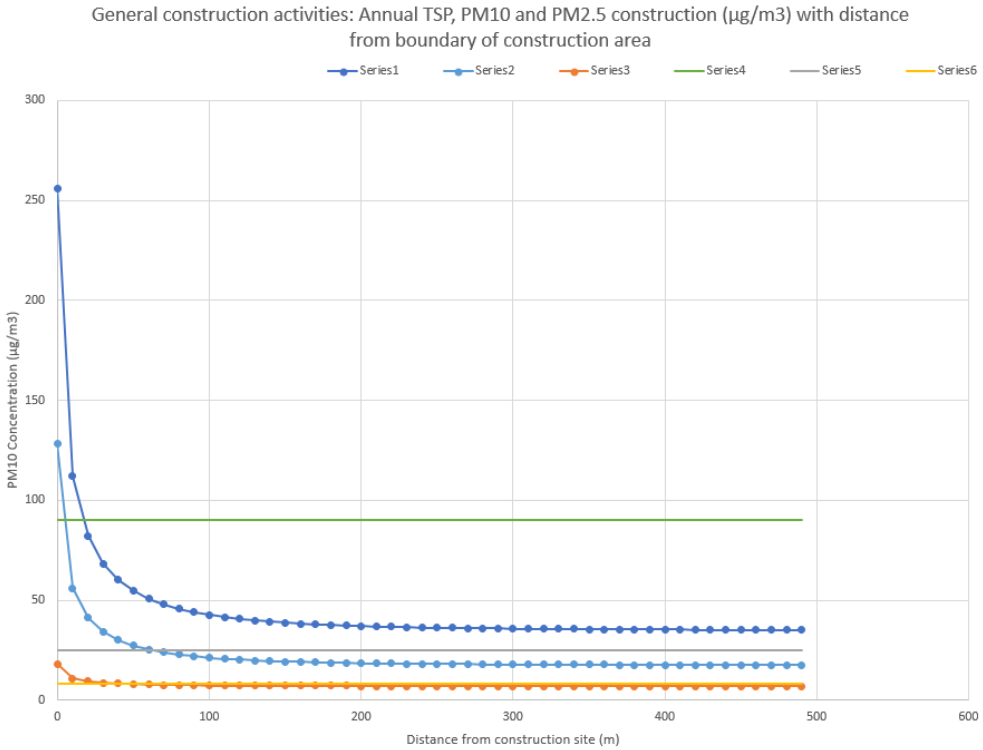


Figure 18-3 Scenario 1: Annual PM_{10}, $PM_{2.5}$ and TSP concentrations with distance from boundary of construction area (including background)

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 (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 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/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
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.

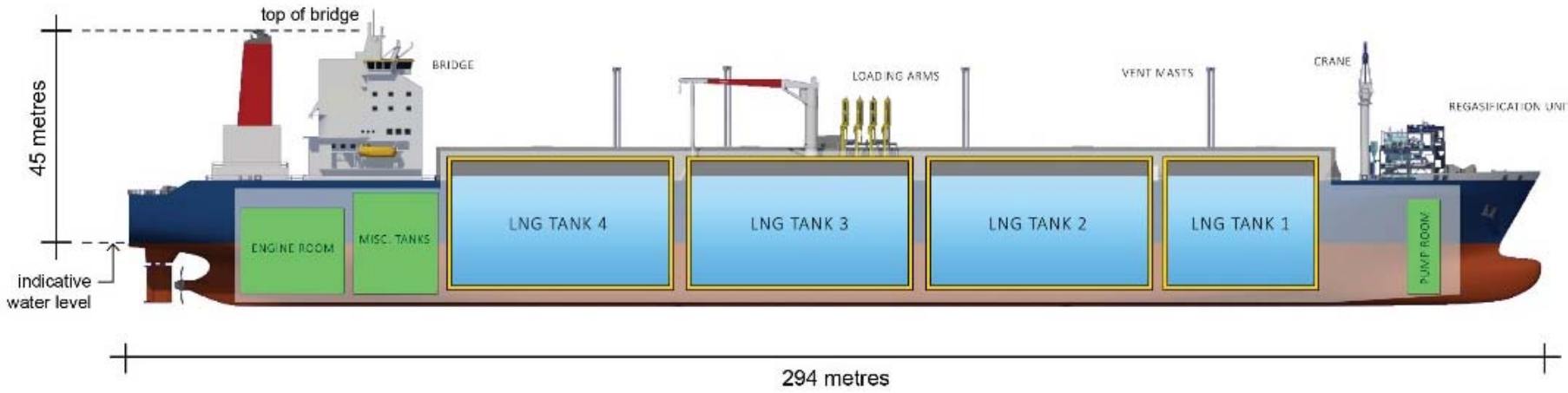


Figure 19-1 Sectional elevation of FSRU with indicative dimensions

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:

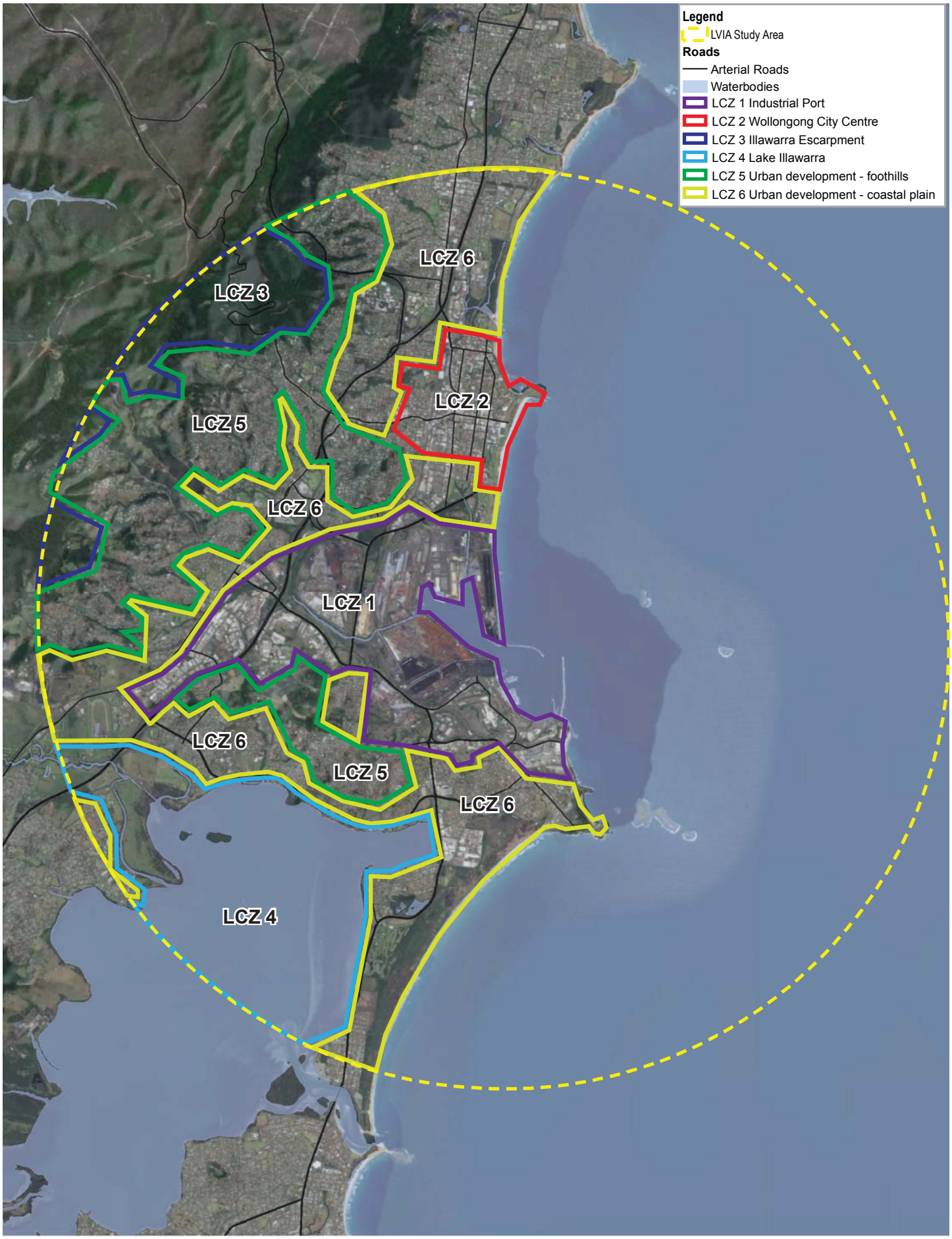
- Highly modified coastline and harbour, including purpose built terminals, silos, overland conveyor belts and towers, and long rocky breakwaters to the harbour opening
- Large scale built form of homogenous colour and industrial materiality, including long corrugated iron sheds, rusty steel chimneys 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

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

N

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.

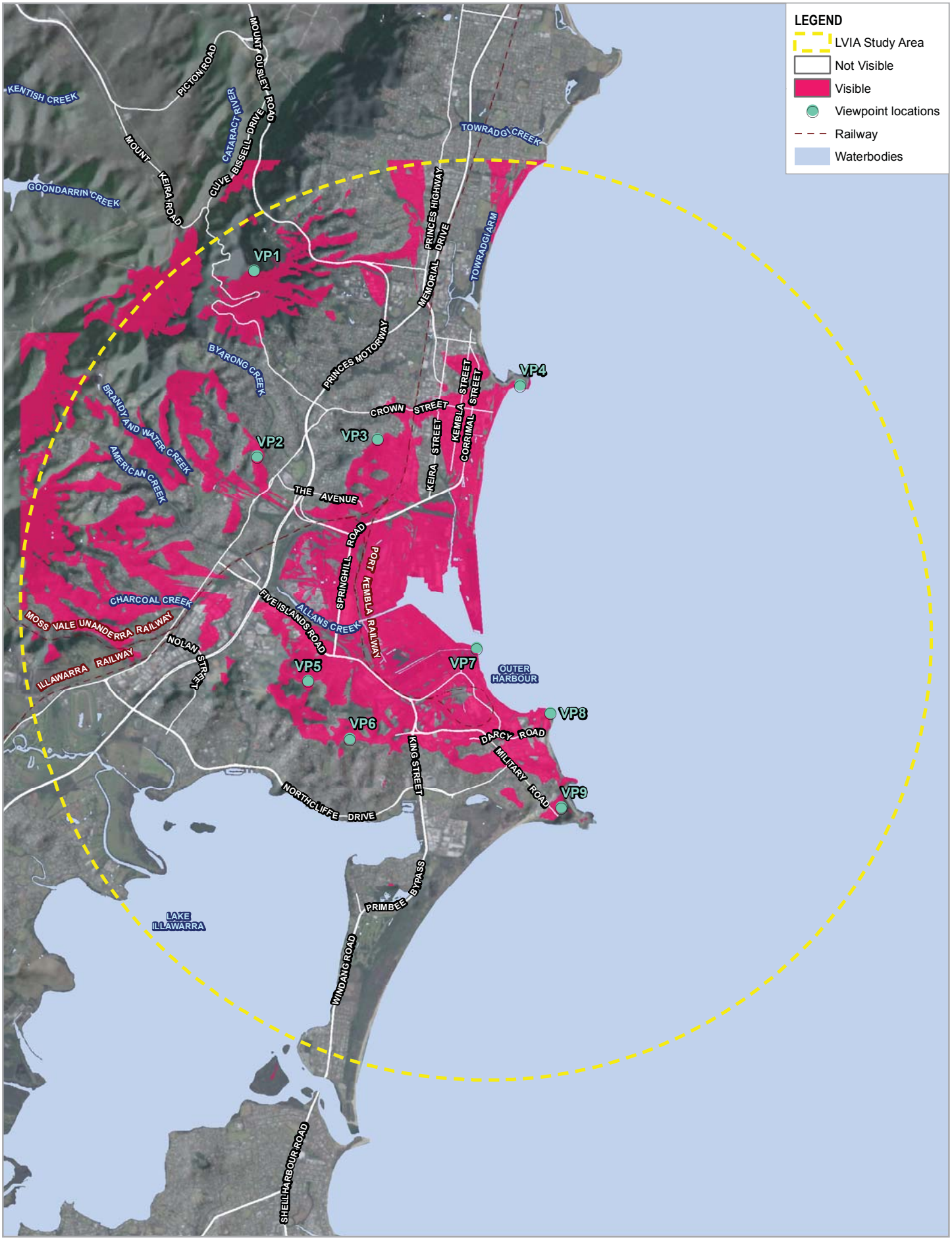
The standard colour palette of the vessels is consistent with that outlined in the Port Kembla Development Code, therefore the vessels fit within the desired built form objectives of the port precinct in relation to colour.

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.



Paper Size ISO A4

0 2,000 4,000

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**
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

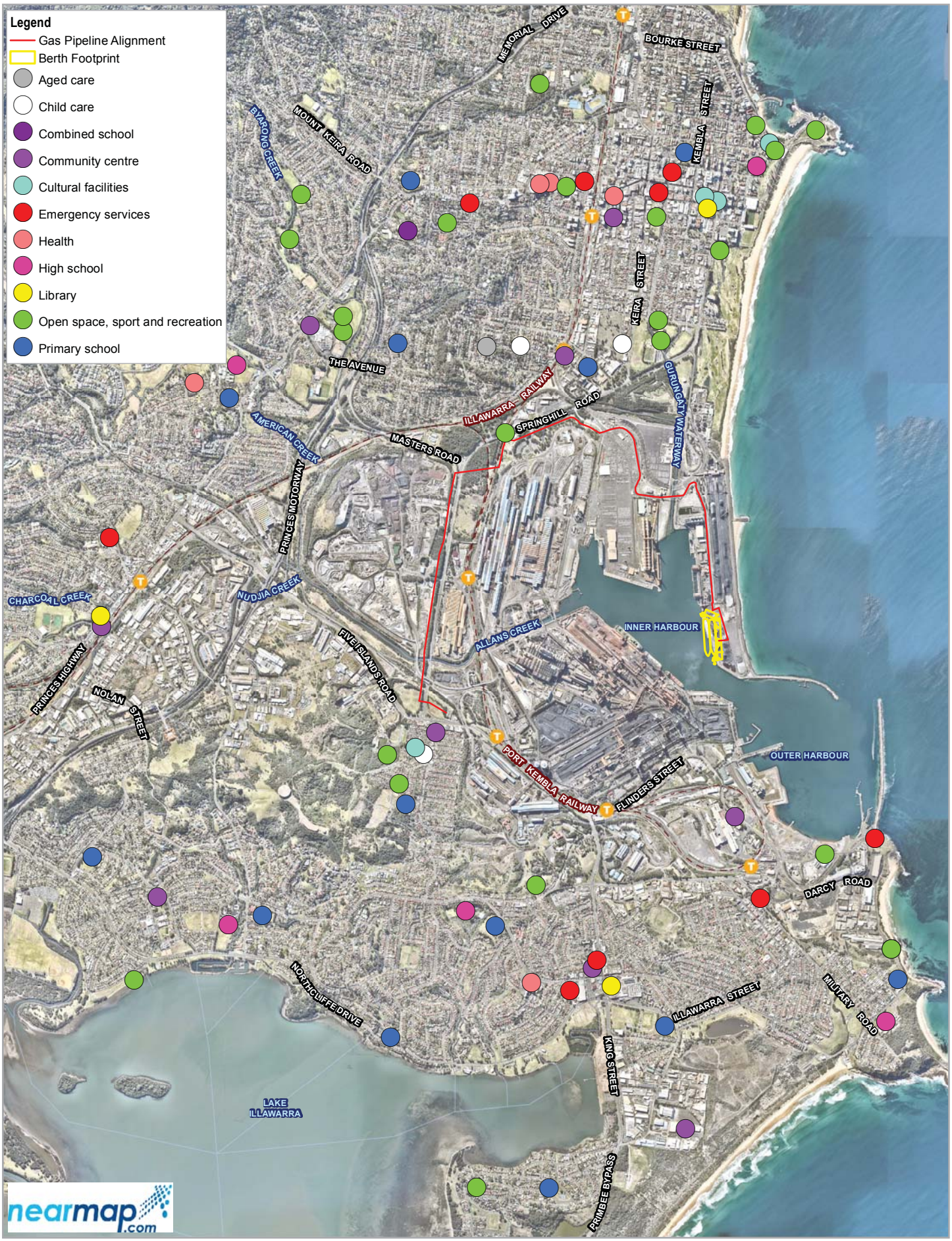
The existing environment in the area surrounding the project is shown in Figure 20-1. As shown Port Kembla is situated about two kilometres south of the centre of Wollongong with surrounding localities including Mangerton, Mount St. Thomas and Figtree to the north-west; Unanderra to the west; Berkeley 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

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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.

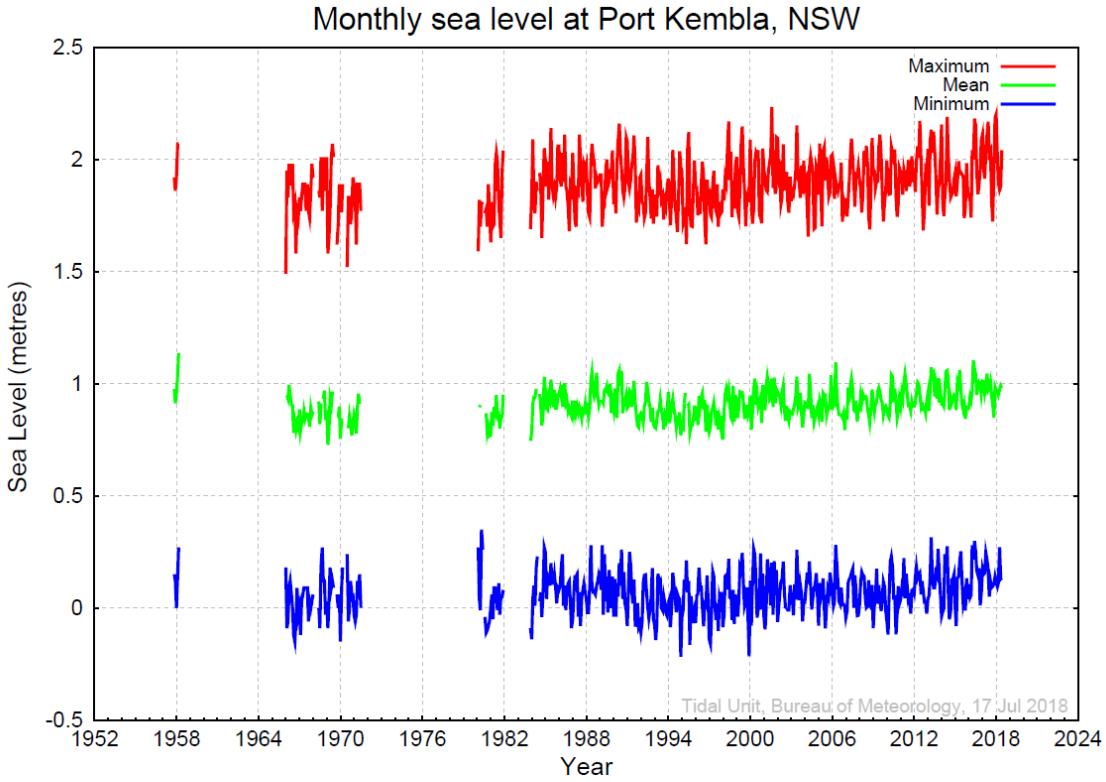


Figure 23-1 Monthly sea level at Port Kembla (BOM, July 2018)

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

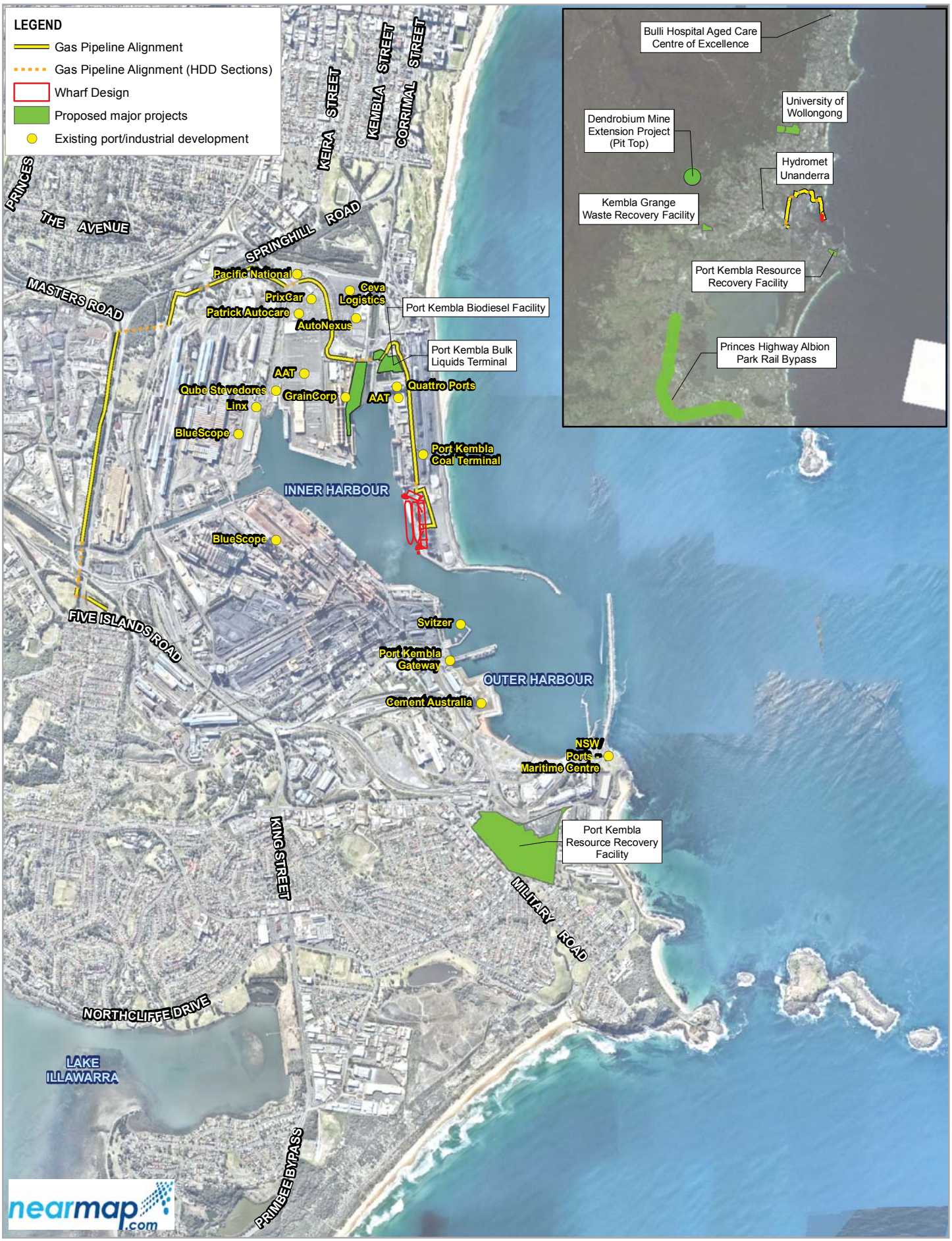
Hydromet Unanderra is a proposed extension to an existing waste treatment facility about 4 kilometres west of the project. The extension would process in the order of 6,500 tonnes of inorganic liquid waste per annum. Environmental assessment requirements for the project were provided in May 2018. It 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

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

N

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.

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