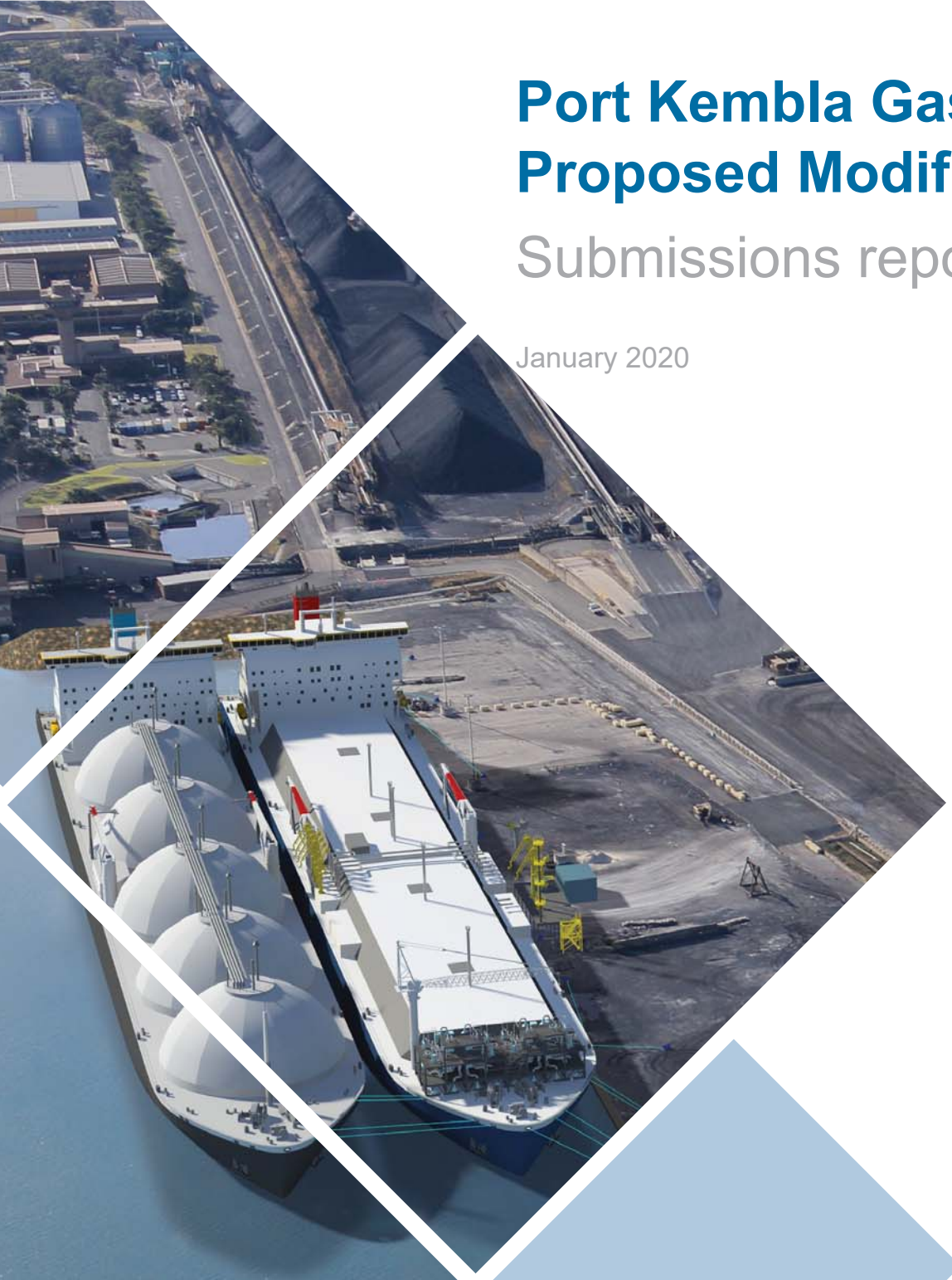
Port Kembla Gas Terminal Proposed Modification

Submissions report

January 2020



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1. Introduction

1.1 Background

Australian Industrial Energy (AIE) proposes to develop the Port Kembla Gas Terminal (the project). The project involves the development of a liquefied natural gas (LNG) import terminal at Port Kembla, south of Wollongong in NSW. The project consists of four key components:

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

LNG will be sourced from worldwide suppliers and transported by LNG carriers to the terminal. It will then be re-gasified for input into the gas transmission network. The project will be the first of its kind in NSW and provide a simple, flexible solution to the state's gas supply challenges.

The project was declared Critical State Significant Infrastructure (CSSI) under section 5.13 of the *Environmental Planning and Assessment Act 1979*. A development application for the project was made (SSI-9471) and accompanied by an Environmental Impact Statement (EIS) (GHD 2018). The EIS was placed on public exhibition and a total of 23 public submissions were received. The Response to Submissions (RTS) was then submitted and incorporated a number of minor amendments to the design and construction methodology for the project. The project received approval from the Minister for Planning and Public Spaces in April 2019.

A modification application for the project was subsequently made (SSI-9471-Mod-1) in November 2019. The proposed modification sought to accommodate potential variability of gas demand and production and was accompanied by an environmental assessment. The proposed modification and environmental assessment were put on public exhibition in December 2019. A total of 8 submissions were received from public authorities, organisations and the public.

1.2 Purpose and structure

The purpose of this report is to summarise the issues raised in submissions and provide responses to those issues. The structure and content of this report is as follows:

- Section 2 — Description of the project and proposed modification
- Section 3 — Submissions, issues raised and responses
- Section 4 — Summary and conclusion.

2. Project description

2.1 Overview

This section provides a description of the project and the proposed modification. The approved project as described in the EIS and RTS is described in section 2.2. The proposed modification to the project is described in section 2.3. It is noted that the description of the project and the proposed modification is as described in the modification application and environmental assessment and has been provided here to give context to this submissions report.

2.2 Approved project

Port Kembla Gas Terminal consists of four key components:

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

The layout of the Port Kembla Gas Terminal is shown in Figure 2-2. The EIS described that the project would have the capacity to deliver in excess of 100 PJ of natural gas per annum, which could be increased further to around 140–150 PJ of natural gas per annum through a slight increase in scheduled deliveries and pipeline upgrades. For assessment purposes a flat rate of production of approximately 300 TJ per day and 100 PJ per annum was assumed.

In order to achieve the assessed rate of production it was anticipated that approximately 24 LNG carrier vessels of uniform size would visit Port Kembla in any one year during project operations. This would equate to an LNG carrier vessel arriving every two to three weeks, or around two LNG carrier vessels per month. When an LNG carrier vessel arrived it would tether alongside the FSRU for around 24–36 hours while LNG was transferred to the FSRU. These LNG carrier movements were found to be low in proportion to the vessel movements anticipated from other operational arrangements at the port (1,680 to 2,380 vessel movements per year) and would therefore not significantly increase vessel movements or restrict navigability.

The FSRU would receive the gas from the LNG carrier vessels, convert the LNG to high pressure gas on board, and then transfer the gas to the gas pipeline for delivery to the existing gas transmission network. In order to convert the LNG to high-pressure gas the FSRU would warm the LNG from very low temperatures, in the order of −161°C, to temperatures in the order of 5°C. The FSRU would utilise seawater during this process and for other purposes including cooling of engines and other machinery, ballast systems and a water curtain. It was expected that about 10.5 ML per hour would be utilised in the LNG regasification process, about 2.4 ML per hour for cooling of engines and other machinery, about 5.2 ML per hour for ballast systems and about 0.16 ML per hour for a water curtain.

The seawater would be released back into Port Kembla harbour at a maximum temperature differential of 7°C cooler than ambient seawater temperature at the point of discharge. Discharged seawater would mix rapidly and be within the ANZECC Guidelines limits by the ends of the proposed berth during worst case spring conditions. It is important to note that the maximum temperature differential of 7°C cooler is a conservative estimate. For example, one

train at full capacity typically has a differential at 6.3°C in the most conservative conditions, meaning rich LNG and low send out pressure. Similarly, if one train is running on half capacity the temperature difference is reduced by 50%, hence 3 – 3.5°C. Further given the artificially heightened temperature of seawater in the Inner Harbour due to warm water discharges from other facilities, the contribution of cooler water may assist with overall temperature management of the Inner Harbour.

2.3 Proposed modification

2.3.1 Seasonality

Market analysis carried out since submission of the EIS has identified that demand for gas would be seasonally dependant. Retail customers in particular have a higher demand profile during the winter months in comparison to the more steady state demand profile of industrial customers.

The FSRU operates with a series of three LNG regasification units or trains, which comprise the necessary pumps, motors, heat exchangers, instrumentation, control and emergency shutdown systems. Each of the trains operates on either duty or standby mode, with at least one kept in standby mode to provide redundancy to the overall FSRU operations.

The operational scenario in the EIS included the operation of two trains, plus one on standby, with three LNG booster pumps running throughout the year. The output from each train can also be varied based upon the number of booster pumps and operating pressure. The operation of the trains involves LNG being pumped up from the cargo tanks into a suction drum. The LNG is then pumped through a series of heat exchanges that utilise seawater as a source of natural heat differential to warm up the LNG. Once in a gaseous form, the gas is exported, under pressure, through the marine loading arms into the onshore gas pipeline.

Seasonal demand scenarios have been developed to support the modification assessment to allow for variations in output throughout shown in Table 2-1 and Figure 2-1.

The seasonal demand and associated variability of throughput on the FSRU would not require additional infrastructure or construction methodologies to those described in the EIS.

Table 2-1 Proposed modification

Parameter	EIS	Modification scenarios	
	Base case	Low Season (approx. 6 months)	High Season (approx. 6 months)
LNG Trains	2	1	2
LNG booster pumps	3	1	4
Seawater discharge m^3/hr	10,500	3,250	13,000
Approximate TJ/day	300	120	500
Approximate PJ/year	100	115	

The high demand scenario will likely operate for up to six months from April through to September and will continue to operate with two LNG trains in accordance with the EIS. The high demand scenario will operate with one additional LNG booster pump to achieve higher gas output. Seawater discharges will also increase slightly from 10,500 m3/hr in the EIS to 13,000 m3/hr and have a maximum temperature differential of 7°C consistent with the EIS.

The low demand scenario will likely operate for up to six months from October through to March and will only operate with a single LNG train and LNG Booster pump based upon the lower gas output. Seawater discharges will decrease from 10,500 m3/hr in the EIS to 3,250 m3/hr and have a maximum temperature differential of 7°C, consistent with the EIS.

As discussed in the seawater discharge assessment in the proposed modification, the nearfield comparison of high season discharge against the EIS base case revealed that the increased velocity associated with the higher discharge rate resulted in improved mixing characteristics, smaller temperature changes and reduced discharge concentrations at the edge of a nearfield mixing zone of a similar radius. Far-field modelling of the high season scenarios revealed that whilst cooler discharged seawater would remain above ANZECC Guidelines limits within the lowest 2% of the water column over a worst case area measuring approximately 300m x 500m, the discharge waters would reach acceptable levels at the ends of the proposed berth dredging area during worst case spring conditions.

On this basis, it is considered that the proposed modification is largely consistent with the original EIS and would not result in significantly different impacts.

Figure 2-1 Seasonal demand scenario

In interpreting Table 2-1 and Figure 2-1, it is important to note actual daily customer demand and FSRU output will be influenced by operating conditions (rate of consumption) as well as the calorific content of the LNG delivered to the project. Supply of a relatively lean vs rich cargo could result in variations in total derived units of energy (i.e. TJs) from the same volume of LNG. The demand and output projections (TJ/day) are therefore considered estimates for assessment purposes and to facilitate comparison with the approved development. Similarly, the size and number of LNG deliveries required throughout the year will depend on the changing LNG level in the FSRU, the calorific content of the shipment and demand fluctuations. Essentially, with more variability in customer demand profiles, the project requires more flexibility in the LNG delivery schedule and cargoes.

NSW Ports has separately proposed the removal of shipment limits on individual port tenants, enabling NSW Ports to manage the overall capacity of the port for all port users. The additional movements of LNG carriers required to service a variable supply model are not predicted to negatively impact upon overall vessel movements or navigation within the port. The removal of Condition 6, which limits the project to 26 LNG cargoes per annum, is therefore requested.

The removal of Condition 6 would allow Port Kembla to operate to its capacity and to meet the gas demands of NSW now and in to the future. Port Kembla is identified as a working port of significant economic importance throughout strategic planning documents such as the *Illawarra Regional Strategy*, the *NSW Freight and Ports Plan*, *Future Transport 2056*, and through the operation of *State Environmental Planning Policy (Three Ports) 2013*. Strategic planning has identified Port Kembla as a working port and the removal of this restrictive condition would be consistent with this position.

2.3.2 Air emissions

Modern LNG carriers and FSRUs are typically powered by natural gas, instead of marine diesel or other fossil fuels, and consequently emit significantly lower levels of carbon dioxide, nitrogen oxides and particulates, and almost no sulphur oxides. While the FSRU would typically run on natural gas, it would have the capability to run on marine diesel oil for maintenance purposes or in highly unusual/emergency type situations, in which there is no natural gas available for the engine. As described in the RTS, under these operating conditions there would be the potential for exhaust concentrations to exceed the NOx emissions limit in the *Protection of the Environment Operations (Clean Air) Regulation 2010*.

Increasingly, international and national air emissions standards are reducing the levels of permissible NOx emissions from marine transportation vessels. AIE and the FSRU provider Hoegh LNG are committed to achieving sustainable operations and reducing greenhouse emissions where possible. Given the pace of technological change, it is possible that technology may become available which could reduce NOx emissions when the FSRU is running on marine diesel oil (MDO mode) to a level below the *Protection of the Environment Operations (Clean Air) Regulation 2010* limit. Hoegh LNG has therefore requested that Condition 8, limiting marine diesel oil use to 72 hours per year, be adjusted to note that the condition could be removed subject to the vessel being able to show compliance with *Protection of the Environment Operations (Clean Air) Regulation 2010*. This would remove the need for a further modification should technology be identified which can improve the performance of the vessel in MDO mode.

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 **19 Feb 2019**

Project layout

Figure 2-1

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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

3. Submissions

3.1 Overview

A total of 8 submissions were received during public exhibition of the proposed modification and environmental assessment, including 3 from public authorities, 3 from organisations and 2 from the public. Additionally, questions were provided by the Department of Planning, Industry and Environment's Hazard Unit. A breakdown of submissions is provided in Table 3-1 while the issues raised and responses to those issues are provided in sections 3.2, 3.3 and 3.4.

Table 3-1 Overview of submissions

Submitter	Type	Position
Environment Protection Authority	Public authority	Comment
Port Authority of NSW	Public authority	Comment
Wollongong City Council	Public authority	Comment
NSW Ports	Organisation	Support
Regional Development Australia Illawarra	Organisation	Support
Port Kembla Pollution Meeting	Organisation	Object
Submitter 119337	Individual	Object
Submitter 119959	Individual	Object

3.2 Public authorities

3.2.1 Department of Planning, Industry and Environment

An updated hazard and risk assessment was provided as part of the proposed modification, which documented the potential hazards and risks associated with the low season and high season in relation to the scenario originally assessed in the EIS (the base case). It concluded the proposed modification would not introduce additional hazardous inventories or scenarios. The resulting risk contours were considerably reduced in the low season and were largely similar to the base case in the sensitivity analysis of the high season scenario.

A number of questions concerning the hazard and risk assessment of the proposed modification have been provided by the Department of Planning, Industry and Environment's Hazard Unit. The issues raised included confirmation of the design information, maximum release rates, stored volumes, detection and isolation probability, and mitigated ignition probability.

The hazard and risk assessments in the EIS, RTS and the proposed modification have been based on the same design information including piping and instrumentation diagrams and layouts. This design information is considered to remain representative of the project.

The assessments completed prior to the assessment of the proposed modification did not account for mitigating effects of fire and gas detection, isolation and depressurisation systems. Furthermore, all leak scenarios were modelled from an infinite volume of LNG rather than the actual fixed volumes. These mitigating factors have now been incorporated into the assessment of the proposed modification, specifically the sensitivity analysis of the high season scenario.

Detailed responses to the technical questions raised by the Department of Planning, Industry and Environment's Hazard Unit are provided in Appendix A. The hazard and risk assessment of the proposed modification, incorporating these responses, is provided as Appendix B.

3.2.2 Environment Protection Authority

Issue	Response
<u>Degree of change from original proposal</u> The EPA submission cover letter states that the modification represents a significant change from the original proposal and modelled impacts and states increases to include: • the number and potential size of LNG carriers. The report states up to 52 ships per year (doubled from 26) and up to 180,000 cubic metres in size (from 140,000 cubic metres); • gas received from 4.4 million cubic metres to potentially 9.4 million cubic metres per annum (113% increase); • the maximum cold water discharge rate from 10,500 m3/hr to 13,000 m3/hr. This translates to a potential increase in cold water discharges from 98 gigalitres to 152 gigalitres per annum (55% increase); • the modelled harbour area impacted by the cold water discharges. The harbour floor areas not achieving relevant temperature criteria, at certain times of the year, increases from 0.5 hectares to 15 hectares (a 30 fold increase).	The EPA submission appears not to have taken into account the seasonality of market demand for gas and has therefore mischaracterised the potential increase in scale of the operations. The modification is seeking approval for a variable production profile which includes a low demand season and a high demand season. The high demand scenario will operate for up to six months from April through to September and will utilise two LNG trains in accordance with the original EIS with one additional LNG booster pump to achieve higher gas output and an approximate 24% increase in seawater discharges. The low demand scenario will operate for up to six months from October through to March and will only operate with a single LNG train and LNG Booster pump with an approximate 70% reduction in seawater discharges. The following points clarify the capacity increases highlighted in the EPA submission: • The number of LNG carriers was conservatively assessed to increase from 26 to 52 per annum. The number of ships is a function of the calorific content of the shipment, actual daily consumption, as well as seasonal demand variation. The modification seeks flexibility to increase the number of deliveries (particularly during high season) and to allow for deliveries from different sized carriers to better match market demands. It is noted that NSW Ports have requested the removal of shipment limits on all Port Tenants and the conservative estimated increase has been fully considered in the modification report.

Issue	Response
	• With seasonal variation in demand, total annual production will increase by around 15% from 100 PJ/year to 115 PJ/year rather than the 113% increase represented in the submission. • Seawater discharges will increase from 10,500 m^3/hr in the EIS to 13,000 m^3/hr during the 6 months of the high season and reduce to 3,250 m^3/hr during the six months of the low season resulting in an overall reduction in cold water discharge on an annual basis of around 23% rather than the 55% increase represented in the submission • The predicted harbour area impacted by the cold water discharges has been accurately represented in the submission. However, it is important to consider the extent of the predicted impact area in the context of the overall development which is located in a working harbour with artificially elevated water temperatures and in an active berth pocket. In particular, the maximum extent of the predicted footprint roughly corresponds to the length of the proposed development area which will be dredged during the construction phase, and during operational phases will be subject to a constantly moving albeit moored vessel, adjacent LNG tanker vessel movements, tug operations and other ongoing port maintenance activities such as bed levelling drag bar operations which will ensure the area is constantly disturbed in line with other high traffic areas of the port. As noted in the EIS, the highly utilised and developed Inner Harbour is not known to support as many species as the Outer Harbour. Those that occur are typical of inshore habitats such as the glass perchlet (*Ambassis jacksoniensis*) which are known to exist in depths of 0-10 m and are therefore unlikely to be impacted by changes to the lowest 2% of the water column which equates to minimum depths of -13.2 to -13.5 m).

Issue	Response
<u>Closed loop heat exchange system</u> The submission makes reference to potential impacts of open loop heat exchange systems including cold water discharge, biofouling and potential entrainment of marine biota. The submission recommends that the proponent assess the feasibility of a closed loop heat exchange system in the FSRU.	The use of a closed loop heat exchange system was considered in discussions with the FSRU supplier and deemed unfeasible due to increased fuel consumption and emissions. In particular, advice from the FRSU supplier indicated that adopting a closed loop system would increase fuel consumption up to 400% when compared to an open system. This is an FSRU technology typically only used in very cold climates where the use of the ambient water temperature differential is not great enough to adequately warm the LNG. Closed loop operations have implications for fuel consumption, greenhouse gas emissions and operational costs, and as such a closed loop system was not considered further.
<u>Related projects</u> The submission makes reference to related projects that would operate in conjunction with the project, including a gas pipeline. The submission recommends that the projects be considered in an integrated and holistic way to protect the environment.	The modification is not seeking any variation to its originally proposed footprint. Both APA and Jemena have separately commenced planning processes associated with new or upgraded pipelines in the local area connecting to the PKGT. Any proposed third party connecting gas pipeline would be subject to a separate assessment and approval process under the *Environmental Planning and Assessment Act 1979*.
<u>Mixing zone mitigation</u> The submission makes reference to potential impacts of cool water discharges and potential for the proposed modification to increase the area of these potential impacts on seawater and habitat. In particular, it makes reference to the predicted exceedances of Australian and New Zealand Environment and Conservation Council (ANZECC) water	<u>Application of ANZECC Guidelines</u> The ANZECC Guidelines present numerical guidelines which can be used as a basis to assess the impact of the development of the Port Kembla Gas Terminal against defined objectives or values for the receiving waters. The core concept of the ANZECC Guidelines relates to managing water quality for environmental values. For each environmental value, the

Issue	Response
quality objectives in relation to cool water discharge in an area outside the near-field mixing zone. The submission recommends that further mixing zone mitigation options be assessed to minimise the area affected by discharges and achieve the water quality objectives. The identified mitigation options include: • Closed loop heat exchange system • Outlet design (diffuser) • Pre-discharge dilution • Discharge by ocean outfall • Discharge to BlueScope canal.	guidelines identify particular water quality characteristics or 'indicators' that are used to assess whether the condition of the water supports that value. The ANZECC Guidelines also advocate an 'issues-based' approach to assessing ambient water quality, rather than the application of rigid numerical criteria without an appreciation of the context. This means that the guidelines focus on: • the environmental values we are seeking to achieve or maintain; • the outcomes being sought; and • the ecological and environmental processes that drive any water quality problem. It should also be noted that the environmental values and respective numerical indicator values apply to ambient background water quality and are not intended to be applied to mixing zones associated with a release from a point source discharge. Discharges from the FSRU therefore need to be considered in recognition of other land uses and existing water quality within the working harbour at Port Kembla. In particular, it is important to note that the maximum extent of the non-compliant footprint occurs during spring and is restricted to the lowest 2% of the water column over an area measuring approximately 300m x 500m. Under the spring high season production scenario, temperatures within a thin layer of the water column between -13.2 to -13.5 m (below low tide) are predicted to be approximately 0.5°C colder than the ANZECC Guideline limits at the edge of the nearfield mixing zone. Predicted water temperatures within this thin layer continue to equalise to the surrounding conditions, warming to within 0.25°C of the guideline limits within approximately 100m of the nearfield zone and to within 0.1°C of the guideline limits within approximately 170m of the nearfield zone. By the ends

Issue	Response
	of the proposed berth dredging area, temperatures are predicted to be compliant with the ANZECC Guideline limits. In considering these predictions, it should be highlighted that modelled temperature differential of 7°C cooler is a conservative upper estimate. For example, one train at full capacity typically has a differential at 6.3°C in the most conservative conditions, meaning rich LNG and low send out pressure. Similarly, if one train is running on half capacity the temperature difference is reduced by 50%, hence a smaller temperature difference of 3 – 3.5°C. Consequently, the predicted cool water impact areas will actually be even smaller than those predicted by the model under all operating scenarios. The maximum extent of the non-compliant footprint roughly corresponds to the length of the proposed development area which will be dredged during the construction phase and during operational phases will be subject to intermittent disturbance from vessel movements and port maintenance activities such as bed levelling in line with other high traffic areas of the port. These activities are expected to result in removal of existing biofouling and benthic communities from the site prior to the commencement of operations and minimal impact during operations for any relocating communities. As noted in the EIS, the highly utilised and developed Inner Harbour is not known to support as many species as the Outer Harbour. Those that occur are typical of inshore habitats such as the glass perchlet (*Ambassis jacksoniensis*) which are known to exist in depths of 0-10 m and are therefore unlikely to be impacted by the predicted temperature changes. Nevertheless, following receipt of the submissions, further liaison has been undertaken with the FSRU supplier to investigate opportunities to reduce the impacts of discharge. The potential options considered and adopted are described below:

Issue	Response
	Closed loop heat exchangers Refer response provided above. Use of diffusers Consideration was given to the use of diffusers to improve plume mixing behaviour. Diffusers are effective for the modification of near-field zones but have no significant effect on far-field mixing zones. The predicted areas of non-compliance with the ANZECC guidelines for this project relate to the far-field model predictions. As such diffusers would not significantly improve overall outcomes as considered in the far-field modelling. Pre-discharge dilution While additional ambient temperature seawater could be pumped into the system to reduce the temperature difference of the stream at the point of discharge, given the operational costs and additional greenhouse gas emissions associated with pumping large volumes of seawater, pre-discharge dilution is considered detrimental to the overall project outcomes. Discharge by ocean outfall or to BlueScope canal Following consideration of alternative discharge locations such as the stern of the vessel and ocean discharge, it is apparent that the proposed discharge outlets at the bow of the FSRU (southern end of the berth) provide the greatest dilution capacity, minimise the likelihood of shoreline hugging plumes and confine potential impacts to the marine environment of the lowest value. In particular, the tidal velocities through the constriction between the Inner and Outer Harbour known as “the cut” are greater than those at the stern of the FSRU and those encountered adjacent to the relatively sheltered ocean shoreline east of the site. Construction of an offshore outfall would facilitate access to exposed open waters. However, far-field plume mixing behaviours would be reliant on

Issue	Response
	more variable metocean conditions rather than the primarily tidal driven processes of the Harbour. Furthermore, the marine environments beyond the Outer Harbour have been impacted to a lesser extent by historical activities and are considered of higher value. Construction and operation of a discharge outfall pipeline beyond Port Kembla would be expected to provide intermittent benefits to far-field plume mixing behaviours under certain metocean conditions only and would result in increased impacts to higher value marine environments beyond the Outer Harbour. Consideration was also given to the beneficial reuse of cool water on or off-site. No potential uses for cool seawater were identified on the northern side of the Inner Harbour. Cool seawater was considered to be of value to the existing BlueScope operations on the southern shoreline however the engineering costs associated with transporting the relatively low volume of moderately cooler water through operational port areas rendered this option unfeasible. Preliminary discussions with NSW Ports revealed that any pipelines crossing or adjacent to navigation areas (inside or outside the Harbour) would need to be trenched to a depth below potential future channel depths, which would require additional dredging works. It should also be noted that discharging to the alternative locations mentioned above would require additional pumping effort which would result in greater emissions and running costs than currently proposed.
<u>Industrial discharges</u> The submission makes reference to the warm water industrial discharge from the BlueScope facility incorporated into the assessment of the cold water discharge.	The BlueScope warm water flows used in the updated modelling are based on Cardno's 2007 investigations when the operation was running two blast furnaces. We are aware that operations were reduced to a single blast

Issue	Response
It states the warm water industrial discharge from the BlueScope facility would be halved following the closure of one of the two blast furnaces operating at the facility in 2013. The submission requests clarification that the assessment accurately reflects the current state of the Inner Harbour.	furnace in 2013 which in turn reduced the associated discharges but were not able to source updated discharge data during preparation of the EIS. Accordingly, modelling was undertaken to conservatively capture the upper and lower bounds of BlueScope discharge, i.e. scenarios running two blast furnaces and scenarios with zero BlueScope discharges and allows for a "like for like" comparison of the predicted impacts associated with the original development and the proposed modification. This approach ensures that the assessment considers the possible future discharge operations of BlueScope and covers the current state of the Inner Harbour. We highlight that the largest non-complying near bed footprint predicted by the modelling was associated with Scenario 11 which modelled the high season discharge rate (13,000 m3/hr) along with the BlueScope warm water flows during Spring. Any reduction in the discharge of BlueScope's warm water flows would result in an improved case, closer to the scenarios which modelled PKGT discharge without BlueScope's influence. In considering the impact of BlueScope's warm water flows, it is important to note that when BlueScope's discharges are considered as part of the ambient conditions, the "background" median and 20th percentile temperatures are warmer, leading to a greater predicted impact footprint when cool water is discharged by the PKGT. This is offset by the simultaneous discharge of BlueScope's warm water flows which counters the proposed PKGT cool water discharge. The result is that where PKGT's proposed cool water discharge is considered in conjunction with BlueScope's warm water (simultaneous and ambient) discharge, results are generally comparable to a scenario where PKGT's cool water discharge is discharged without BlueScope's warm water discharge. As a result, the worst case scenario varies from season to season but is typically within 50-100 m of either case.

Issue	Response
	Modelling of the upper and lower bounds of BlueScope discharge ensures that the assessment considers the possible future discharge operations of BlueScope and covers the current state of the Inner Harbour.
Marine growth prevention system The submission makes reference to the potential impacts of the marine growth prevention system and notes the sodium hypochlorite modelling of the project with the proposed modification indicated there would be a similar near-field mixing zone to the EIS. In this regard, the submission recommends that the existing consent conditions continue to apply to the project with the modification.	As identified in the submission, the assessment of the mixing zone in the proposed modification concluded that there would be similar near-field mixing zone. It is agreed that the existing conditions of approval remain appropriate.
Biota entrainment The submission states that increased water throughput in the open loop heat exchange system may cause biota entrainment. It requests an assessment of potential biota entrainment and mitigation measures that may be incorporated into the FSRU.	Impingement and entrainment is dependent on the screen slot aperture, flow velocity, and current passing the screen. An increase in flow volume to 13,000 m^3/hr (312 ML/day) and associated increase in intake velocity to 1.57 m/s during high season will result in an increase in biota impinged and entrained. Entrainment studies of the Sydney Desalination Plant found that a 500 ML/day intake would result in the entrainment of approximately 2% of the ichthyofauna population within a 300 m x 3 m area around the intake. Larval populations within the Inner Harbour are expected to be substantially less dense than those estimated in the rocky reef habitat adjacent to Cape Solander by Sydney Water (2005). Additionally, the high season flow volume (312 ML/day) is considerably less than 500 ML/day and only expected to operate at that capacity during the high season. Thus while there is likely to be some impact to the ichthyofauna within the harbour, the impact on a regional scale is expected to be minimal.

Issue	Response
	Sydney Water (2005) suggests that an intake velocity below 0.6 m/s would assist in minimising impingement while Missimer *et al*. (2015) indicate that velocities below 0.3 m/s did not significantly affect impingement. Low season intake velocities (0.39 m/s) are therefore unlikely to result in significant impingement of biota however high season intake velocities are likely to result in impingement of biota. As described in the Marine Ecology chapter of the EIS, the highly utilised and developed Inner Harbour is not known to support many fish species. Those that are present (glass perchlet and Japanese striped goby) are likely to be at risk of impingement if caught within the intake current, particularly during high season. This risk however, would be restricted to the immediate vicinity of the intake, with velocities expected to diminish rapidly from the intake screen. These species are common across the region and unlikely to be significantly impacted. Technologies including velocity caps and screens are known to effectively reduce intake velocities and minimise the risk of impingement to marine biota. Discussions with the FSRU supplier indicate that should additional mitigation be required, it is notionally possible to retrofit additional strainers over the inlets once the vessel is securely moored. However, it was noted that the heavy nature of the strainers affect the handling / stability of the vessel. Quick removal of the strainers in emergency situation and/or navigation away from the berth pocket would be impacted by the presence of retro-fitted strainers. The FSRU supplier has indicated the existing intake and strainer arrangement below the keel of the vessel has been optimised to achieve balanced outcomes in relation to intake velocity, entrainment and impingement risk, marine growth, maintenance, vessel draft at berth and seagoing capabilities. Given the potential challenges for safe navigation, as

Issue	Response
	well as the limited benefit to already assessed biota impacts, the use of retrofitted strainers is not considered further.
<u>Engine utilisation</u> The submission notes that the assessment of potential air quality impacts of the project with the proposed modification assumes that two engines are active on board both the FSRU and the LNG carrier respectively. It notes this is consistent with the assessment in the EIS. The submission recommends that only two engines are active on board the FSRU and LNG carriers as a condition of consent.	The assessments of potential air quality impacts on the EIS and in the proposed modification assumed the operation of two engines on board the FSRU and LNG carrier respectively, which was considered to be representative of normal operations. The EIS also included assessment of four engines on board the FSRU operating and two engines on the LNG carrier. The assessments found that there would be no incremental or cumulative exceedances of the relevant criteria at receptor locations as a result of the modelled operations, including with four FSRU engines operating. The existing conditions of approval state the proponent must carry out the development generally in accordance with the EIS and in compliance with any environment protection licence issued for the development. The existing conditions of approval also require the development and approval of an air quality management plan, which must include measures demonstrating compliance of the project with the conditions of approval. It is also noted that the proponent would not have operational control over LNG carriers and those carriers would be subject to international laws and regulations. The existing conditions of approval are considered to be suitable to ensure air quality is adequately managed.

Issue	Response
<u>Marine diesel oil</u> The submission notes the existing condition of approval that limits the operation of the FSRU on marine diesel oil to 72 hours. It makes reference to the request that the condition be removed or amended subject to being able to demonstrate compliance of the vessel with the *Protection of the Environment Operations (Clean Air) Regulation 2010*. The submission states that it does not object to the request that the condition be removed but states that the condition should not be amended to refer to prescribed limits in the *Protection of the Environment Operations (Clean Air) Regulation 2010*. It instead states that the proponent should limit the use of marine diesel oil to as low as practicable. It also states that monitoring may be carried out to verify the emissions to air and that any such monitoring is carried out in accordance with the *Approved methods for the modelling and assessment of air pollutants in NSW*.	As discussed in the EIS, RTS and the proposed modification the FSRU would only operate in marine diesel oil mode in limited situations. It is preferable from both an operational efficiency and environmental perspective that the FSRU utilises LNG rather than marine diesel oil as a fuel source. With regard to an amended condition, a condition limiting use of marine diesel oil to as low as practicable is considered suitable.
<u>LNG carriers</u> The submission notes the existing condition of approval that establishes a limit of 26 LNG carrier shipments in any calendar year. It makes reference to the request that the condition be removed or modified to account for variability in shipments and production. It recommends that any change include an operational limit, such as gas throughput or discharge limits, matching assessed impacts.	The EIS, RTS and proposed modification assessed potential impacts of the operation of the project on the environment, including those resulting from the operation of an LNG carrier and the FSRU during LNG transfer. The potential impacts of the operation of a LNG carrier and the FSRU were found to be limited and manageable, with no predicted exceedances of air quality criteria or noise criteria at sensitive receptors. These findings would be expected to hold independent of the number of scheduled LNG carrier arrivals, as the EIS included conservative assessment of a LNG carrier and FSRU at berth at all times.

Issue	Response
	It is considered that without a limit on the LNG carriers, existing conditions of approval are adequate to manage the potential impacts of the operation of the project. The existing conditions of approval state the proponent must carry out the development generally in accordance with the EIS and in compliance with any environment protection licence issued for the development.
<u>Power supply</u> The submission notes the project power supply would be generated from LNG and recommends consideration of alternative sources such as energy recovery from a closed loop heat exchange system or implementation of shore side power.	It is preferable from both an operational and environmental perspective that the FSRU utilises LNG as a fuel source. Alternatives such as closed loop heat exchange or shore side power are not considered to provide material operational or environmental benefits and are not being considered further at this time.

3.2.3 Port Authority of NSW

Issue	Response
<u>Consultation</u> The submissions notes the conditions of approval requiring consultation with the Port Authority of NSW for the Fire Safety Study, Emergency Plan and emergency procedures. It requests that the conditions of approval require consultation with the Port Authority of NSW for the Hazard and Operability Study and Final Hazard Analysis.	The proponent notes the requirement for consultation with the Port Authority of NSW during development of the Fire Safety Study, Emergency Plan and emergency procedures and accepts the request for consultation during development of the Hazard and Operability Study and Final Hazard Analysis.

Issue	Response
Harbour Master The submission refers to clause 67ZN of the *Ports and Maritime Administration Regulation 2012*, which requires written permission by the Harbour Master for bed disturbance. It states that the information required would include the dredging methodology and spoil disposal locations. It also states that a marine traffic management plan would be required for vessel movements associated with construction, including dredging.	The proponent acknowledges requirements for written permission from the Harbour Master under the *Ports and Maritime Administration Regulation 2012*.

3.2.4 Wollongong City Council

Issue	Response
Pipeline upgrade The submission questions whether the proposed modification would require upgrades to the proposed gas pipeline to cope with higher potential gas throughout during the high season.	The 6 km gas pipeline included in the original EIS does not require any modification to accept the proposed high season volumes. As documented in the hazard and risk assessment of the proposed modification, the operating pressure of the gas pipeline would be slightly reduced during the high season (100 barg) compared to the low season (120 barg). This is due to the FSRU's LNG pumps' characteristics, which deliver less pressure as the pump discharge volume increases.
Greenhouse gas emissions The submission states the objective of Council to have net zero greenhouse gas emissions by 2050, or 2030 as an aspiration. It notes the predicted increases in greenhouse gas emissions from the project and proposed modification relative to the EIS.	The greenhouse gas objectives of Wollongong City Council are acknowledged.

Issue	Response
It requests opportunities to limit increases in greenhouse gas emissions be explored.	As discussed in the EIS, RTS and the proposed modification, the greenhouse gas inventory comprises a small proportion, being about 0.01 per cent, of Australia's national greenhouse gas emissions. The proponent has committed to a number of management measures to avoid, mitigate and manage potential greenhouse gas emissions including implementation of a Ship Energy Efficiency Management Plan and maintaining an International Energy Efficiency Certificate.
<u>Nitrogen oxides emissions</u> The submission notes the existing condition of approval that limits the operation of the FSRU on marine diesel oil to 72 hours and the request that the condition be removed. It states that emissions from the FSRU when using marine diesel oil have the potential to exceed the *Protection of the Environment Operations (Clean Air) Regulation 2010*. It recommends consideration be given to not removing the existing condition of approval.	As discussed in the EIS, RTS and the proposed modification the FSRU would only operate in marine diesel oil mode in limited situations. It is preferable from both an operational efficiency and environmental perspective that the FSRU utilises LNG as a fuel source. The assessment of potential air quality in the proposed modification included an assessment of the potential impacts of operation of the FSRU and an LNG carrier operating on marine diesel oil. It found that there would be no incremental or cumulative exceedances of the relevant criteria at residential receivers. As such, removal of the condition would not be expected to result in exceedances and the utilisation of marine diesel oil on the FSRU would remain as low as practicable. The request that the condition be removed or amended was subject to being able to demonstrate compliance with the *Protection of the Environment Operations (Clean Air) Regulation 2010*.
<u>Sensitive receptors</u> The submission refers to the hazard and risk assessment of the proposed modification and notes that the nearest residences would be outside predicted high season risk contours.	The assessment of potential hazard and risks of the proposed modification considered a range of hazardous scenarios including jet fire, flash fire, pool fire or explosion.

Issue	Response
It states the high season would be during the cool months of winter and shoulder seasons during which prevailing weather conditions would include west-south-west airflows, directed away from nearest residences. It recommends that a condition of approval limit the high season to the above months and prevailing weather conditions to limit potential impacts on sensitive receptors in the event of a gas leakage or other emergency.	The assessment incorporated worst case assumptions such as not taking into account the mitigating effect of fire and gas detection, isolation and depressurisation systems. As identified in the submission, the assessment found that nearest residences would be outside the predicted risk contours. The findings of the hazard and risk assessment were based on annual average weather data from the Bureau of Meteorology. Seasonal variation in the weather data would not materially affect the risk contours to the extent that potential impacts would occur at residences. As such, a condition limiting high season operations to specific months or weather conditions is not considered necessary to mitigate potential hazards and risks.
Noise and vibration The submission notes the noise and vibration assessment of the proposed modification found that its potential impacts would be consistent with the EIS and that existing conditions of approval would apply.	As stated in the submission, the assessment of noise and vibration assessment in the proposed modification found that, consistent with the EIS, noise during operation would comply with the relevant noise criteria. It is agreed that the existing conditions of approval remain appropriate.

3.3 Organisations

3.3.1 NSW Ports

Issue	Response
Operational flexibility The submission notes that the project applies to land managed by NSW Ports under a 99 year lease and that NSW Ports consequently has an	The proposal for the removal of the condition is supported.

Issue	Response
interest in the approval containing the operational flexibility so as not to limit it in its management of the land and port operations to meet growing trade needs in NSW. The submission notes the existing condition of approval that establishes a limit of 26 LNG carrier shipments in any calendar year and states such limits would restrict the ability to rapidly respond to the State's energy needs. It further states that it strongly supports the removal of any such condition of consent that would limit the ability of the port to cater for trade and energy supply demands.	

3.3.2 Regional Development Australia Illawarra

Issue	Response
<u>LNG carriers</u> The submission notes the existing condition of approval that establishes a limit of 26 LNG carrier shipments in any calendar year and the request for removal of the condition. It states the Regional Development Australia Illawarra is in support of the project and the proposed removal of the condition. It notes that NSW Ports also supports its removal.	The support for the proposed removal of the condition is acknowledged.
<u>Local content</u> The submission notes the potential economic benefits of the project including capital investment and employment. It states that Regional Development Australia strongly supports the maximisation of local content for both construction and operation.	As discussed in the EIS, the proponent is committed to implementing a contracting and procurement strategy that maximises local content to support local employment and business opportunities during construction,

Issue	Response
	and working with interested local parties to support qualification/certification pathways for specialised roles on the FSRU.

3.3.3 Port Kembla Pollution Meeting

Issue	Response
<u>Approval pathway</u> The submission states the scale of the proposed modification and any connecting gas pipeline justifies that the project be reassessed rather than modified.	As stated in the modification report, the project will remain substantially the same development as originally approved. A small increase in output is required to respond to seasonality of demand while additional infrastructure or alteration to proposed construction methodologies is not required. The proposed modification does not involve any change to the proposed gas pipeline as assessed and amended in the EIS and RTS. Any proposed upgraded or alternative connecting gas pipeline outside of the project footprint would be subject to a separate assessment and approval process under the *Environmental Planning and Assessment Act 1979*.
<u>Seawater discharge</u> The submission notes the revised volume of seawater discharge from the project with the proposed modification. It disputes that the potential impacts would be minimal.	As discussed in the seawater discharge assessment in the proposed modification, the comparison of high season discharge against the EIS base case revealed that the increased velocity associated with the higher discharge rate resulted in improved mixing characteristics, smaller temperature changes and reduced discharge concentrations at the edge of a nearfield mixing zone of a similar radius. On this basis, it is considered that the proposed modification would not result in significant different impacts to the EIS.

Issue	Response
Hazard and risk The submission states the proposed modification along with other hazardous industries significantly increases hazards and risks such as explosion and terrorism. The submission also makes reference to the cumulative risk of explosion or other hazards posed by the gas pipeline proposed by APA. It requests that a complete reassessment take place including consideration of the other industrial activities in the area.	An updated hazard and risk assessment was provided as part of the proposed modification, which documented the potential hazards and risks associated with the low season and high season in relation to the scenario originally assessed in the EIS (the base case). The updated hazard and risk assessment concluded the proposed modification would not introduce additional hazardous inventories or scenarios. The resulting risk contours were considerably reduced in the low season and were largely similar to the base case in the mitigated high season scenario. The risk of propagation of hazard events causing damage or escalation of the hazard events at other facilities was also assessed. It was found that the relevant hazard contour (23 kW/m^2 at 5E-05 pa) would not impact nearby onshore industrial facilities. The existing conditions of approval require further assessments of hazard and risk including a Fire Safety Study, Emergency Plan, Hazard Operability Study and Final Hazard Analysis. Further assessment at this time is not considered to be necessary. Any proposed third party connecting gas pipeline would also be subject to a separate assessment and approval process under the *Environmental Planning and Assessment Act 1979*.

3.4 Individuals

3.4.1 Submitter 119337

Issue	Response
Ecological impact The submission makes reference to a report which states there would be 125 threatened flora and fauna species, and 4 endangered ecological	The submissions appears to make reference to the scoping report for APA's proposed Port Kembla to Wilton Gas Pipeline, which is subject to a separate

Issue	Response
communities, in or near a pipeline alignment. It opposed the pipeline on the grounds of potential ecological impact.	assessment and approval process under the *Environmental Planning and Assessment Act 1979*.

3.4.1 Submitter 119959

Issue	Response
<u>Public exhibition</u> The submissions states the two week exhibition period was inadequate.	As stated in the proposed modification, the project with the proposed modification will remain substantially the same development as originally approved. It would not involve additional infrastructure or alteration to proposed construction methodologies. Given the above, the two week exhibition period was determined to be adequate.
<u>Greenhouse gas and climate change</u> The submission objects to the project on the basis of climate change. It states that global gas use for energy should be limited and new fossil fuel projects should not be occurring. It states the claim that gas creates fewer greenhouse gas emissions than coal does not account for emissions associated with the extraction, transport and production of gas. It notes the project greenhouse gas inventory includes Scope 1 and 2 emissions. It states Scope 3 emissions should also be included. The submission makes reference to the objective of Wollongong City Council to have net zero greenhouse gas emissions by 2050. It states the project should have a plan in place to comply with this commitment. It states that many of the key objectives of the project could instead be met by investment in renewable energy.	As discussed in the EIS and RTS, while the consumption of natural gas may eventually be displaced by the consumption various non-fossil fuel alternatives, until that occurs, natural gas provides consumers with a fossil fuel option with some environmental benefits, including producing about half the carbon dioxide per unit energy compared to coal. It is acknowledged the greenhouse gas inventory of the project was predicted to increase by about 19% as a result of the proposed modification. As discussed in the EIS and RTS, the greenhouse gas inventory comprises a mall proportion of Australia's national greenhouse gas emissions, being about 0.01 per cent. This remains the case with the proposed modification. The proponent has committed to a number of management measures to avoid mitigate and manage potential greenhouse gas emissions including

Issue	Response
It states the project may prevent development of more sustainable port uses.	implementation of a Ship Energy Efficiency Management Plan and maintaining an International Energy Efficiency Certificate.
<u>Economic and employment risks</u> The submission makes reference to a number of economic and employment risks. It also questions the life of the project, whether it would be 5 years or 15 years, and if this would provide long term contracts. It also states the project with the proposed modification does not account for how variability in predicted gas demand and production would affect project employment.	As discussed in the EIS, RTS and proposed modification, the project addresses potential gas supply and price issues in NSW and is considered to be strategically robust. Based on existing demand, the project is expected to have an operational life of 10 to 15 years, which could be extended subject to sufficient ongoing gas demand. It should be noted the FSRU is a sea-going vessel. As a result, there is more flexibility with the project infrastructure than a typical on-shore facility. If there is no requirement for on-going gas supplies to NSW, the vessel can simply be sailed away and the berth converted to alternative uses. Once fully operation, the project is expected to employ about 40–50 personnel. Variability in predicted gas demand as discussed in the proposed modification would not be expected to affect this estimate of employment.
<u>Demand forecast</u> The submission states that the gas demand and production forecasts in the EIS and the proposed modification are unreliable. It states this is evidenced by the change in demand and production forecasts between the EIS and the proposed modification, and potential variability within those forecasts.	The original EIS, RTS and modification all draw on gas demand information from public Government and industry publications. The key reason for a variation in the demand profile outlined in the modification is the inclusion of retail clients, not just industrial clients, in the potential customer base for the project. Retail clients have a significant seasonal fluctuation in their requirements, which could not be met by the steady-state proposal of the original EIS.

Issue	Response
<u>LNG carriers</u> The submission states that the potential environmental impacts of increased LNG carriers, particularly during predicted high seasons, is not adequately assessed. It states the increased LNG carries may significantly increase potential impacts with regard to matters such as hazard and risk, waste management, traffic and access, noise and vibration, water resources and air quality.	The potential impacts of flexibility in the schedule of LNG carriers were assessed in the proposed modification. The assessments demonstrated the modification would not significantly increase potential impacts.
<u>Marine diesel oil</u> The submission notes the existing condition of approval that limits the operation of the FSRU on marine diesel oil to 72 hours. It makes reference to the request that the condition be removed or amended subject to being able to demonstrate compliance of the vessel with the *Protection of the Environment Operations (Clean Air) Regulation 2010*. It states that the removal of the condition on the basis that technology may improve is not acceptable and objects to its removal.	As discussed in the EIS, RTS and the proposed modification, the FSRU would only operate in marine diesel oil mode in limited situations. It is preferable from both an operational efficiency and environmental perspective that the FSRU utilises LNG as a fuel source. An amendment to facilitate the early adoption of technologies which can further improve the environmental performance of the FSRU when operating in marine diesel oil mode has been requested.
<u>Substantially same development</u> The submission states the project with the proposed modification is not substantially the same development as described in the EIS.	As stated in the proposed modification, the project with the proposed modification will remain substantially the same development as originally approved. It would not involve any additional footprint area infrastructure or alteration to proposed construction methodologies. In some instances, the environmental impacts of the project will actually be reduced by the introduction of seasonal operations.

4. Conclusion

AIE is seeking a modification of the Minister's approval for the Port Kembla Gas Terminal under section 5.25 of the *Environmental Planning and Assessment Act 1979*. The modification is to accommodate the potential for more variability in customer demand profiles and associated flexibility in operational parameters including the delivery schedule and options of LNG cargoes.

An environmental assessment has been prepared to consider the potential environmental impacts arising from the proposed modification under Section 5.25 of the *Environmental Planning and Assessment Act 1979*. The proposed modification will not significantly alter the project footprint or the construction methodology. The assessment has therefore focussed upon potential environmental impacts which might occur as a result of a variable operational model.

The key issues that were found to be potentially affected by the proposed modification include hazard and risk, water resources, marine ecology, noise and vibration, air quality, port navigation, greenhouse gas, and social and economic matters. In general, the proposed modification was not found to significantly affect or introduce additional environmental impacts.

Overall, the Port Kembla Gas Terminal will remain substantially the same development as approved under the original Infrastructure approval (SSI 9471). The proposed modification does not seek to significantly alter the nature or scale of the proposed development.

Appendices

Appendix A
Hazard and risk responses

Port Kembla Gas Terminal-Mod-1 (SSI-9471-Mod-1) Response to Submissions - Attachment 1

No.	Question	Response
1	Page 16 of the Hazard and Risk Assessment (Appendix A) lists possible safety features and the subsequent risk consideration for the project operating with a throughput of 500 T/J per day.	-
1a	Noting "the existing QRA part count data" was considered in the modification: i. did the sensitivity analysis consider the revised inventory based on the largest isolatable inventory for topside equipment for all scenarios? ii. were all the released inventory in the models updated according to the relevant inventory based on the current design? iii. are "the existing" QRA part counts based on the latest FSRU design information?	i. Yes. The largest topside isolatable volume is applied to all scenarios. This volume is estimated from the header between LNG storage and regasification unit including the regasification suction drum. ii. All scenarios were updated with conservative volume size based on the largest topside isolatable. As it would be very time consuming to estimate the volumes for each of the scenario by using plot plans and general arrangements, for simplicity and conservatism, the largest topside isolatable volume was applied to all scenarios. iii. The FSRU design has not been changed since the initial QRA parts count. Therefore, the QRA parts count is still valid. Note the parts count includes a 15% contingency. Report (401010-01496-SR-TEN-0003) rewording in Section 3.2 modified.
1b	A 30 second isolation response time has been assumed. Is this isolation time required by the class society rules for the FSRU? If so, please provide the reference.	There are no Class Requirements for closing time of ESD valves. In the SIGTTO guidelines for ESD, a closing time of 25 – 30 seconds for manifold valves is mentioned. Report (401010-01496-SR-TEN-0003) rewording in Section 3.2.3 modified.
1c	A Safety Integrity Level 1 (SIL 1) fire and gas detection and isolation system has been assumed (and a SIL 2 capable system is expected). Does the class society rules for the FSRU require a minimum SIL 1 rating? If so, please provide the reference.	There are no Class Requirements for minimum SIL rating on FSRUs / LNGC. However, according to conservative generic failure data taken from Exida Safety Equipment Reliability Handbook, 3rd Edition, Volume 1 to 3, the DU failure for: - Generic fire detector is 1.58E-02 pa (Item No. 1.2.2) - Generic gas detector is 3.50E-03 pa (Item No. 1.2.4) - General purpose PLC is 2.55E-02 pa (Item No. 2.3.1) - Generic actuated ball valve is 2.00E-02 (Item No. 3.5.1) This would result in a conservative F&G detection and isolation loop of SIL 1 (i.e. PFD of 4.56E-02 when serviced 2 yearly). Also see 1g response below. Report (401010-01496-SR-TEN-0003) rewording in Section 3.2.3 modified.
1d	Noting the assumed average de-pressuring leak rates are based on the largest isolatable inventory: i. how are the average leak rates are determined? (Are they determined based on a time-varying release model? Or is a time-varying release model adopted for the current model?) ii.was the original Preliminary Hazard Analysis (PHA) based on peak leak rates throughout the release?	i. The average de-pressing leak rates for all scenarios were based on the leak reduction ratio modelled using PHAST time-varying releases model for various leak sizes with conservative pressures (i.e. 5.5 barg LP system and 100 barg HP system) and volume (i.e. largest topside isolation volume). ii. Yes. The original PHA risk contours were based on peak leak rates.
1e	The mitigated ignition probability (IP) is currently based on the average de-pressuring leak rate. Please clarify whether such approach results in significant variance in ignition probability for all the release scenarios.	The IP reduction were within an order of magnitude with largest reduction 45%. See tables to the right. Note there was no change to the IPs for the larger releases were unchanged. These larger releases tend to drive out the 5E-05 and lower risk contours.

Process condition for LP system with largest inventory:
- 5.5 barg
- -160 °C

Leak Size	Initial Leak Rate (kg/s)	Averaged Rate (kg/s)	Reduction in IP	new IP
10 mm	1.081	0.803	13.0%	0.00235
25 mm	6.757	3.397	44.8%	0.00933
50 mm	27.029	14.012	43.3%	0.03828
100 mm	108.116	61.186	39.1%	0.16470
FB	1729.860	1482.900	0.0%	0.65000

Process condition for HP system with largest inventory:
- 100 barg
- -160 °C

Leak Size	Initial Leak Rate (kg/s)	Averaged Rate (kg/s)	Reduction in IP	new IP
10 mm	4.626	2.471	41.9%	0.00672
25 mm	28.915	15.048	43.2%	0.04109
50 mm	115.659	66.447	38.3%	0.17842
100 mm	462.636	323.263	0.0%	0.65000
FB	1850.540	1602.730	0.0%	0.65000

1f	Please provide a comparison table for the major risk contributors of the project, which includes the release inventory, peak release rate, the adopted average leak rate, the original IP, the mitigated IP, and any other reduction factors applied to the major risk contributors.	Risk model has been reran with a Risk Ranking Point at the Wharf to measure the top 10 risk contributors at this location. See table on the right. Table has been included in the Modification 1 Submissions Report.
1g	It appears that the E-Tree implies all release events will have some form of SIL 1 level isolation system. As such, a mitigated IP has been assumed for isolation successful scenarios for all events. This assumption seems to be optimistic and it depends on how the isolatable inventories are considered in the model. Please provide justification on whether this assumption is credible and revise the model if required.	The gas detection and isolation system only applies to the LNGC / FSRU and wharf topside equipment. The LNGC / FSRU cargo storage tanks and export pipeline are excluded due to large inventory sizes. Although it is noted that a SIL 1 F&G system is assumed, the base assumption is that 1 in 10 fire / gas incidents will not be detected and isolated. The detection can either be from BPCS, operator intervention and/or F&G system. The PFD set at 0.1 is in-line with typical PFD for BPCS or operator intervention (i.e. high stress situation), which is usually less reliable than a dedicated F&G system with PFD usually much lower than 0.1. Report (401010-01496-SR-TEN-0003) rewording in Section 3.2.3 modified.
1h	Is the intent of the last paragraph on page 16 of Appendix A is to state that the IP and inventory of releases for LNGC, FSRU cargo storage tanks and export pipeline are unchanged from those considered in the original EIS?	Yes. Sentence reworded in the report (401010-01496-SR-TEN-0003)
2	Please clarify whether Figure 3.9 of Appendix A is based on the result of the sensitivity analysis (i.e. considering the possible safety features).	Figure 3.9 is based on the peak rate scenarios. A sentence has been added in the report (401010-01496-SR-TEN-0003) after the first paragraph in Section 3.2.4 to note this.
3	Please clarify how the increased throughput during the high season may alter the risk from the HP pipeline (for example, would the high demand require an increase in the maximum allowable operating pressure and its transfer rate). It is noted that the risk contour along the HP pipeline has not changed (except at the Cringila area).	At high season the operating pressure of the pipeline is 100 barg instead of 120 barg for the base case. Comparing Figure 3-1 (Base Case) and Figure 3-4 (High Demand Case), the risk contour along the pipeline has decreased slightly due to the drop in pressure for the winter case (high demand) and thus no change to the pipeline MAOP.
4	Please clarify the mercaptan transport and storage requirement for the high season case, and how the toxic risk may be different from the original EIS with the increased throughput.	The concentration of Mercaptan within the gas in the export pipeline is unchanged for the high demand case. It is also expected that the Mercaptan storage vessel at the wharf will remain the same with increased top-up frequency during the high demand season. Therefore, the maximum impact distances for Mercaptan storage vessel LOC will not change compared to the original EIS.

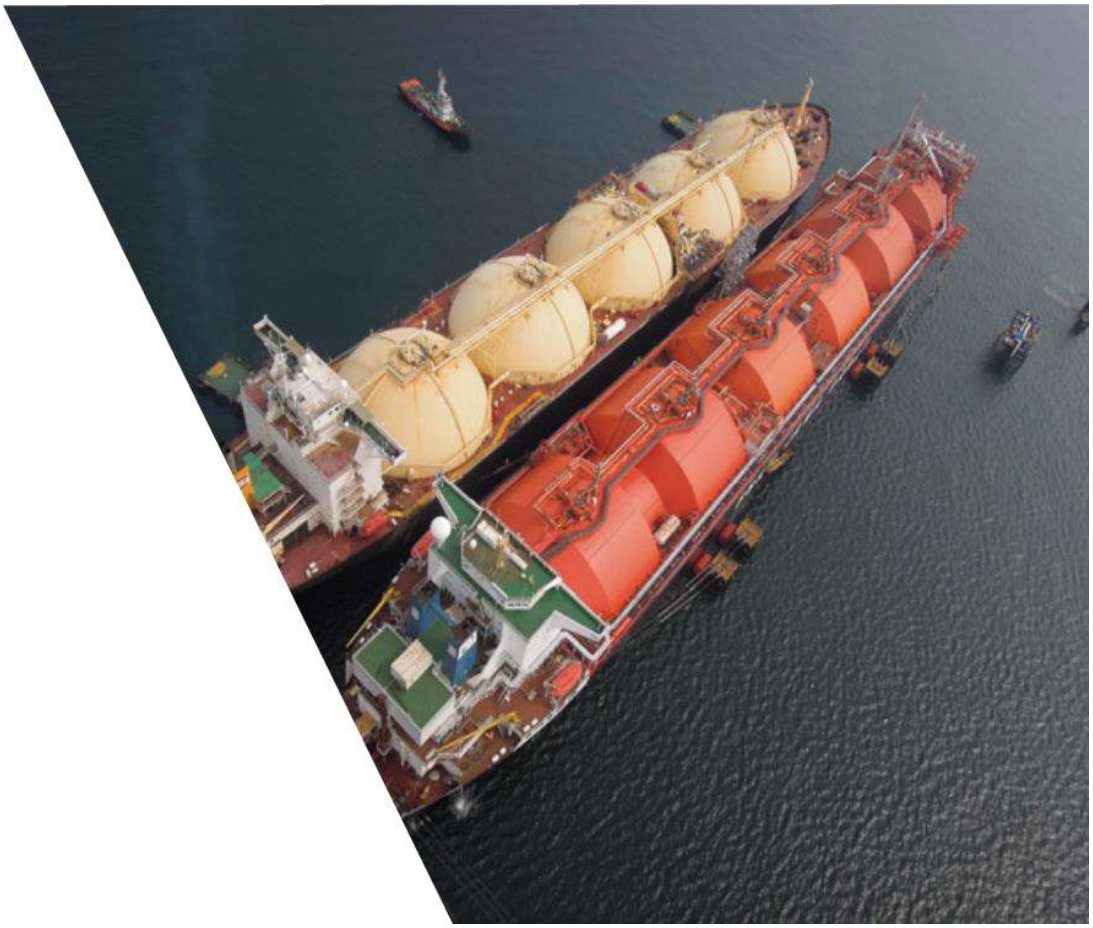
Risk Ranking at Wharf	Model Name	Model Description	Base Case Inventory (m^3)	Mitigated Inventory (m^3)	Peak Leak Rate (kg/s)	Peak IP	Mitigated IP % Reduction	Mitigated IP
1	Feed Hdr - FB	Headers (LNG feed to regasification)	Infinite	46.7	972.4	0.650	0.0%	0.650
2	Cargo Hdr - FB	Headers (LNG to Cargo Tanks)	Infinite	46.7	3889.4	0.650	0.0%	0.650
3	Tank BOG Hdr - FB	Headers (Cargo Cold Gas)	Infinite	46.7	49.3	0.123	0.0%	0.123
4	Warm BOG Hdr - FB	Headers (Warm Gas from LD Compressors)	Infinite	46.7	675.2	0.650	0.0%	0.650
5	Spray Hdr - FB	Headers (LNG Spray)	Infinite	46.7	69.1	0.173	0.0%	0.173
6	Wharf Transfer - FB	Wharf Topside (HP Gas Transfer System)	Infinite	46.7	2588.1	0.650	0.0%	0.650
7	Wharf Pig - FB	Wharf Topside (Pig Launcher)	Infinite	46.7	3380.4	0.650	0.0%	0.650
8	Pumps Out - FB	Regas Module (LNG from Regas Unit Pumps to LNG Vaporizer)	Infinite	46.7	2019.8	0.650	0.0%	0.650
9	Gas Return Hdr - FB	Headers (Gas from HD Compressors)	Infinite	46.7	3889.4	0.650	0.0%	0.650
10	Pumps Out - 50mm	Regas Module (LNG from Regas Unit Pumps to LNG Vaporizer)	Infinite	46.7	126.2	0.316	43.3%	0.179

Appendix B
Hazard and risk assessment

AUSTRALIAN INDUSTRIAL ENERGY

Port Kembla Gas Project

Preliminary Hazard Analysis Addendum - Seasonal Variations



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PROJECT 401010-01496-SR-TEN-0003 – Port Kembla Gas Project

Rev	Description	Original	Review	WorleyParsons Approval	Date	Customer Approval	Date
0	Issued for Use	Donald Law Jan 31 2020	Andrew Fergusson 31 Jan 2020	PP Andrew Fergusson 31 Jan 2020	31 January 2020		
		D Law	A Fergusson	F Losty			

Contents

1. INTRODUCTION

1.1 Project Overview

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

NSW currently imports more than 95% of the natural gas it uses, with the majority of supplies coming from Victoria and South Australia. In recent years, gas supplies to the Australia east coast market have tightened, resulting in increased prices for both industrial and domestic users.

Port Kembla Gas Terminal consists of four key components:

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

LNG will be sourced from worldwide suppliers and transported by LNG carriers to the Port Kembla Gas Terminal. The LNG will then be regasified for input into the NSW gas transmission network. The project will be the first of its kind in NSW and provide a simple, flexible solution to the state's gas supply challenges.

1.2 Proposed Modification

The Project was declared Critical State Significant Infrastructure (CSSI) in accordance with section 5.13 of the Environmental Planning and Assessment Act 1979 (EP&A Act) and received Infrastructure Approval from the Minister for Planning and Public Spaces on the 24th of April 2019.

Approval of the project was based upon the development described in the Port Kembla Gas Terminal Environmental Impact Statement (EIS) (GHD 2018) as amended in the Response to Submissions (RTS) (GHD 2019).

The EIS stated the project would have the capacity to deliver in excess of 100 petajoules (PJ) per annum and also indicated that the capacity of the project could be increased further to 140–150 PJ per annum in the future. The EIS assumed a relatively flat demand profile throughout the year based upon the predicted demands from a predominantly industrial customer base. The assessment presented in the EIS for operation of the gas terminal was therefore based upon a flat rate of production with two LNG trains operating within the FSRU.

Further analysis of market has identified that demand for gas would be seasonally dependant, with higher demand, particularly from retail customers in winter months. The rate of production will need to respond to this demand and will also be influenced by operational parameters such as the calorific content of LNG delivered to the project. Accordingly, the supply will likely vary from the assumed flat rate of around 300 Terajoules (TJ) per day for any given season or shipment of LNG.

AIE is therefore seeking a modification of the Minister's approval for the Port Kembla Gas Terminal under section 5.25 of the Environmental Planning and Assessment Act 1979. The modification will seek authorisation to increase capacity of the project and allow for seasonality.

The modification will also require an increase to the overall number of LNG carrier deliveries per year to accommodate both the seasonality and the increase in capacity. The EIS anticipated the arrival of 24 consistently sized (170,000 cubic metre) vessels. However, with seasonality, incoming vessels may vary considerably in size from approximately 140,000 cubic metres to 180,000 cubic metres.

1.3 Objectives

The objective of this addendum to the Preliminary Hazard Analysis (PHA) [3] is to assess the proposed operational changes at the planned Port Kembla Gas Terminal against the Hazard and Risk requirements of the Secretary's Environmental Assessment Requirements (SEARs) issued 10 August 2018 specifically the requirements of Hazardous Industry Planning Advisory Paper (HIPAP) No. 4 Risk Criteria for Land Use Planning [2].

1.4 Acronyms

The abbreviations utilised in this project are listed below.

Abbreviation	Definition
AIE	Australian Industrial Energy
CSSI	Critical State Significant Infrastructure
EIS	Environmental Impact Statement
F & G	Fire and Gas
FSRU	Floating Storage and Regasification Unit
HIPAP	Hazardous Industry Planning Advisory Paper
LNG	Liquefied Natural Gas
LNGC	Liquefied Natural Gas Carrier

Abbreviation	Definition
NSW	New South Wales
PHA	Preliminary Hazard Analysis
PJ	Petajoules
PKCT	Port Kembla Coal Terminal
RTS	Response to Submissions
SIGTTO	Society of International Gas Tanker and Terminal Operators
SIL	Safety Integrity Level
SSI	State Significant Infrastructure

2. PROPOSED MODIFICATION DETAILS

The intent of the proposed modification is to account for potential additional delivery of natural gas, driven in part by higher retail customer demand, and associated changes to project operating parameters such as deliveries by LNG carriers.

The PHA [3] presented in the EIS was based on the assumed flat demand profile of 309 TJ per day for any given season. For the modification of the Minister's approval, the seasonal demands are modelled separately. The PHA has been updated based on the operating conditions summarised in Table 2-1.

Table 2-1: Proposed Modification [1]

Parameter	Base Case	Proposed Modification	
		Low Season	High Season
LNG Trains	2	1	2
LNG Trains Operating Pressure barg	120	120	100
Seawater discharge m^3/hr	10,500	3,250	13,000
LNGC Deliveries per year	26	26	52
Approximate TJ/day	309	120	500

Figure 2-1 shows the expected demand profile.

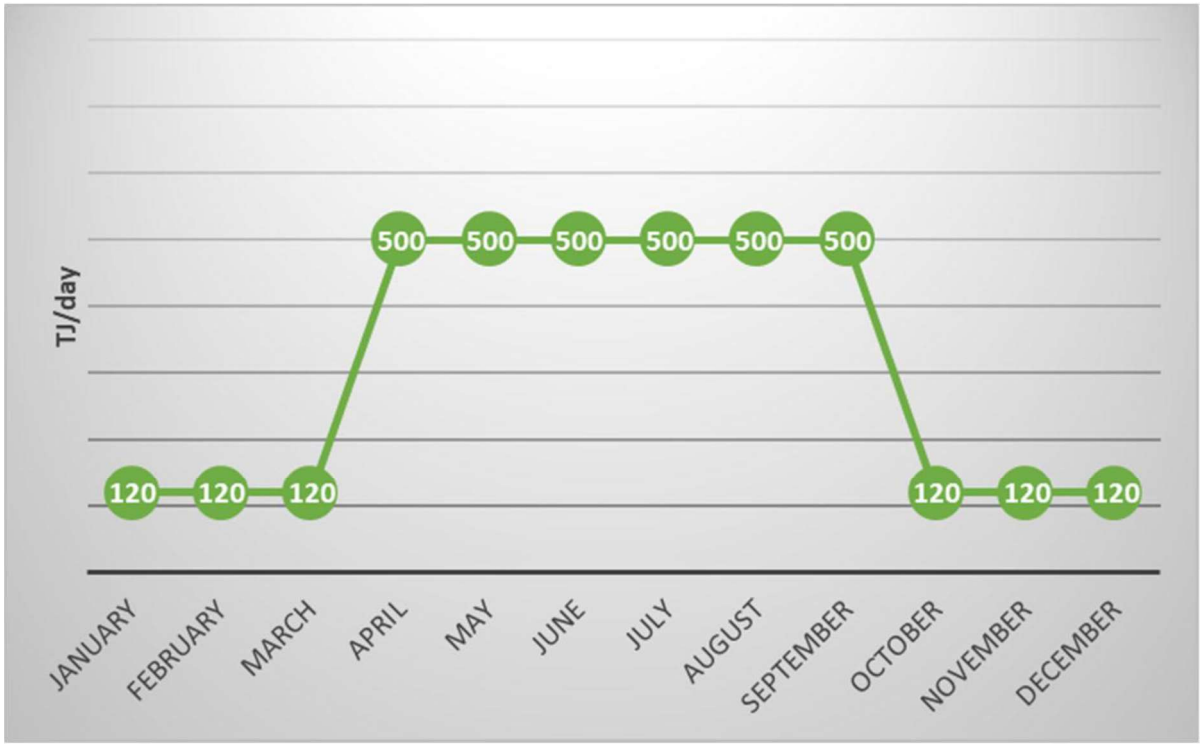

Figure 2-1: Seasonal Demand Profile [1]

3. HAZARD AND RISK ASSESSMENT

The Port Kembla Gas Terminal will remain substantially the same development as originally approved under SSI 9471. The proposed modification does not seek to significantly alter the nature or scale of the proposed development. Therefore, the proposed operational changes are not expected to significantly alter safeguarding systems proposed under the original development.

The proposed operational changes do not introduce additional hazardous inventories or scenarios. The hazards, hazardous scenarios and potential consequences identified within the PHA [3] remain unchanged.

The increase in the frequency of LNGC movements and LNG unloading increases the potential for loss of containment of LNG during transfer or ship collision during vessel movements. The risk assessment has therefore conservatively assumed 52 LNGC movements and unloading activities per year for the base case, low and high demand cases.

Production flowrate influences the consequences of low frequency, large loss of containment events such as full bore ruptures where the loss of pressure is rapid, and the release rate drops to the production rate before further reducing after detection, isolation and blowdown / depressuring if provided. The increase in production rate drives up the release rate and ignition probability which is proportional to the release rate, increasing risk.

The risk contours presented in the existing PHA [3] conservatively take no credit for detection and isolation. This approach has been maintained for the initial analysis presented in this addendum. However, in addition, a sensitivity analysis has been completed to include detection and isolation. The results of the initial modelling and sensitivity case are presented in the following sections.

3.1 Risk Criteria

The impact of modifications will be assessed by comparing the updated risk contours to the Hazardous Industry Planning Advisory Paper (HIPAP) No. 4 Risk Criteria for Land Use Planning [2]. These criteria are presented in Table 3-1.

Table 3-1: Fatality Risk Criteria

Risk (pa)	Land Use
5E-07	Sensitive land use; e.g. hospitals, schools, child-care facilities, old age housing
1E-06	Residential area; including hotels, motels, tourist resorts
5E-06	Commercial development; including retails centres, offices and entertainment centres
1E-05	Active open space; including sporting complexes
5E-05	Industrial

3.1.1 Propagation Risk

Heat radiation levels of 23 kW/m^2 and explosion overpressure levels of 14 kPa are considered sufficient to cause damage at neighbouring industrial operations to the extent where further hazardous incidents can potentially occur [2].

In order to ensure the risk of property damage at neighbouring installations the frequency of these impact levels occurring should not exceed a risk of 50 in a million per year (5E-05 pa).

3.1.2 Injury Risk

Heat radiation levels of 4.7 kW/m^2 and explosion over pressure levels of 7 kPa [2] are considered sufficient to cause injury to the public. As such the frequency of these impact levels should not exceed 50 in a million per year (5E-05 pa) at residential and sensitive areas.

3.2 Risk Assessment

The FSRU design has not changed since the initial PHA [3] and has been carried forward to use in the following assessments. The parts count conducted for the initial PHA includes a 15% contingency to account for minor design modifications and changes to the Piping and Instrumentation Diagrams (P&IDs) .

3.2.1 Base Case

The base case assumes an averaged flat demand profile of 309 TJ/day throughout the year based on the seasonal demands presented in Figure 2-1. The PHA risk model [3] inputs were maintained as outlined in the PHA with the exception of the LNGC deliveries. To accommodate the increased production from April to September it is conservatively assumed 52 LNGC deliveries are required per year.

Figure 3-1 and Figure 3-2 show the fatality risk contours generated with the LNGC deliveries increased to 52 per year.

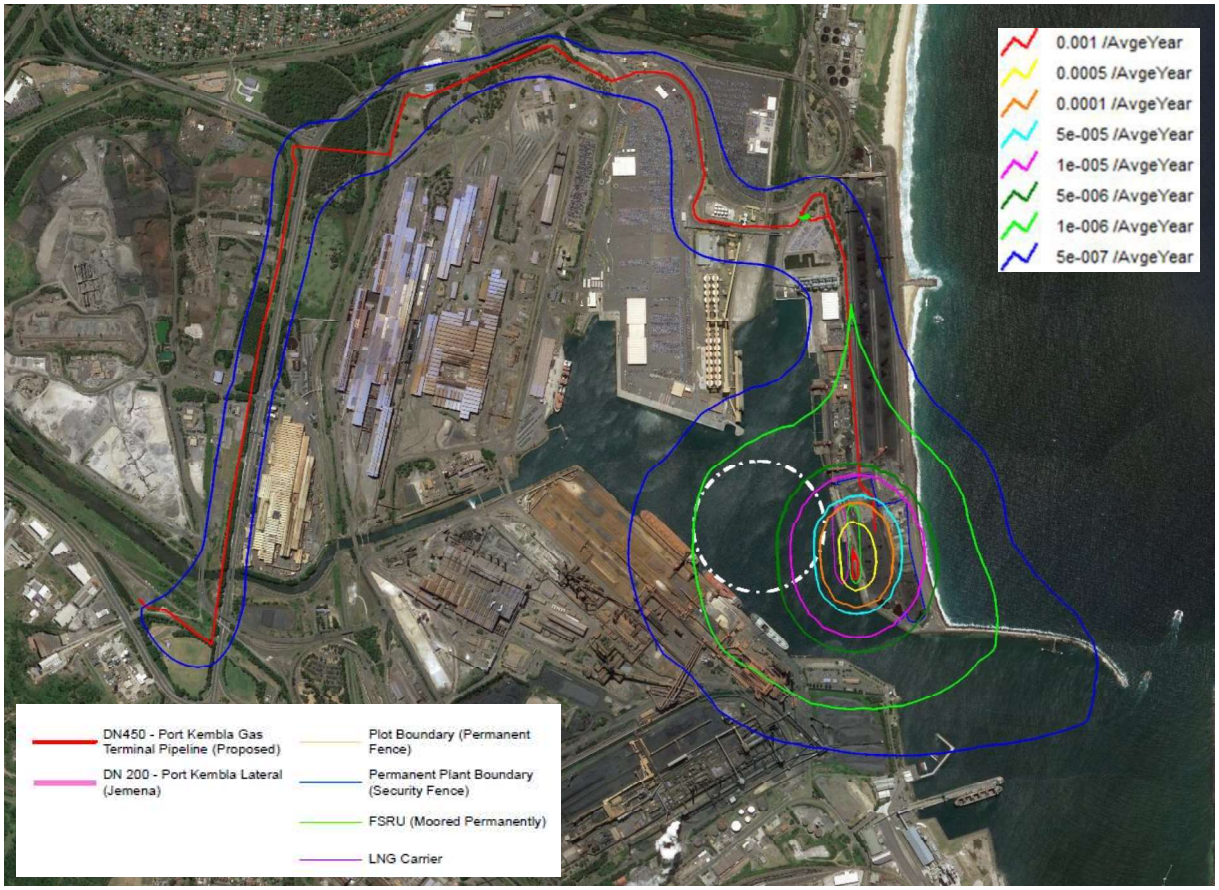

Figure 3-1: Fatality Risk Contours – Base Case

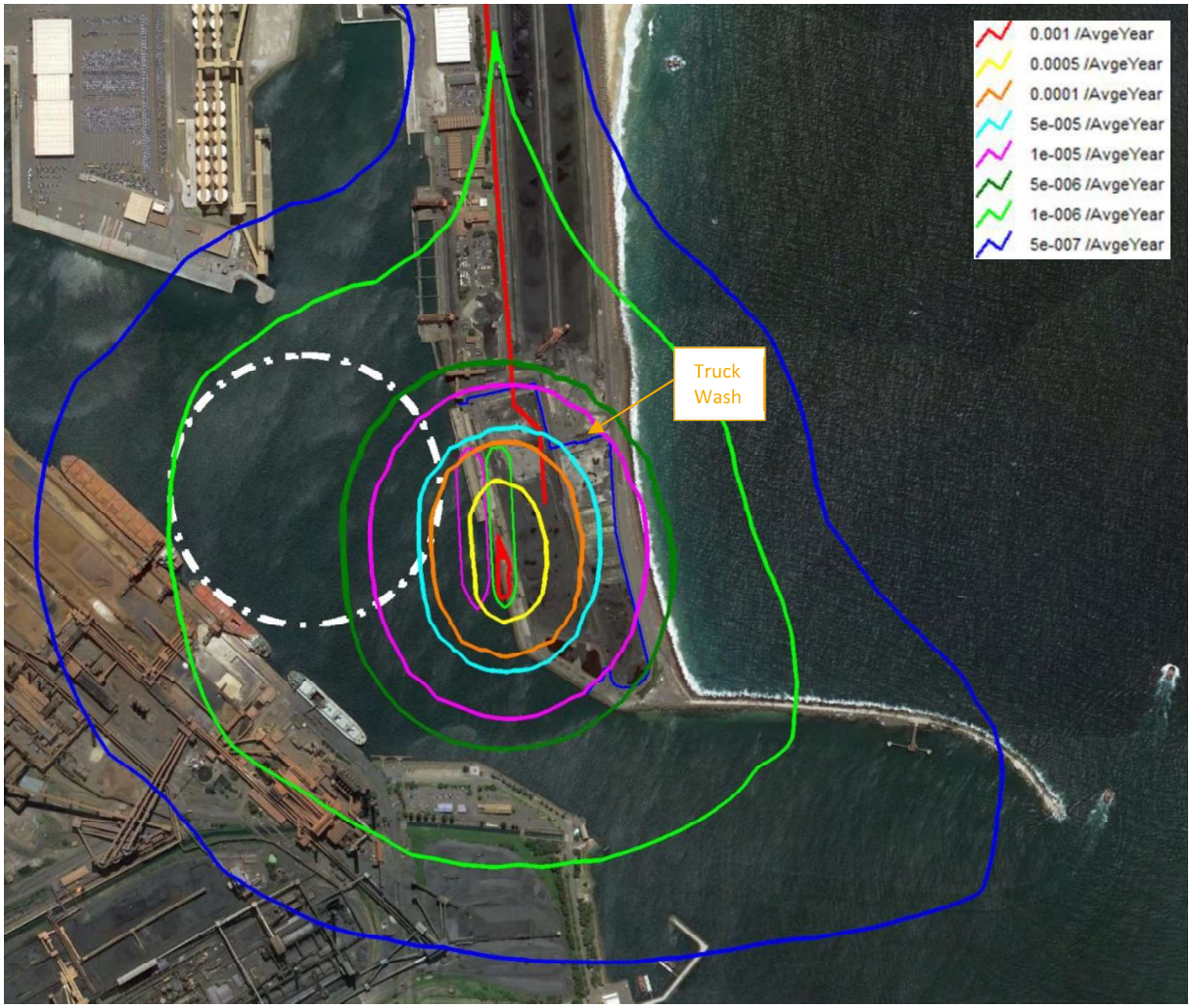

Figure 3-2: Berth Fatality Risk Contours – Base Case

The HIPAP4 Land Use Planning criteria states that the 5E-05 pa risk contour, as a target, should be contained within the boundaries of the industrial site where applicable. This risk contour is largely within the site boundary. However, it slightly extends beyond the wharf fence line at the north-east. It does not impact the truck wash located in this area.

The 1E-05 pa risk contour for active open spaces also extends beyond the wharf fence line, across Seawall Road and extends into the harbour. Seawall Road is a private road located on industrial land, controlled by NSW Ports and the Port Kembla Coal Terminal. It is opened to the public during daylight hours only and regularly closed for poor weather and/or other operational needs, including bulk haulage, construction/maintenance, etc. The road can be closed and secured at these times via security fencing and lockable gates. Access restrictions can be implemented and enforced by NSW Ports as required. Exposure for public users of Seawall Road is likely to be for short durations and numbers are limited as indicated by NSW Ports:

"The road tends to be used by surfers, rock fishers and occasional on-lookers for unusual events, such as the arrival of a large cruise ship. However, numbers of users are in the dozens, not the 100's, with the largest crowds seen there for the arrival of the Port's first cruise ship. Subsequent cruise ship arrivals have seen the crowd numbers dwindle."

Vessel entry into the Port Kembla Inner Harbour is controlled by the Port Authority and unauthorised entry is prohibited and enforced. Exposure of the public in this area is therefore expected to be low.

Propagation and injury risks have been calculated for the high demand case only as this higher rate will drive the consequences and hence the risk see Section 3.2.4.

3.2.2 Low Demand Case (120 TJ/day)

The low demand case will operate for up to six months from October through to March and will only operate with a single LNG train and LNG Booster pump required for the lower gas output. All other model inputs were maintained as outlined in the PHA.

Figure 3-3 and Figure 3-4 show the risk contours generated for the Low Demand 120 TJ/day case.

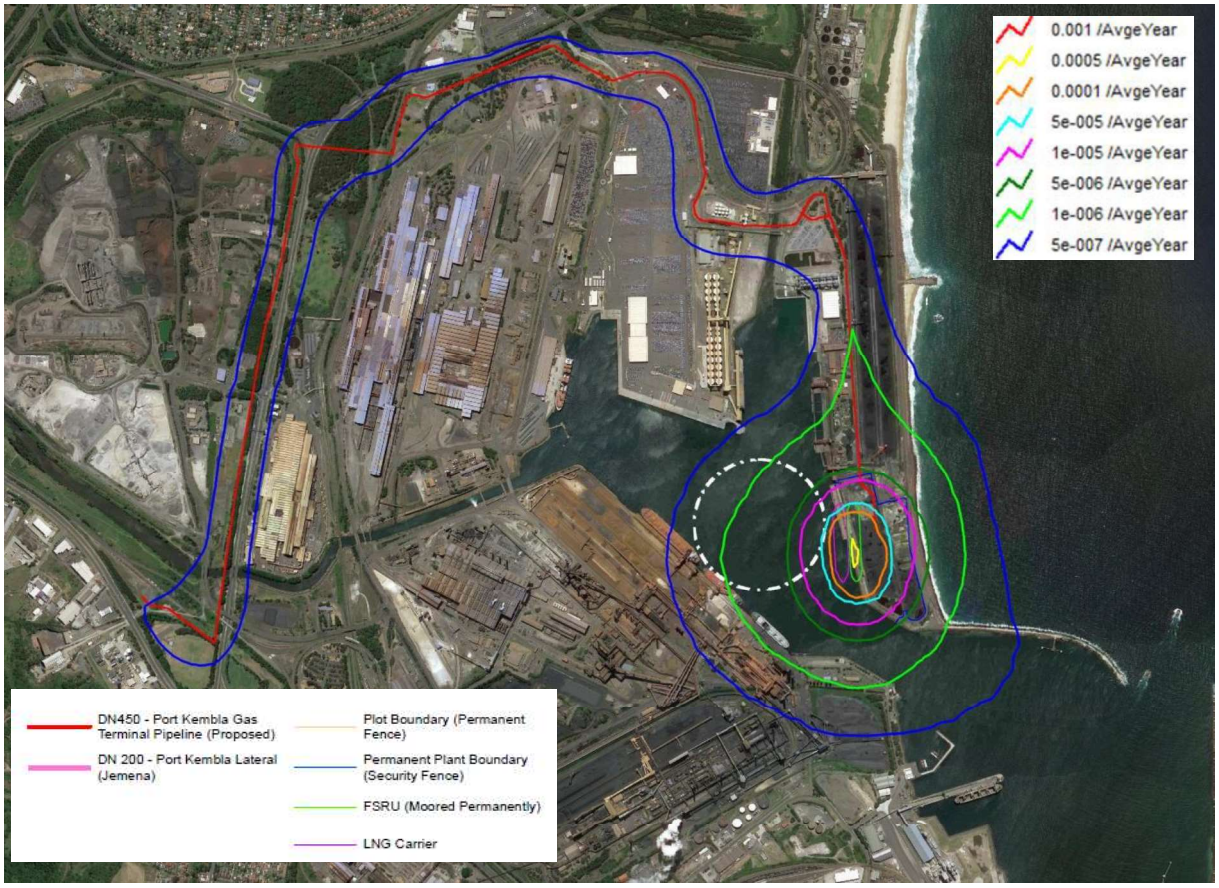

Figure 3-3: Overall Risk Contours – Low Demand Case

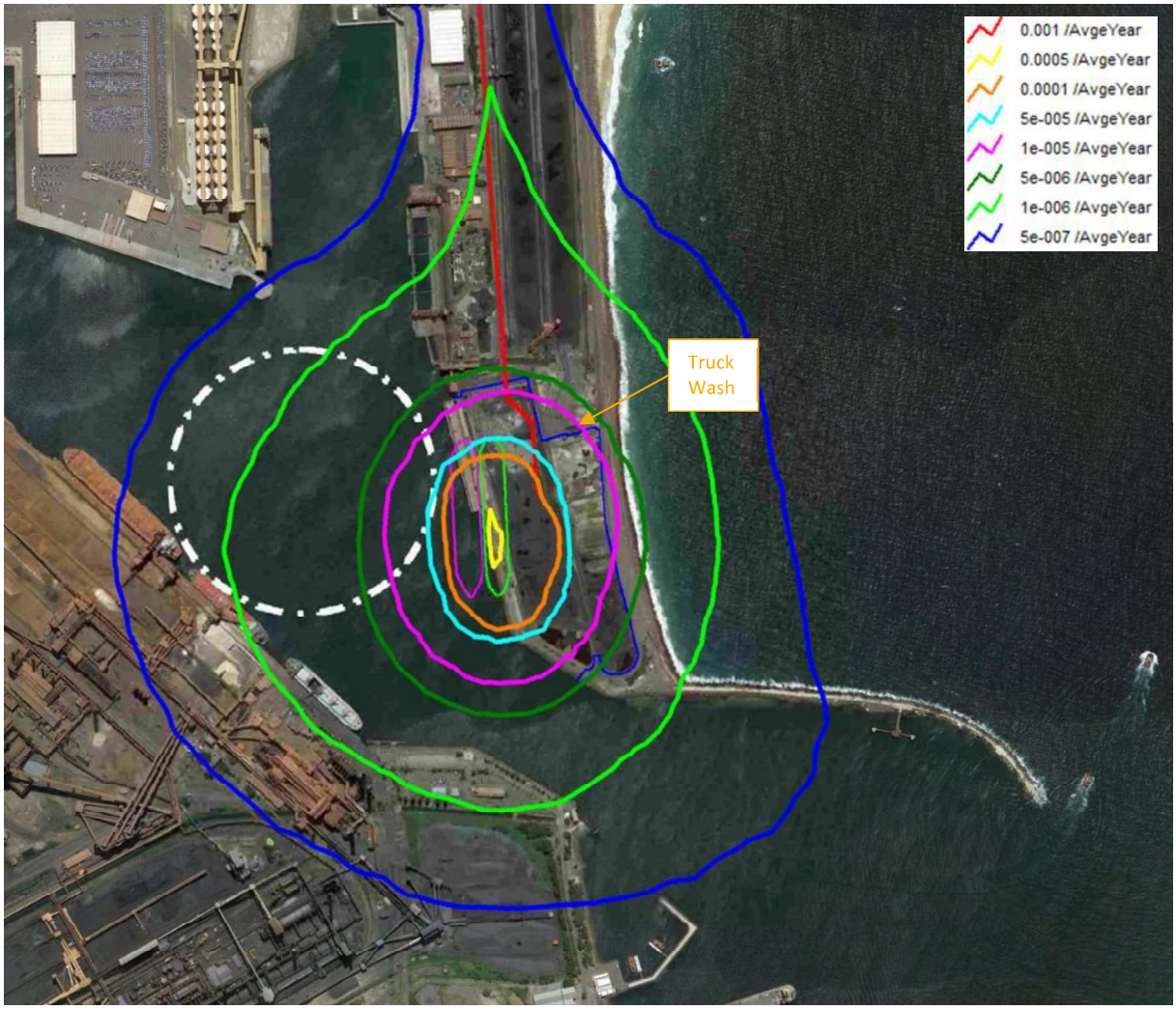

Figure 3-4: Berth Risk Contours – Low Demand Case

The 5E-05 pa risk contour for industrial areas is within the site boundary and does not impact the truck wash located near the north-east boundary fence line.

The 1E-05 pa risk contour for active open spaces extends beyond the wharf fence line and across a small portion of Seawall Road, where public exposure to risk is slightly greater than 1E-05 pa. The discussion in Section 3.2 relating to Seawall Road equally applies to the Low Demand Case.

3.2.3 High Demand Case (500 TJ/day)

The high demand case may operate for up to six months from April through to September and will continue to operate with two LNG trains in accordance with the EIS. However, the high demand case will operate with one additional LNG booster pump to achieve higher gas output. To accommodate the increased production, it is conservatively assumed 52 LNGC deliveries are required per year.

Figure 3-5 and Figure 3-6 show the risk contours generated for the High Demand Case.

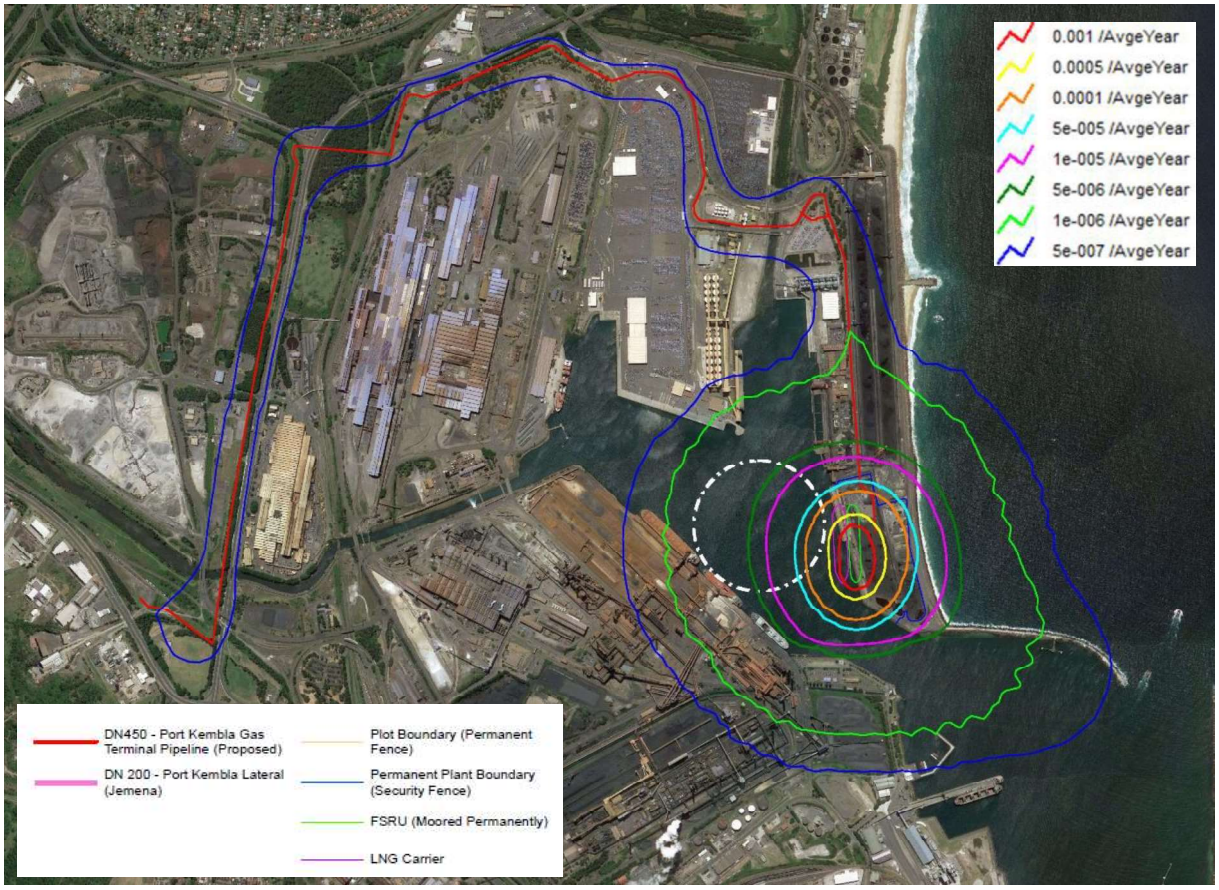

Figure 3-5: Fatality Risk Contours – High Demand Case

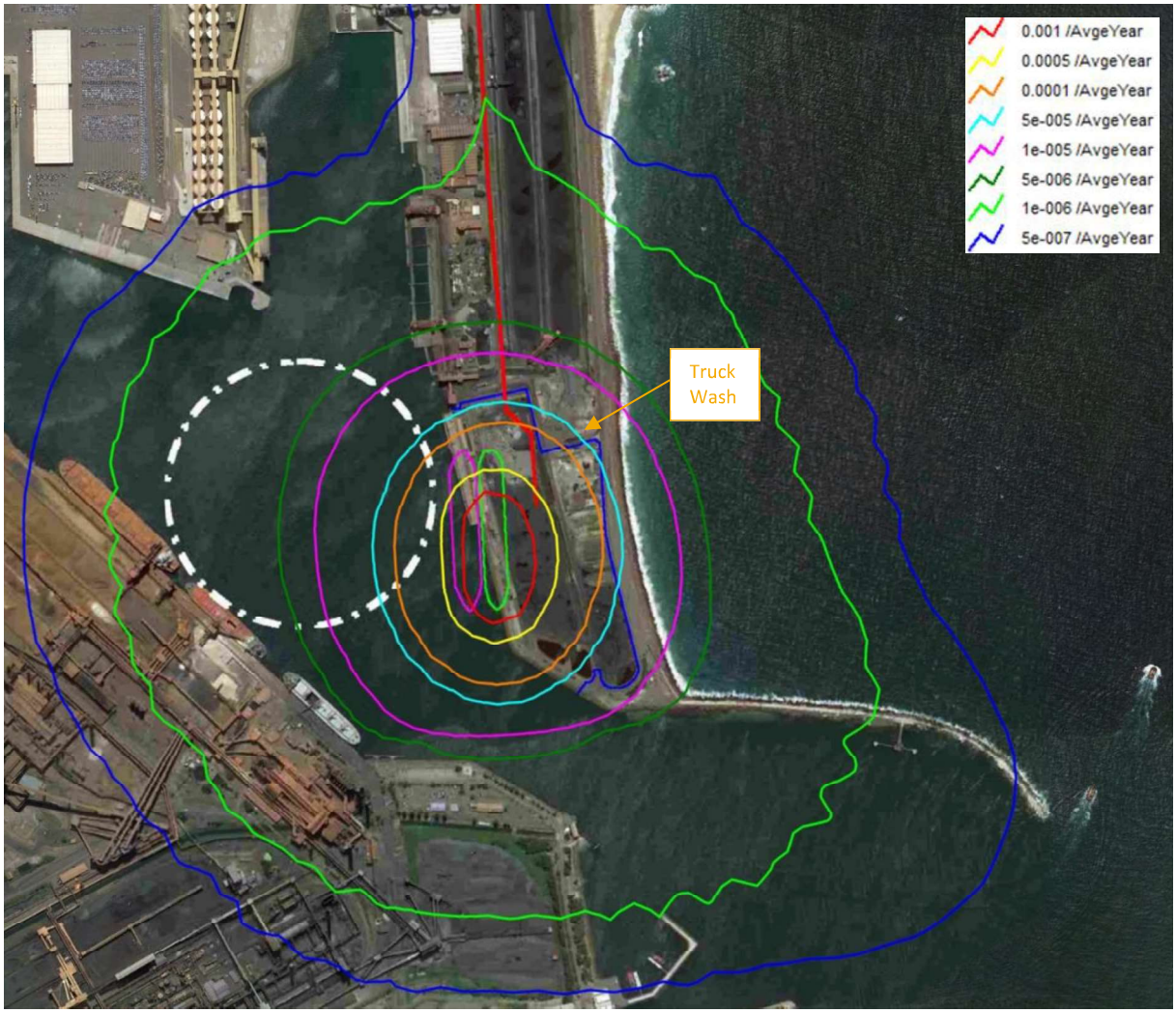

Figure 3-6: Berth Fatality Risk Contours – High Demand Case

The 5E-05 pa risk contour for industrial areas extends beyond the wharf fence line on the east boundary and extends beyond the truck wash located in this area. While the exposure at the truck wash area is slightly greater than 5E-05 pa risk, the risk to an individual is low due to limited exposure durations (i.e. low truck wash usage with limited duration).

The 1E-05 pa risk contour for active open spaces also extends beyond the wharf fence line, across Seawall Road and extends into the harbour. The discussion in Section 3.2 relating to Seawall Road equally applies to the High Demand Case noting that the high demand case is expected to occur during winters months when public access to Seawall Road for recreation is likely to be lower than during summer months.

The increased LNGC deliveries has extended the 1E-06 and 5E-07 pa risk contours along the ship route through the harbour. However, this has negligible risk impact to the other port users (including cruise ship terminal at berth 106) in the harbour.

The methodology used in the Quantitative Risk Assessment (QRA) to generate the risk contours presented is based on a number of conservative assumptions. Two of the more prominent conservative assumptions are:

- Fire and Gas (F&G) detection and isolation depressuring systems available on the FSRU and LNGC are not taken into account; and
- All leak scenarios are modelled with an infinite volume, taking no account of detection and isolation or finite volumes.

Detection, isolation and depressuring reduces the release rate and the ignition probability and therefore reduces risk significantly.

A sensitivity analysis has been conducted for the 500 TJ/day high demand case to account for detection and isolation. The steps taken are as follows:

1. Existing QRA parts count data and FSRU plot plans were used to estimate the largest isolatable volume for the FSRU topside equipment (i.e. header between LNG storage and regasification unit including regasification suction drum). This single largest volume is conservatively used in the QRA modelling for all leak scenario volumes, except for the LNGC and FSRU cargo storage tanks and export pipeline.
2. Mitigated (averaged) depressuring leak rates for 5.5 barg (Low Pressure (LP)) and 100 barg (High Pressure (HP)) liquid handling equipment were determined using the largest isolatable volume from step 1 (allowing for 30 seconds for F&G detection and isolation to occur). Shutdown valve closure time is consistent with the Society of International Gas Tanker and Terminal Operators (SIGTTO) Guidelines for manifold valves).
3. Using the equation presented below and assuming that 1 in 10 fire / gas incidents will not be detected and isolation initiated by either the Basic Process Control System (BPCS), F&G detection system and/or operator intervention the mitigated risk is calculated. The Probability of Failure on Demand (PFD) set at 0.1 is in-line with the typical failure probability for a BPCS or operator intervention under a high stress situation. There is no class requirement for the minimum Safety Integrity Level (SIL) rating on FSRU / LNGC. However, according to the failure data from Exida (Safety Equipment Reliability Handbook [5]), a conservative PFD for a F&G detection and isolation system is 0.02 with yearly maintenance. Therefore, PFD of 0.1 is considered to be conservative.

Event	Detection & Isolation Initiated?	Risk
Leak	No - 0.1	Leak Freq (L_f) x Unmitigated IP (use peak discharge rate) (IP_U)
	Yes - 0.9	Leak Freq (L_f) x Mtigated IP (use averaged discharge rate) (IP_M)
Fire Frequency = $L_f \times IP_U \times 0.1 + L_f \times IP_M \times 0.9 = L_f \times (0.1 \times IP_U + 0.9 \times IP_M)$		

4. Using the mitigated (averaged) leak rates from step 2 and United Kingdom Offshore Operators Association (UKOOA) Ignition Probability model [6], the mitigated Ignition Probability (IP) reduction ratios were determined for the LP and HP scenarios noted in step 2.

5. The mitigated IP determined for the HP case in step 2 were applied to all leak scenarios with pressure > 5.5 barg.

Process condition for HP system with largest inventory:
- 100 barg
- -160 °C

Leak Size	Initial Leak Rate (kg/s)	Averaged Rate (kg/s)	Reduction in IP	new IP
10 mm	4.626	2.471	41.9%	0.00672
25 mm	28.915	15.048	43.2%	0.04109
50 mm	115.659	66.447	38.3%	0.17842
100 mm	462.636	323.263	0.0%	0.65000
FB	1850.540	1602.730	0.0%	0.65000

6. The mitigated IP determined for the LP case in step 2 were applied to all leak scenarios with pressure ≤ 5.5 barg.

Process condition for LP system with largest inventory:
- 5.5 barg
- -160 °C

Leak Size	Initial Leak Rate (kg/s)	Averaged Rate (kg/s)	Reduction in IP	new IP
10 mm	1.081	0.803	13.0%	0.00235
25 mm	6.757	3.397	44.8%	0.00933
50 mm	27.029	14.012	43.3%	0.03828
100 mm	108.116	61.186	39.1%	0.16470
FB	1729.860	1482.900	0.0%	0.65000

Note that the IPs and inventory volumes of the LNGC and FSRU cargo storage tanks and export pipeline leak scenarios were left unchanged from the 500 TJ/day high demand case (taking no credit for detection and isolation).

By applying the above steps to reduce the ignition probability and isolatable volumes, accounting for SIL 1 F&G detection and isolation system, the resulting risk contours generated from the proposed 500 TJ/day increased production throughput and increased weekly LNGC deliveries were modelled and are presented in Figure 3-7 and Figure 3-8.

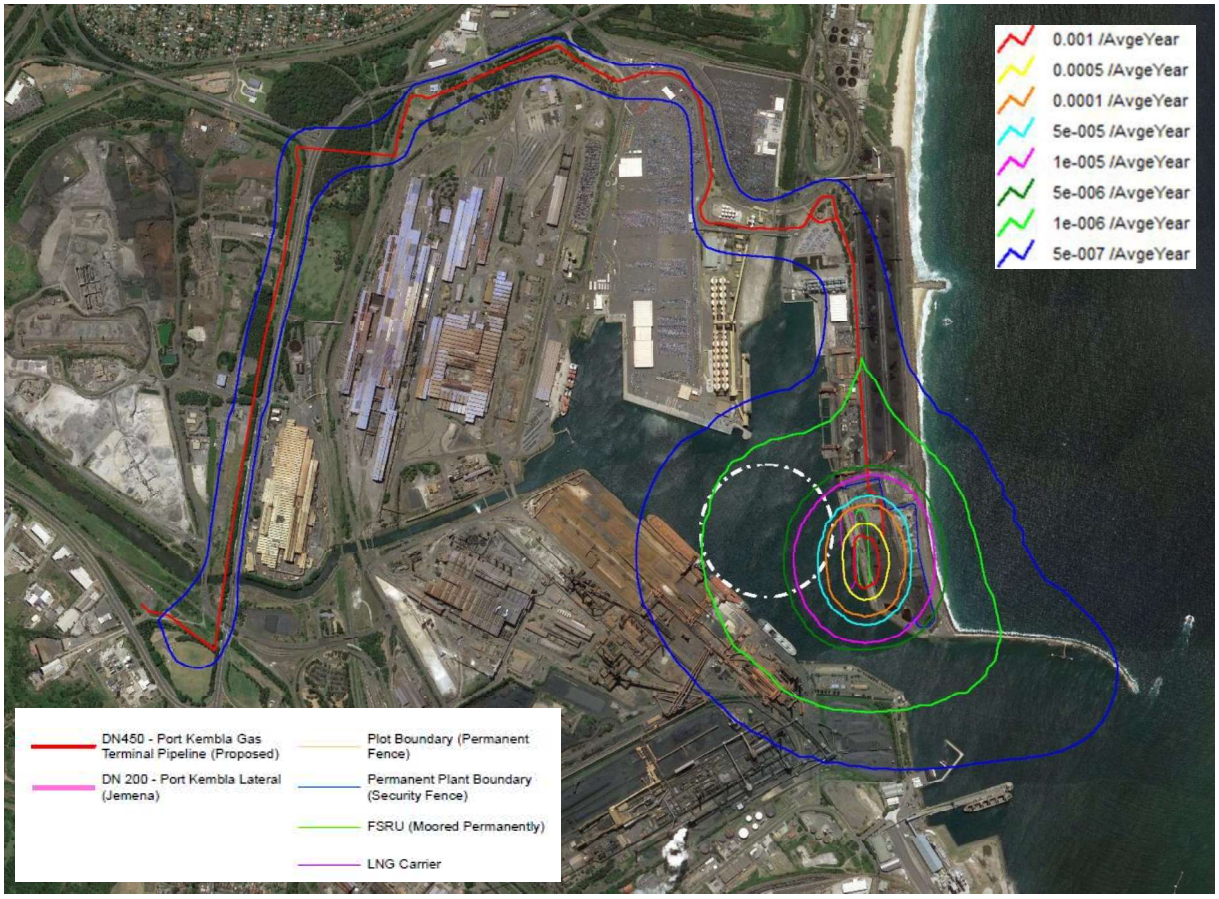

Figure 3-7: Fatality Risk Contours – High Demand Sensitivity F&G Detection & Isolation

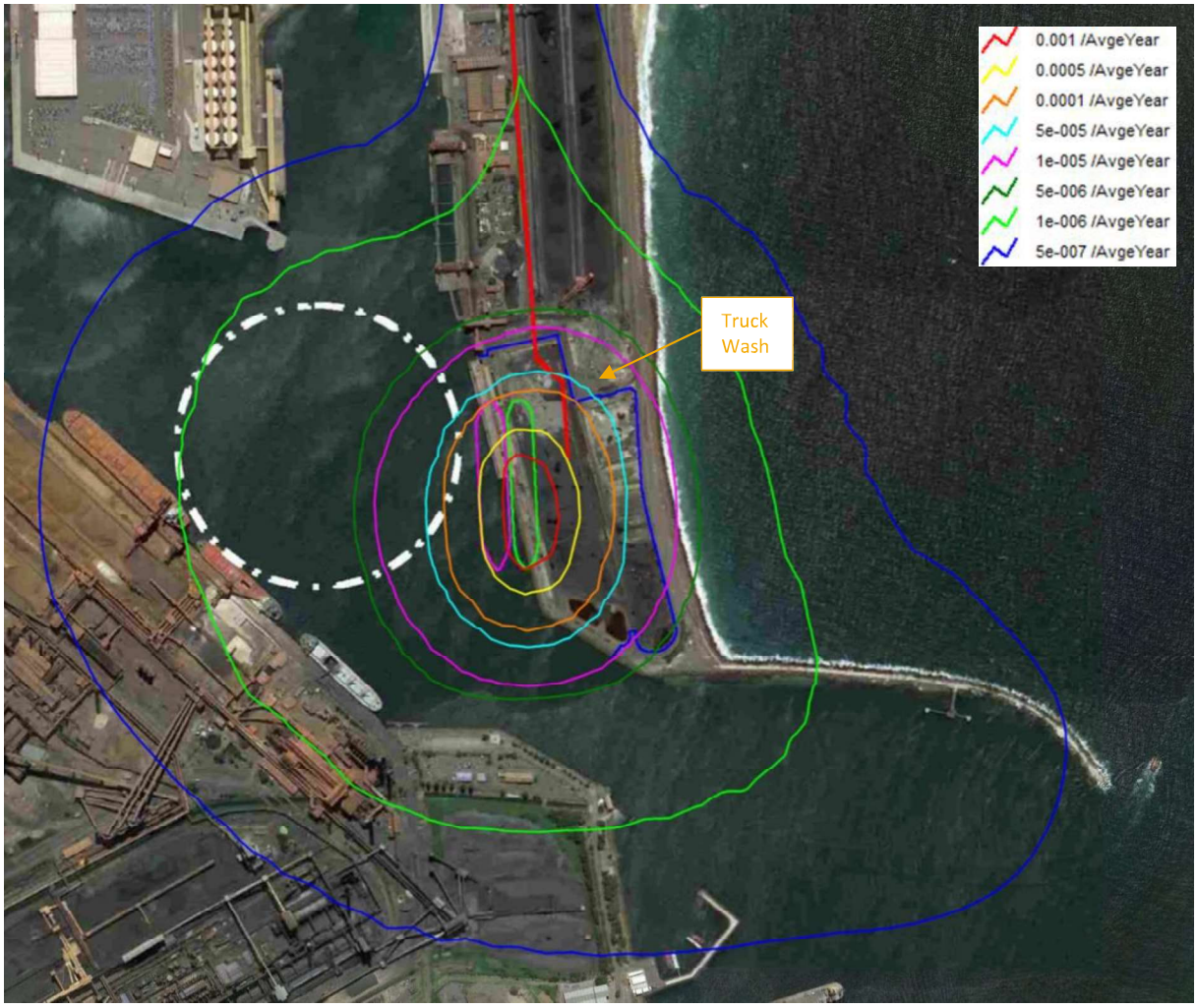

Figure 3-8: Berth Fatality Risk Contours – High Demand Sensitivity F&G Detection & Isolation

Comparing the sensitivity case in Figure 3-7 and Figure 3-8 to the High Demand Case in Figure 3-5 and Figure 3-6 the 5E-05 and 1E-05 risk contours have contracted. The 5E-05 pa risk contour for industrial areas extends slightly beyond the wharf fence line on the north-east boundary and does not impact the truck wash located in this area. Note further reduction in the contours may be realised through calculation of individual isolatable section volumes and applying these to the risk model.

The 1E-05 pa risk contour for active open spaces extends beyond the wharf eastern fence line and across Seawall Road to the shoreline. The 1E-06 and 5E-07 pa risk contours have contracted.

3.2.4 Propagation and Injury Risks

Damage and propagation risk due to heat radiation levels in excess of 23 kW/m^2 and explosion overpressure levels greater than 14 kPa were assessed for the Port Kembla Gas Terminal site operating at the High Demand rate to determine whether there was a potential for the site to present a risk of escalation at neighbouring facilities. Additionally, injury risk due to heat radiation levels in excess of 4.7 kW/m^2 and explosion overpressure levels greater than 7 kPa were assessed. This assessment considered the entire project scope including the LNGC, FSRU, wharf facility and pipeline.

Note that the assessment of propagation and injury risks was completed for 500 TJ/day high demand case taking no credit for F&G detection and isolation systems (see Figure 3-5).

Figure 3-9 shows the 5E-05 pa frequency of heat radiation levels of 4.7 kW/m^2 which have the potential to cause injury extends marginally outside of the fence line. However, there are no sensitive or residential areas are within this area.

The 5E-05 pa frequency of heat radiation levels of 23 kW/m^2 which have the potential to cause damage and escalation at neighbouring facilities is generally within the fence line. The 23 kW/m^2 at 5E-05 pa frequency contour does not impact the nearby onshore industrial facilities including the coal terminal truck wash.

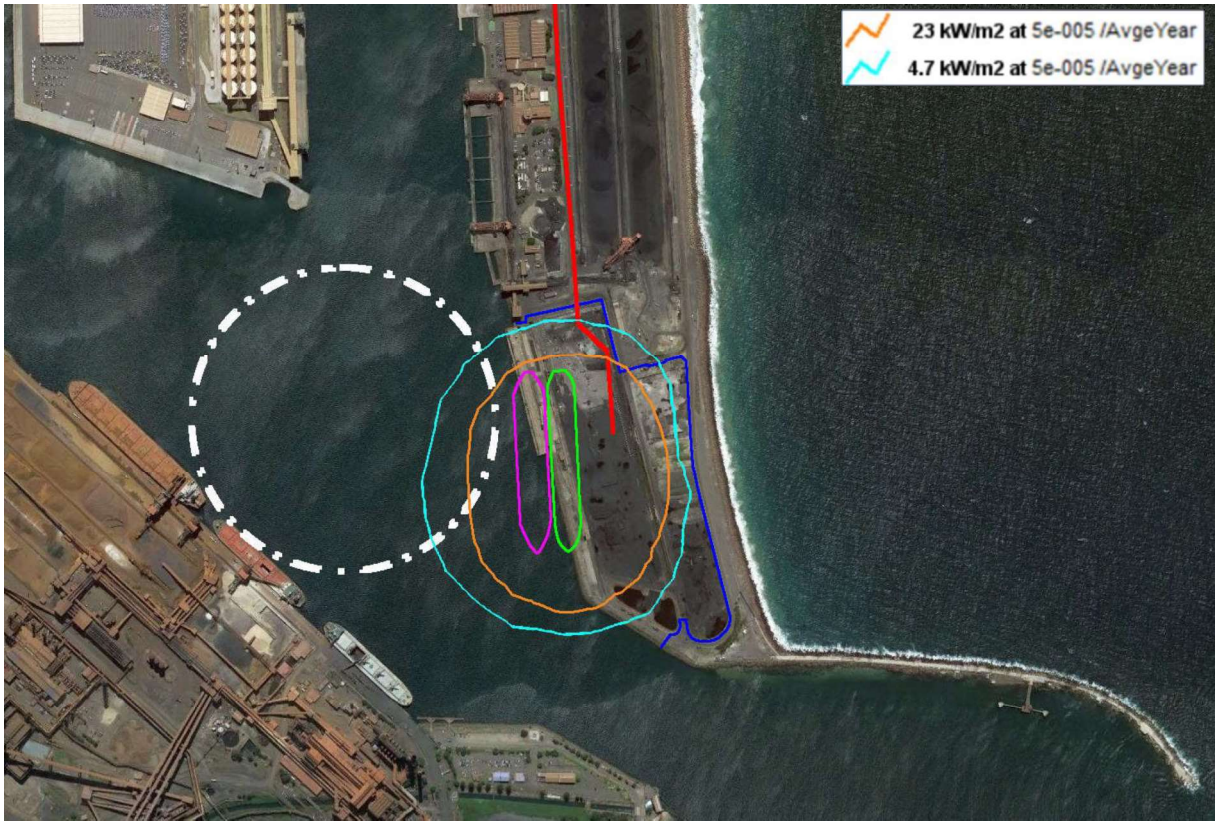

Figure 3-9: High Demand Case 23 kW/m^2 Heat Flux Risk Contours

Figure 3-10 shows the 5E-05 pa frequency of explosion overpressure levels of 7 kPa which has the potential to cause injury remains on the FSRU, in the vicinity of the regasification module. It does not impact any sensitive or residential areas.

The 5E-05 pa frequency contour for explosion overpressure levels of 14 kPa which have the potential to cause damage and escalation at neighbouring facilities, in the vicinity of the regasification module. There is no risk of damage or propagation at the surrounding industrial facilities due to explosion at the berth.

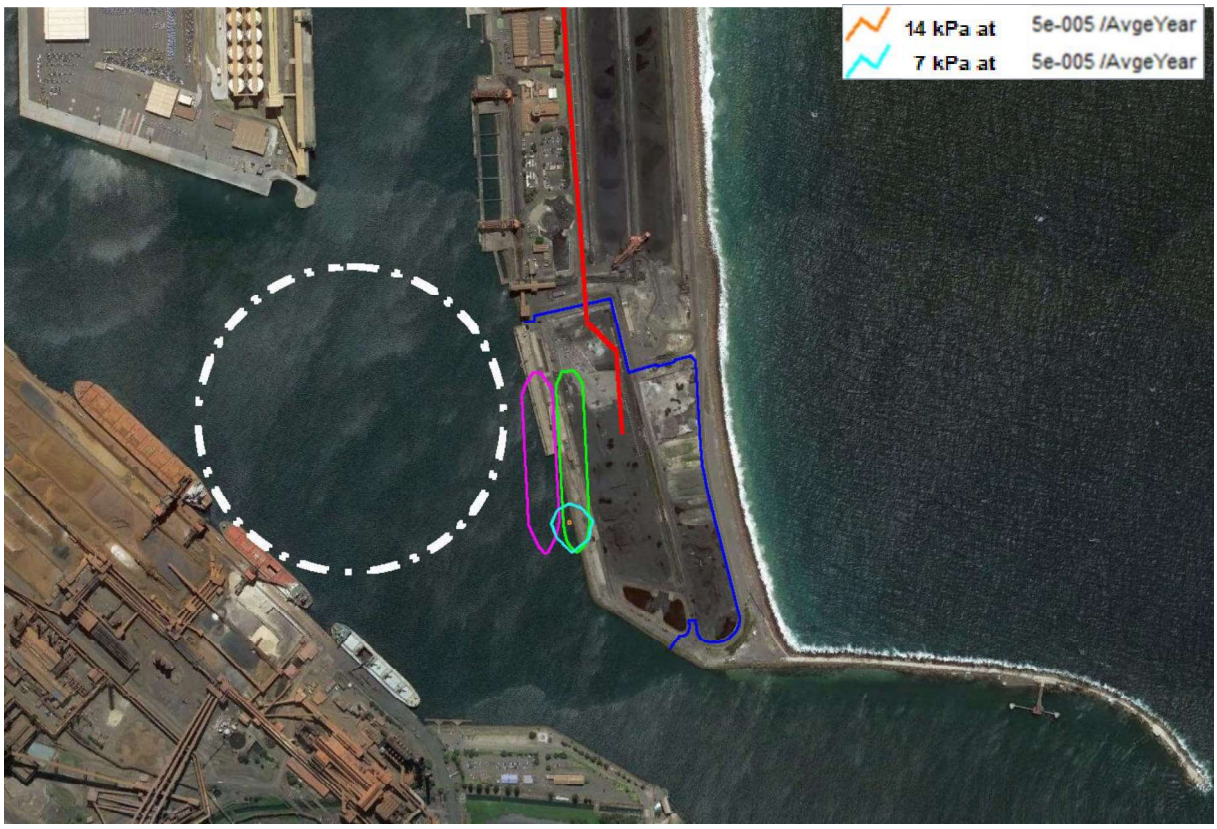

Figure 3-10: High Demand Case 14 kPa Explosion Overpressure Risk Contours

Propagation and injury risks determined for 500 TJ/day high demand case (see Section 3.2.4), which comply with HIPAP 4, are more onerous compared to the Base Case and the 120 TJ/day low demand case and hence the assessment was not repeated at the lower rates.

4. FINDINGS

The hazards and risks associated with the proposed operational changes at the planned Port Kembla Gas Terminal were assessed.

The assessment found that the proposed operational changes do not introduce additional hazardous inventories or scenarios. The hazards, hazardous scenarios and potential consequences identified within the PHA remain unchanged.

The PHA risk model was updated to consider the seasonal demands presented in the Port Kembla Gas Terminal Modification Scoping Report [1] and the updated risk contours compared to the HIPAP 4 Risk Criteria for Land Use Planning [2]. The results are presented in Table 4-1 and Table 4-2 below.

Table 4-1: Fatality Risk Results Summary

HIPAP 4 Criteria (pa)	Land Use	Criteria Met
5E-07	Sensitive land use; e.g. hospitals, schools, child-care facilities, old age housing	Yes – All Cases
1E-06	Residential area; including hotels, motels, tourist resorts	Yes – All Cases. Cruise ships will berth outside the 1E-06 contour and will only be exposed to higher than 1E-06 risk whilst entering / leaving the Inner Harbour, i.e. exposure is low.
5E-06	Commercial development; including retails centres, offices and entertainment centres	Yes – All Cases
1E-05	Active open space; including sporting complexes	No – Limited risk exposure to people accessing Seawall Road. The area is on industrialised land and is a private road. The road is only open during daylight hours and may be closed during daylight hours for a variety of other port operational requirements. As a result, large numbers of people do not use this road regularly or gather in this area.
5E-05	Industrial	Yes - Low Demand Case No – Base Case and High Demand Case. The risk contour is largely within the proposed facility boundary. The contour is beyond the facility boundary in the north eastern corner in the vicinity of the PKCT truck wash.

The 309 TJ/day Base Case with increased LNGC deliveries is generally identical to the original risk contours presented in the PHA [3] and there are no significant changes in the impact to neighbouring land users.

The 120 TJ/day low demand case, contours shows neighbouring industrial land users are not exposed to risk greater than 5E-05 pa and the majority of Seawall Road is not exposed to risk greater than 1E-05 with the exception of a small portion to the east of the PKGT facility.

The increased production rate considered in the 500 TJ/day high demand case pushes the 1E-05 and 5E-05 contours further from the FSRU than those for the Base Case shown in Figure 4-1. Applying credit for gas detection, isolation and accounting for limited inventories within the FSRU topsides to the high demand case reduces the contours and they are largely similar to the base case. Refer to Figure 4-2.

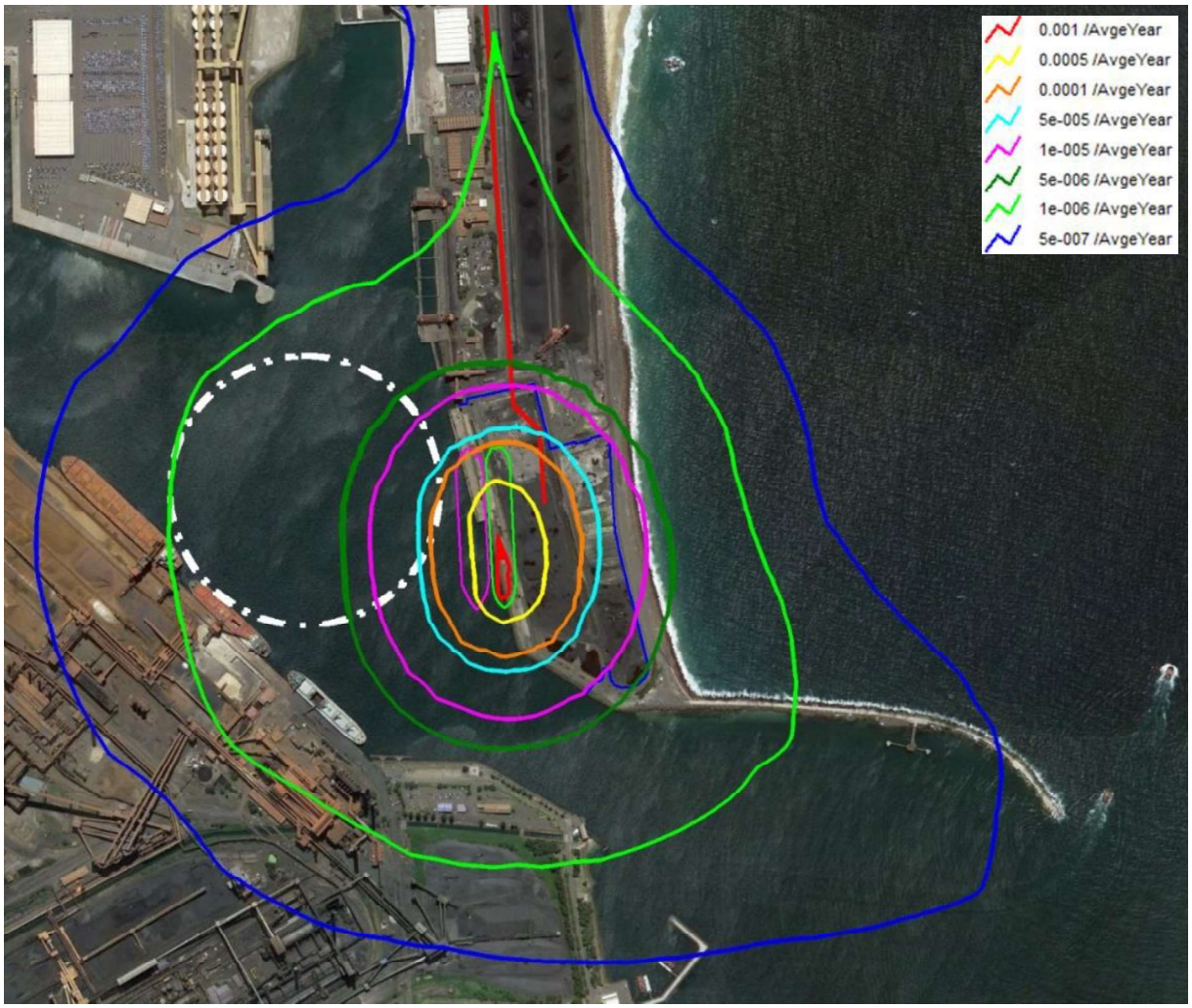

Figure 4-1: Berth Fatality Risk Contours – Base Case Scenario

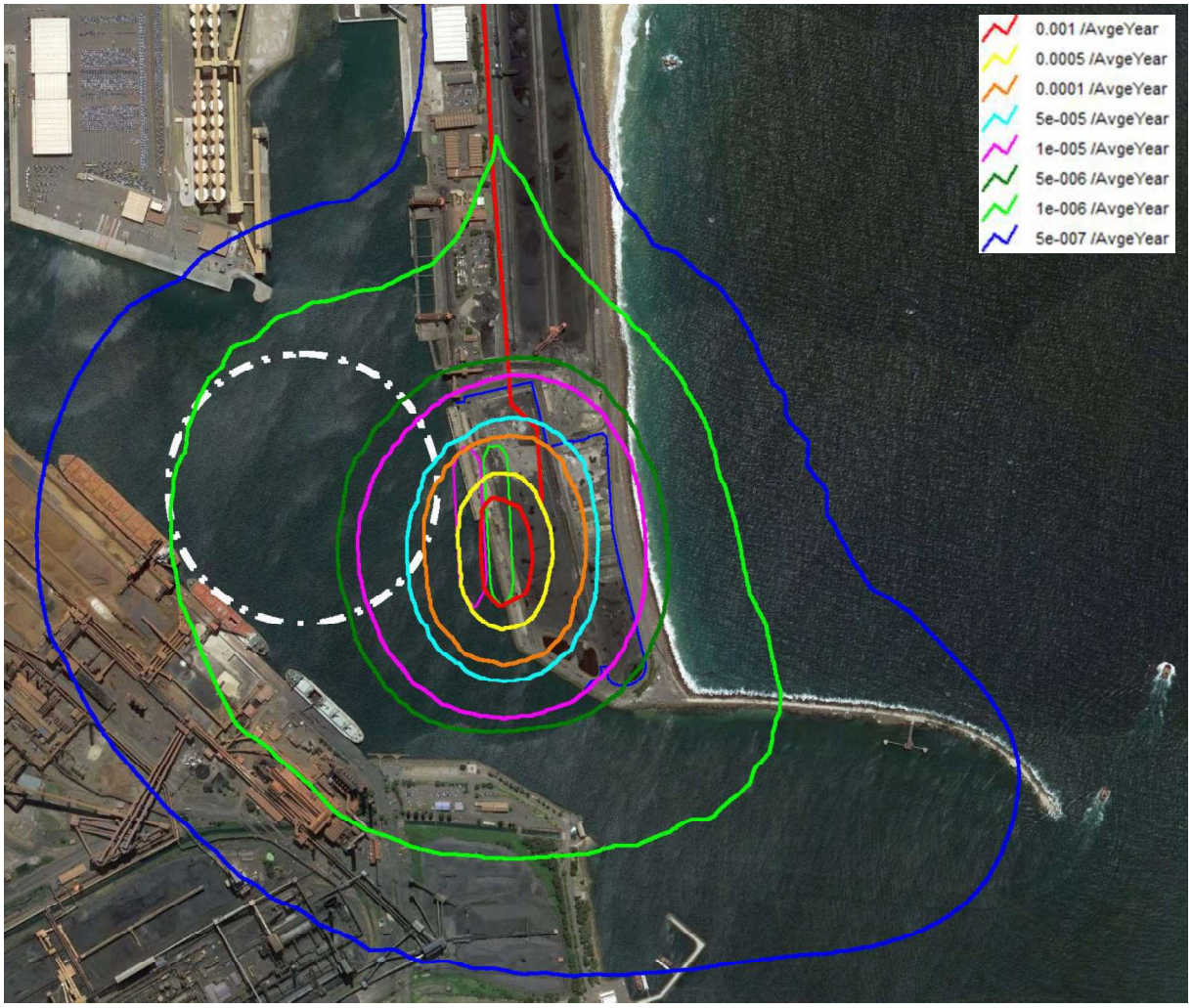

Figure 4-2: Berth Fatality Risk Contours – High Demand Sensitivity F&G Detection & Isolation Scenario

The 5E-05 pa risk contour for industrial areas extends beyond the wharf fence line on the east boundary and extends beyond the truck wash located in this area. While the exposure at the truck wash area is slightly greater than 5E-05 pa risk, the risk to an individual is low due to limited exposure durations (i.e. low truck wash usage with limited duration).

The 1E-05 pa risk contour for active open spaces also extends beyond the wharf fence line, across Seawall Road and extends into the harbour.

Seawall road is a private road located on industrial land, controlled by NSW Ports and the Port Kembla Coal Terminal. It is opened to the public during daylight hours only and regularly closed for poor weather and/or other operational needs, including bulk haulage, construction/maintenance, etc. The road can be closed and secured at these times via a security fencing and lockable gates. Access restrictions can be implemented and enforced by NSW Ports has required. Exposure for public users of Seawall Road is likely to be for short durations and numbers are limited as indicated by NSW Ports:

"The road tends to be used by surfers, rock fishers and occasional on-lookers for unusual events, such as the arrival of a large cruise ship. However, numbers of users are in the dozens, not the 100's, with the largest crowds seen there for the arrival of the Port's first cruise ship. Subsequent cruise ship arrivals have seen the crowd numbers dwindle."

The high demand case is expected to occur during winters months when public access to Seawall Road for recreation is likely to be lower than during summer months.

Vessel entry into the Port Kembla Inner Harbour is controlled by the Port Authority and unauthorised entry is prohibited and enforced. Exposure of the public in this area is therefore expected to be low.

Propagation and injury risks were assessed against the HIPAP4 Risk Criteria for Land Use Planning [2] for the 500 TJ/day high demand case to present a risk of injury to personnel and escalation at neighbouring facilities. The assessment considered the entire project scope including the LNGC, FSRU, wharf facility and pipeline and showed the propagation and injury risk both comply with the 5E-05 pa criteria. Refer to Table 4-2 below.

Table 4-2: Propagation and Injury Risk Results Summary

Frequency (pa)	HIPAP 4 Criteria	Criteria Met
5E-05	Damage and propagation – 23kW/m^2	Yes
5E-05	Damage and propagation – 14kPa	Yes
5E-05	Injury – 4.7kW/m^2	Yes
5E-05	Injury – 7kPa	Yes

Propagation and injury risks determined for 500 TJ/day high demand case (see Section 3.2.4), which comply with HIPAP 4, are more onerous compared to the Base Case and the 120 TJ/day low demand case and hence the assessment was not repeated at the lower rates.

5. REFERENCES

1. Port Kembla Gas Terminal – Modification Scoping Report, GHD, October 2019
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