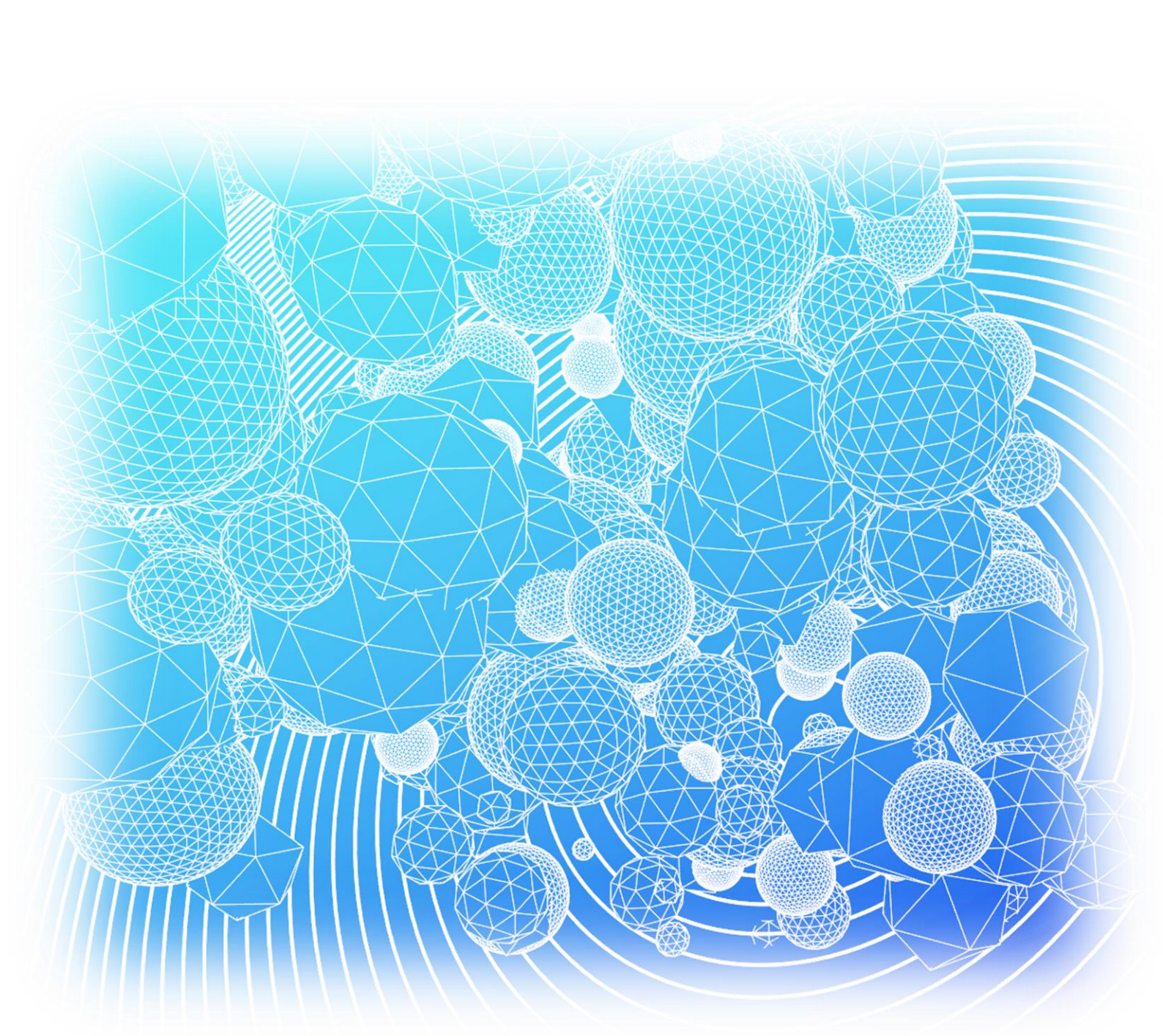

Human Health Risk Assessment – Port Kembla Bulk Liquids Terminal

Prepared for: Cardno

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Prepared by	 Jackie Wright Director/Principal

Limitations

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It is prepared in accordance with the scope of work and for the purpose outlined in the Section 1 of this technical working paper.

The methodology adopted and sources of information used are outlined in this technical working paper. Environmental Risk Sciences has made no independent verification of this information beyond the agreed scope of works and assumes no responsibility for any inaccuracies or omissions. No indications were found that information contained in the reports for use in this assessment was false.

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Glossary of Terms

Acute exposure	Contact with a substance that occurs once or for only a short time (up to 14 days).
absorption	The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.
Adverse health effect	A change in body function or cell structure that might lead to disease or health problems.
Background level	An average or expected amount of a substance or material in a specific environment, or typical amounts of substances that occur naturally in an environment.
Biodegradation	Decomposition or breakdown of a substance through the action of micro-organisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).
Body burden	The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.
BTEX	Benzene, toluene, ethylbenzene and total xylenes
Carcinogen	A substance that causes cancer.
Chronic exposure	Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure].
DECCW	Department of Environment, Climate Change and Water
Detection limit	The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.
Dose	The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An “exposure dose” is how much of a substance is encountered in the environment. An “absorbed dose” is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.
DPE	Department of Planning and Environment
EC	European Commission
EP&A Act	Environmental Planning and Assessment Act 1979
EPA	Environment Protection Authority
Exposure	Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].
Exposure assessment	The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.
Exposure pathway	The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed) to it. An exposure pathway has five parts: a source of contamination (such as chemical leakage into the subsurface); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receiver population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Guideline value	Guideline value is a concentration in soil, sediment, water, biota or air (established by relevant regulatory authorities such as the NSW Department of Environment and Conservation (DEC) or institutions such as the National Health and Medical Research Council (NHMRC), Australia and New Zealand Environment and Conservation Council (ANZECC) and World Health Organisation (WHO)), that is used to identify conditions below which no adverse effects, nuisance or indirect health effects are expected. The derivation of a guideline value utilises relevant studies on animals or humans and relevant factors to account for inter- and intra-species variations and uncertainty factors. Separate guidelines may be identified for protection of human health and the environment. Dependent on the source, guidelines will have different names, such as investigation level, trigger value, ambient guideline etc.
HHRA	Human Health Risk Assessment
Inhalation	The act of breathing. A hazardous substance can enter the body this way [see route of exposure].
LGA	Local Government Area
LOAEL	Lowest-observed-adverse-effect-level - The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.
LOR	Limit of Reporting
Metabolism	The conversion or breakdown of a substance from one form to another by a living organism.
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NOAEL	No-observed-adverse-effect-level - The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.
NSW	New South Wales
OEH	Office of Environment and Heritage
OEHHA	Office of Environmental Health Hazard Assessment, California Environment Protection Agency (Cal EPA)
PAH	Polycyclic aromatic hydrocarbon
Point of exposure	The place where someone can come into contact with a substance present in the environment [see exposure pathway].
Population	A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).
Receiver population	People who could come into contact with hazardous substances [see exposure pathway].
Risk	The probability that something will cause injury or harm.
Route of exposure	The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact]
Toxicity	The degree of danger posed by a substance to human, animal or plant life.
Toxicity data	Characterisation or quantitative value estimated (by recognised authorities) for each individual chemical for relevant exposure pathway (inhalation, oral or dermal), with special emphasis on dose-response characteristics. The data are based on available toxicity studies relevant to humans and/or animals and relevant safety factors.

Toxicological profile	An assessment that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.
Toxicology	The study of the harmful effects of substances on humans or animals.
Uncertainty factor	Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WHO	World Health Organisation

Executive Summary

TQ Holdings Australia Pty Ltd (TQ) is planning to develop a proposed Port Kembla Bulk Liquids Terminal (PK BLT) within Port Kembla, New South Wales, Australia. The terminal will have a storage capacity of up to 288 ML which will be used for combustible and flammable liquids. The proposed development will be located in the vicinity of the Port Kembla Coal Terminal (PKCT), GrainCorp Grain Terminal, Quattro Grain Terminal, and Australian Amalgamated Terminal (AAT).

A new state significant development (SSD) application supported by an Environmental Impact Statement (EIS) is required to be submitted to the Department of Planning and Environment (DPE) for assessment.

The Secretary's Environmental Assessment Requirements (SEARs) (under Section 115Y of the *Environmental Planning and Assessment Act* 1979) indicate that under the requirements of Air Quality, a human health risk assessment is required to be undertaken covering all pollutants of concern and exposure pathways (i.e. inhalation, ingestion and dermal).

Cardno has been engaged to prepare the EIS for TQ. Environmental Risk Sciences Pty Ltd (enRiskS) has been engaged by Cardno to undertake the Human Health Risk Assessment (HHRA).

The conduct of the HHRA has specifically evaluated potential health impacts within the local community associated with emissions to air from the proposed storage of fuel products in the PK BLT. The assessment has evaluated potential impacts of volatile chemicals derived from the storage of these fuels, and road tanker loading activities at the terminal when fully constructed (i.e. at maximum capacity). The chemicals evaluated include benzene, toluene, ethylbenzene, xylenes and vapour phase emissions of polycyclic aromatic hydrocarbons, assumed to be as toxic as benzo(a)pyrene. As these are volatile chemicals the key pathway of exposure assessed is the inhalation of these chemicals in air. Ingestion and dermal contact are not considered to be complete pathways of exposure relevant to the PK BLT.

Based on the assessment undertaken there are no acute or chronic impacts on the health of the local community surrounding the project.

(blank)

Section 1. Introduction

1.1 Project Background

TQ Holdings Australia Pty Ltd (TQ) is planning to develop a proposed Port Kembla Bulk Liquids Terminal (PK BLT) within Port Kembla, New South Wales, Australia. The terminal will have a storage capacity of up to 288 ML which will be used for combustible and flammable liquids. The proposed development will be located in the vicinity of the Port Kembla Coal Terminal (PKCT), GrainCorp Grain Terminal, Quattro Grain Terminal, and Australian Amalgamated Terminal (AAT).

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Cardno has been engaged to prepare the EIS for TQ. Environmental Risk Sciences Pty Ltd (enRiskS) has been engaged by Cardno to undertake the Human Health Risk Assessment (HHRA).

1.2 Objectives and Scope of Work

The overall objective of the HHRA presented in this report is to assess risks to human health within the local community associated emissions to air during normal operations.

The assessment has specifically addressed inhalation exposures within the surrounding community. In addition the nature of the pollutants being considered has been reviewed and where there is the potential release of chemicals that may bind with particulates and be persistent and bioaccumulative, there is the potential for these chemicals to deposit onto surfaces where exposure may also occur via incidental ingestion and/or dermal contact.

It is noted that the assessment presented in this report relies upon the assessment of air quality impacts presented in the report "Air Quality and Greenhouse Gas Assessment" prepared by Pacific Environment Limited (PEL, 2015) (also referred to as the Air Quality Impact Assessment or AQIA).

In addition, information on the potential presence of contamination in soil and groundwater at the PK BLT presented in the report "Soils and Groundwater Impact Assessment, Proposed Port Kembla Bulk Liquids Terminal" prepared by Cardno (Cardno 2015) have been considered in relation to the potential for contamination to be present and proposed operations at the site to result in exposures in offsite areas.

This assessment relates to impacts in the off-site areas. No assessment of exposures by workers within the boundary of the facility has been undertaken.

This assessment has considered emissions to air from the proposed facility at the completion of Stage 3.

1.3 Approach to Human Health Risk Assessment

1.3.1 What is a risk assessment?

Risk

Risk assessment is used extensively in Australia and overseas to assist in decision making on the acceptability of the risks associated with the presence of contaminants in the environment and evaluation of projects with potential risks to the public. Risk is commonly defined as the chance of injury, damage, or loss. Therefore, to put oneself or the environment "at risk" means to participate, either voluntarily or involuntarily, in an activity or activities that could lead to injury, damage, or loss.

Voluntary risks are those associated with activities that we decide to undertake such as driving a vehicle, riding a motorcycle and smoking cigarettes.

Involuntary risks are those associated with activities that may happen to us without our prior consent or forewarning. Acts of nature such as being struck by lightning, fires, floods, tornados, etc, and exposures to environmental contaminants are examples of involuntary risks.

Defining risk

Risks to the public and the environment are determined by direct observation or by applying mathematical models and a series of assumptions to infer risk. No matter how risks are defined or quantified, they are usually expressed as a probability of adverse effects associated with a particular activity. Risk is typically expressed as a likelihood of occurrence and/or consequence (such as negligible, low or significant) or quantified as a fraction of, or relative to, an acceptable risk number.

Risks from a range of facilities (e.g. industrial or infrastructure) are usually assessed through qualitative and/or quantitative risk assessment techniques. In general, risk assessments seek to identify all relevant hazards; assess or quantify their likelihood of occurrence and the consequences associated with these events occurring; and provision of an estimate of the risk levels for people who could be exposed, including those beyond the perimeter boundary of a facility.

1.3.2 Overall approach

The methodology adopted for the conduct of this HHRA is in accordance with national and international guidance that is endorsed/accepted by Australian health and environmental authorities, and includes:

- EnHealth Environmental Health Risk Assessment: Guidelines for Assessing Human Health Risks from Environmental Hazards: 2012 (enHealth 2012a);
- EnHealth Health Impact Assessment Guidelines: September 2001 (enHealth 2001);
- EnHealth Exposure Factors Guide, EnHealth Council, 2012 (enHealth 2012b);
- National Environment Protection Council (NEPC) Schedule B(8) Guideline on Community Consultation and Risk Communication, National Environment Protection (Assessment of Site Contamination) Measure, 1999 (NEPC 1999 amended 2013a);
- NEPC National Environmental Protection (Air Toxics) Measure, Impact Statement for the National Environment Protection (Air Toxics) Measure, 2003 (NEPC 2003); and

- United States Environment Protection Agency (USEPA) Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment), EPA-540-R-070-002, January 2009 (USEPA 2009).

Where required (and referenced within this report) international guidance from the World Health Organisation (WHO) or United States Environment Protection Agency (USEPA) has been used to supplement the above.

1.3.3 Features of the risk assessment

The HHRA has been carried out in accordance with international best practice and general principles and methodology accepted in Australia by groups such as NEPC and enHealth. There are certain features of risk assessment methodology that are fundamental to the assessment of the outputs and to drawing conclusions on the significance of the results. These are summarised below:

- A risk assessment is a tool (that is systematic) that addresses potential exposure pathways based on an understanding of the nature and extent of the impact assessed and the uses of the local area by the general public. The risk assessment is based on an estimation of maximum, or worst-case, ground level concentrations modelled in the local community and hence is expected to overestimate the actual risks.
- Conclusions can only be drawn with respect to emissions to air derived from the project as outlined in this assessment.
- The HHRA does not provide an evaluation of the overall health status of the community or any individuals. Rather, it is a logical process of calculating and comparing potential exposure concentrations (acute and chronic) in surrounding areas (associated with the project) with regulatory and published acceptable air concentrations that any person may be exposed to over a lifetime without unacceptable risk to their health. It can also involve calculating an incremental impact that can be evaluated in terms of an acceptable level of risk.
- The risk assessment reflects the current state of knowledge regarding the potential health effects of chemicals identified and evaluated in this assessment. This knowledge base may change as more insight into biological processes is gained, further studies are undertaken and more detailed and critical review of information is conducted.

Section 2. Project Description

2.1 General

This section presents an overview of the project being considered in this report. The details presented are only a summary. Full details are presented in the environmental impact statement.

2.2 Location

The proposed TQ PK BLT is to be located in the inner harbour of Port Kembla, which is located 3 km south of Wollongong in NSW. TQ has a long term lease over the land from NSW Ports, which includes non-exclusive access and use of Berth 104. The land allotments are shown in **Table 2.1**.

Table 2.1 Site Allotments

Description	Part Lot No.	Deposited Plan (DP)	Approximate Area (ha)
Site 1	2	1125445	1.8
Site 2	301	1148391	4.11
Site 3	11	1182111	0.44
Berth 104	70	1182824	0.85

The surrounding land uses include:

- North of the Site – Wollongong Golf Club, Car Storage, Wollongong Sewerage Treatment Plant (operated by Sydney Water), Autonexus, Port Kembla Coal Terminal receival area and Greenhouse Park (Wollongong Council);
- South of the Site – BlueScope Steel and Quattro Grain Terminal;
- East of the Site – Port Kembla Coal Terminal, Quattro Grain Terminal and Australian Amalgamated Terminals multi-purpose berth; and
- West of the Site – GrainCorp Grain Terminal, GrainCorp Liquid Terminals, Australian Amalgamated Terminals, PrixCar Services and Patrick Autocare.

Figure 2.1 and **Figure 2.2** show the location of the proposed PK BLT site and the surrounding facilities and land use.

2.3 Project Overview

The facility at Port Kembla will operate as a bulk liquids import terminal, from which finished fuel products will be despatched by road tankers (and potentially by rail into the future). The terminal will primarily handle petroleum products and biofuels with, depending on future demand.

The project consists of the construction and operation of three distinct stages (refer to **Figure 2.3** for a layout and location of the proposed tanks).

- Stage 1 – A total of 14 tanks (plus slops) with capacities up to 18,500 m^3. The tanks are 10 – 29- m in diameter and have heights ranging from 20 – 29 m. The throughput is anticipated to be 720 mega litres per annum (MLpa) at commencement, increasing to 1,200 MLpa.
- Stage 2 – This stage is expected to begin operations 6 months after the commencement of Stage 1 operations. A total of total of 19 tanks (plus slops) will be in use during Stage 2

(includes Stage 1 tanks) with capacities, diameters and heights as per Stage 1 dimensions. The additional capacity will allow throughput to increase to 2,000 MLpa.

- Stage 3 – An additional 4 tanks are proposed for this stage. The details of this phase are subject to future demand. The additional capacity for Stage 3 will allow the terminal throughput to increase to approximately 2,900 MLpa.

The facility is being designed to import and store up to seven fuel products. However the storage mix is dependent upon future demand, in addition to Federal Government legislation and NSW mandates regarding renewable fuels at the time the terminal is operational. The facility is anticipated to operate 24 hours a day, 365 days a year.

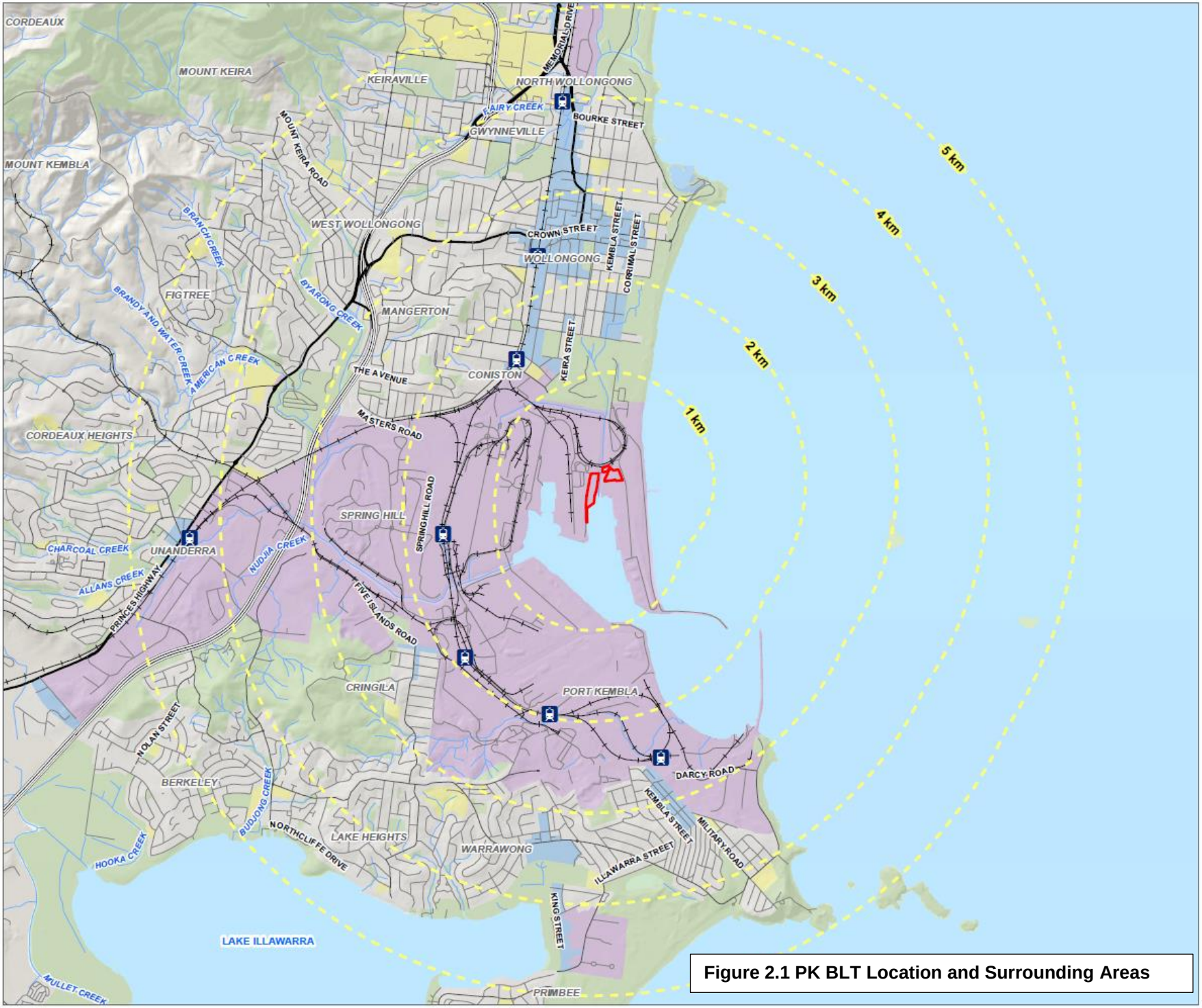

Figure 2.1 PK BLT Location and Surrounding Areas

Location Plan

PORT KEMBLA

Legend

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

Land Use (ABS, 2011)

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

1:40,000 Scale at A3

Kilometres

0 0.5 1 1.5 2

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
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Coordinate System: GDA 1994 MGA Zone 56
Project: 82015103
Map: 82015103-GIS-018-ESALocationPlan.mxd 03
All base data supplied by LPI unless otherwise stated.

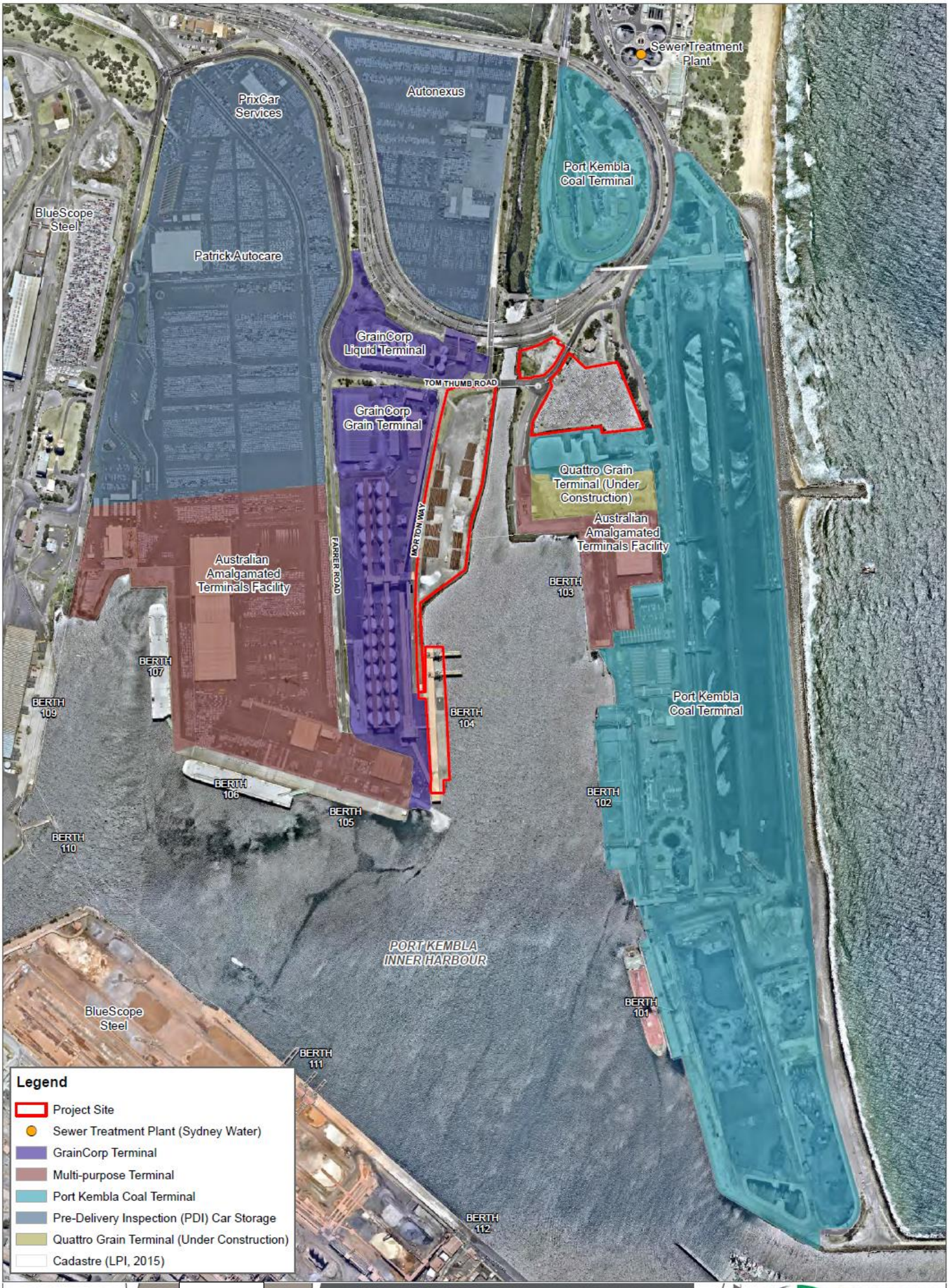

Figure 2.2

1:6,000 Scale at A3

Metres 0 50 100 150 200

Adjoining Developments Plan

PORT KEMBLA

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2015-09-08
Coordinate System: GDA 1994 MGA Zone 56
Project: 82015103-01
Map: 82015103-GS-019-ESAAdjoiningDevelopments.mxd 04
Aerial imagery supplied by nearmap (January, 2015)

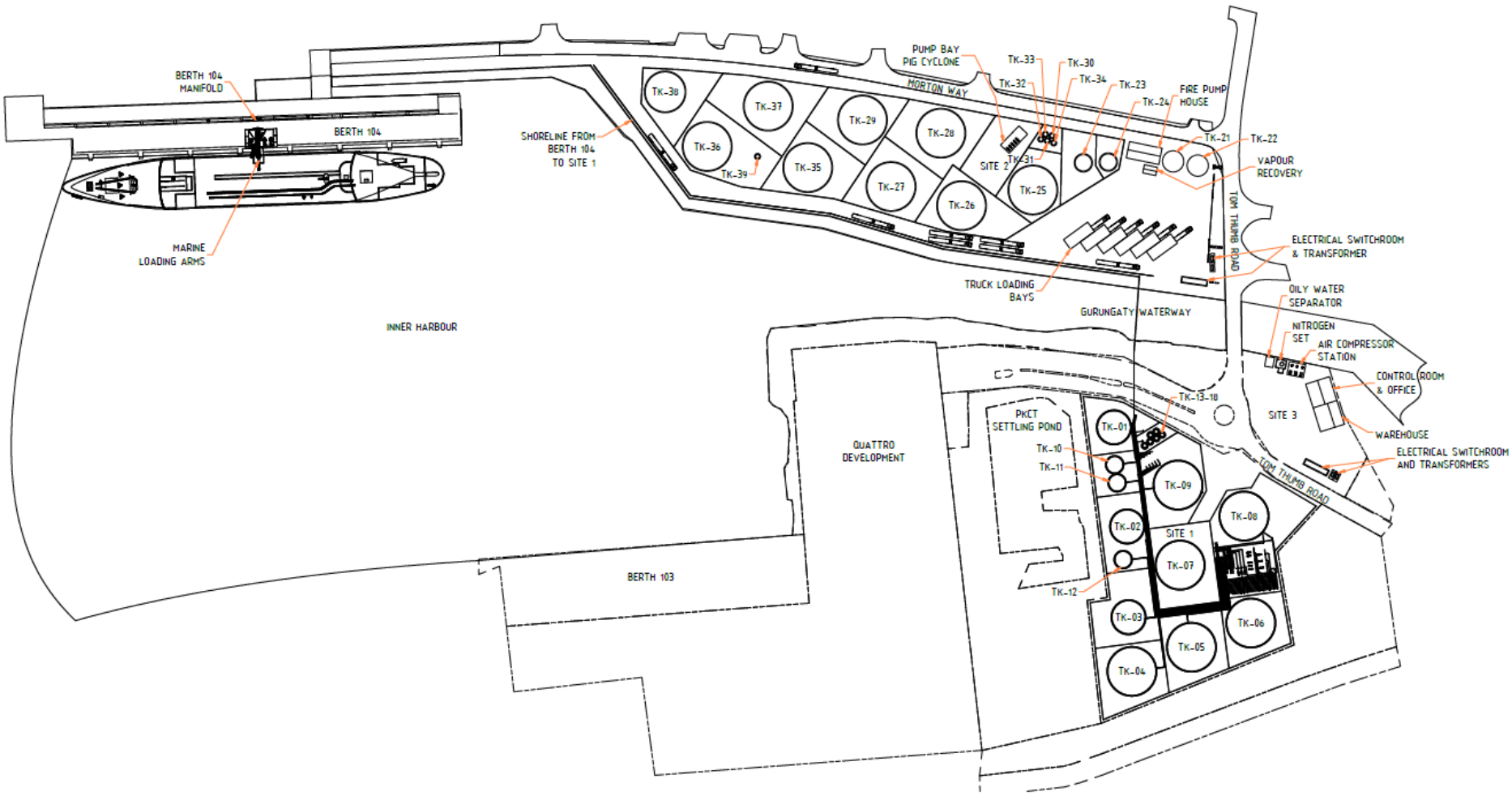

Figure 2.3 Terminal Layout and Emission Sources

PORT KEMBLA BULK LIQUIDS TERMINAL
SITE WIDE
LAYOUT

DRAWING No. 10001-100
DRAWING STATUS: PRELIMINARY - NOT FOR CONSTRUCTION
REV: 00.10
SCALE: 1 : 1250
A1

2.4 Product Storage

The proposed site comprises stored bulk petroleum and renewable fuel products that may include diesel fuels, unleaded petrol fuels and jet fuel.

Infrastructure at the site associated with the storage of these products include truck loading facilities, product transfer pipelines, bunding, Vapour Recovery Unit (VRU), monitoring systems, fire and hydrocarbon (leak/spill) detection monitoring and alarms and fire protection systems.

2.5 Potential Risk Issues

The assessment of potential risks to human health evaluated in this assessment has focused on activities associated with the proposed project that has the potential to result in exposures in surrounding (off-site) areas.

The key risk issue addressed in this report relates to the release of volatile organic compounds (VOCs) to air associated with the proposed storage of fuel products at the PK BLT site. These impacts are specifically addressed in this report.

Review of soil and groundwater contamination (Cardno 2015) did not identify the presence of soil contamination at the PK BLT site. Hence during construction works, other than the generation of dust, there are no risk issues related to the presence of contaminants in dust that may be generated.

During construction dust will be managed (mitigated) through measures to be implemented in the Construction Environment Management Plan (CEMP) and hence no significant dust impacts are expected during the construction of the proposed project.

All fuel storage and refuelling areas will be bunded and operation of the proposed facility will be undertaken in accordance with an Operational Environmental Management Plan to manage and monitor activities/events that may impact soil or groundwater. No impacts are expected that would result in contamination that may affect off-site areas.

2.6 Assessment of Emissions to Air

Emissions to air from the proposed project have been assessed within the AQIA. The assessment evaluated the emission of key VOCs present in the fuel products proposed to be stored at the site, and emitted to air during road tanker loading. In addition the assessment also evaluated impacts associated with nitrogen dioxide, sulfur dioxide and particulates from combustion sources, specifically the engines of ships at Berth 104. In relation to the assessment of nitrogen dioxide, sulfur dioxide and particulates, the assessment determined that the project will result in a small increase in concentrations in off-site areas[1], well below the available health based criteria available from the NSW EPA. On this basis no further assessment of these pollutants is required in this assessment.

[1] The AQIA determined that the highest increase in concentrations in off-site areas occurred for nitrogen dioxide, with a maximum increase of 9% of the relevant criterion.

On this basis the assessment presented in this report has more specifically focused on emissions to air of VOCs, with the following VOCs further evaluated:

- Benzene;
- Toluene;
- Ethylbenzene; and
- Xylenes.

In addition the assessment has also evaluated potential emissions of polycyclic aromatic hydrocarbons (PAHs). PAHs are a group of compounds that include smaller chemicals that are volatile or semi-volatile in nature, that includes naphthalene, and other larger/heavier chemicals such as benzo(a)pyrene (BaP), that are not considered to be sufficiently volatile to be of concern.

The air quality assessment has undertaken a conservative assumption that all PAHs that may be present in the stored fuels may be emitted to air as a vapour (i.e. all the compounds are volatile or semi-volatile), and the impacts of these releases can be evaluated using a toxicity equivalent concentration relative to BaP (i.e. a total concentration of 20 PAHs summed with consideration of their relative toxicity to BaP). It is noted that from a toxicological perspective the non-volatile compounds are more toxic than the lighter PAH compounds likely to be in a vapour phase. Hence such an approach provides an overestimation of actual risk.

The AQIA estimated emissions of VOCs to air using the TANKS software package, which estimates tank breathing emissions from chemical storage tanks in accordance with the National Pollutant Inventory (NPI) Emission Estimation Manual for Fuel and Organic Liquid Storage (Version 3.2, published in 2011). Emissions were assumed to occur 24 hours per day, 365 days of the year.

Ground level concentrations of the VOCs and PAHs emitted from the tanks were then estimated using an air dispersion model (CALPUFF) that accounted for the local terrain and meteorology.

The AQIA provided maximum predicted 1 hour average concentrations at a number of sensitive receptor locations, discussed further in **Section 3**.

Section 3. Community profile

3.1 General

This section provides an overview of the community potentially impacted by the project. The key focus of the assessment presented is the local community, as assessed within the AQIA and hazard analysis.

The site is located within an industrial area. Residential areas are located beyond the industrial/port area with the suburbs of Coniston, Mount St Thomas and Cringila located within 2km of the site as shown in **Figure 3.1**.

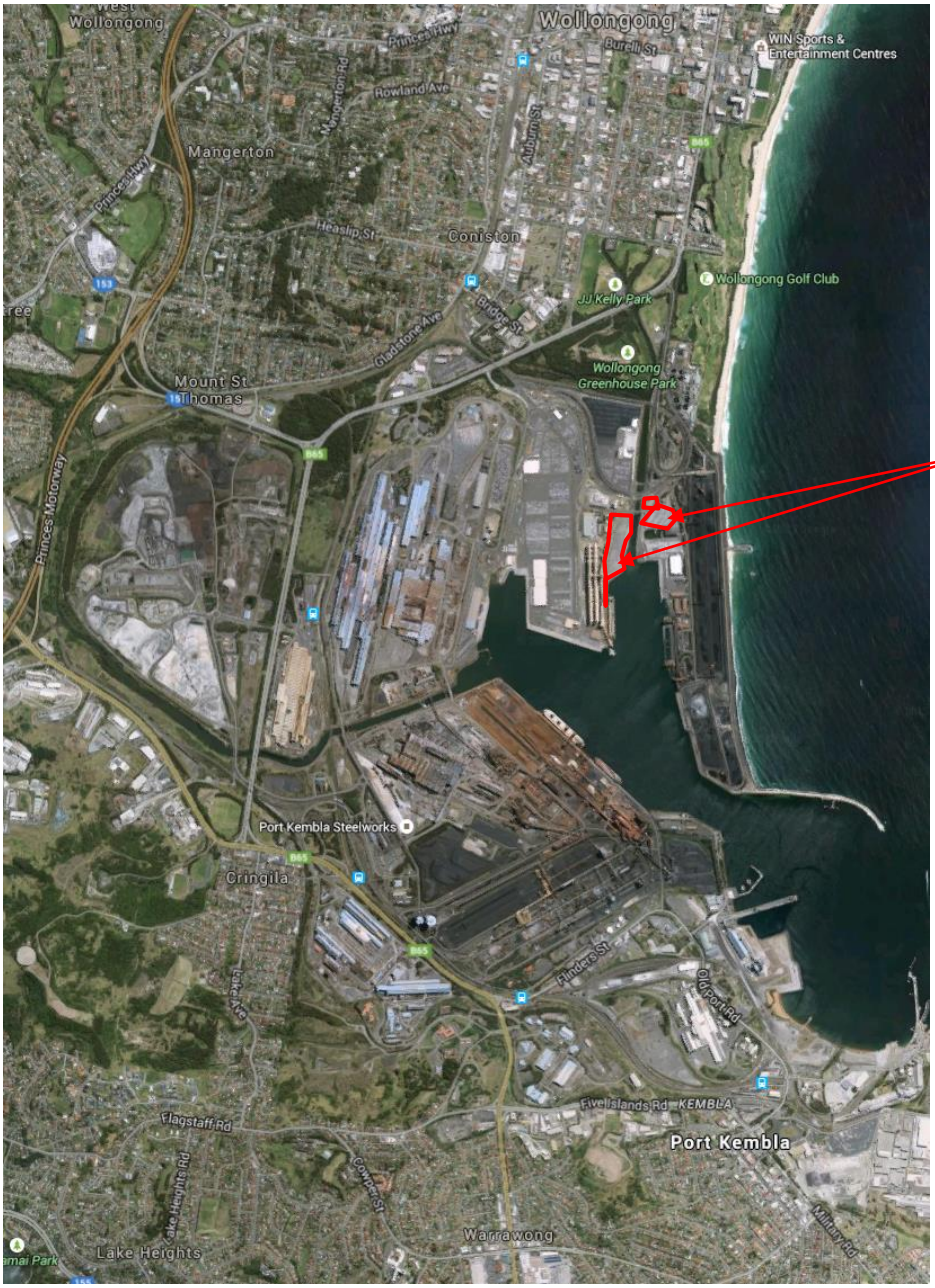

Figure 3.1 Surrounding Suburbs

3.2 Sensitive Receivers

Sensitive receivers are locations in the local community where more sensitive members of the population, such as infants and young children, the elderly or those with existing health conditions or illnesses, may spend a significant period of time. These locations comprise hospitals, child care facilities, schools and aged care homes/facilities. The AQIA has specifically included a number of sensitive receivers located within the surrounding community, as listed in **Table 3.1**.

Table 3.1 Sensitive Receivers

Sensitive Receiver ID	Location	Easting (m)	Northing (m)	Elevation (m)	Approximate Distance from Site (m)
1	Coniston Public School	305898	6187146	14	1320
2	Wollongong Greenhouse Park	306632	6186758	7	710
3	Wollongong Baptist Church	306330	6187818	7	1800
4	Coniston Train Station	305701	6187237	18	1510
5	392 Keira St, Wollongong	306248	6187287	8	1300
6	42 Swan St, Wollongong	306376	6187564	6	1540
7	163 Kembla St, Wollongong	306639	6187527	4	1480
8	179 Corrimal St, Wollongong	306867	6187491	5	1470
9	314 Gladstone Ave, Mt St Thomas	304462	6186661	26	2260
10	240 Gladstone Ave, Mt St Thomas	304947	6186741	22	1820
11	350 Gladstone Ave, Mt St Thomas	304113	6186711	16	2610
12	111 Gladstone Ave, Mt St Thomas	305421	6186970	19	1530
13	33 Five Islands Rd, Cringila	304840	6184069	4	2750
14	Entrance to Site	306614	6186000	1	50

3.3 Population profile

Table 3.2 presents a summary of a selected range of demographic measures relevant to the suburbs that surround the site, with comparison to greater Sydney and the rest of NSW (excluding greater Sydney). It is noted that the state suburb of Coniston encompasses the site, Coniston, Spring Hill, Mount St Thomas and part of Cringila.

Table 3.2 Summary of population statistics

Statistic	Coniston	Cringilla	Wollongong	NSW
People				
- Male	1083 (49.7%)	1094 (51.8%)	8598 (51.4%	3408878 (49.3)
- Female	1097 (50.3%)	1020 (48.2%)	8120 (48.6%)	3508780 (50.7%)
Age distribution				
- 0-9 years	11.9%	13.9%	7.1%	12.9%
- 10-19 years	10.1%	13.7%	7.3%	12.7%
- 20-64 years	59.7%	56.5%	69.9%	59.7%
- >65 years	18.3%	15.9%	15.7%	14.7%
Unemployment	10.4%	13.1%	9.6%	5.9%

3.4 Existing air environment

Limited data is available in relation to the existing levels of BTEX and PAHs (as BaP equivalents) in air in the local area.

The NSW EPA undertook ambient air monitoring at a number of locations in NSW during the period 1996 to 2001 (NSW DEC 2004a, 2004b). This included the sampling of VOCs and PAHs in ambient air in the Wollongong area, including Albion Park, Kembla Grange and Warrawong; and the additional sampling of PAHs in ambient air at an additional 3 locations in Port Kembla. In relation to ambient levels of BTEX and PAHs, most of the data is dated and does not reflect ambient air concentrations that are typically dominated by emissions from vehicles/trucks as the fuels used in Australia has changed from 2001 to 2015 particularly in relation to the percentage of benzene. However no new data on levels of BTEX and PAHs in ambient air has been collected by the NSW EPA from the Wollongong area since 2001.

The available ambient air monitoring data for Wollongong, Kembla Grange and Warrawong (closest monitoring locations to the site) reported from 1996 to 2001 indicates the following average concentrations (NSW DEC 2004a):

- benzene = 0.87 to 2.6 µg/m^3
- toluene = 1.5 to 4.1 µg/m^3
- ethylbenzene = 0.4 µg/m^3
- xylenes = 1.7 to 3 µg/m^3

In relation to the monitoring of PAHs in ambient air, the monitoring reported PAHs present as a particulate phase (as PM10), not vapour phase PAHs (NSW DEC 2004b). The sampling undertaken reported average concentrations of total PAHs in the Illawarra region that ranged from 0.62 to 1.71 ng/m^3. It is noted that the measure of total PAHs differs from a BaP TEQ.

BlueScope Steel operates a number of ambient (community) air monitoring locations (under their EPA licence 6092) that includes the monitoring of benzene and PAH levels (from selected locations while the plant is operating). A licence monitoring report[2] for the period 1 August 2013 to 31 August 2013 indicates the following:

- Benzene is typically reported in air at a concentration of 0.061 to 0.17 µg/m^3, which is lower than reported in earlier sampling undertaken by the NSW EPA. This reflects the lower percentage of benzene in current fuels.
- Total PAHs (as particulate phase only) are typically reported in air at concentrations in the order of 0.67 to 1.88 ng/m^3, similar to the averages of total PAHs reported by the NSW EPA.

[2] https://www.bluescopesteel.com/media/316333/2013%208%20port%20kembla%20steelworks%20monthly%20report%20august%202013.pdf

Section 4. Assessment of Human Health Impacts

4.1 General

The assessment of human health risks associated with emissions to air of VOCs and PAHs from the storage tanks at the site has been undertaken on the basis of the following:

- Review of the health effects and nature of the chemicals evaluated in this assessment, and the exposure pathways relevant to the local community (**Sections 4.2 and 4.3**);
- Review of potential acute health risks, based on comparing the maximum predicted concentrations with guidelines that are based on the protection of acute exposures by the general public (**Section 4.4**);
- Review of potential chronic health risks, based on comparing the maximum predicted concentrations with guidelines that are based on the protection of long-term (chronic) exposures by the general public (**Section 4.5**).

The assessment of acute and chronic exposures has included the calculation of a hazard index (HI). A HI is the ratio of the maximum predicted concentration to the guideline. Each individual HI is added up to obtain a total HI for all the volatile chemicals. The total HI is a sum of the potential hazards associated with all the volatile chemicals together assuming the health effects are additive, and is evaluated as follows:

- A total HI ≤ 1 means that all the maximum predicted concentrations are below the health based guidelines and there are no additive health impacts of concern.
- A total HI > 1 means that the predicted concentrations (for at least one individual compound) are above the health based guidelines, or that there are at least a few individual volatile chemicals where the maximum predicted concentrations are close to the health based guidelines such that there is the potential for the presence of all these together (as a sum) to result in adverse health effects.

4.2 Sources and Health Effects of Key Chemicals

The following presents a summary of the key sources, uses and health effects that have been associated with the key chemicals evaluated in this assessment.

4.2.1 Benzene

Uses and sources include (NSW DEC 2004a): Obtained in the coking of coal and in the production of illuminating gas from coal. Produced during petroleum refining. A gasoline additive. A natural component of coal tar and of oil-derived products. Emitted in motor vehicle exhaust. Evaporation of fuels during petrol refilling and from vehicle fuel tanks. Releases to air from service stations, the rubber industry, chemical plants, footwear manufacturing. Used in the manufacture of detergents, pesticides, varnishes, lacquers, pharmaceuticals, dyes, plastics and resins. Used for printing and lithography, paint, rubber, dry cleaning, adhesives and coatings, detergents, preparation and use of inks. A thinner for paints and a degreasing agent. A solvent for waxes, resins, oils and natural rubber. In glues, household cleaning products and paint strippers. Used primarily as a raw material in the synthesis of styrene, phenol, cyclohexane, aniline, chlorobenzenes and other products. Present in crude oil, petrol and cigarette smoke. Occurs naturally in forest fires.

Potential health effects of inhalation exposures include the following (ATSDR 2007a): Breathing very high levels of benzene can result in death, while high levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. The major effect of benzene from long-term exposure is on the blood. Benzene causes harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance for infection. Long-term exposure to high levels of benzene in the air can cause leukemia, particularly acute myelogenous leukemia, often referred to as AML. This is a cancer of the bloodforming organs. The International Agency for Research on Cancer (IARC) and the EPA have determined that benzene is carcinogenic to humans.

4.2.2 Toluene

Uses and sources include (NSW DEC 2004a): A natural component of coal tar, crude oil and oil-derived products. A gasoline additive. Produced in the refining of petrol. Occurs in vehicle exhaust. Emissions from vapours and spilling of petrol, commercial and household painting and paint, tobacco smoke, and consumer products containing toluene. Emitted by the chemical industry, rubber manufacturers, the pharmaceutical industry, printing, manufacturers of paints, varnishes and lacquers. Naturally emitted from forest fires. In medication, explosives, insecticides and dyes. Used for metal degreasing and metal recovery. A solvent for paints, resins, oils, fats, lacquers, varnishes, rubber cement and perfumes and a thinner for inks. A cleaning agent for machinery and electrical equipment and a grain fumigant. Used in refrigerants. An intermediate for fluorocarbons and pesticides. Used in organic synthesis for chlorination of organic compounds.

Potential health effects of inhalation exposures include the following (ATSDR 2001): Toluene may affect the nervous system. Low to moderate levels can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, loss of appetite, and hearing and colour vision loss. These symptoms usually disappear when exposure is stopped. Inhaling high levels of toluene in a short time can make you feel light-headed, dizzy, or sleepy. It can also cause unconsciousness, and even death. High levels of toluene may affect the kidneys. Studies in humans and animals generally indicate that toluene does not cause cancer.

4.2.3 Ethylbenzene

Uses and sources include (NSW DEC 2004a): A solvent and a natural component of coal tar and of oil-derived products. Emitted from coal tar and petroleum processing facilities. A component of automotive and aviation fuels. Released from fuel filling and from vapours from motor vehicle fuel tanks. Used in the production of synthetic rubber. Present in tobacco smoke.

Potential health effects of inhalation exposures include the following (ATSDR 2010a): Exposure to high levels of ethylbenzene in air for short periods can cause eye and throat irritation. Exposure to higher levels can result in dizziness. Irreversible damage to the inner ear and hearing has been observed in animals exposed to relatively low concentrations of ethylbenzene for several days to weeks. Exposure to relatively low concentrations of ethylbenzene in air for several months to years (i.e. chronic exposures) causes kidney damage in animals. The International Agency for Research on Cancer (IARC) has determined that ethylbenzene is a possible human carcinogen. All available reviews of toxicity indicate there is a threshold (i.e. a level below which there are no health effects).

4.2.4 Xylenes

Uses and sources include (NSW DEC 2004a): A natural component of coal tar and of oil-derived products. Occurs in vehicle exhaust. Used in the manufacture of dyes, polyester and alkyl resins. A solvent for paints, coatings, adhesives and rubbers. Used in the printing trade, in insecticides and aviation fuel.

Potential health effects of inhalation exposures include the following (ATSDR 2007b): No health effects have been identified at the background levels (in air) that people are exposed to on a daily basis. High levels of exposure for short or long periods can cause headaches, lack of muscle coordination, dizziness, confusion, and changes in one's sense of balance. Exposure to high levels of xylene for short periods can also cause irritation of the skin, eyes, nose, and throat; difficulty in breathing; problems with the lungs; delayed reaction time; memory difficulties; stomach discomfort; and possibly changes in the liver and kidneys. It can cause unconsciousness and even death at very high levels. Both the International Agency for Research on Cancer (IARC) and the US EPA have found that there is insufficient information to determine whether or not xylene is carcinogenic.

4.2.5 PAHs

Polycyclic aromatic hydrocarbons (PAHs) are chemical compounds of carbon and hydrogen containing at least two six-sided (benzene) carbon rings. They may contain many fused rings, some of which may not be six-sided. Hundreds of PAHs have been identified in atmospheric particles

Uses and sources include (NSW DEC 2004b): PAHs are formed during the combustion of organic matter. Sources of PAHs include diesel and gasoline engines, solid fuels (e.g. coal and wood for heating and cooking), industrial processes (e.g. coke ovens used for steel manufacture, aluminium smelters and oil refining) and the burning of vegetation (e.g. stubble burning, bushfire hazard reduction and bushfires).

Potential health effects of exposures include the following (ATSDR 1996): Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people. Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people. Most studies relate to benzo(a)pyrene (BaP), with many of the studies undertaken on other PAHs addressing their relative toxicity to BaP. Some PAHs (referred to as carcinogenic PAHs) have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer). The International Agency for Research on Cancer (IARC) and the EPA have determined that BaP is carcinogenic to humans. There is limited data that suggests short-term (acute) health effects occur as a result of exposure to PAHs. The most significant effects relate to chronic exposures, where carcinogenic effects are of most importance. These are most commonly assessed on the basis of adopting a BaP toxicity equivalent assessment approach.

Assuming all the PAHs evaluated in this project are as toxic and BaP will result in an overestimation of actual risk as the more volatile PAHs are significantly less toxic than BaP.

4.3 Potential for Exposure

Benzene, toluene, ethylbenzene and xylenes are volatile chemicals that when released to air stay in the vapour phase where inhalation exposures are of most importance. These chemicals are not persistent or bioaccumulative in the environment and will not adsorb to particulates or dust. Hence there is no potential for the community to be exposed to these chemicals via any other pathway other than inhalation.

The physical and chemical properties of PAHs are dependent on the number of aromatic rings and the molecular mass. At usual ambient temperatures, PAHs exist in the atmosphere as a gas, or adsorbed onto solid particles, or as particles. Lighter PAHs (lower molecular weight, fewer rings) are more likely to be in the gas (or vapour) phase rather than in the particle phase. The lightest member of the PAH family is naphthalene, a two-ring species, and is found in the vapour phase in the atmosphere. PAHs with three to five rings may have vapour pressures in an intermediate range and are present 'in part in the gas phase and partially associated with particles'. Such species are referred to as semivolatile. PAHs with five or more rings tend to be solids adsorbed onto other particulate matter in the atmosphere. An assessment of both particulate and gaseous PAHs in Galveston (Texas, USA) and found that on average, for the two and three-ring species less than 5% of PAHs was in the particle phase. Of the four-ring species, fluoranthene and pyrene also had less than 5% in the particle phase, while chrysene had on the order of 25%, and benz(a)anthracene about 45%. PAH species with five rings or more had greater than 50% in the particle phase (NSW DEC 2004b).

The PAHs evaluated in this assessment are assumed to be the more toxic, carcinogenic compounds that can be assessed as BaP. The assessment undertaken has assumed that BaP evaporates from the stored fuel products and is dispersed off-site in air as a vapour. There are no sources of particulate phase PAHs associated with this project.

PAHs in the gas or vapour phase primarily react with hydroxyl radicals although other radicals are important. Hydroxyl radicals are predominantly generated in the atmosphere by photochemical processes, most notably the photolysis of ozone in the presence of water vapour. These radicals are more abundant during summer than winter and can be present at significant concentrations during daylight hours. The potential for vapour phase BaP to adsorb to particulates in the atmosphere depends on the level of organic carbon in the particulate matter and the residency time of vapour phase BaP in air. Higher organic carbon levels may occur where particulates are derived from combustion sources. This project does not include combustion sources and hence the only particulates likely to be in air are derived from other sources. While some particulates may be present in air that are derived from combustion sources, their percentage is not known and nor is the likely potential for vapour phase BaP to sorb onto these particles. It is noted that the maximum annual average concentration of vapour phase BaP predicted in air from the project, 0.078 ng/m^3 is well below the background level of particulate phase BaP measured in the local area, 0.67-1.9 ng/m^3. If it were assumed that 10% of the vapour phase BaP sorbed to particulates the contribution to background is very low and would not be measurable. As such there is no potential for significant increases in BaP that may be present on particulates in air or deposited to surfaces. No assessment of other exposure pathways associated with the deposition of particulate phase BaP is warranted.

The assessment of PAHs in air has therefore focused on the inhalation pathway, assuming 100% of the BaP concentration estimated in air remains in a vapour phase.

4.4 Assessment of Acute Exposures

The predicted (incremental) concentrations of individual volatile organic compounds and polycyclic aromatic hydrocarbons associated with the project (based on the speciation as outlined above) have been reviewed against published peer-reviewed health based guidelines that are relevant to acute exposures (where relevant). The health based guidelines adopted (identified on the basis of guidance from enHealth 2012) are relevant to exposures that may occur to all members of the general public (including sensitive individuals) with no adverse health effects. The guidelines available relate to the duration of exposure. For acute exposures these guidelines are based on exposures that may occur for a short period of time (typically between an hour and up to 14 days). These guidelines are available to assess peak exposures (based on the modelled 1-hour maximum concentration) that may be associated with volatile organic compounds in the air.

The assessment has been conducted based on the sum of the maximum predicted concentrations at each receptor associated with tank venting as well as road tanker loading.

Table 4.1 presents the acute health based guidelines that are available for the volatile compounds addressed in this assessment.

Table 4.2 presents review of the predicted 1-hour average air concentrations at each of the receptors against the relevant guidelines, calculation of a hazard index and total hazard index.

Review of the acute assessment presented in **Table 4.2** indicates that the maximum short-duration peak (1 hour average) concentrations of volatile organic compounds (assessed as the key individual volatile organic compounds and as a sum of all the individual volatile organic compounds) in air surrounding the site are below the relevant acute health based guidelines.

This means all concentrations in air are well below a level that has the potential to result in adverse health effects in all members of the public associated with exposure to short-duration peak air concentrations.

Table 4.1 Acute Health Based Air Criteria for Volatile Chemicals Assessed

Key VOC	Health based acute guideline (mg/m^3)	Reference and basis for guideline
Benzene	**0.029**[A1] **to 0.17**[T1] (lower value adopted)	**A1**: Acute guideline (1hr to 14 day exposure), based on immunological effects in mice. Acute inhalation guideline (for exposures from 1 hour to 14 days) from review by ATSDR for benzene (ATSDR 2007c). **T1**: Acute 1 hour health based guideline, based on depressed peripheral lymphocytes and depressed mitogen-induced blastogenesis (mice study). TCEQ, Benzene, Development Support Document. Texas Commission of Environmental Quality, 1 hour average guideline value (include additional 3.3 fold safety factor). This acute guideline is lower than that derived by the OEHHA (based on older studies) (TCEQ 2013a)
Toluene	**4.5**[T2]	**T2**: Acute 1 hour health based guideline, based on eye and nose irritation, increased occurrence of headache and intoxication in human male volunteers. TCEQ, Toluene, Development Support Document. Texas Commission of Environmental Quality, 1 hour average guideline value (include additional 3.3 fold safety factor) (TCEQ 2013b).
Ethylbenzene	**22**[A2]	A2: Acute guideline (1hr to 14 days), based on auditory effects in rats exposed to ethylbenzene for 8 hours per day for 5 days. The criteria was derived by determining a human equivalent concentration relevant to acute exposures, with use of a human PBPK model. The criteria is derived from a review by ATSDR (2010) for ethylbenzene (ATSDR 2010b).
Xylenes	**2.2**[T3]	**T3**: Acute 1 hour health based guideline, based on mild respiratory effects and subjective symptoms of neurotoxicity in human volunteers. TCEQ, Xylenes, Development Support Document. Texas Commission of Environmental Quality, 1 hour average guideline value (include additional 3.3 fold safety factor) (TCEQ 2013c).
Benzo(a)pyrene	**NA**	Limited data available to assess acute inhalation exposures. Most significant health effects relevant to BaP relate to chronic exposures.

Table 4.2 Assessment of Acute Inhalation Exposures from Tank Venting and Road Tanker Loading (all concentrations in mg/m^3)

ID	Location	Benzene		Toluene		Ethylbenzene		Xylenes		Total HI
		Guideline	0.029	Guideline	4.5	Guideline	22	Guideline	2.2	
		Max 1-hr average	HI	Max 1-hr average	HI	Max 1-hr average	HI	Max 1-hr average	HI	
1	Coniston Public School	5.9E-04	2.0E-02	4.6E-03	1.0E-03	4.5E-03	2.1E-04	2.0E-03	9.0E-04	2E-02
2	Wollongong Greenhouse Park	1.7E-03	5.8E-02	1.3E-02	2.9E-03	1.3E-02	6.1E-04	4.8E-03	2.2E-03	6E-02
3	Wollongong Baptist Church	2.6E-04	8.9E-03	2.0E-03	4.5E-04	1.8E-03	8.3E-05	1.0E-03	4.7E-04	1E-02
4	Coniston Train Station	4.0E-04	1.4E-02	3.2E-03	7.0E-04	2.9E-03	1.3E-04	1.5E-03	6.9E-04	1E-02
5	392 Keira St, Wollongong	5.5E-04	1.9E-02	4.4E-03	9.7E-04	4.2E-03	1.9E-04	1.9E-03	8.5E-04	2E-02
6	42 Swan St, Wollongong	3.6E-04	1.2E-02	2.9E-03	6.4E-04	2.5E-03	1.1E-04	1.4E-03	6.5E-04	1E-02
7	163 Kembla St, Wollongong	3.7E-04	1.3E-02	2.9E-03	6.5E-04	2.7E-03	1.2E-04	1.4E-03	6.4E-04	1E-02
8	179 Corrimal St, Wollongong	3.7E-04	1.3E-02	2.8E-03	6.3E-04	2.6E-03	1.2E-04	1.4E-03	6.5E-04	1E-02
9	314 Gladstone Ave, Mt St Thomas	2.1E-04	7.3E-03	1.7E-03	3.7E-04	1.1E-03	4.9E-05	1.3E-03	5.8E-04	8E-03
10	240 Gladstone Ave, Mt St Thomas	2.4E-04	8.4E-03	1.9E-03	4.3E-04	1.6E-03	7.1E-05	1.1E-03	5.1E-04	9E-03
11	350 Gladstone Ave, Mt St Thomas	1.3E-04	4.4E-03	1.0E-03	2.2E-04	7.4E-04	3.4E-05	6.6E-04	3.0E-04	5E-03
12	111 Gladstone Ave, Mt St Thomas	3.7E-04	1.3E-02	3.0E-03	6.7E-04	2.6E-03	1.2E-04	1.5E-03	6.8E-04	1E-02
13	33 Five Islands Rd, Cringila	1.5E-04	5.3E-03	1.2E-03	2.7E-04	8.6E-04	3.9E-05	8.4E-04	3.8E-04	6E-03
14	Entrance to Site	2.0E-03	6.8E-02	1.5E-02	3.4E-03	1.0E-02	4.6E-04	1.1E-02	5.2E-03	8E-02
									Acceptable total HI	**≤1**

4.5 Assessment of Chronic Exposures

The predicted (incremental) concentrations of individual volatile organic compounds and polycyclic aromatic hydrocarbons associated with the project (based on the speciation as outlined above) have been reviewed against published peer-reviewed health based guidelines that are relevant to chronic exposures (where relevant). The health based guidelines adopted (identified on the basis of guidance from enHealth 2012) are relevant to exposures that may occur to all members of the general public (including sensitive individuals) with no adverse health effects. In relation to the assessment of chronic exposures the guidelines are based on exposures that may occur all day, every day for a lifetime. For most of the community receptors this is appropriate as many of these relate to residential areas. However for the site entrance, such an assumption is overly conservative. To address potential worker exposures at the site entrance an exposure adjustment factor of 0.32 has been adopted. This factor relates to workers being exposed 12 hours per day (rather than 24 hours per day) for 240 days per year (rather than 365 days per year).

Chronic guidelines address long-term exposures and are typically applied to annual average exposure concentrations. Annual average exposure concentrations were not provided in the AQIA and hence a longer duration annual average has been estimated using a default conversion factor of 0.08 (1-hour to annual average) (OEHHA 2003, 2014).

Table 4.3 presents the chronic health based guidelines that are available for the volatile compounds addressed in this assessment.

Table 4.4 presents review of the estimated annual average air concentrations at each of the receptors against the relevant guidelines, calculation of a hazard index and total hazard index.

Table 4.3 Chronic Health Based Air Criteria for Volatile Chemicals Assessed

Key VOC	Health based acute guideline (mg/m^3)	Reference and basis for guideline
Benzene	**0.0017**[W1]	**W1**: Benzene is classified as a known human carcinogen by IARC. Chronic guideline based on excess risk of leukaemia. WHO (WHO 2000, 2010) Air Quality Guidelines, value for benzene is based on non-threshold carcinogenic effects (excess lifetime risk of leukaemia). Guideline value based on incremental cancer risk of 1x10^{-5}, consistent with guidance provided by enHealth (enHealth 2012a)
Toluene	**5**[U1]	**U1**: USEPA evaluation for toluene (most recently reviewed in 2005). Chronic guideline based on neurological effects in an occupational study (converted to public health value using safety factors). This is the most current evaluation of effects associated with chronic inhalation exposure to toluene and is consistent with the value used to derive the NEPM (NEPC 1999 amended 2013b) health based guidelines
Ethylbenzene	**0.26**[A1]	**A1:** Chronic guideline based on neuropathy in a rat study, and use of a PBPK model to adjust the data to be relevant to humans. Guideline available from the ATSDR (ATSDR 2010b) is the most current and relevant value.
Xylenes	**0.22**[A2]	**A2:** Chronic guideline based on mild subjective respiratory and neurological symptoms in an occupational study (converted to public health value using safety factors). ATSDR Toxicological Profile for Xylene, chronic inhalation guideline derived is the most current robust evaluation (ATSDR 2007d)
Benzo(a)pyrene TEQ	**0.00000012**[W2]	**W2:** BaP is classified by IARC as a known human carcinogen, which relates to BaP as well as all the other carcinogenic PAHs assessed as a BaP toxicity equivalent value. WHO (WHO 2010) Guidelines for Indoor Air Quality, value for BaP is based on non-threshold carcinogenic effects from occupational study of coke workers (lung cancer is critical effect). The chronic guideline is based on protection from lung cancer for an occupational study. Guideline value based on incremental cancer risk of 1x10^{-5}, consistent with guidance provided by NEPM (1999 amended 2013) and enHealth (2012)

Table 4.4 Assessment of Chronic Inhalation Exposures (all concentrations in mg/m^3)

ID	Location	Benzene		Toluene		Ethylbenzene		Xylenes		BaP		Total HI
		Guideline	0.0017	Guideline	5	Guideline	0.26	Guideline	0.22	Guideline	0.00000012	
		Annual average	HI	Annual average	HI	Annual average	HI	Annual average	HI	Annual average	HI	
1	Coniston Public School	4.7E-05	2.8E-02	3.7E-04	7.4E-05	3.6E-04	1.4E-03	1.6E-04	7.2E-04	6.1E-08	5.1E-01	5E-01
2	Wollongong Greenhouse Park	1.3E-04	7.9E-02	1.1E-03	2.1E-04	1.1E-03	4.1E-03	3.9E-04	1.8E-03	1.7E-07	1.4E+00	2E+00
3	Wollongong Baptist Church	2.1E-05	1.2E-02	1.6E-04	3.2E-05	1.5E-04	5.6E-04	8.3E-05	3.8E-04	2.6E-08	2.2E-01	2E-01
4	Coniston Train Station	3.2E-05	1.9E-02	2.5E-04	5.0E-05	2.3E-04	8.9E-04	1.2E-04	5.5E-04	4.1E-08	3.4E-01	4E-01
5	392 Keira St, Wollongong	4.4E-05	2.6E-02	3.5E-04	7.0E-05	3.4E-04	1.3E-03	1.5E-04	6.8E-04	5.7E-08	4.8E-01	5E-01
6	42 Swan St, Wollongong	2.9E-05	1.7E-02	2.3E-04	4.6E-05	2.0E-04	7.7E-04	1.2E-04	5.2E-04	3.6E-08	3.0E-01	3E-01
7	163 Kembla St, Wollongong	3.0E-05	1.8E-02	2.3E-04	4.7E-05	2.1E-04	8.2E-04	1.1E-04	5.2E-04	3.8E-08	3.1E-01	3E-01
8	179 Corrimal St, Wollongong	2.9E-05	1.7E-02	2.3E-04	4.5E-05	2.1E-04	7.9E-04	1.1E-04	5.2E-04	3.7E-08	3.1E-01	3E-01
9	314 Gladstone Ave, Mt St Thomas	1.7E-05	1.0E-02	1.3E-04	2.7E-05	8.6E-05	3.3E-04	1.0E-04	4.6E-04	2.0E-08	1.6E-01	2E-01
10	240 Gladstone Ave, Mt St Thomas	1.9E-05	1.1E-02	1.5E-04	3.1E-05	1.2E-04	4.8E-04	8.9E-05	4.1E-04	2.3E-08	1.9E-01	2E-01
11	350 Gladstone Ave, Mt St Thomas	1.0E-05	6.0E-03	8.0E-05	1.6E-05	5.9E-05	2.3E-04	5.3E-05	2.4E-04	1.2E-08	1.0E-01	1E-01
12	111 Gladstone Ave, Mt St Thomas	3.0E-05	1.8E-02	2.4E-04	4.8E-05	2.1E-04	8.0E-04	1.2E-04	5.5E-04	3.8E-08	3.1E-01	3E-01
13	33 Five Islands Rd, Cringila	1.2E-05	7.3E-03	9.8E-05	2.0E-05	6.9E-05	2.6E-04	6.8E-05	3.1E-04	1.6E-08	1.3E-01	1E-01
14	Entrance to Site*	1.6E-04	3.0E-02	1.2E-03	7.9E-05	8.2E-04	1.0E-03	9.1E-04	1.3E-03	1.7E-07	4.6E-01	5E-01
											Acceptable total HI	**≤1**

* Calculated HI includes exposure adjustment factor of 0.32 to address exposures by workers, rather than residents

Review of the chronic assessment presented in **Table 4.4** indicates that the maximum long-term average (annual average) concentrations of volatile organic compounds and polycyclic aromatic hydrocarbons (assessed as individual VOCs and vapour phase BaP as well as a sum of all the individual VOCs and vapour phase BaP) in air surrounding the site are below the relevant long-term (chronic) health based guidelines. These are guidelines that are based on the protection of public health for inhalation exposures all day (24 hours), every day (365 days per year) for a lifetime (at least 70 years).

In addition it is noted that the concentrations predicted are well below the background concentrations reported in the local area, as outlined in **Section 3.4**.

This means all concentrations in air are well below a level that has the potential to result in adverse health effects in all members of the public associated with long-term (chronic or lifetime) exposure to emissions from the site.

Section 5. Conclusions

An assessment of health impacts within the local community associated with emissions to air from the proposed storage of fuel products in the PK BLT has been undertaken. The assessment has evaluated potential impacts of volatile chemicals derived from the storage of these fuels, and the road tanker loading activities at the terminal when fully constructed (i.e. at maximum capacity). The chemicals evaluated include benzene, toluene, ethylbenzene, xylenes and vapour phase emissions of polycyclic aromatic hydrocarbons, assumed to be as toxic as benzo(a)pyrene.

Based on the assessment undertaken there are no acute or chronic impacts on the health of the local community surrounding the project.

Section 6. References

ATSDR 1996, *ToxFaqs for Polycyclic Aromatic Hydrocarbons (PAHs)*, Agency for Toxic Substances and Disease Registry. <http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=121&tid=25>.

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