Manildra Port Kembla Storage Facility

Air Quality Assessment

Manildra Group

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→ **The Power of Commitment**

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Glossary and abbreviations

Term	Definition
AQA	Air quality assessment, as presented in this document
AWS	Automatic weather station
AEL	Air emission limits, as prescribed by relevant authorities
BAT	Best Available Techniques
DPIE	Department of Planning, Industry and Environment
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
g/s	Grams per second
Incremental	Impacts due to the proposal alone (as opposed to cumulative which is calculated as the incremental impacts plus background)
LGA	Local government area
m^3/h	Metres cubed per hour
mg/m^3	Milligrams per cubic metre
ML	Mega litre
NSW	New South Wales
proposal	Bulk Liquids Facility project
The site	Site B, Foreshore Road, Port Kembla

1. Introduction

1.1 Overview

Manildra Group (Manildra) propose to develop a Bulk Liquids Facility project (the proposal) at Site B, Foreshore Road, Port Kembla (the site). GHD Pty Ltd (GHD) was engaged by Manildra to conduct an air quality assessment for the proposal.

1.2 Project description

Manildra operates a 300 Mega Litre (ML) per year beverage grade ethanol plant at its Bomaderry plant within the Shoalhaven local government area.

Manildra is planning to develop a bulk liquids storage facility in Port Kembla to receive, store and export beverage grade ethanol product. The proposal also includes two related pipelines from the facility location at Site B, Foreshore Road to the existing Berth 206. One pipeline is for loading product out, the second pipeline is a return line for flushing the system.

At present, a total of six above-ground storage tanks are proposed within a single bunded area. The total volume of the storage tanks is proposed at 24 ML of ethanol product (Class 3 PG II under the relevant ADG / AS1940 Classification).

The 300 millimetre (mm) diameter pipelines will be above-ground where possible, but may be underground through the area where public access is permitted, and traverse approximately 950 metres (m) from the proposed facility location at Site B to an existing wharf structure at Berth 206.

Refer to the attached draft high level concept site layout in Appendix A for an illustration of the proposed bulk liquid storage facility.

1.3 Purpose of this report

This air quality assessment was prepared by GHD in support of Manildra's proposal to assess potential air quality impacts during operation of the proposal.

1.4 Scope

The scope of the air quality assessment included the following tasks:

- Receipt of plans, elevations for the proposed change of use plus identification of vents and/ or stacks where emissions to atmosphere will occur.
- Calculate ethanol emission rates from the sources using National Pollutant Inventory (NPI) guidance
- Configure a CALPUFF dispersion model to simulate the emissions to air from tanks, vents and stacks for the proposal. Conduct dispersion modelling to predict worst case ground level impacts for the identified emissions to air. Assess the compliance of the proposal against applicable air quality assessment criteria.
- Conduct a review of industry best practice techniques for the storage, transfer and handling of liquids to inform benchmarking of the proposal's mitigation measures against best practice.
- Provide recommended management measures to improve the performance of the proposal with respect to potential air quality impacts.
- Prepare a final report.

1.5 Assessment methodology overview

1.5.1 Construction assessment

Based on a review of the proposed construction methodology, agency requirements, and identification of emissions to air that could occur during construction, a qualitative-based approach that focused on management was adopted to assess the construction of the project. A risk-based approach in accordance with the Institute of Air Quality Management Guidance on the assessment of dust from demolition and construction (2014) (IAQM guidance) (Institute of Air Quality Management, 2014) was adopted to assess potential particulate matter (dust) impacts during construction of the project.

1.5.2 Operational assessment

1.5.2.1 Incremental assessment

A quantitative air quality assessment utilising air quality dispersion modelling was undertaken to assess potential worst case air quality impacts from operation of the proposal in accordance the NSW EPA *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (2016) (the Approved Methods).

Emissions to air were estimated based on emissions concentration limits provided by NSW Government *Protection of the Environment Operations (Clean Air) Regulation 2010* and guidance contained with Australian Government Department of the Environment and Water Resources *Nation Pollutant Inventory Emissions estimation technique manual for Beer and ready-to-drink alcoholic beverage manufacturing* Version 1.2 March 2007.

The primary emission to air was identified to be ethanol. All emissions of volatile organic compounds (VOC) were assumed to consist of ethanol only.

The Approved Methods considers ethanol to be an individual odorous air pollutant, and therefore ground level ethanol concentrations were assessed against the individual odorous air pollutant criteria for ethanol. The assessment criteria is provided as the incremental impact for assessment at the nearest existing or likely future off-site sensitive receptors, therefore no consideration to background ethanol concentrations was included in this assessment.

Air quality dispersion modelling was undertaken to predict ground level concentration ethanol levels. Model results were presented as tabulated values at each sensitive receptor location and contour plots to illustrate the predicted pattern of dispersion.

1.5.2.2 Cumulative assessment

It is acknowledged that ethanol emissions may combine with various other pollutants in the atmosphere emitted by nearby developments to contribute to odour impacts caused by the accumulation of individual odorous air pollutants which result in the formation of a complex mixture of odorous air pollutants.

Whilst the Approved Methods does not provide guidance regarding cumulative odour assessments (it states that odour impacts are to be reported as incremental impacts, i.e. predicted impact due to the pollutant source alone). a two-step screening review was undertaken to determine the risk of cumulative odour impacts occurring:

1. Nearby emissions review – a review of emissions reported to the National Pollutant Inventory database was undertaken to identify any nearby developments that emit odorous emissions. A search radius of 2.5 km identified nine facilities with emissions to air, of which, six were identified to emit odorous air pollutants (key odorous air pollutants listed for each facility);
   - Australian Marine Fuels (total volatile organic compounds (TVOC) and ethanol),
   - IXOM Port Kembla Site (TVOC),
   - Kel Campbell-Kembla Petroleum Depot (toluene, xylene, TVOC) and
   - Pacific National Port Kembla Outer Harbour (xylenes, TVOC and cumene).
   - Port Kembla Milling (TVOC)

- BlueScope Steel Port Kembla Steelworks (ethanol, hydrogen sulfide, methanol, toluene, TVOC, xylenes).

The other facilities identified to emit ethanol emissions were Australian Marine Fuels located approximately 1.4 km to the northwest of the proposal and BlueScope Steel Port Kembla Steelworks located approximately 2 km to the northwest of the proposal. Australian Marine Fuels reported 960 kg of ethanol emissions in the 2019-2020 period (equivalent to approximately 10% of total ethanol emissions from the proposal) and BlueScope Steel Port Kembla Steelworks reported 110 kg of ethanol emissions in the 2019-2020 period (equivalent to approximately 1% of total ethanol emissions from the proposal) (refer Section 4.2 for emissions estimation). Due to relatively low quantities of ethanol released from these facilities, cumulative impacts are not expected. It is noted each individual odorous air pollutants has an unique odour character and hedonic tone and therefore their corresponding odour impacts would not necessary sum linearly (i.e. odour from some pollutants may not contribute to total odour).

2. Geospatial review – a geospatial review of nearby industry, the proposal and sensitive receptor locations was undertaken to identify if cumulative impacts could occur from nearby developments (i.e. could a receptor be downwind from the proposal and another nearby development at the same time, and so emissions from sources are dispersed towards a single receptor). No existing or future developments that emit odorous emissions were considered close enough or aligned along the same wind direction to cause cumulative impacts.

The review concluded that there would be a low risk of cumulative odour impacts and therefore no further consideration to cumulative impacts was considered necessary.

1.6 Structure

The report consists of the following sections:

– **Section 1 – Introduction:** Provides an overview of the assessment
– **Section 2 – Existing environment:** Describes the existing environment as relevant to this assessment
– **Section 3 – Context:** Describes the legislative and policy context for the assessment and other relevant guidelines
– **Section 4 – Project emissions to air:** Presents the type and quantity of air emissions from the proposal.
– **Section 5 – Impact assessment:** Presents a summary of the air impacts
– **Section 6 – Best practice and recommended mitigation measures:** Provides an overview of the proposed best practices benchmarked against industry best practice and includes recommended mitigation measures to be implemented to minimise air impacts
– **Section 7 – Conclusion:** Presents a summary of the findings and sets out the principal conclusions of the assessment

1.7 Limitations

This report: has been prepared by GHD for Manildra Group and may only be used and relied on by Manildra Group for the purpose agreed between GHD and Manildra Group as set out in section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Manildra Group arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1.8 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Manildra Group and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.8 Assumptions

This air quality assessment relied upon the following assumptions:

– Details of the proposal including a detailed description of all operational activities likely to produce air quality emissions, a conceptual site layout, tank dimensions (diameter, height, capacity), tank layout, ethanol flowrates and scrubber stack properties were provided by Manildra and/or TfA Project Group.

2. Existing environment

2.1 Study area and surrounding land uses

The site is located at ‘Site B’ Foreshore Road, Port Kembla and is formally described as Lot 6 DP1236743 shown in Figure 1. It is noted that Lot 6 encompasses a relatively large parcel of land within the overall Port Kembla area and that Port Kembla has an Inner Harbour area and an Outer Harbour area. The site is referenced within the Outer Harbour area.

The site is located in the Wollongong City Council local government area (LGA) and falls within land zoned ‘SP1 - Special Activities’ under State Environmental Planning Policy (Three Ports) 2013 (Three Ports SEPP) and is surrounded by land included in the ‘SP1 – Special Activities’ zone.

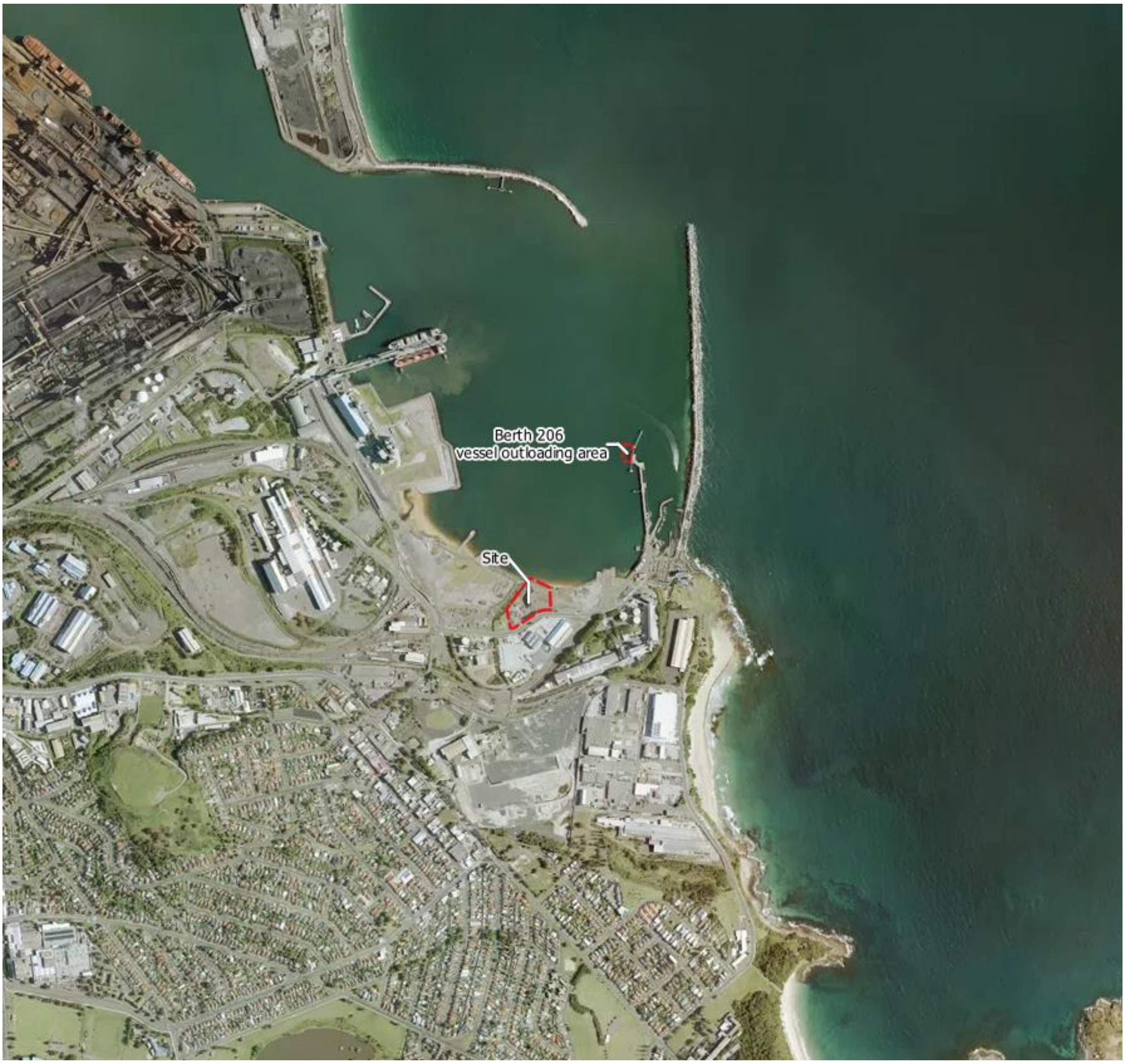

Figure 1 ***Proposal location (aerial imagery sourced from MetroMap)***

2.2 Sensitive receptors

The Approved Methods defines sensitive receptors as locations where people are likely to work or reside and may include a dwelling, school, hospital, office or recreation areas.

The location of identified sensitive receptors are listed in Table 1 with universal transverse Mercator coordinates (eastings and northings), receptor type, locality with respect to the proposal and address. The location of representative sensitive receptors in the surrounding area are shown in Figure 2.

Table 1 Location of identified sensitive receptors

Receptor ID	Easting (m)	Northing (m)	Receptor type	Approximate distance and direction from Proposal	Address
R01	307810	6182974	Industrial	25 m, south	7 Foreshore Rd, Port Kembla
R02	308309	6183160	Commercial	430 m, east	91 Foreshore Rd, Port Kembla
R03	307219	6182745	Residential	590 m, southwest	19 Five Islands Rd, Port Kembla

Legend

- Sensitive receptors
- Sources
- Site

Paper Size ISO A4

0 100 200 m

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

N

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Air Quality Assessment

Site context and location of identified sensitive receptors

Project No. **12553198**
Revision No. **6**
Date. **27/04/2022**

FIGURE 2

Document Path: C:\Users\nspurrett\Desktop\Air Quality\2021-12553198-Manildra Port kembla Storage Facility Air Quality Assessment\QGIS\12553198-Manildra Port kembla Storage Facility_02.qgz
Print Date: 27/04/2022

Data Source:Google Earth Imagery 2021.
Created By: nspurrett

3. Context

3.1 Secretary’s Environmental Assessment Requirements

The SEARs relevant to air quality, and reference to where they are addressed in this report, are outlined in Table 2.

Table 2 Air quality SEARs

Requirement	Where address in report
Planning Secretary’s Environmental Assessment Requirements (SEARs) (SSD- 33042483)	
Air quality and odour	
– a quantitative assessment of the potential air quality, dust and odour impacts of the development (construction and operation) on surrounding landowners, businesses and sensitive receptors, in accordance with relevant Environment Protection Authority guidelines, including:	This report
– a detailed description of all operational processes and activities, inputs and outputs and characterisation of all emission sources	Section 4
– details of proposed mitigation, management and monitoring measures, benchmarked against best practice measures for emission control in similar facilities, including for all on-road diesel trucks associated with the development	Section 6
– an assessment of cumulative impacts from existing or approved port or industrial operations in the area	Section 1.5.2.2

3.2 Project requirements from the EPA

The NSW EPA stipulated the following requirements relating to air quality:

A suitably qualified expert should be engaged to provide the following information to support the application:

1. Detailed description of the proposed activities. Consideration must be given to, but not necessarily be limited to:

a) A detailed process description of activities and/or unit operations that are proposed to be undertaken at the premises.

b) A detailed description of process input and outputs, including those inputs that affect air emission discharges to the environment.

2. A detailed characterisation of all emissions sources from the proposed operations, (including working and breathing losses of the tanks). In characterising emission sources, consideration must be given to:

a) Frequency and/or magnitude of emissions from proposed sources, due to such factors as:

- Number of batches for those unit operations/processes that are batch processes

- Operating hours

- Operating capacity of specific unit operations/processes

- Potential operational variability, and the implications that this variability may have on the frequency and/or magnitude of air emissions

3. A detailed description of all reasonable and feasible measures that will be undertaken to:

a) prevent, control, mitigate or abate air emissions; and

b) protect the environment from harm as a result of the emissions

The proposed mitigation measures should be benchmarked against current best practice for emissions control from similar facilities, and may include, but not be limited to:

a) a large loading gantry with a vapor recovery unit, and

b) floating roof tanks with secondary seals.

Where priority is not given to the highest level of control, the proponent should provide robust justification with supporting evidence on why these measures are not feasible or practical for implementation. In doing so, consideration must be given but not be limited to the following aspects:

a) Air quality and health impacts;

b) Plant efficiency;

c) Implementation timeframe;

d) Technical and engineering constraints; and

e) An assessment of the risk and potential impacts associated with point and fugitive source emissions from the proposed operations. The assessment of risk relates to environmental harm, risk to human health and amenity.

3.3 Legislative and policy context to the assessment

The relevant legislation and government guidance for the air quality assessment of the proposal are:

- NSW *Protection of the Environment Operations Act 1997* (POEO Act)
- NSW *Protection of the Environment Operations (Clean Air) Regulation 2010* (POEO Clean Air Regulation)
- National Environment Protection Council (NEPC) *National Environment Protection (Ambient Air Quality) Measure* (the Air NEPM)
- NSW EPA *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (2016) (the Approved Methods).

The POEO Act provides the statutory framework for managing pollution in NSW, including the procedures for issuing licences for environmental protection on aspects such as waste, air, water and noise pollution control. The POEO Act requires that no occupier of any premises causes air pollution (including odour) through a failure to maintain or operate equipment or deal with materials in a proper and efficient manner. The operator must also take all practicable means to minimise and prevent air pollution (sections 124, 125, 126 and 128 of the POEO Act). The POEO Act includes the concept of 'offensive odour' (section 129) and states it is an offence for scheduled activities to emit 'offensive odour'.

The POEO Clean Air Regulation provides regulatory measures to control emissions from motor vehicles, fuels, and industry.

The National Environment Protection Council of Environmental Ministers, now the National Environment Protection Council (NEPC), set uniform national standards for ambient air quality in February 2016. These are known as the Air NEPM. The Air NEPM sets non-binding standards and ten-year goals (for 2026). The Air NEPM contains goals for the identified relevant pollutants inclusive of particulates and concentration limits, averaging periods and number of allowed exceedances for each of the identified pollutants. The Air NEPM standards apply to regional air quality as it affects the general population. The standards do not apply in areas impacted by localised air emissions, such as industrial sources, construction activity, and heavily trafficked streets and roads.

The Approved Methods lists the statutory methods for modelling and assessing emissions of air pollutants from stationary sources in NSW. It considers the above-mentioned legislation and guidance to provide pollutant assessment criteria.

3.4 Emission limits

The POEO Clean Air Regulation outlines air emission limits (AEL) in *Schedule 2 Standards of concentration for scheduled premises: afterburners, flares and vapour recovery units* (Clause 38). AEL relevant to the proposal have been reproduced in Table 3. Emissions to air for all vapour recovery units must comply with this emission limit.

Table 3 ***Relevant AELs for emissions: NSW POEO Schedule 2 Standards of concentration for scheduled premises: vapour recovery units***

Air impurity	Plant	Averaging period	Standard of concentration
Volatile organic compounds (VOCs), as n-propane equivalent	Any vapour recovery unit treating air impurities that originate from material not containing any principal toxic air pollutant (Group 6)	1 hour rolling	40 mg/m^3 (Dry, 273 K, 101.3 kPa)

3.5 Air quality impact assessment

Assessment criteria has been taken from the Approved Methods. These criteria should be met at and beyond the boundary of the facility including at all existing or future off-site sensitive receptors. The assessment criteria should be assessed against incremental impacts only (i.e. predicted impact of the proposal alone without including any background sources). The assessment criteria applicable to the proposal presented in milligrams per cubic metre (mg/m^3) is summarised in Table 4.

Table 4 ***Air quality impact assessment criteria***

Pollutant	Pollutant classification	Averaging period and percentile	Assessment criteria (mg/m^3)
Ethanol	Individual odorous air pollutant	1 hour, 99.9^{th} percentile	2.1

4. Project emissions to air

4.1 Construction

4.1.1 Overview

The key emissions to air from the construction of the proposal have been identified upon review of the construction methodology. Low levels of dust emissions (TSP and PM_{10}) are expected during early construction efforts, primarily during site establishment earthworks. Based on the expected magnitude and duration of construction dust emissions, a risk-based assessment of potential impact has been undertaken in accordance with IAQM guidance.

Minor vehicle exhaust emissions are expected throughout the construction period; however, sources will be discontinuous, transient, and mobile, and therefore the air quality risk associated with vehicle emissions during construction is low.

4.1.2 Construction dust emissions

Construction is anticipated to take approximately 250 days in duration. However, the majority of dust emissions are expected to occur during site establishment earthworks. Earthmoving equipment proposed for construction activities include:

– 3 x earthmoving plant for a duration of 2 weeks
– 1 x excavator for a duration of 8 weeks
– 1 x mobile crane for a duration of 30 weeks
– 1 x feeder crane for a duration of 30 weeks

Dust emissions are expected via use of the earthmoving plant (for a period of 2 weeks) during grading and leveling activities associated with site establishment. Once the foundation of the site has been established (i.e. concrete slab has been poured) significant dust emissions are not anticipated. It is noted that the site is currently free from vegetation, therefore vegetation removal and associated dust emission would not occur.

4.2 Operation

4.2.1 Process overview

The bulk liquids storage facility in Port Kembla would have the capacity to receive, store and export ethanol product. A description of the proposal features, overview of the proposed site operation and details of any proposed safety and best practice design are provided below.

The proposal would have the following physical features:

– 6 x 4 ML stainless steel ethanol storage tanks. Each tank would have a diameter of 16.5 metres and a wall height of 20 metres. Walls would be manufactured from 2202 grade stainless steel while the floor, roof and gussets would be manufactured from 304 grade stainless steel. The storage would have a frangible roof, pressure/vacuum (P/V) relief valves, painted exterior, nitrogen filled void above liquid, foam firefighting system piped into tank above max liquid level, radar level controller and back-up level full probe, all functions controlled via Programmable Logic Controller (PLC). The tanks would be designed to operate within pressure range -2.0/+1.8 kpa and the tank contents will be affected only by atmospheric conditions say 0 deg to 40 deg C. Internal floating roofs are often used on similar storage tanks, but in this case are not practical since internal floating roof tanks have vents through the dome top roof. This allows air to breathe. Correspondingly water vapour and impurities are drawn into the space above the floating roof. The water vapour including the impurities will condense and pass through the seals around the perimeter of the floating roof. This has the potential to contaminate the higher beverage/food grade ethanol in the storage.

- 2 x 230 kilolitre (kL) slop tanks. Each slop tank would have a diameter of 4.5 metres and a height of 15 metres. They would be manufactured from 304 grade stainless steel and contain P/V relief valves, explosion relief valve/s, painted exterior, nitrogen filled void above liquid, foam fire fighting system piped into tank above max liquid level and all functions would be controlled via a Programmable Logic Controller (PLC).
- 2 x 300 mm pipelines from the facility location at Site B, Foreshore Road to the existing Berth 206. One pipeline is for loading product out, the second pipeline is a return line for flushing the system. The pipelines will be above-ground where possible but may be underground through the area where public access is permitted, and traverse approximately 950 metres from the proposed facility location at Site B to an existing wharf structure at Berth 206. The pipeline would be charged with ethanol for approximately 500 hours per year during pigging and loadout to vessels, at all other times the pipelines rests charged with nitrogen.
- All equipment in contact with ethanol would be manufactured from Stainless steel and tank bunds would be concrete

Site operations would occur as follows:

- Ethanol would be delivered to the proposal site via road tankers of 74,000 litre capacity, followed by discharge into storage tanks (6 x 4 ML stainless steel ethanol storage tanks) at a rate of 200 m^3/h (2 x 100 m^3/h), via two loading arms configured for a double and b double trucks. Road tanker inloading to storage tanks would be automated so that truck drivers can operate the system from an operators console.
- Ethanol would be outloaded to vessels moored at berth 206 at a rate of up to 1,000 m^3/h. Typical ethanol shipments range between 5 ML to 10 ML, with a total annual outloading volume of 200 million litres per year. Outloading to vessels will require some input from operators, the pumps will be VSD controlled and ramp up/down during start up/slow down. The system would be controlled from the wharf and the tank farm.
- Flushing and pigging of the outloading pipeline (with a return line of the same capacity) would be undertaken to the ship, storage tanks or slops tank. Pigging would also occur for the return pipeline.
- Outloading of ethanol to ISO tanks and road tankers for local markets would be undertaken at a rate of up to 200 m^3/h via 2 loading arms configured for a double and b double trucks. Outloading to ISO tanks & road tankers would be automated similarly to inloading.
- ISO tanks would be cleaned from a roofed gantry allowing access to the top of ISO tanks and road tankers. Cleaning would be undertaken using steam from a small liquefied petroleum gas (LPG) fired steam boiler introduced by hand spray.
- Outloading of slops from the slops tank would occur at a rate of 100 m^3/h via 1 loading arm. Slops would be recycled through the Nowra distillery.
- Vapours from the tank inloading and filling of ISO tanks and road tankers will be collected and processed through a vapour recovery unit wet scrubbing system. Scrubber water will be sent to the slops tanks to be transported to Nowra for reprocessing.
- Spilled material will be captured in the main tank farm bund or the tanker bunds and pumped to the slops tank, then recycled through the Nowra distillery. Rainwater from the bunds will be tested for ethanol, then if clean, pumped to a water sump or lagoon to be used to water landscaping. Excess will be discharged to the canal.

Safety and best practice design aspects that are included in the proposal as are follows:

- The proposal would be designed to comply with technical design standards AS1940, AS 2885 and other Australian Standards. Equipment will be designed to comply with appropriate design standards including API 620 for the tanks, AS/NZS std 60079.10.1.2009
- Proposed Hardware Safety Systems would comprise of dry break couplings, independent high level trips on tanks, NDT testing of critical pipes, emergency shutdown valves, P/V valves on tanks, emergency pressure relief systems on tanks and system to ensure nitrogen filled vapour space.
- Proposed fire systems would comprise of detection, preventative systems include nitrogen filling of tank headspaces, protection systems include foam nozzles to tanks above liquid level, 2 firewater pumps supplied by 2 shared tanks, water sprinklers as required at tank farm & wharf, fire water in the tank farm will be contained in the bund and pumped to the slops tank, to be disposed of offsite and firefighting system in truck loading area.

– A vapor recovery system that would collect and treat all vapours from the tank inloading and filling of ISO tanks and road tankers. The vapor recovery system would process vapours through a wet scrubbing system prior to dispersion to atmosphere. Scrubber water will be sent to the slops tanks to be transported to Nowra for reprocessing.

4.2.2 Emission identification

Sources of air emissions comprise of the ethanol vapours generated by typical operations of the proposal. There is potential for ethanol emissions to arise from several operations to be conducted at the facility, namely:

– Use of ethanol storage tanks including:
  - Working losses (evaporative losses during filling operations)
  - Breathing losses (evaporative losses during storage, also referred to as 'standing losses')
– Transfer operations including:
  - Inloading of road tankers to storage tanks
  - Filling and outloading of ISO tanks
  - Filling and outloading of road tankers
  - Loadout to vessels moored at berth
– Fugitive losses from pipeline and fitting leaks

Small quantities of other air pollutants such as combustion emissions would occur from road tankers and the small LPG boiler (which would be used for tank cleaning). Emissions from these sources would occur irregularly (i.e. only when road tankers enter or exit the facility and when tanks are being cleaned) and in small quantities compared against nearby existing industry. Therefore, emissions from these sources were considered negligible and no further assessment was deemed necessary.

4.2.3 Emission estimation

4.2.3.1 Ethanol tank emissions

Manildra propose to install a vapor recovery system that would capture and divert all tank working and breathing losses for treatment through a vapour recovery unit scrubber prior to dispersion via a stack. The scrubber would be designed to comply with the POEO Clean Air Regulation vapour recovery unit AEL outlined in Table 3.

The AEL is provided for VOC emissions, however for assessment purposes all VOC emissions were assumed to be ethanol. It is noted that ethanol is considered a VOC by the National Pollutant Inventory. Further, the emission estimation factors for total VOC and for ethanol in the NPI manual are equivalent for beverage grade ethanol handling.

Ethanol emissions from the vapour recovery unit scrubber were calculated based on discharge properties provided by Manildra and TfA Project Group and standards of concentration limits enforced by the POEO Clean Air Regulation. A summary of the vapour recovery unit scrubber stack properties and calculated ethanol emission rate is provided in Table 5.

Table 5 Vapour recovery unit scrubber stack properties

Parameter	Value	Units
Stack height	15	m
Stack flowrate	450	m^3/hr
Stack diameter	0.1	m
Stack velocity	15.9	m/s
Exhaust temperature	25	°C

Parameter	Value	Units
Normalised flowrate[1]	414.3	Nm^3/hr
Stack VOC concentration limit (assumed to be equivalent to ethanol concentration limit)	40	mg/Nm^3 dry
Ethanol emission rate	0.0046	g/s
	145.2	kg/year

4.2.3.2 Transfer operation emissions

The vapor recovery system (as discussed in Section 4.2.2) would capture and treat all emissions from:

– Unloading of road tankers to storage tanks
– Filling and outloading of ISO tanks
– Filling and outloading of road tankers

Therefore, emissions from these sources are accounted for in the vapour recovery unit scrubber stack (refer Table 5).

It is understood that loadout to vessels moored at berth would occur as follows:

– Vessels would arrive cleaned and ready to accept ethanol
– Ethanol loading is undertaken using submerged pipes where the vessels tanks are fed by pipes which terminate in a sump in the bottom of the tank and
– Vapours collected within the vessel tank headspace are vented via vents on top of the vessel during loading.

During loadout to vessels moored at berth, ethanol vapours would evaporate into the headspace of the vessel tank. As the tank fills with ethanol, vapour headspace is displaced by incoming liquid which forces vapour collected in the tank headspace out the vents on top of the vessel.

Ethanol emissions from loadout to vessels were calculated based on guidance contained within Australian Government Department of the Environment and Water Resources *Nation Pollutant Inventory Emissions estimation technique manual for Beer and ready-to-drink alcoholic beverage manufacturing* Version 1.2 March 2007 (NPI guidance).

An emission factor of 0.052 kg/KL[2] for filling alcohol storage tanks (supplied in appendix B of NPI guidance) was adopted to estimate emissions during loadout to vessels expressed as kilograms of ethanol emitted to air per kilolitre of ethanol loaded.

Manildra advised that vessels at berth would be loaded with ethanol at a rate of 1,000 m^3/h. Therefore the peak ethanol emission rate from vessel loading was predicted to be 13.9 g/s assuming no controls are implemented (to account for potential worst case emissions).

However, a total outloading volume of 200 million litres is proposed per year (equates to 200 hours per year based on an outloading rate of 1,000 m^3/h, equivalent to 2.3% of the time), therefore emissions from loadout to vessels moored at berth would be relatively rare. Based on the total annual outloading volume, the annual ethanol emissions rate from vessel loading was predicted to be 9,984 kg/year.

A summary of the vessel vapour vent stack properties and calculated ethanol emission rate is provided in Table 6.

Table 6 Vessel vapour vent properties

Parameter	Value	Units
Stack height	10	m
Stack flowrate	1,000	m^3/hr

[1] Vapour recovery unit scrubber stack flowrate was normalized to 274 K and 101.325 kPa, exhaust moisture content was unknown and therefore a moisture content of 0% was conservatively assumed for the normalization calculation
[2] Emissions factor was multiplied by alcohol percentage (96%) in accordance with NPI guidance to calculate the emission factor for the solution specific to the project

Parameter	Value	Units
Stack diameter[3]	0.1	m
Stack velocity	35.4	m/s
Exhaust temperature	25	°C
Ethanol emission rate	13.9	g/s
	9,984.0	kg/year

4.2.3.3 Fugitive emissions

Fugitive ethanol emissions would occur from typical operations of the proposal due to minor leaks from various standard pressurised tank componentry including valves, pumps, pump seals, compressors and fittings (connectors and flanges). It is anticipated that the fugitive ethanol emissions would be discontinuous, variable and relatively minor compared with other ethanol emissions on site.

Fugitive emissions from the pipeline would only occur while the pipeline is charged with ethanol which Manildra advised would be approximately 500 hours per year (equivalent to 5.7% of the time) during pigging and loadout to vessels. At all other times, the pipelines rests charged with nitrogen and therefore no fugitive emissions would occur.

Fugitive emissions are considered minor and were therefore not included in the quantitative assessment. Instead, appropriate management measures were recommended to minimise fugitive emissions where possible.

4.2.4 Emissions summary

A summary of all emissions sources with commentary outlining the mechanism of emission release is provided in Table 7.

Table 7 Summary of emissions source

Source	Source details	Commentary
Ethanol tank emissions	Working losses	All vapour will be captured via a vapor recovery system and diverted through the scrubber.
	Breathing losses	
Transfer operation emissions	Inloading of road tankers to storage tanks	
	Filling and outloading of ISO tanks	
	Filling and outloading of road tankers	
	Loadout to vessels moored at berth	Vapour is vented via vents on top of vessel during loading,
Fugitive emissions	pipeline and fitting leaks	Considered negligible

A summary of site wide ethanol emissions is provided in Table 8.

Table 8 Summary of site ethanol emissions

Source	Peak ethanol emission rate (g/s)	Annual ethanol emissions (kg/year)
Vapour recovery unit stack	0.0046	145
Vessel loadout	13.9	9,984

Vessel loadout accounted for 99.97% of cumulative peak site emissions (and 98.57% of annual site emissions) and was therefore identified as the primarily source of emissions to air. However, it should be noted that vessel loadout emissions would only occur for approximately 200 hours per year (equivalent to 2.3% of the time).

[3] Stack diameter of vessel vents estimated to be 0.1 metres. It was assumed that all exhaust flow would be directed through a single vent at any one time.

5. Impact assessment

5.1 Construction

5.1.1 Assessment approach

A risk-based approach in accordance with IAQM guidance was adopted to assess potential particulate matter impacts during the construction of the proposal.

The IAQM guidance recommends that a detailed risk assessment be undertaken where there is a human receptor within 350 m or an ecological receptor within 50 m of the construction footprint, or where there is a human or ecological receptor within 50 m of any haulage routes up to 500 m from the site entrance.

Given there are human receptors within 350 m of the construction footprint, a detailed risk assessment has been undertaken.

5.1.2 Risks identified

The construction program has been divided into three activity groups that have potential to cause significant dust emissions. These activities are earthworks, construction and track-out. To identify the risk of dust impact from construction works, the size and scale of each activity must be determined as well as the sensitivity of the surrounding environment.

Size and scale

The size and scale of the activities are determined by not only the physical size of the project but other factors that are likely to increase or decrease the amount of dust created during each construction activity. Table 9 outlines these factors for each activity and the resulting size and scale descriptor as defined by the IAQM Guidance.

Table 9 Size and scale of construction activities

Activity	Description	Size and scale descriptor
Earthworks	– Proposal construction area is ~ 15,000 m^2 – Leveling of earth required prior to construction of the proposal – 3 x earthmoving plant to be in operation at a time	Medium
Construction	– Buildings being constructed are < 25,000 m^3 in volume – Construction of concrete slab – Construction of minor site buildings (site office) with material with low potential for dust release (e.g. metal, cladding or timber). – Installation of prefabricated tanks	Low
Track-out	– Estimated that there will be < 10 heavy duty vehicle movements per day (total deliveries estimated to be 250 trips for concrete agitators, 50 trips for steel delivery and 200 trips for miscellaneous other deliveries) – Vehicle movements along paved roads	Low

Sensitivity

The sensitivity of the surrounding environment is determined by the number of high risk, medium risk and low risk receptors within a certain proximity of the construction footprint. High sensitivity receptors include dwellings, educational institutions, and medical facilities. Medium sensitivity receptors include commercial, and industrial premises. Low sensitivity receptors include farmland, recreational parklands, and other public spaces. The sensitivity is determined for three areas of concern, these are:

- Sensitivities of people to dust soiling effects
- Sensitivities of people to the health effects of PM_{10}

– Sensitivities of receptors to ecological effects.

The sensitivities for each area for all construction activities are outlined in Table 10.

Table 10 Sensitivity of areas of concern for all construction activities

Activity	Description	Sensitivity
Sensitivities of people to dust soiling effects	– One medium sensitivity receptor located within 50 m from any construction activity – More than 10 medium sensitivity receptors are within 350 m from any construction activity	Low
Sensitivities of people to the health effects of PM_{10}\	– The annual average PM_{10} concentrations from the closest two DPIE ambient air monitoring stations for the most recent calendar year (01/01/2021 – 31/12/2021) are 15.1 µg/m^3 at the Wollongong station and 17.6 µg/m^3 at the Kembla Grange station – One medium sensitivity receptor is located within 50 m from any construction activity. – More than 10 medium sensitivity receptors are within 350 m from any construction activity	Low
Sensitivities of receptors to ecological effects.	– No high or medium sensitive ecological features within 50 m of the construction activity	Low

Risk summary

The risk matrix uses the sensitivity and scale to determine the risk of dust impacts on the surrounding receptors. Table 11 outlines the risk matrix determined for the construction of the proposal. The risk identified for earthwork activities was **Low Risk** while the risk identified for all other construction and track-out activities was **negligible** for all sensitivity types. Proposed specific mitigation measures are provided in Section 6.3 to further minimise the risk of dust impacts at receptor locations during construction works.

Table 11 Risk matrix for dust impacts during construction

Impact	Risk		
	Earthworks	Construction	Track-out
Dust soiling	Low risk	Negligible	Negligible
Human health	Low risk	Negligible	Negligible
Ecological	Low risk	Negligible	Negligible

5.2 Operation

5.2.1 Modelling methodology

5.2.1.1 Dispersion modelling

Predicted air quality impacts were modelled in accordance with the Approved Methods using an approved computer software model CALPUFF. CALPUFF is a non-steady-state, Gaussian puff dispersion model. It is accepted for use by the NSW EPA for application in environments where wind patterns and plume dispersion is strongly influenced by complex terrain, the land–sea interface or where there is a high frequency of stable, calm night-time conditions.

CALPUFF model settings were selected based on the recommendations provided in the *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia* (J Barclay and J Scire, Atmospheric Studies Group TRC Environmental Corporation, 2011), with the exception of the MDISP parameter for which the model default value was used.

For this assessment, the CALPUFF dispersion model was used to predict ground-level 99.9th percentile one hour averaged concentrations from the proposal. The CALPUFF dispersion model utilised a meteorological dataset of one year in duration. The grid size used in the CALPUFF model was equivalent to the CALMET domain (use of CALMET further discussed in section 5.2.1.2). The same grid resolution of 250 metres used for the CALMET model was used in CALPUFF.

The CALPUFF model was run for two potential operating scenarios (refer Section 5.2.2). The CALPUFF model assumed peak emissions from both sources (vapour recovery unit stack and vessel loadout vents depending on operating scenario) occurred constantly, 24 hours per day, 365 days per year to conservatively predict worst case 1 hour concentrations, despite vessel loadout (identified as the primary source of emissions accounting for 99.97% of cumulative site emissions) would occur for approximately 200 hours per year (equivalent to 2.3% of the time).

This meant that impacts during the worst case operation scenario (when both the vapour recovery unit stack and vessel loadout vents are emitting ethanol emissions) are simulated for a greater range of meteorological conditions and therefore considers a greater number of possible conditions when calculating worst case air quality impacts.

Building wake effects from proposed on site buildings and tanks were included through use of the Building Profile Input Program (BPIP) PRIME algorithm.

The source properties and emission rates utilised in the disposal modelling are detailed in section 4.

5.2.1.2 Meteorological modelling

Local meteorology including long term wind speed and direction, as well as atmospheric stability, influence how air pollutants are dispersed into the local environment.

Site specific meteorological data used to drive the dispersion model was generated by use of the Weather Research and Forecast model (WRF) and CALMET meteorological models to produce a three-dimensional wind field which also takes into account local variations in the terrain. Prognostic WRF data was used as an ‘initial guess field’ for the CALMET meteorological model.

A representative year was chosen for modelling purposes based on review of Southern Oscillation Index (SOI) for the past 10 years and an analysis BoM data recorded at Port Kembla Automatic weather station (AWS) for the last year calendar years (01/01/2016 – 31/12/2020). The review resulted in the selection of the 2017 calendar year (01/012017 – 01/01/2018) as the representative year for modelling purposes.

Details of the procedure undertaken to produce the site-specific meteorology are provided in Appendix B.

5.2.2 Modelled scenarios

Due to the high variability of site ethanol emissions, dispersion modelling was undertaken for two scenarios, namely:

– Typical operations – assumed normal operation of the site including road tanker deliveries, tank to tank transfers and processing of tank headspace via the vapour recovery unit. Ethanol emissions would occur from the vapour recovery unit stack only.
– Worst case operations – assumed vessel loadout would occur in addition to typical operations described above. Ethanol emissions would occur from the vapour recovery unit stack and vessel loadout. Worst case operations is considered rare and would occur approximately 2.3% of the time based on the proposed annual ethanol loadout rate.

5.2.3 Predicted concentrations

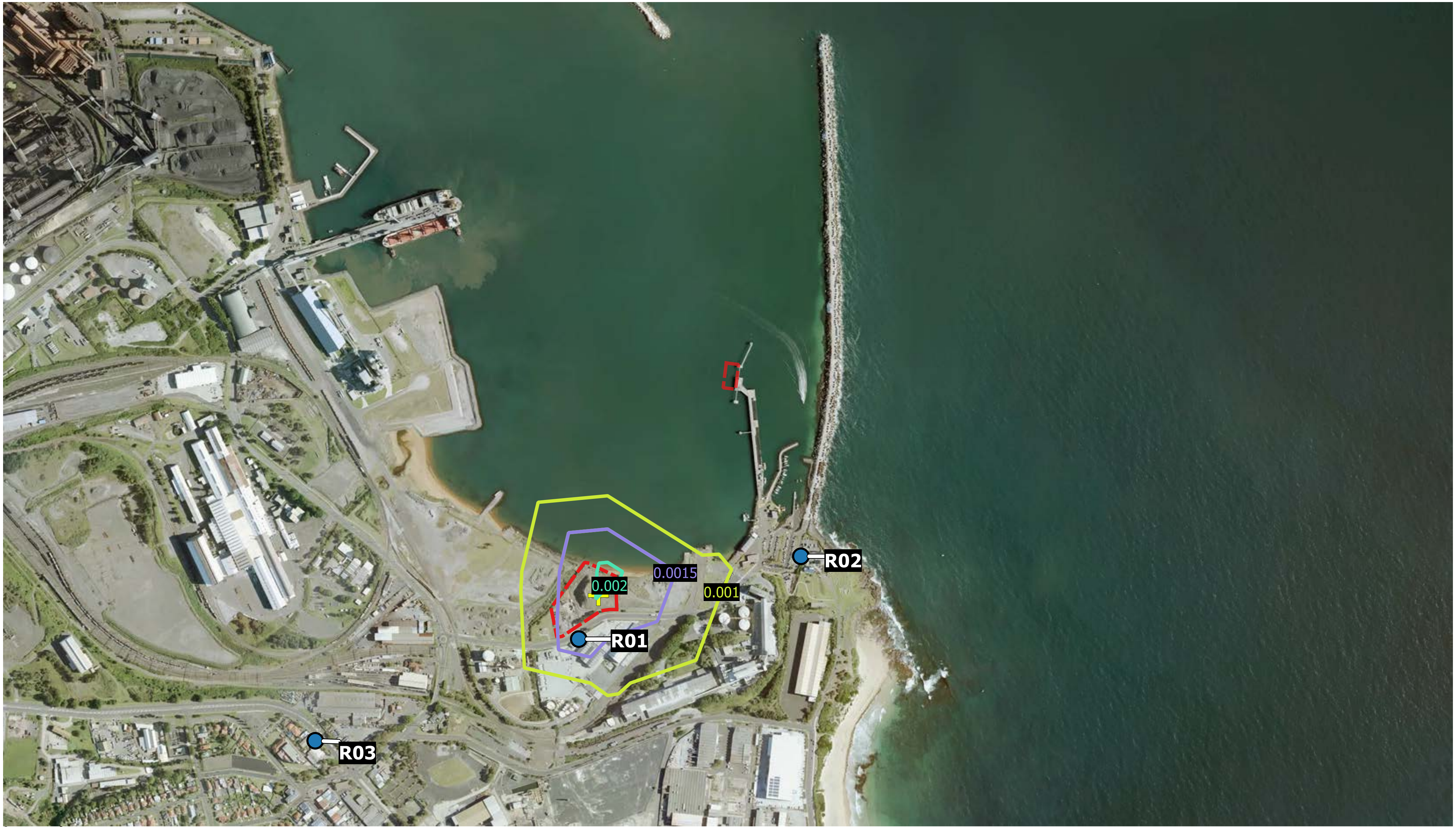
The predicted ethanol concentrations at sensitive receptor locations are provided in Table 12.

The model predictions were compared against the Approved Methods assessment criteria which is presented as 1 hour averaged 99.9th percentile incremental concentrations to be applied at the nearest existing or likely future off-site sensitive receptor. Contour dispersion plots showing the pattern of dispersion for incremental typical and worst case operations are provided as Figure 3 and Figure 4 respectively.

Compliance with the assessment criteria was predicted for both typical and worst case operations. It is noted that predicted ethanol concentrations were orders of magnitude below the assessment criteria (ethanol concentration equivalent to 0.09% of the criteria at worst impacted receptor 1) for typical operations.

Table 12 Predicted pollutant concentrations

Receptor	Predicted incremental ethanol concentration (mg/m^3, 1 hour averaged, 99.9th percentile)	
	Typical operations	Worst case operations
Assessment criteria (mg/m^3)	**2.1**	**2.1**
R01	0.0018	1.6
R02	0.0005	1.9
R03	0.0002	0.3



Legend

- Sensitive receptors
- Sources
- Site

Predicted ethanol concentrations (mg/m3)
(Assessment criteria = 2.1 mg/m3)

- 0.002
- 0.0015
- 0.001

Paper Size ISO A4

0 200 400 m

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

N

GHD

Manildra Group
Manildra Port Kembla Storage Facility
Air Quality Assessment

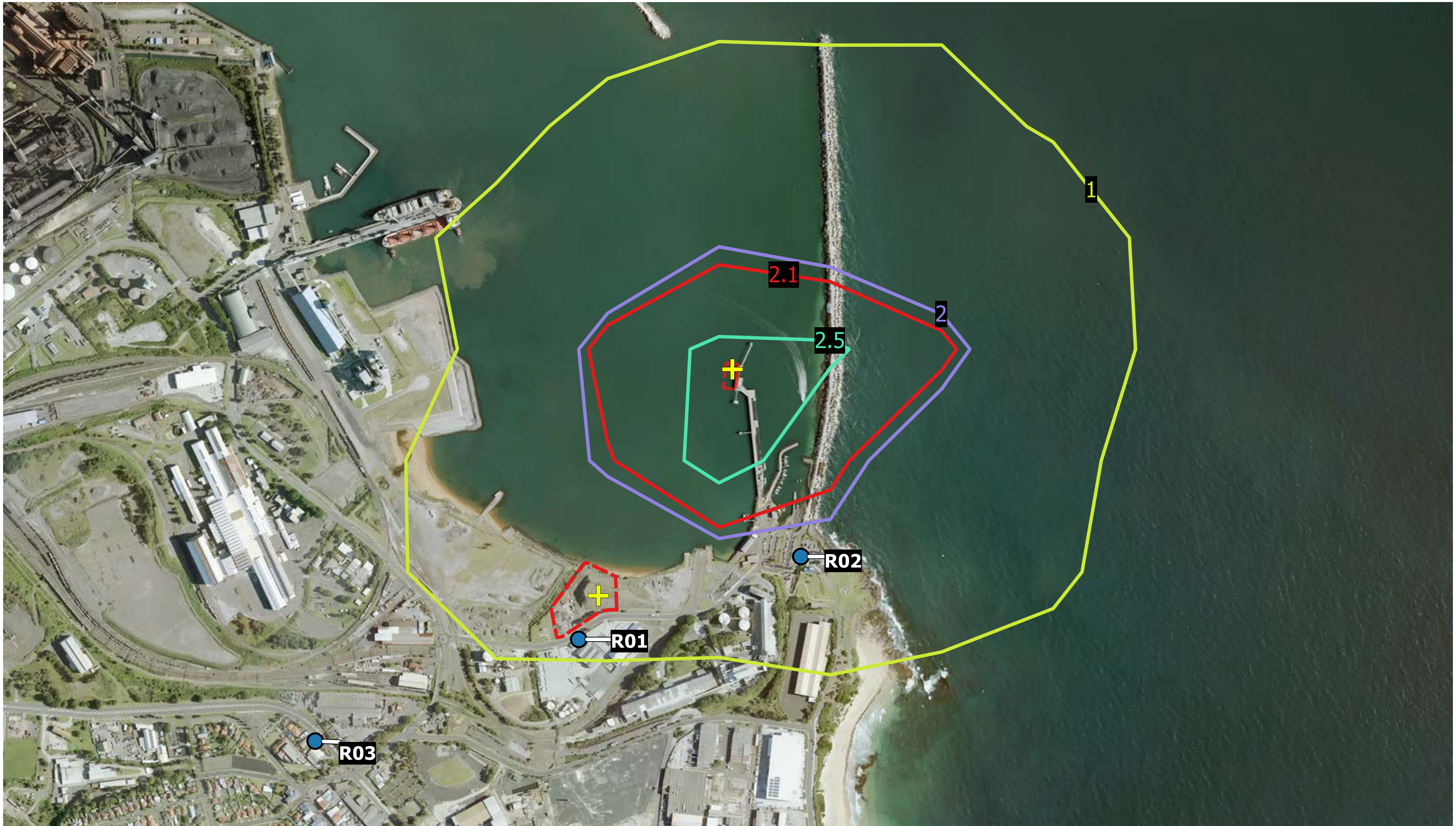
Predicted incremental ethanol concentrations for typical operation (1hour averaged, 99.9th percentile, mg/m3)

Project No. **12553198**
Revision No. **6**
Date. **27/04/2022**

FIGURE 3

Document Path: C:\Users\nspurrett\Desktop\Air Quality\2021-12553198-Manildra Port kembla Storage Facility Air Quality Assessment\QGIS\12553198-Manildra Port kembla Storage Facility_02.qgz
Print Date: 27/04/2022

Data Source:Google Earth Imagery 2021.
Created By: nspurrett



Legend

- Sensitive receptors
- Sources
- Site

Predicted ethanol concentrations (mg/m3)
(Assessment criteria = 2.1 mg/m3)
- 1
- 2
- 2.1
- 2.5

Paper Size ISO A4
0 200 400 m
Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

N

GHD

Manildra Group
Manildra Port Kembla Storage Facility
Air Quality Assessment

Predicted incremental ethanol concentrations for worst case operation (1hour averaged, 99.9th percentile, mg/m3)

Project No. 12553198
Revision No. 6
Date. 27/04/2022

FIGURE 4

Document Path: C:\Users\nspurrett\Desktop\Air Quality\2021-12553198-Manildra Port kembla Storage Facility Air Quality Assessment\QGIS\12553198-Manildra Port kembla Storage Facility_02.qgz
Print Date: 27/04/2022

Data Source:Google Earth Imagery 2021.
Created By: nspurrett

6. Best practice and recommended mitigation measures

6.1 Proposed use of best practice

A process overview for the proposal including a description of the best practices intended as part of the proposal is provided in Section 4.2.1.

Key best practices aspects relevant to controlling emissions to air include:

- Use of a vapor recovery system to collect and treat all vapours from tank inloading and filling of ISO tanks and road tankers. The vapour recovery wet scrubbing system would control emissions to air to comply with the POEO Clean Air Regulation AEL outlined in *Schedule 2 Standards of concentration for scheduled premises: afterburners, flares and vapour recovery units* (Clause 38).
- Charging of pipelines with nitrogen when at rest (i.e. when not in use), limiting the opportunity for fugitive emissions to occur.
- Painting of the exterior of tanks.
- Use of pressure and vacuum relief valves.
- Automation of inloading to storage tanks and outloading to ISO tanks and road tankers to prevent overfill.
- Use of on-road diesel trucks that comply with currently legislated vehicle standards namely the Euro VI emission standard, which is the most recently introduced European emission standard containing the most stringent emissions limits to date.

6.2 Review of best practice

This section provides a review of best practice measures outlined in European Commission *Integrated Pollution Prevention and Control Reference Document on Best Available Techniques on Emissions from Storage* (2006) ('EC IPPC reference document'). The EC IPPC reference document contains information regarding best available techniques (BAT) and emissions control measures (ECM) for the storage, transfer and handling of liquids and liquefied gases.

A review of BAT provided in the EC IPPC reference document benchmarked against mitigation measure to be implemented in the proposal is provided in Table 13 (with a focus on BAT to prevent and reduce emissions to air).

Table 13 Benchmarking of BAT against proposal

BAT – Storage, transfer and handling of liquids and liquefied gases	EC IPPC reference document guidance	Benchmark of proposal mitigation
General principles to prevent and reduce emissions		
Inspection and maintenance	BAT is to apply a tool to determine proactive maintenance plans and to develop risk-based inspection plans such as the risk and reliability based maintenance approach.	A comprehensive maintenance programme will be implemented based on the Mainpac Maintenance system utilised at the Nowra plant.
Leak detection and repair programme	For large storage facilities, according to the properties of the products stored, BAT is to apply a leak detection and repair programme. Focus needs to be on those situations most likely to cause emissions (such as gas/light liquid, under high pressure and/or temperature duties).	Pipelines would be charged with nitrogen when at rest to prevent unnecessary fugitive emissions from leaks. The maintenance programme will include pipeline checks as per AS 2885. The pump bunding will have a leak detection system installed which will raise an alarm and stop pumps when ethanol vapour is detected.

BAT – Storage, transfer and handling of liquids and liquefied gases	EC IPPC reference document guidance	Benchmark of proposal mitigation
Location and layout	BAT is to locate a tank operating at, or close to, atmospheric pressure aboveground. However, for storing flammable liquids on a site with restricted space, underground tanks can also be considered. For liquefied gases, underground, mounded storage or spheres can be considered, depending on the storage volume.	Tanks would be located aboveground.
Tank colour	BAT is to apply either a tank colour with a reflectivity of thermal or light radiation of at least 70 %, or a solar shield on aboveground tanks which contain volatile substances.	Exterior of tanks would be painted.
Emission minimisation principle in tank storage	BAT is to abate emissions from tank storage, transfer and handling that have a significant negative environmental effect.	A vapour recovery wet scrubbing system would be implemented to abate emissions. Internal floating roofs are often used on similar storage tanks, but in this case are not practical since internal floating roof tanks have vents through the dome top roof. This allows air to breathe. Correspondingly water vapour and impurities are drawn into the space above the floating roof. The water vapour including the impurities will condense and pass through the seals around the perimeter of the floating roof. This has the potential to contaminate the higher beverage/food grade ethanol in the storage.
Considerations on transfer and handling techniques		
Piping	BAT is to apply aboveground closed piping in new situations. For existing underground piping it is BAT to apply a risk and reliability based maintenance approach	Use of aboveground piping is prioritised where possible, but underground piping may be used through areas where public access is permitted. Piping below ground level will be protected by the latest coating and cathodic protection systems.
Vapour treatment	BAT is to apply vapour balancing or treatment on significant emissions from the loading and unloading of volatile substances to (or from) trucks, barges and ships. The significance of the emission depends on the substance and the volume that is emitted, and has to be decided on a case-by-case basis.	A vapour recovery wet scrubbing system for land-based sources would be implemented to abate emissions. A vapour recovery system was not considered necessary for ship loading based on the following rationale: – Emissions would occur from an offshore location which is a significant distance from sensitive receptors – Loadout to vessels (and corresponding emissions to air) would occur relatively infrequently – Emissions to air are considered low risk as ethanol is not classified as a principal toxic air pollutant (it is classified as an individual odorous air pollutant) and therefore is considered to pose less risk to environmental harm or risk to human health and amenity. Further, with regard to amenity, the unpleasantness of ethanol is not generally considered as significant as for many other odourous air pollutants such as hydrogen sulfide.

BAT – Storage, transfer and handling of liquids and liquefied gases	EC IPPC reference document guidance	Benchmark of proposal mitigation
Preventing incidents and (major) accidents		
Safety and risk management	BAT in preventing incidents and accidents is to apply a safety management system	The processes have been studied in a HAZOP in accordance with the HIPAP 8 guidelines. The action items from the HAZOP study, along with standard operating procedures will be incorporated into a Site Safety Management System.
Operational procedures and training	BAT is to implement and follow adequate organisational measures and to enable training and instruction of employees for safe and responsible operation of the installation	Procedures will be written for all operations, experienced operational personnel will be involved in developing the procedures. All operational personnel will be inducted to these procedures. A HAZOP study which has been conducted has revealed areas where procedures will be required.
Leakage due to corrosion and/or erosion	BAT is to prevent corrosion by: – selecting construction material that is resistant to the product stored – applying proper construction methods – preventing rainwater or groundwater entering the tank and if necessary, removing water that has accumulated in the tank – applying rainwater management to bund drainage – applying preventive maintenance, and – where applicable, adding corrosion inhibitors, or applying cathodic protection on the inside of the tank	All equipment in contact with ethanol will be manufactured from Stainless steel to prevent corrosion.
Operational procedures and instrumentation to prevent overfill	BAT is to implement and maintain operational procedures – e.g. by means of a management system to ensure that: – high level or high pressure instrumentation with alarm settings and/or auto closing of valves is installed – proper operating instructions are applied to prevent overfill during a tank filling operation, and – sufficient ullage is available to receive a batch filling	Inloading to storage tanks and outloading to ISO tanks and road tankers would be automated and tank functions would be controlled by PLC to prevent overfill. Slops and storage tanks will each have a radar level gauge with an independent high level trip to prevent overfill.

6.3 Recommended management measures

The following management and mitigation measures are recommended to improve the air quality performance of the proposal:

– Use of standard dust mitigation measures during construction activities (particularly during any earth-working activities) including:
  - Inform construction staff of activities likely to cause high dust emissions (as part of site inductions) and appropriate methods to mitigate dust emissions.
  - Use dust suppression watering during high dust generating activities
  - Reducing or stopping construction works if dust plumes are observed travelling off site beyond the site boundary

  - Covering of loads during transport to prevent loss of material
- Regular maintenance of the vapour recovery unit scrubber to ensure to meets the standards of concentration outlined in the POEO Clean Air Regulation.
- Regular inspection and maintenance of all plant/equipment, including on-road transport fleet

7. Conclusions

GHD conducted an air quality assessment for Manildra's proposed Bulk Liquids Facility project at Port Kembla. The proposal plans to receive, store and export ethanol product generated from Manildra's Bomaderry ethanol plant.

Potential impacts associated with dust emissions during construction of the proposal were assessed using a risk assessment based on the UK IAQM guidance. The risk of impacts from earthworks was considered to be low, while the impact construction and track-out activities was considered to be negligible. Recommendations for dust management during construction have been provided in section 6.3 to further reduce the risk of dust impacts from construction of the proposal.

An air quality emission inventory was prepared for operation of the proposal based on emissions concentration limits provided by NSW Government *Protection of the Environment Operations (Clean Air) Regulation 2010* and guidance contained with Australian Government Department of the Environment and Water Resources *Nation Pollutant Inventory Emissions estimation technique manual for Beer and ready-to-drink alcoholic beverage manufacturing* Version 1.2 March 2007. The primary emission to air was identified to be ethanol.

Air quality dispersion modelling was undertaken based on two scenarios including typical operations and worst-case operations. The assessment predicted compliance with the assessment criteria at all sensitive receptor locations for both operating scenarios. Based on a review of nearby development, no cumulative air quality impacts are expected.

Based on assumptions as outlined in the assessment, the proposal is predicted to comply with the relevant air quality assessment criteria when assessed in accordance with the Approved Methods.

8. References

Australian Government Department of the Environment and Water Resources *Nation Pollutant Inventory Emissions estimation technique manual for Beer and ready-to-drink alcoholic beverage manufacturing* Version 1.2 March 2007.

EPA, 2016. *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*. NSW Government Gazette of 26 August 2005, minor revisions November 2016. Sydney, NSW: Department of Environment and Conservation NSW (DEC).

European Commission *Integrated Pollution Prevention and Control Reference Document on Best Available Techniques on Emissions from Storage* (2006)

Institute of Air Quality Management. (2014). Guidance on the assessment of dust from demolition and construction. London: Institute of Air Quality Management.

J Barclay and J Scire, Atmospheric Studies Group TRC Environmental Corporation, 2011. *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia.*

NSW *Protection of the Environment Operations Act 1997*

NSW *Protection of the Environment Operations (Clean Air) Regulation 2010*

National Environment Protection Council (NEPC) *National Environment Protection (Ambient Air Quality) Measure*

Appendices

Appendix A

Proposed site layout

PROJECT MANAGERS | PLANNERS | DESIGNERS | ENGINEERS

TfA Project Group

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REV	DATE	BY	DESCRIPTION	CHK	APP
A	24.06.21	LCC	PRELIMINARY ISSUE	BV	BP
B	26.07.21	P	PRELIMINARY ISSUE	BV	BP
C	29.07.21	LCC	D.A. ISSUE	BV	BP
D	14.10.21	LCN	RE-ISSUE FOR DA	BV	BP
E	16.03.22	HE	BOILER CHANGE TO LPG	BV	BP

PROJECT CLIENT: MANILDRA GROUP — 100% AUSTRALIAN OWNED

PROJECT DETAILS: MANILDRA GROUP
PORT KEMBLA
BULK LIQUIDS FACILITY
FORESHORE ROAD
PORT KEMBLA, NSW

DRAWING TITLE: PROPOSED SITE LAYOUT

STATUS: D.A. ISSUE

DATE CREATED	ORIGINAL SCALE	SHEET
24.06.21	1:500	A1

DO NOT SCALE THIS DRAWING. CONFIRM ALL DIMENSIONS ON SITE.

DRAWING NO	REV
20399-DA-A01	E

Appendix B

Meteorological modelling

Overview

This appendix outlines the methodology used to synthesise meteorology for the proposal. The meteorology is used in CALPUFF to drive the dispersion model.

Local meteorology, including long term wind speed and direction as well as atmospheric stability, can influence how pollutants are dispersed into the local environment.

Site specific meteorological data used to drive the dispersion model was generated by the Weather Research and Forecast model (WRF) and CALMET meteorological models. The CALMET simulation produced a 3D wind field for the modelled year. Prognostic WRF data was used as inputs into the CALMET model. Details of the procedure undertaken to produce the site specific meteorology is outlined in the following sections.

Methodology

The characterisation of local wind patterns generally requires accurate site-representative hourly recordings of wind direction and speed over a period of at least a year.

In order to produce a representative site-specific meteorological data set, the following methodology was carried out:

– Production of a 3D gridded dataset with the prognostic model WRF

– Using the WRF 3D gridded dataset as an initial guess field for the CALMET meteorological model

Nearby BoM station review

A review of nearby BoM station is provided in Table B1.

Table B.1 Nearby BoM station review

BoM station	Approximate distance from Site	Availability of meteorological data	BoM station setting
Port Kembla AWS (BoM ID: 68253)	0.5 km east of the Site	Began operation in 1990. All desired meteorological parameters except cloud data available.	Located on eastern most wharf in Port Kembla
Bellambi AWS (BoM ID: 68228)	12 km North of the site	Began operation in 1988. All desired meteorological parameters available.	Located on exposed headland
Albion Park (Wollongong airport) (BoM ID: 68241)	14 km southwest of the site	Began operation in 1999. All desired meteorological parameters available.	Located in cleared airport setting

Due to close proximity to the proposal, the Port Kembla AWS was selected for inclusion in the representative year analysis.

Representative year selection

A representative year was chosen for modelling purposes based on review of Southern Oscillation Index (SOI) for the past 10 years and an analysis BoM data recorded at Port Kembla AWS for the last year calendar years (01/01/2016 – 31/12/2020).

The SOI indicates the intensity of El Nino or La Nina events in the Pacific Ocean. A value of less than -7 often indicates El Nino episodes (typically accompanied by sustained warming of the central and eastern tropical Pacific Ocean, a decrease in the strength of the Pacific Trade Winds, and a reduction in winter and spring rainfall over much of eastern Australia and the Top End) while a value of greater than 7 often indicates La Nina episodes (typically associated with stronger Pacific trade winds and warmer sea temperatures to the north of Australia.

Waters in the central and eastern tropical Pacific Ocean become cooler during this time. Together these give an increased probability that eastern and northern Australia will be wetter than normal)[4].

The SOI for the past 10 years is shown in Figure B1.

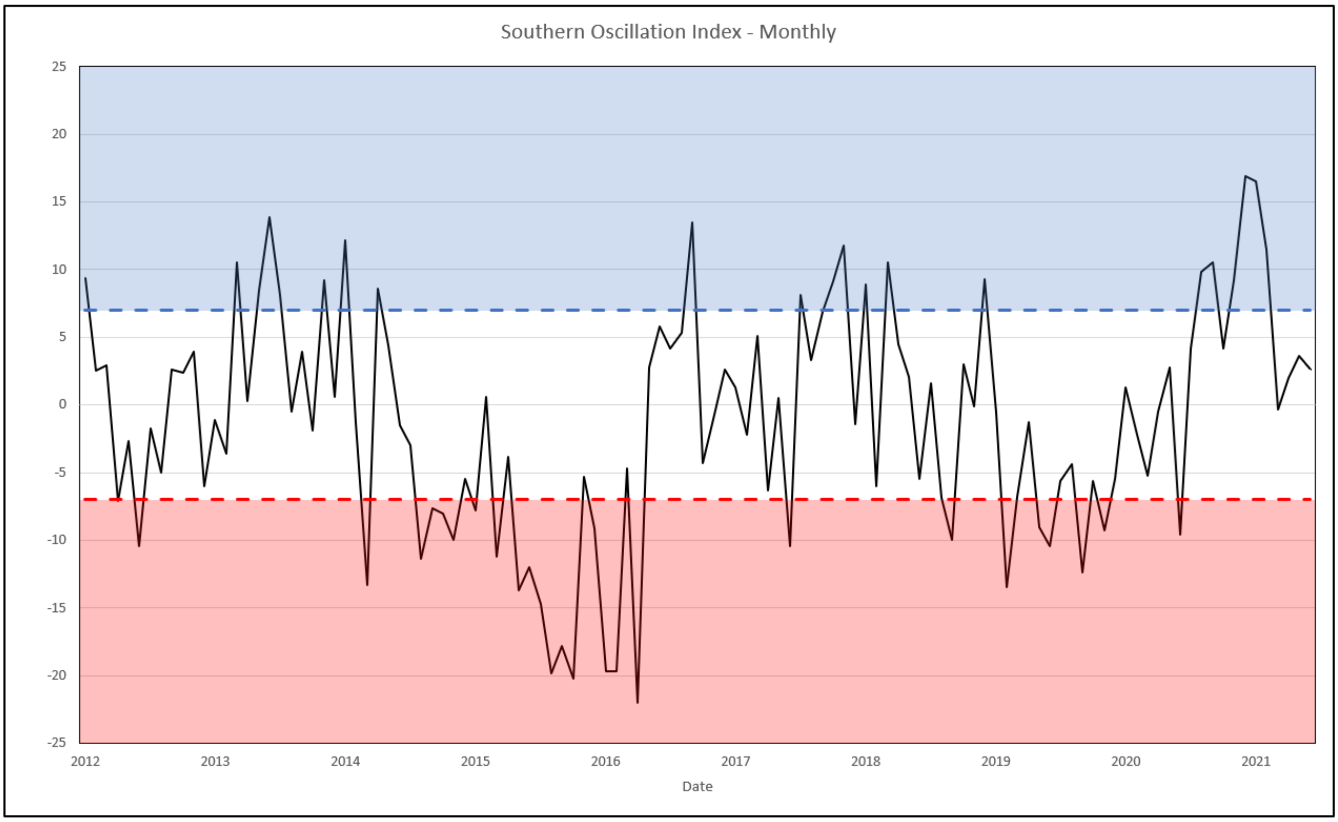

Figure B.1 Southern Oscillation Index for last 10 years (2012 – 2021

Probability density function plots of Port Kembla AWS data (2016-2020) for wind speed, wind direction and temperature are provided in Figure B2, Figure B3 and Figure B4 respectively.

[4] SOI data and description of El Nino and La Nina episodes sourced from Australian Government BoM, available online: **http://www.bom.gov.au/climate/current/soi2.shtml**

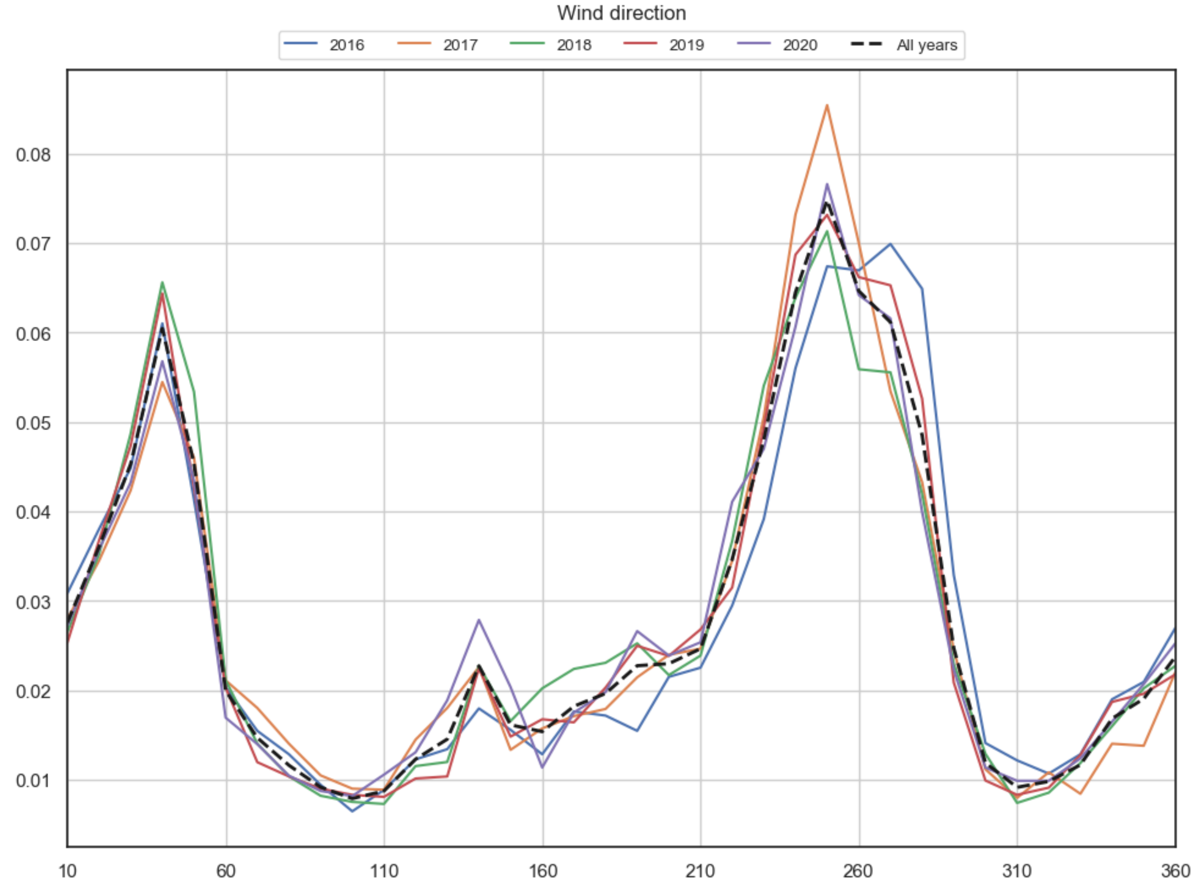

Figure B.2 Wind direction plot (Port Kembla AWS, 2016 – 2020)

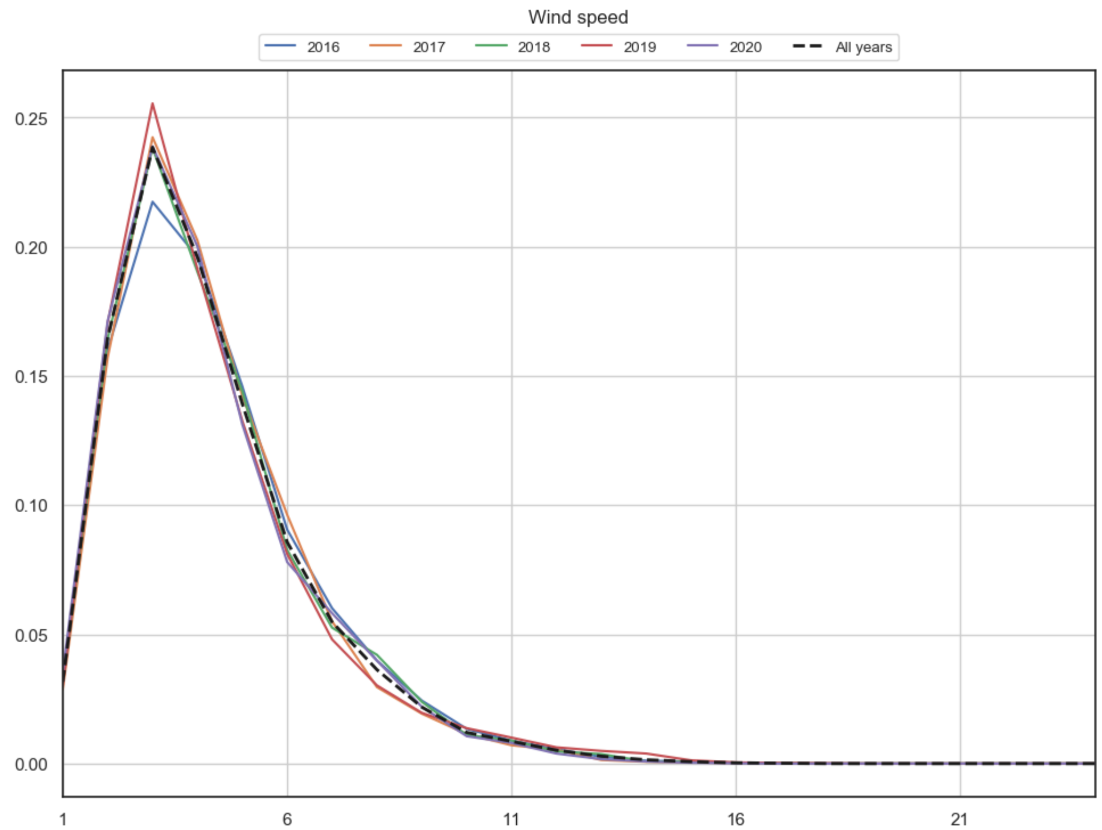

Figure B.3 Wind speed plot (Port Kembla AWS, 2016 – 2020)

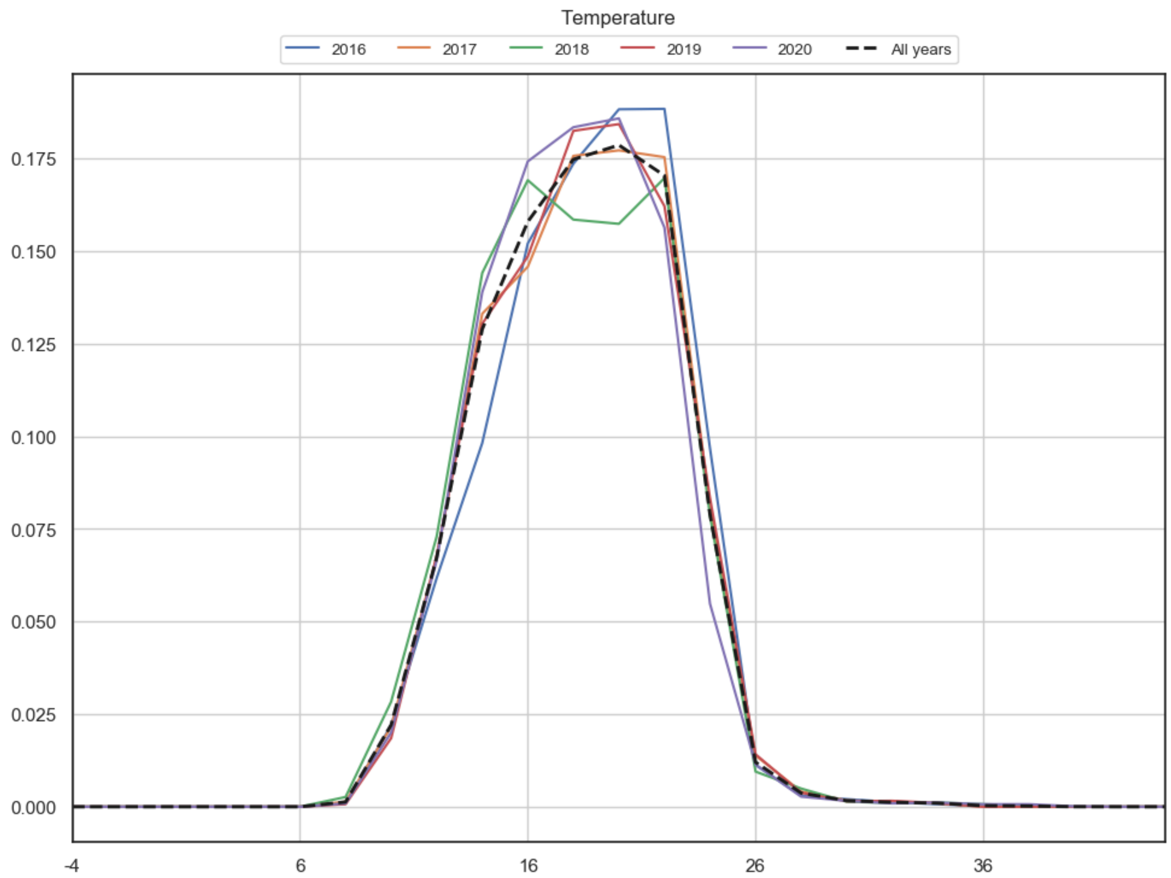

Figure B.4 *Temperature plot (Port Kembla AWS, 2016 – 2020)*

Based on the review of SOI data and meteorological conditions recorded at Port Kembla AWS, the representative year selected for modelling purposes was 2017.

Prognostic meteorology

The parameters for the prognostic WRF model are summarised in Table B1.

Table B.2 *WRF model parameters*

Parameter	Value
Modelled period	1 January 2017 to 31 December 2017
Domain centre	Latitude: 34.602506 S Longitude: 150.6581 E
Domain grid spacing	1 km
Domain size	100 x 100 km
Number of vertical levels	25

CALMET modelling

CALMET (Version 7) was used to resolve the wind field around the subject site to 250 metres spatial resolution. The application of CALMET for this purpose is an approved modelling approach in NSW as per the Approved Methods with model guidance documentation provided.

Upon completion of the broad scale WRF modelling runs, a CALMET simulation was set up to run for the model period using the three dimensional gridded data output from the WRF model as an initial guess field. This approach is consistent with guidance documentation.

CALMET was run using the 'No-Obs' mode (i.e. surface observational data was not included in the model). Given the site is located within a complex land-sea interface, it was deemed that introduction of observational data into the model would lead to inconsistencies/irregularities in the predicted wind field, where blending of the observations and initial guess field is carried out. This is especially true at wind field levels above the surface level on the coastline, which are critical in this instance when assessing dispersion of pollutants from the ship loading vent sources.

A comparison of the predicted and observed wind field was carried out which showed good agreement with respect to frequency and pattern of various wind speeds. The level of agreement is deemed sufficient for dispersion modelling purposes, especially where peak 1-hour averaging periods are of concern and further the error associated with the model prediction is deemed preferable in comparison to the errors associated with the introduction of surface data (as described above).

All model settings were selected based on the recommendations provided in the Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia (J Barclay and J Scire, Atmospheric Studies Group TRC Environmental Corporation, 2011) except for MDISP which the default value was used.

The southwest corner of the CALMET domain, or the origin, was located at UTM Zone 56 coordinates 285 kilometres east and 6164 kilometres north. The CALMET domain extended 40 kilometres to the east and north.

The CALMET domain consisted of 160 grids in both the east and north directions, with a grid resolution of 0.25 kilometre.

The CALMET model parameters are summarised in Table B2. The TERRAD value was selected based on inspection of the terrain elevations in the immediate vicinity of the subject site. It should be noted that multiple TERRAD values were tested and the value producing the best results was selected.

Terrain and land use data used for the CALMET modelling are presented in Figure B5 and Figure B6.

Table B.3 Summary of CALMET model parameters

Parameter	Value
Modelled period	1 January 2017 to 31 December 2017
Mode	No obs (NOOBS = 2)
UTM zone	56
Domain origin (south-west corner)	Easting: 285 km Northing: 6164 km
Domain size	160 x 160 at 0.25 km resolution (40.0 km x 40.0 km)
Number of vertical levels	11
Vertical levels (m)	0, 20, 40, 80, 160, 320, 640, 1200, 2000, 3000, 4000,
CALMET settings for hybrid mode Settings selected in accordance with (OEH, 2011)	TERRAD = 1.75 km
Initial guess field	WRF .m3d file used as an initial guess field for CALMET
Surface data	N/A
Upper air data	No site specific upper air data is used. Upper air data is included within the WRF .m3d initial guess field.
Land use and terrain data	Land use data was manually developed through assessment of aerial imagery to accurately reflect the land use in the area. High-resolution terrain data was sourced from the STRM 1-second (~30 m) database.

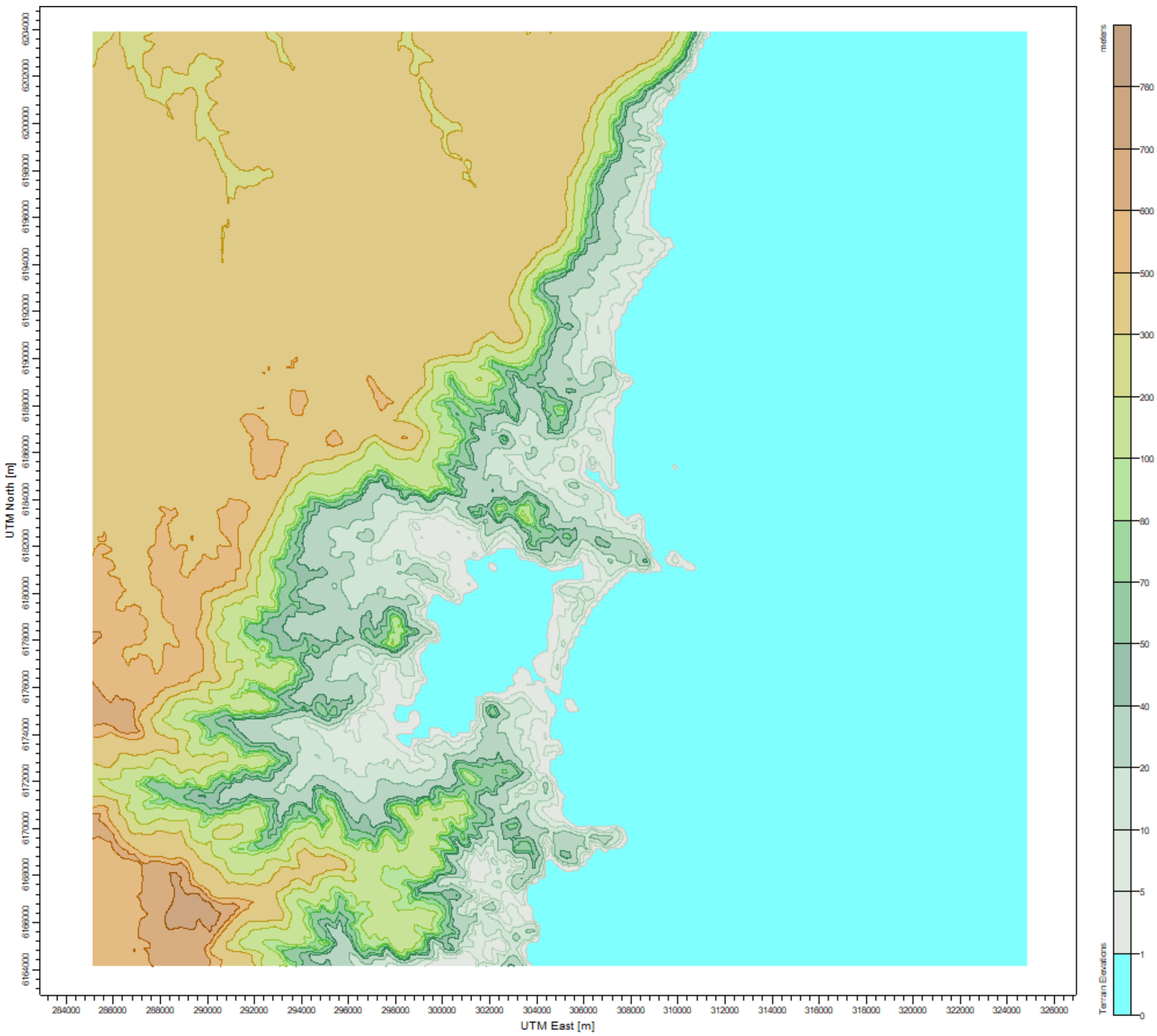

Figure B.5 Terrain data used for CALMET modelling

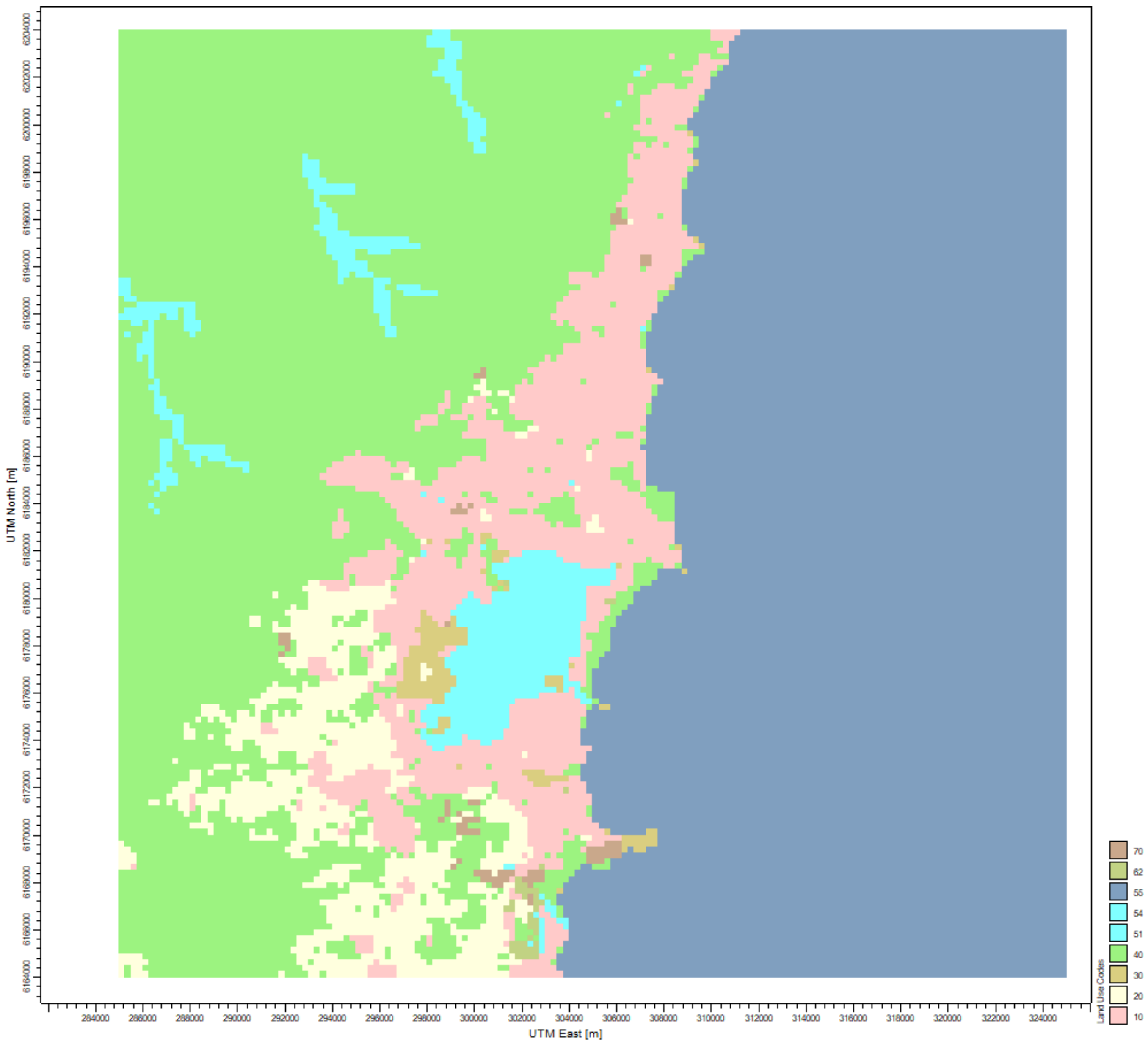

Figure B.6 ***Land use data used for CALMET modelling***

The local meteorology largely determines the pattern of off-site air quality impact on receptors (houses, businesses and industry). The effect of wind on dispersion patterns can be examined using the wind and stability class distributions at the site from the dataset that is produced by CALMET. The winds at the site are most readily displayed by means of wind rose plots, giving the distribution of winds and the wind speeds from these directions.

The features of particular interest in this assessment are (i) the dominant wind directions and (ii) the relative incidence of stable light wind conditions that yield minimal mixing (defines peak impacts from ground-based sources).

Annual wind patterns

The wind rose for the entire data period taken at the project site is shown in Figure B7 and shows the following features:

The predominant annual average wind directions are from the west

– Lower wind speeds (1 – 3 m/s) are rare but can occur from any direction
– The average wind speed measured was 5.7 metres per second
– Calm conditions (wind speeds less than 0.5 m/s) occurred 0.2 per cent of the time.

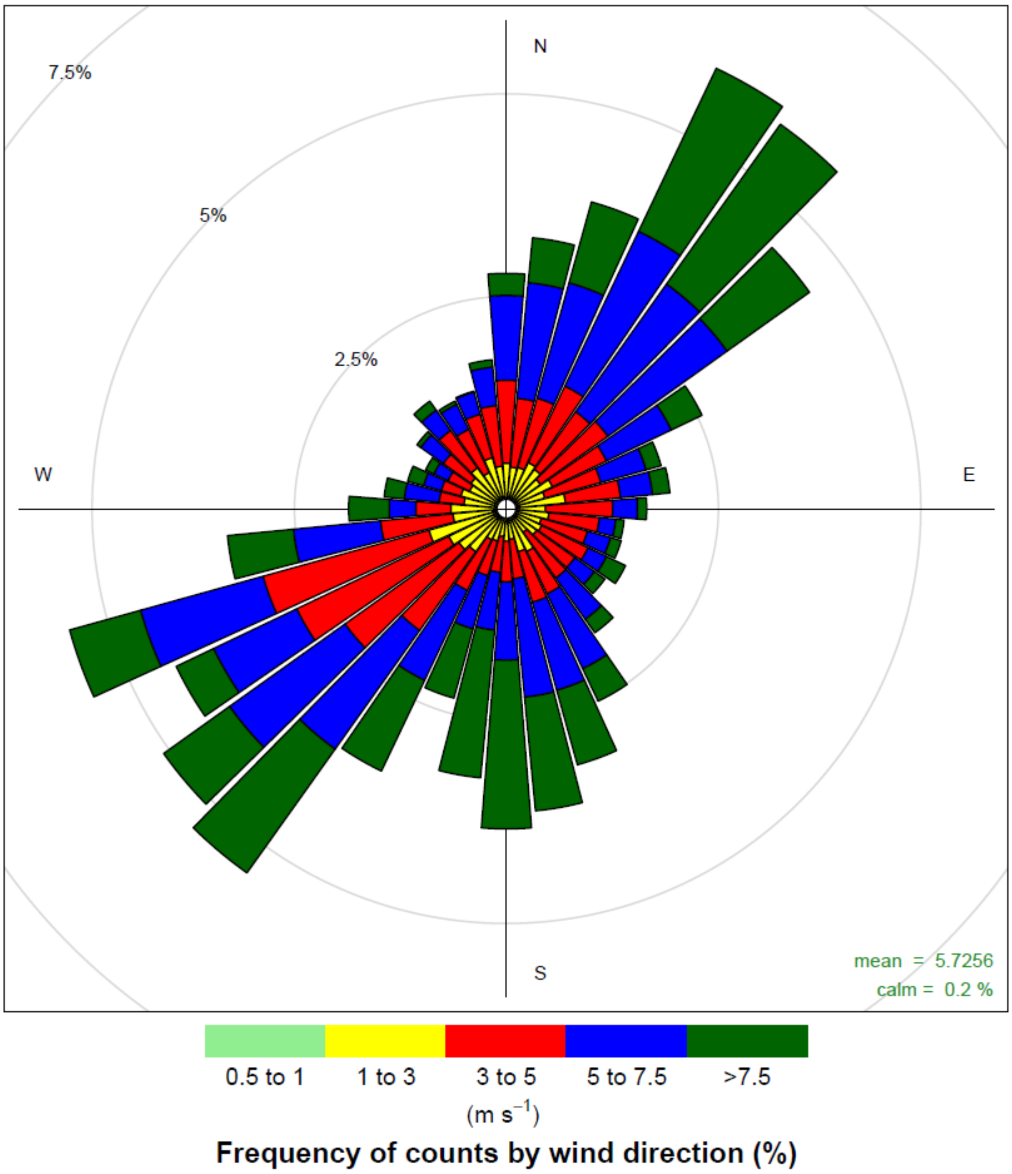

Figure B.7 Wind rose at site from CALMET (2017)

Pattern of atmospheric stability

Atmospheric stability substantially affects the capacity of a pollutant such as gas, particulate matter or odour to disperse into the surrounding atmosphere upon discharge and is a measure of the amount of turbulent energy in the atmosphere.

There are six Pasquill-Gifford classes (A-F) used to describe atmospheric stability, and these classes are grouped into three stability categories; stable (classes E-F), neutral (class D), and unstable (classes A-C). The climate parameters of wind speed, cloud cover and insolation (solar radiation) are used to define the stability category as shown in Table B3. As these parameters vary from day to night, there is a corresponding variation in the occurrence of each stability category.

Stability is most readily displayed by means of stability rose plots, giving the frequency of winds from different directions for various stability classes A to F.

Table B.4 Stability category relationship to wind speed and stability characteristics

Stability category	Wind speed range (m/s)[a]	Stability characteristics
A	0 – 2.8	Extremely unstable atmospheric conditions, occurring near the middle of day, with very light winds, no significant cloud
B	2.9 – 4.8	Moderately unstable atmospheric conditions occurring during mid-morning/mid-afternoon with light winds or very light winds with significant cloud
C	4.9 – 5.9	Slightly unstable atmospheric conditions occurring during early morning/late afternoon with moderate winds or lighter winds with significant cloud
D	≥6	Neutral atmospheric conditions. These occur during the day or night with stronger winds, during periods of total cloud cover or during the twilight period
E	3.4 – 5.4 b	Slightly stable atmospheric conditions occurring during the night-time with significant cloud and/or moderate winds
F	0 – 3.3 [b]	Moderately stable atmospheric conditions occurring during the night-time with no significant cloud and light winds

Note: a Data sourced from the Turner's Key to the P-G Stability Categories, assuming a Net Radiation Index of +4 for daytime conditions (between 10:00 am and 6:00 pm) and –2 for night-time conditions (between 6:00 pm and 10:00 am)

b Assumed to only occur at night, during Net Radiation Index categories of –2.

Figure B8 shows the frequency of stability class for all hours of the model generated dataset. The following observations were made:

- Unstable atmospheres (classes A, B and C) occur 19 per cent of the time.
- Neutral atmosphere conditions (class D) are the dominant stability state of the atmosphere occurring 55 per cent of the time
- Stable conditions (classes E and F) occur 26 per cent of the time

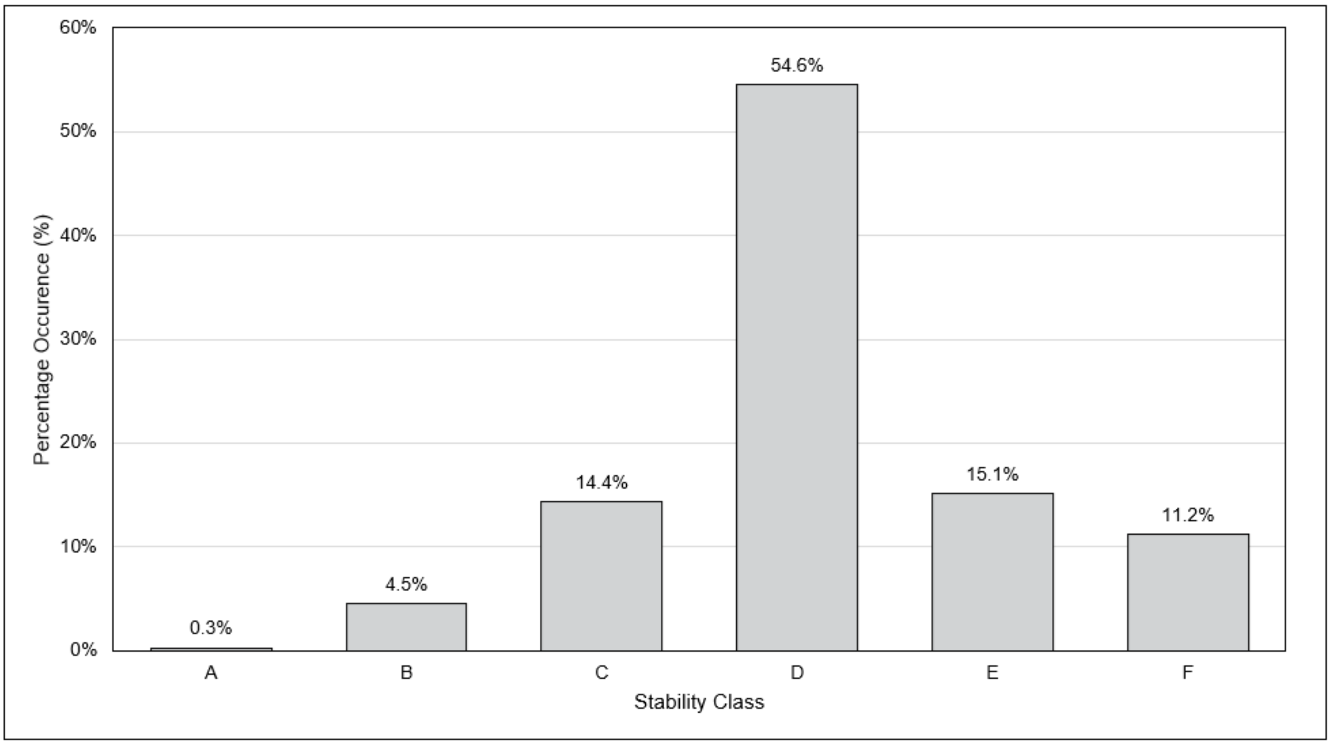

Figure B.8 ***Distribution of stability class for the model period***

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