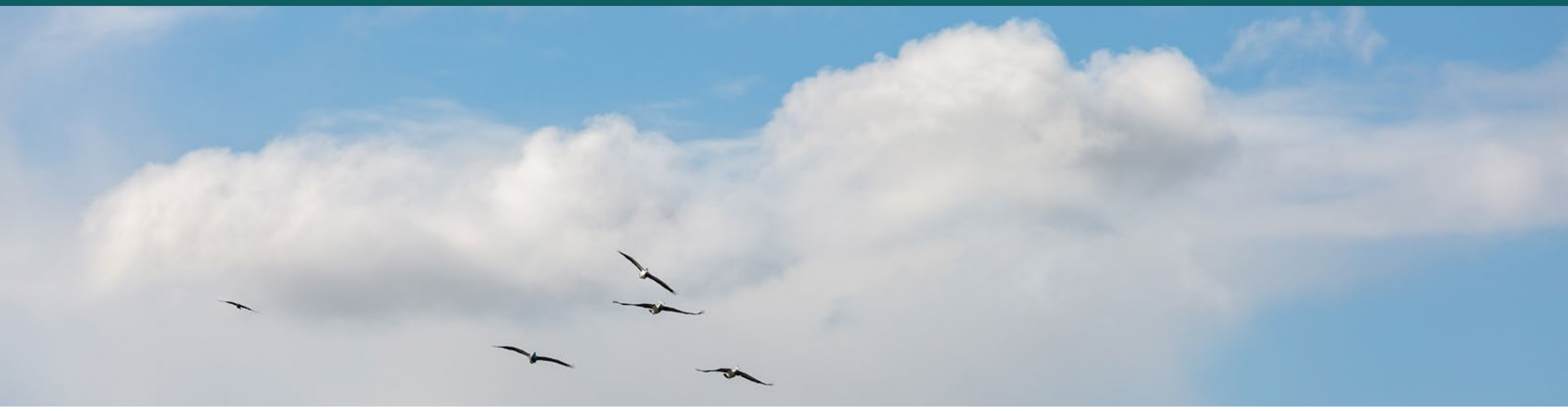
Chapter 12
Air quality



This chapter discusses the potential air quality impacts associated with the construction and operation of the Gas Import Jetty and Pipeline Project (the Project) and is based on the impact assessment presented in EES Technical Report G: *Air quality impact assessment.*

12.1 Overview

Air quality is characterised by concentrations of substances in the ambient air (that is, atmospheric air in its natural state), including gases and particles. Air pollution can affect people's health, lifestyles and their enjoyment of outdoor spaces.

Project construction activities including removing topsoil, excavating the pipeline trench and driving construction vehicles on unsealed roads have the potential to produce dust, affecting the amenity of an area. Vehicle exhaust emissions and equipment fuel combustion are also contributors of air pollutants during construction.

The operation of the floating storage and regasification unit (FSRU) would involve burning gas to power the engines and, when in closed-loop mode, the gas-fired boilers. The engines could also operate on liquid fuel if required (such as diesel). These processes emit various pollutants referred to as air pollution indicators that have potential to reduce air quality if their concentration exceeded certain air emission thresholds.

Ambient air quality is regulated in Victoria under the *Environment Protection Act 1970* (Environment Protection Act) and the *State Environment Protection Policy (Air Quality Management) 2001* (the SEPP (AQM)) by the Environment Protection Authority (EPA) Victoria.

The SEPP (AQM) aims to manage emissions so that beneficial uses of the air environment are protected and Victoria's air quality goals and objectives are met. The SEPP (AQM) sets design criteria (as ambient ground level concentrations) for new stationary sources of emissions such as the FSRU. The Environment Protection Act requires a licence and/or a Works Approval for scheduled premises that exceed air emissions thresholds under Schedule 1 of the Environment Protection (Scheduled Premises) Regulation 2017.

Emissions related to greenhouse gases are discussed in **Chapter 11** *Greenhouse gas*.

Air pollution indicators relevant to the Project

- Nitrogen dioxide (NO_2) is a brownish gas that exists in the atmosphere with nitric oxide, the mixture of which is commonly referred to as nitrogen oxides (NOx). Nitrogen oxides are a product of combustion such as in motor vehicle and industrial combustion processes. NO_2 can damage human respiration and plant health.
- Carbon monoxide (CO) is a colourless, odourless gas produced by the incomplete combustion of fuels containing carbon. Exposure to CO can cause carbon monoxide poisoning, and chronic exposure can cause memory loss, confusion and depression.
- Sulfur dioxide (SO_2) is a strong-smelling, colourless gas that can irritate lungs. It is produced when industrial processes burn fuel with a high sulfur content.
- Particulate matter refers to the many types and sizes of particles suspended in the air we breathe. PM_{10} (particles with an aerodynamic diameter less than or equal to 10 micrometres) and $PM_{2.5}$ (particles with an aerodynamic diameter less than or equal to 2.5 micrometres) can have health implications. PM_{10} often arises from wind-blown dust. $PM_{2.5}$ can be emitted through combustion activities or from chemical reactions between other pollutants in the atmosphere.
- Volatile Organic Compounds (VOCs) are carbon-based chemicals that easily evaporate at room temperature and are hazardous to human health. Many common household materials and products give off VOCs, which include benzene, formaldehyde and Polycyclic Aromatic Hydrocarbons (PAHs).
- Formaldehyde is a colourless, flammable gas at room temperature that has a strong odour. Generating electricity and manufacturing wood products are the largest industrial sources of formaldehyde in Australia. Exposure to formaldehyde may cause adverse health effects such as nasal and eye irritation, neurological effects, and increased risk of asthma and/or allergy.

12.2 EES evaluation objective

The scoping requirements for the EES set out the following relevant draft evaluation objective for air quality:

> **Social, economic, amenity and land use – To minimise potential adverse social, economic, amenity and land use effects at local and regional scales.**

To assess the potential impacts of the construction and operation of the Project on amenity at local and regional scales, an air quality impact assessment was undertaken (see EES Technical Report G: *Air quality impact assessment*).

12.3 Methodology

The approach adopted for the air quality impact assessment involved the following key tasks:

- a review of relevant legislation and policy at Commonwealth, state and local level
- a desktop review of relevant baseline data and reports
- characterisation of existing ambient air concentrations of air quality indicators and local meteorological conditions using EPA Victoria and Bureau of Meteorology (BoM) monitoring data
- a risk assessment as described in **Chapter 5** *Key approvals and assessment framework* to inform the impact assessment and development of additional mitigation measures
- assessment of air quality impacts due to construction of the Project using semi-quantitative methodologies provided in the United Kingdom's Institute of Air Quality Management (IAQM) document, *Guidance on the assessment of dust from demolition and construction* (IAQM, 2014)
- modelling of air pollutants from the operation of the FSRU using AERMOD (American Meteorological Society/Environment Protection Agency Regulatory Model), an atmospheric dispersion modelling system endorsed by the EPA Victoria as the regulatory model for use in air quality assessments in Victoria
- development of mitigation measures for the construction and operation of the Project in response to the air quality impact assessment.

12.4 Study area

The air quality impact assessment involved separate study areas for the construction and operation phases of the Project as shown in **Figure 12-1**.

- Construction impact assessment study area:
  - A buffer of 350 metres around the pipeline construction right of way (ROW), access tracks and facilities (the boundary of the construction works area) for an assessment of the type, number and proximity of sensitive receptors (such as residential dwellings) to dust sources during construction. The selection of 350 metres is consistent with the conservative guidance set out in the IAQM method and takes into account the decline in airborne concentrations and the rate of deposition over distance.
- Operations impact assessment study area:
  - A 10 by 10-kilometre grid surrounding the FSRU at the Crib Point Jetty, which covers nearby populated regions. Within this grid, 38 representative sensitive receptors were allocated to predict concentrations at specific locations, with the closest being 1.2 kilometres from the FSRU. This information was used to model the air pollution indicators at each representative receptor location from the operation of the FSRU.

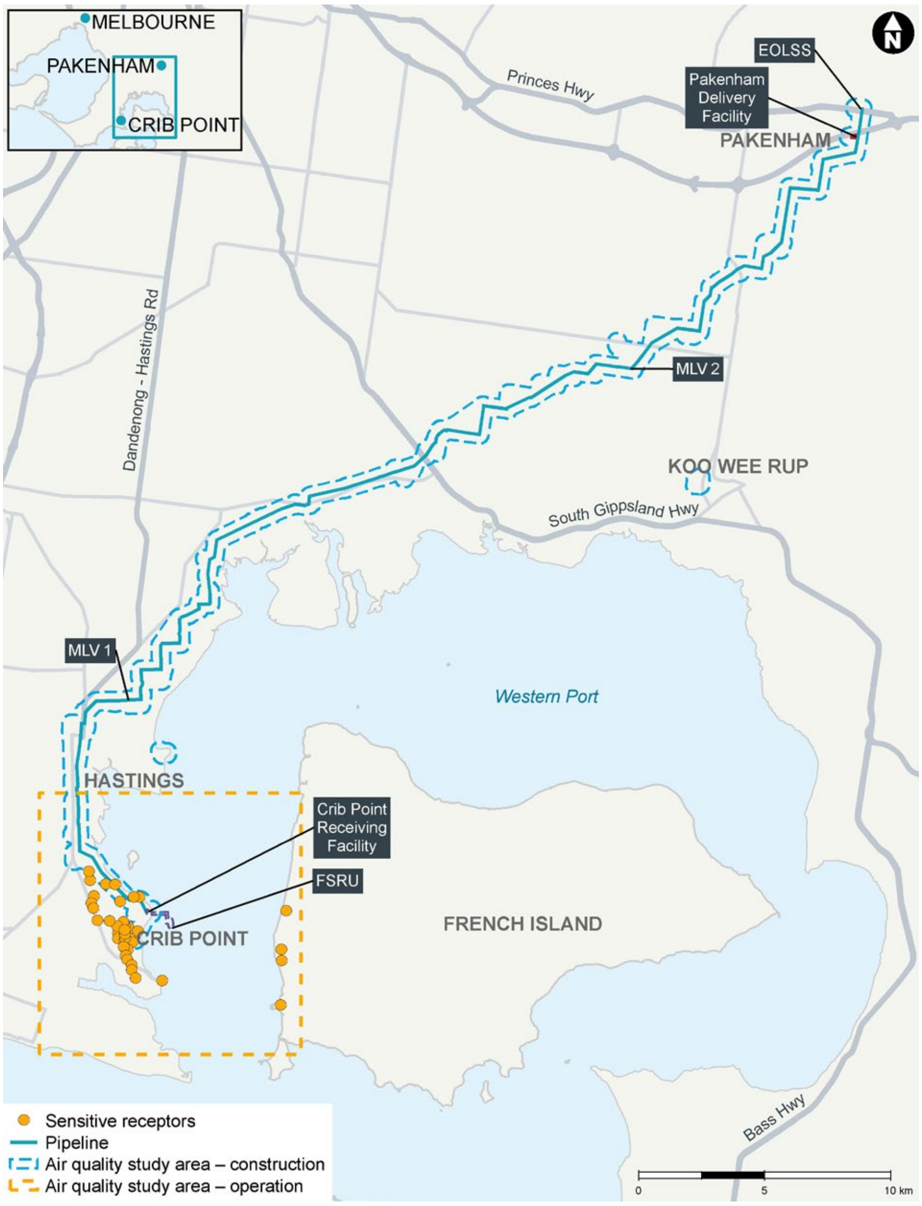


Figure 12-1: Air quality study area

12.4.1 Key assumptions

Operational emissions from the pipeline, Crib Point Receiving Facility, Pakenham Delivery Facility and liquefied natural gas (LNG) carriers berthed alongside the FSRU were not included in the modelling for the following reasons:

- There are no expected fugitive emissions from the pipeline.
- There are no significant fugitive emissions from general operations of plant and equipment at the Crib Point Receiving Facility, with emissions from maintenance of the vent stack not part of normal operations. This is a similar case for the vent stack at the Pakenham Delivery Facility.
- Natural gas demand is estimated as 7,540 gigajoules per annum for the operation of the three gas-fuelled water bath heaters at the Pakenham Delivery Facility. This means that emissions of NO_x (as NO_2), CO and VOC are all below 1.1 kilograms per day (kg/day). This is approximately 1 per cent of the scheduled premise air emissions threshold under the Environment Protection Act (100 to 500 kg/day) and so these emissions were not included in the modelling.
- During unloading of LNG to the FSRU, emissions from LNG carriers would be the equivalent of 2.1 per cent of the FSRU fuel demand during closed loop regasification. This would occur approximately 16 per cent of the year. Given the comparatively low fuel consumption of the LNG carrier compared with the FSRU and because LNG carriers would be infrequently berthed next to the FSRU, emissions from LNG carriers would not materially affect the operational air quality assessment outcomes, and so were not included in the modelling. It is also unlikely the FSRU engines would operate at 100 per cent when unloading from the LNG carrier.

12.5 Existing conditions

Existing air conditions are characterised by concentrations of air quality indicators in the ambient air and the local meteorology. The local meteorology can influence the development, chemical transformation, dispersion and deposition of air pollutants.

12.5.1 Ambient air quality

Ambient air quality monitoring data are collected by the EPA Victoria from monitoring stations in metropolitan Melbourne. The nearest monitoring station to the Project is located in Dandenong. Air quality monitoring stations are shown in **Figure 12-2**.

The EPA Victoria air quality monitoring data collected from these stations are used to enable reporting of air quality against the *National Environment Protection (Ambient Air Quality) Measure (AAQ)* (AAQ NEPM) criteria.

No air quality monitoring data is available for the Western Port area. It is expected that air quality conditions in Western Port are better than in the metropolitan region, given the distance between the majority of Melbourne's main air pollution sources (such as roadways) and the study area. The use of EPA Victoria monitoring data for this assessment is therefore conservative.

The air quality monitoring stations measure CO, NO_2, ozone, SO_2, PM_{10}, $PM_{2.5}$ and lead. The background air pollution indicator concentrations adopted for the assessment are shown in **Table 12-1**. These represent the highest 70th percentile concentration of one year's observed hourly concentrations measured from the last five years, as per the SEPP (AQM) methodology to determine background conditions. The background pollutant concentrations from Footscray, Geelong, Dandenong and Alphington air quality monitoring stations were compiled as they had more representative data available for the air pollution indicators of interest.

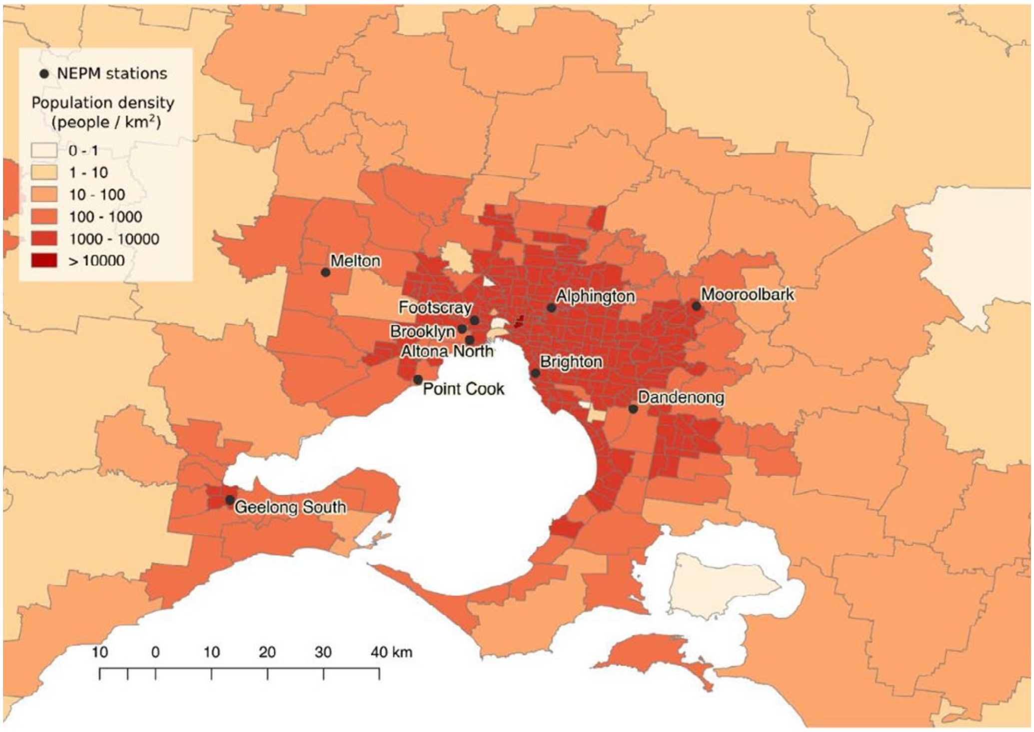


Figure 12-2: EPA Victoria air quality monitoring stations

Table 12-1: Background air pollution indicator concentrations

Pollutant	Averaging period	Adopted background pollutant concentrations		Data source	
		ppm	µg/m³	Monitoring station	Land use category
NO_2	1 hour	0.027	54.7	Alphington	Residential/light industrial
	Annual	0.012	24.3	Footscray	Industrial/ residential
CO	1 hour	1.1	1360	Alphington	Residential/light industrial
	8 hour	0.7	863		
PM_{10}	1 hour	-	44.6	Dandenong	Light industrial
	24 hour	-	23.6		
	Annual	-	19.9		
$PM_{2.5}$	1 hour	-	19.3	Alphington	Residential/light industrial
	24 hour	-	10.2		
	Annual	-	7.9		
SO_2	1 hour	0.006	16.9	Geelong	Light industrial/ residential

ppm = parts per million; µg/m³ = micrograms per cubic metre

12.5.2 Meteorology and climate

Understanding the local meteorology informs modelling of air pollutant dispersion from the FSRU at Crib Point during its operation and potential dust impacts during construction of the Project. Rainfall acts as a natural dust suppressant, with construction dust impacts more likely during drier periods. Local wind speed and direction influences the dispersion of dust and pollutants. Topography and natural barriers may reduce airborne concentrations.

The AERMOD model uses BoM monitoring data and data from The Air Pollution Model (TAPM) as inputs. TAPM is a predictive meteorological and air pollution model developed by CSIRO connected to various databases, which can be used to predict three-dimensional meteorology, including terrain induced air circulation.

An understanding of local terrain is important for dispersion modelling. The terrain in the immediate area surrounding the Crib Point Jetty is predominantly flat and approximately 30 kilometres north-east of open waters. A small mountain range, 15 kilometres from Crib Point, runs north-south on the Mornington Peninsula with elevations up to approximately 200 metres above mean sea level, which may influence the local meteorology at the location of the FSRU.

The closest BoM station to the Gas Import Jetty Works is located at Cerberus (Station number 086361), approximately five kilometres to the south-west of the Crib Point Jetty. Cerberus is situated in similar terrain to the proposed location of the FSRU and is suitable to provide an indication of meteorology.

Climate data has been recorded at the Cerberus BoM site since 1986. The annual mean rainfall is 720 millimetres across an average of 106 days each year. August is the wettest month, with a mean rainfall of 75 millimetres, while January is the driest month with a mean rainfall of 37 millimetres. Humidity follows a diurnal cycle, with higher humidity in the morning compared with the afternoon.

Wind predictions have been extracted from AERMOD for the FSRU location using the BoM and TAPM inputs. The yearly wind speed statistics for 2014 to 2018 are presented in **Table 12-2**. The Table shows little variation of wind speed in the last five years, with a minor variation in average and maximum wind speed.

Table 12-2: Yearly AERMOD Crib Point wind statistics 2014–2018

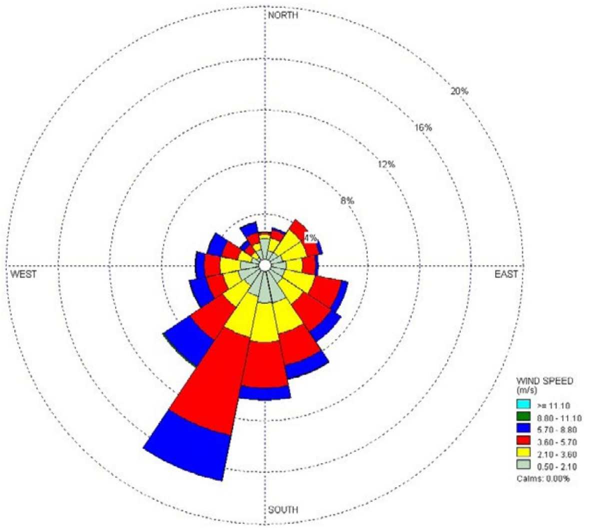
Wind parameters	2014	2015	2016	2017	2018
Average (m/s)	3.06	2.82	2.99	2.95	3.19
Maximum (m/s)	13.3	11.4	12.2	11.4	12.8
Calms (%) (<0.5 m/s)	6.5	20.2	20.1	7.1	6.9

m/s = metres per second

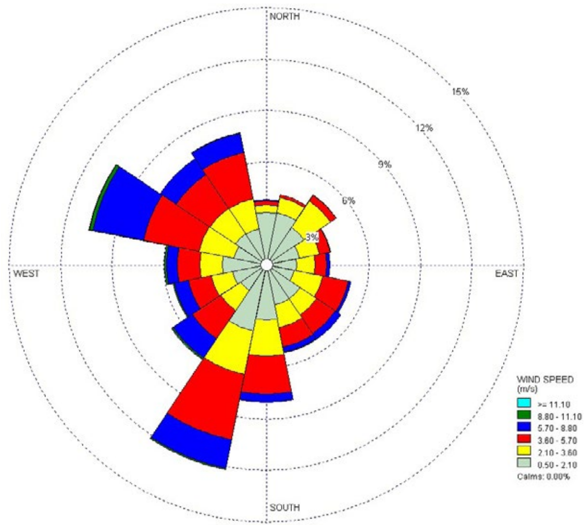
Seasonal wind roses for 2014 to 2018 are shown in **Figure 12-3**. The wind roses show the wind direction and speed. The seasonal data shows the wind speed is generally highest from the north-west and south-west in autumn and spring, the north-west in winter and the south-west in summer.

Figure 12-3: AERMOD Crib Point seasonal wind roses, 2014–2018

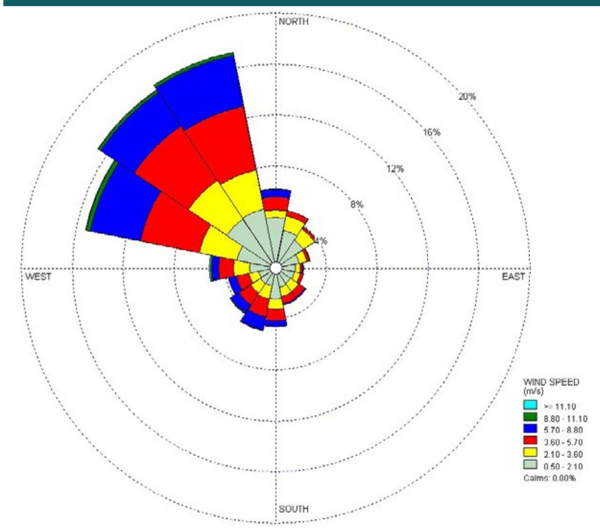
Summer wind rose



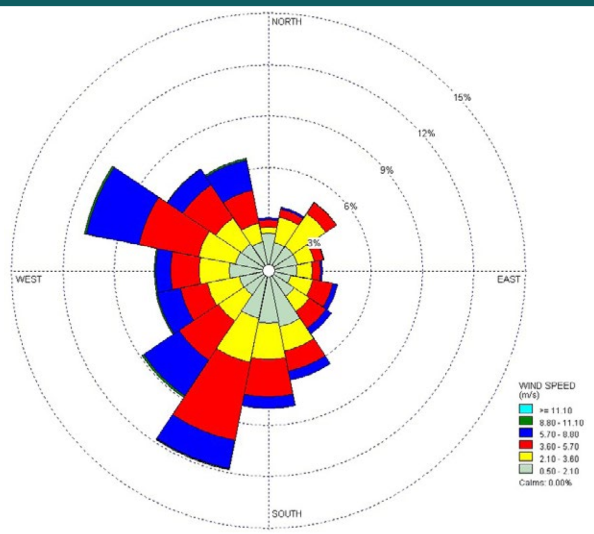
Autumn wind rose



Winter wind rose



Spring wind rose



12.6 Risk assessment

The risk assessment identified the risks associated with potential air quality impacts of the Project during its construction and operation. These consider the environmental, social, economic and health and safety consequences of each risk and their likelihood of occurring.

Risk ratings were applied to each identified risk pathways assuming that initial mitigation measures were in place. Initial mitigation measures are measures that are either a regulatory requirement or are considered standard practice for construction projects. Where the initial risk ratings were categorised as medium or higher, additional mitigation measures have been developed to lower the residual risk where practicable.

A summary of the identified risks relating to air quality are outlined in **Table 12-3**. The identified risks are further discussed in **Section 12.7** (Construction impacts) and **Section 12.8** (Operation impacts) of this chapter. Mitigation measures relating to air quality impacts are presented in **Section 12.9** (Mitigation measures) of this chapter and in **Chapter 25** *Environmental Management Framework*.

A risk register including the likelihood and consequence of each risk pathway is provided in Attachment III *Environmental risk report*.

Table 12-3: Risks – air quality

Risk ID	Works area	Risk pathway	Initial mitigation measures	Initial risk rating	Additional mitigation measures	Residual risk rating
Construction						
AQ1	Gas Import Jetty Works and Pipeline Works	Site clearance and construction site establishment activities result in the generation of dust (particulates) resulting in deterioration of the existing air quality environment.	MM-AQ01 Dust suppression	Medium	MM-AQ02 Restricted vehicle movements MM-AQ03 Crushed rock on access tracks MM-AQ04 Speed restrictions MM-AQ07 Dust monitoring	Low
AQ2	Gas Import Jetty Works and Pipeline Works	Construction activities (e.g. excavation, drilling, vehicle movements) result in the generation of dust (particulates) resulting in deterioration of the existing air quality environment.	MM-AQ01 Dust suppression	Medium	MM-AQ02 Restricted vehicle movements MM-AQ03 Crushed rock on access tracks MM-AQ04 Speed restrictions MM-AQ07 Dust monitoring	Low
AQ3	Gas Import Jetty Works and Pipeline Works	Climatic conditions result in the generation of dust (particulates) resulting in deterioration of the existing air quality environment.	MM-AQ01 Dust suppression	Medium	MM-AQ06 Weather monitoring MM-AQ07 Dust monitoring	Low
AQ4	Pipeline Works	Increased dust emissions near the construction worksite (within urban environment) due to handling of spoil resulting in deterioration of the existing air quality environment.	Reinstatement of excavated material progressively as per **Chapter 20** *Agriculture*	Medium	Change to HDD in Stony Point rail corridor as described in **Chapter 19** *Business* MM-AQ05 Covering vehicle loads MM-AQ07 Dust monitoring	Low
AQ5	Gas Import Jetty Works and Pipeline Works	Construction equipment, vehicles and plant results in the generation of combustion emissions resulting in deterioration of the existing air quality environment.	MM-AQ09 Construction equipment maintenance	Low	No additional mitigation measures identified	Low
AQ6	Gas Import Jetty Works and Pipeline Works	Odour from contaminated soils (including acid sulfate soils) resulting in amenity impacts.	MM-AQ08 Odorous soils management	Very low	No additional mitigation measures identified	Very low
Operation						
AQ7	Gas Import Jetty Works	Combustion emissions (such as particulates, nitrogen dioxide, sulphur dioxide, carbon monoxide, benzene, polyaromatic hydrocarbons) from use of the FSRU resulting in deterioration of the existing air quality environment.	MM-AQ10 Maintenance of the FSRU burners	Medium	MM-AQ11 Monitoring FSRU air emissions	Low
AQ8	Gas Import Jetty Works and Pipeline Works	Accidental release of gas or spill resulting in emission of odour (mercaptan) or deterioration of the existing air quality environment.	Safety standards as per **Chapter 16** *Safety, hazard and risk* MM-AQ09 Operational equipment maintenance	Low	No additional mitigation measures identified	Low

12.7 Construction impacts

Construction of the Project would produce dust likely reducing air quality, particularly along the pipeline ROW, from site clearing and excavation activities as well as access tracks due to vehicles being driven over unsealed surfaces (Risk IDs AQ1 and AQ2). Pipeline construction activities would occur in a progressive linear manner. Sensitive receptors would therefore likely be exposed to relatively short periods of construction at any given point along the proposed pipeline alignment, meaning that impacts from dust would generally be temporary and localised.

Construction of the End of Line Scraper Station (EOLSS) would require a deep excavation of approximately 5.5 metres to connect the pipeline to the Victorian Transmission System (VTS) and install the buried pipework and foundations. The excavated material from this deep excavation would be stockpiled onsite for reuse once construction activities were completed.

Establishment and construction of the Crib Point Receiving Facility, Pakenham Delivery Facility and mainline valves (MLVs) are also expected to generate dust. However, dust-generating activities at these locations would not be as substantial as those expected along the pipeline alignment and at the EOLSS as there would be limited excavation and soil stockpiling at these locations. If soil could not be reused on the construction sites due to its geotechnical suitability or quality, it would be transported off-site and disposed of appropriately.

The IAQM semi-quantitative methodology was used to assess the risk of air quality impacts during construction. This methodology is typically used for projects of this scale and nature and assesses the risk of potential impacts without mitigation. The results of the IAQM methodology were used to inform the Project air quality risk assessment presented in **Section 12.6** (Risk assessment) of this chapter.

The IAQM assessment methodology requires that key construction activities for the Project are separated into four types to reflect their different potential impacts:

- demolition – the removal of an existing structure(s)
- earthworks – operations involved in loosening, excavating, shaping and compacting soil or rock
- construction – activities associated with the provision of the new structure(s)
- trackout – transport of dust and dirt from the construction site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network.

The IAQM risk ratings for each of these four construction activities are listed in **Table 12-4** with an explanation of the potential dust emission magnitude of the activity combined with the sensitivity of the area to dust soiling or human health impacts. The ratings were calculated using a specific matrix for each activity and assessed without mitigation measures. The dust emission magnitude refers to the scale and nature of the works (small, medium or large). The sensitivity of the area takes into account the types of, proximity and number of receptors, and the local background concentration of PM_{10} in the case of human health sensitivity (low, medium or high sensitivity).

Table 12-4: IAQM risk ratings

	Demolition	Earthworks	Construction	Trackout
Potential dust emission magnitude	Small (total building volume <20,000 m^3, with low potential for dust release). Less than 10 small agricultural buildings will be removed.	Large (area greater than 10,000 m^2, potentially dusty soil, more than 10 heavy earth moving vehicles active at one time, total material moved more than 100,000 tonnes). Clearing of vegetation, trench excavation, stockpiling of material, backfilling and compaction.	Small (total building volume <25,000 m^3, construction material with low potential for dust release). Pipe stringing, bending and lowering in and construction of Jetty Infrastructure and pipeline facilities with low dust generating potential.	Medium (10–50 heavy duty vehicle outward movements in any one day, moderately dusty surface material, unpaved road length 50–100 m). Plant and spoil trucks leaving site not expected to exceed 50 per day at a particular site along the ROW.
Dust soiling				
Sensitivity of the area	Medium: for all sections of the pipeline except Hastings, <10 sensitive receptors are within 50 m of the construction footprint. Although pipeline construction works in Hastings may have 31–50 high-sensitivity receptors within 20 m of the construction footprint the potential dust emission magnitude is 'Medium' due to the use of HDD along most of the alignment in Hastings, requiring less excavation. The central and northern parts of the pipeline alignment and near the EOLSS where open trenching and large excavation works would occur are more sparsely populated.			
IAQM risk rating	Low	Medium	Low	Medium
Human health (PM_{10})				
Sensitivity of the area	Low: the southern section of the pipeline alignment may have 31–50 high sensitivity receptors (dwellings) within 20 m of the construction footprint and 51–70 high sensitivity receptors within 50 m. Annual average background PM_{10} concentration is between 15 µg/m^3 and 20 µg/m^3 which is below the EPA Victoria criterion of 25 µg/m^3. This means the sensitivity of the area to increases in PM_{10} is low.			
IAQM risk rating	Negligible	Low	Negligible	Low

The outcome of the IAQM assessment shows that unmitigated air emissions from the construction of the Project pose a low risk for dust soiling from demolition and construction and a medium risk for earthworks and trackout. Human health impacts from the Project present a negligible to low IAQM risk.

To relate these IAQM derived risk ratings back to the Project risk assessment in **Section 12.6**, using the medium risk rating for dust soiling during earthworks, the consequence of dust impacts is considered to be moderate (see Risk IDs AQ1, AQ2 and AQ4).

In addition, it is possible that extreme weather events such as dry and windy conditions would occur during construction, which may generate dust from wind erosion on exposed surfaces (see Risk ID AQ3). Monitoring of weather using available data sources such as the BoM (see mitigation measure MM-AQ06) would inform mitigating measures for dust generation from the construction sites. Dust producing work would be monitored on windy days when the wind is blowing towards receptors and, if necessary, modified or stopped until the extreme weather event has ceased.

Dust suppression techniques such as water sprays on unsealed surfaces, stockpiles and during loading and unloading of dust-generating materials would be used as an initial mitigation measure for construction of the Project (see mitigation measure MM-AQ01). Construction vehicles, plant and equipment would be required to remain within the construction footprint, pipeline ROW and on designated roads and tracks to minimise ground disturbance (see mitigation measure MM-AQ02). Speed restrictions on the ROW and access tracks would also be implemented in built up areas to minimise dust generation from vehicle movements along unsealed access tracks (see mitigation measure MM-AQ04).

Additional measures to reduce dust would be considered and implemented as required by the Project's construction contractor or as a result of verified community complaints. Observational monitoring for potential dust-generating sources would be undertaken by the construction contractor. If the works were creating levels of dust which are observed to be causing a hazard that cannot be supressed by water sprays or other devices, the works would be modified or stopped until the dust hazard is reduced to a manageable level (see mitigation measure MM-AQ07).

Another additional mitigation measure, if required and in consultation with relevant stakeholders, involves using crushed rock on existing unsealed access tracks to supress dust being disturbed from vehicles driving over exposed soil surfaces (see mitigation measure MM-AQ03). Vehicles carrying loads using public roads would be covered if there is a potential for loss of dust or litter (see mitigation measure MM-AQ05).

Implementation of these additional mitigation measures would reduce the likelihood of deterioration of the existing air quality environment from dust during construction and so the residual risk rating is reduced to low.

Non-dust-related air emissions from construction works is a low risk. These include combustion emissions from construction equipment, vehicles and plant (Risk ID AQ5) as well as odour emissions from excavated soils which may be contaminated (Risk ID AQ6). To mitigate these risks to air quality, construction equipment would be maintained in good condition to minimise ignition risk, spills and air emissions that may cause nuisance (see mitigation measure MM-AQ09).

While it is unlikely that odorous soils would be excavated based on field investigations detailed in **Chapter 10** *Contamination and acid sulfate soils*, in the event that odorous soils were uncovered, ground disturbance activities would cease, and the site assessed to determine appropriate management actions in consultation with suitably qualified personnel. If odorous soils were found to be contaminated, the EPA Victoria would be notified as soon as reasonably possible (see mitigation measure MM-AQ08).

Boil-off gas

Despite insulation of the tanks in which the LNG is stored which limits the admission of external heat, slight evaporation of the LNG will occur during storage, shipping and loading/unloading operations. This natural evaporation of small amounts of LNG is known as boil-off and results in boil-off gas that needs to be removed from the tanks to manage tank pressure.

When the FSRU is regasifying and sending out gas, boil-off gas is recovered and used as a fuel source in the generators on the FSRU, with any excess being recondensed back into a liquid and stored as LNG. Boil-off gas can also be compressed via a minimum send out compressor (MSO) onboard the vessel and delivered to the gas transmission network.

12.8 Operation impacts

The operation of the FSRU would emit various pollutants primarily from the use of gas-fired boilers to regasify the LNG in closed loop operation, and combustion within the dual fuel engines (see Risk ID AQ7). As described in **Chapter 4** *Project description*, the dual-fuel engines would operate on boil-off gas from the LNG cargo under normal operations and could also operate on light fuel oil (such as marine diesel oil) or heavy fuel oil if required. Marine diesel oil would primarily be used during emergencies or during non-routine maintenance.

Modelled scenarios assume continuous operation of the FSRU in open or closed loop regasification mode. Open loop scenario assumes four reciprocating gas engines operating at peak power (as the boilers are not used for regasification when operating in open loop mode). Closed loop scenarios assume four reciprocating gas engines and either two or three boilers operating at peak power to power three regasification trains. Worst case scenarios, with the FSRU operating at peak capacity are only expected to occur for 10 per cent of the year.

The four worst-case FSRU operating scenarios were modelled for the air quality impact assessment:

1. Gas-fuelled – four natural gas-fuelled engines operating at 100 per cent load during regasification in open loop mode.
2. Gas-fuelled – two boilers and four natural gas-fuelled engines operating at 100 per cent load during regasification in closed loop mode.
3. Gas-fuelled – three boilers and four natural gas-fuelled engines operating at 100 per cent load during regasification in closed loop mode.
4. Liquid-fuelled engines – two diesel-fuelled engines operating at 25 per cent load, which would only be operating on liquid fuel when the gas-fuelled boilers were not in use.

The maximum concentration predicted over an averaging period of one hour for NO_2, CO, PM_{10} and $PM_{2.5}$ and three minutes for VOC, PAH and benzene concentrations at the 38 sensitive receptor locations assessed for each scenario is summarised in **Table 12-5**. The maximum concentration predicted over an averaging period of one hour for SO_2 concentrations and three minutes for formaldehyde concentrations at the sensitive receptors are also shown in **Table 12-5** for the liquid-fuelled engines scenario.

The maximum predicted pollutant concentrations were calculated excluding background concentrations (the FSRU alone) and including background concentrations (cumulative emissions from the FSRU and background concentrations). The cumulative value that includes background concentrations were compared against the SEPP (AQM) design criteria as a percentage of the criteria where background concentrations are available.

Table 12-5: Summary of maximum predicted pollutant concentrations from operation of the FSRU modelled at sensitive receptor locations, 99.9th percentiles

Pollutant	Averaging period	SEPP (AQM) design criteria (µg/m³)	Maximum predicted pollutant concentration (µg/m³)		Per cent of SEPP (AQM) design criteria* (%)
			Excluding background	Including background	
1. Gas-fuelled – open loop scenario					
NO_2	1 hour	190	14.5	69.2	36%
CO	1 hour	29,000	36.2	1396	4.8%
VOC	3 minute	-	35.9	-	-
PM_{10}	1 hour	80	2.58	47.2	59%
$PM_{2.5}$	1 hour	50	2.16	21.5	43%
PAH	3 minute	0.73	0.000052	-	0.007%
Benzene	3 minute	53	0.134	-	0.25%
Formaldehyde	3 minute	40	16.9	-	42%
2. Gas-fuelled – two boilers scenario					
NO_2	1 hour	190	16.2	70.9	37%
CO	1 hour	29,000	41.0	1401	4.8%
VOC	3 minute	-	36.5	-	-
PM_{10}	1 hour	80	3.00	47.6	59%
$PM_{2.5}$	1 hour	50	2.51	21.8	44%
PAH	3 minute	0.73	0.000053	-	0.007%
Benzene	3 minute	53	0.136	-	0.26%
Formaldehyde	3 minute	40	17.1	-	43%
3. Gas-fuelled – three boilers scenario					
NO_2	1 hour	190	17.2	71.9	38%
CO	1 hour	29,000	43.9	1404	4.8%
VOC	3 minute	-	36.8	-	-
PM_{10}	1 hour	80	3.25	47.9	60%
$PM_{2.5}$	1 hour	50	2.72	22.0	44%
PAH	3 minute	0.73	0.000054	-	0.007%
Benzene	3 minute	53	0.137	-	0.26%
Formaldehyde	3 minute	40	17.3	-	43%

Pollutant	Averaging period	SEPP (AQM) design criteria (µg/m³)	Maximum predicted pollutant concentration (µg/m³)		Per cent of SEPP (AQM) design criteria* (%)
			Excluding background	Including background	
4. Liquid-fuelled engines scenario					
NO_2	1 hour	190	24.7	79.4	42%
CO	1 hour	29,000	23.0	1383	4.8%
VOC	3 minute	-	19.9	-	-
PM_{10}	1 hour	80	2.38	47.0	59%
$PM_{2.5}$	1 hour	50	1.99	21.3	43%
SO_2	1 hour	450	6.35	23.2	5.2%
PAH	3 minute	0.73	0.0000029	-	0.0004%
Benzene	3 minute	53	0.20	-	0.37%
Formaldehyde	3 minute	40	0.020	-	0.05%

*per cent of the SEPP (AQM) design criteria was calculated including background data where this was available.

There were no exceedances of the SEPP (AQM) design criteria at the sensitive receptors or at any gridded receptor locations on land for the pollutants modelled.

Modelling predicts that for the gas-fuelled scenarios, NO_2 concentrations exceed the SEPP (AQM) design criterion of 190 µg/m³ when combined with 54.7 µg/m³ background concentrations within approximately 50 metres of the FSRU (over water). Formaldehyde concentrations exceed the design criterion of 40 µg/m³ within approximately 200 metres of the FSRU, at a number of areas over water to the south and east of the FSRU and a small area of the Crib Point foreshore.

The predicted pollutant concentrations for two typical operating scenarios of the FSRU (equivalent to a gas production rate of 500 million standard cubic feet per day) are presented in Appendix C of EES Technical Report G: *Air quality impact assessment*. The purpose of these scenarios is to assess emissions for a typical operating scenario where two regasification trains are running. The two typical operating scenarios assessed were:

- Open loop – three gas-fuelled engines operating at 5000 kilowatts (kW) during regasification.
- Combined loop – three gas-fuelled engines operating at 5000 kW plus two boilers. Combined loop regasification mode would be used when the seawater intake temperature is close to 10 degrees Celsius or below to improve operational efficiency with respect to regasification. This mode is unlikely to be used for more than 30 days during winter in any given year. Combined loop mode operating at a peak gas production rate of 750 million standard cubic feet per day would be the same as Scenario 2 in **Table 12-5** above (Gas-fuelled, two boiler scenario).

Emission rates and ground level concentrations for the typical scenarios with a gas production rate of 500 million standard cubic feet per day are approximately 35 to 40 per cent less than the worst-case gas-fuelled scenarios.

Graphical representations of the model predictions for NOx (including background concentrations) and formaldehyde (excluding background concentrations) emissions are shown in **Figure 12-4** and **Figure 12-5** for the gas-fuelled closed loop scenario with three boilers. These exceedances are shaded in yellow in the modelled contours.

The gas-fuelled open and closed loop scenarios show that the maximum predicted pollutant concentrations are relatively similar at the sensitive receptors. The gas-fuelled three boilers scenario has marginally higher concentrations of pollutants compared with the open loop and two boilers gas-fuelled scenarios. NOx concentrations are reported at 38 per cent of the criteria, $PM_{2.5}$ concentrations at 43 per cent of the criteria, PM_{10} concentrations at 60 per cent of the criteria and formaldehyde concentrations at 43 per cent of the criteria for the three boilers scenario. Results demonstrate that a third boiler would increase pollutant concentrations by less than 1 per cent at sensitive receptor locations.

At approximately 60 metres from the FSRU, the ground level concentration of formaldehyde is predicted to be below the design criterion (40 µg/m³) for most (99 per cent) of the year. Maximum predicted ground level formaldehyde concentrations at the FSRU are approximately 15 per cent of the Protective Action Criteria developed by the U.S. Department of Energy to help protect the public from health effects of short-term exposures to hazardous chemicals in the air. This indicates there would be no adverse health impacts to workers or receptors in the vicinity of the FSRU.

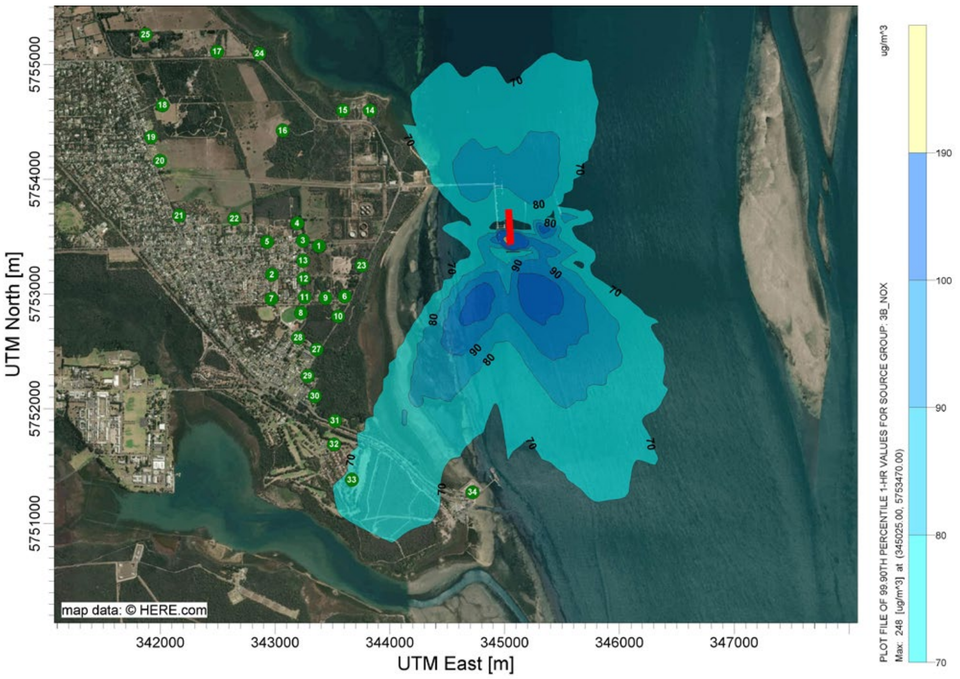


Figure 12-4: Gas-fuelled FSRU, three boiler scenario (closed loop mode), NO_2 concentration results, 99.9th percentile including background (µg/m³)

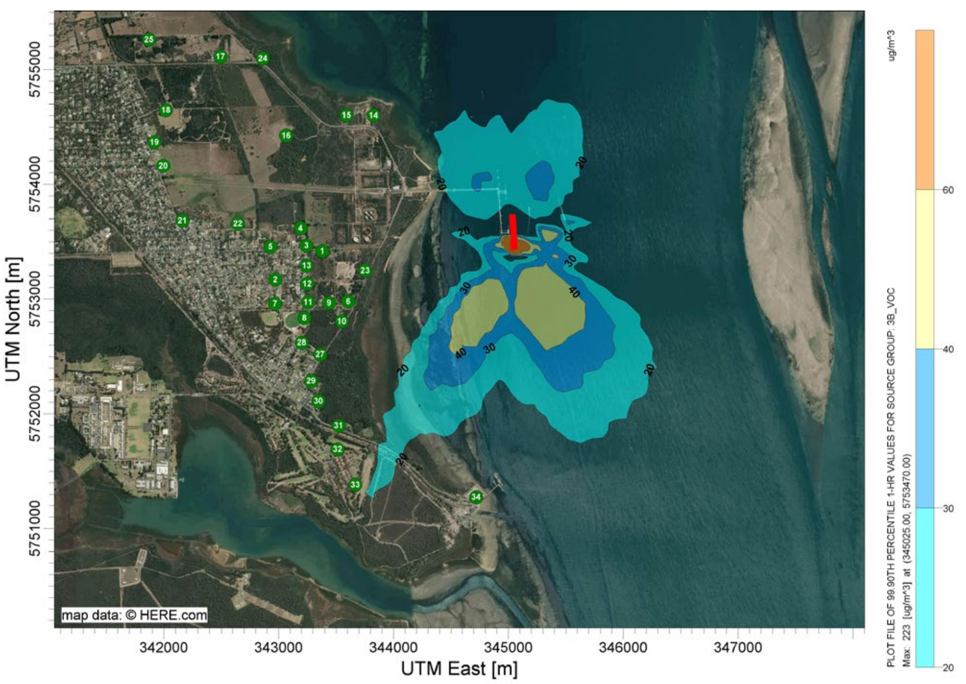


Figure 12-5: Gas-fuelled FSRU, three boiler scenario (closed loop mode), formaldehyde concentration results, 99.9th percentile excluding background (µg/m³)

While the liquid-fuelled engines scenario modelling results show higher emissions of NOx, PM_{10} and $PM_{2.5}$ compared with the gas-fuelled scenarios, they were still within the SEPP (AQM) design criteria at sensitive receptors. Graphical representation of the NOx emissions for the liquid-fuelled engines scenario is shown in **Figure 12-6.**

It is noted that NO_2 concentrations exceed the SEPP (AQM) design criteria of 190 μg/m^3 (when combined with 54.7 μg/m^3 background concentrations) for the liquid-fuelled engines scenario within 50 metres of the FSRU, as shaded in yellow in **Figure 12-6**. However, there were no exceedances of the SEPP (AQM) design criteria at sensitive receptor locations or at any gridded receptor locations on land for the pollutants modelled.

Emission rates from the FSRU can be compared against the scheduled premises threshold as defined in Schedule 1 of the Environment Protection Act to determine whether a licence and/or Works Approval is required for FSRU air emissions. The worst-case emission rates for the FSRU compared against the scheduled premises thresholds are shown in **Table 12-6**.

Table 12-6: Comparison of FSRU emissions to scheduled premises threshold

Pollutant	Operating scenario	Total emissions		Scheduled premises threshold (kg/day)	Exceeds threshold (yes/no)
		Grams per second (g/s)	kg/day		
NO_x (as NO_2)	Gas-fuelled, three boilers	18.32	1583	100	Yes
CO		14.53	1256	500	Yes
VOC		4.45	385	100	Yes
Particulates		1.15	100	100	Yes
SO_2	Liquid-fuelled, two engines at 25% load	5.69	492	100	Yes

From the emissions shown in **Table 12-6**, the FSRU would require a Works Approval from the EPA Victoria. Best practice design parameters and emission standards would be applied so that air emissions were minimised to the extent practicable.

The type of burners and fuel used for the FSRU would be selected to minimise the release of air emissions in accordance with relevant standards. Regular maintenance of the burners in the boilers and engines is also required as per manufacturer's specifications to promote efficient combustion (see mitigation measure MM-AQ10). In addition, an air quality monitoring programme would be designed and implemented to confirm FSRU emission rates comply with design specifications (see mitigation measure MM-AQ11).

The FSRU would be operated in accordance with the conditions of the EPA Victoria licence and/or Works Approval, and so combustion emissions present a low risk to the air quality environment.

Other than the operation of the FSRU, amenity impacts to air quality during operation would be limited. Accidental release of gas or spill of mercaptan (odorant) resulting in odorous emissions or deterioration of the air environment is a low risk (Risk ID AQ8). This is a low risk due to all operational plant and equipment being designed to meet relevant safety standards, which would be managed through appropriate maintenance, storage and handling of the infrastructure to minimise the risk of unintended spills and air emissions. Emergency spill response procedures for mercaptan would be developed and implemented as part of the Operational Safety Management Plan (OEMP) for the Crib Point Receiving Facility. Safety standards and emergency spill response procedures are described in **Chapter 16** *Safety, hazard and risk*.

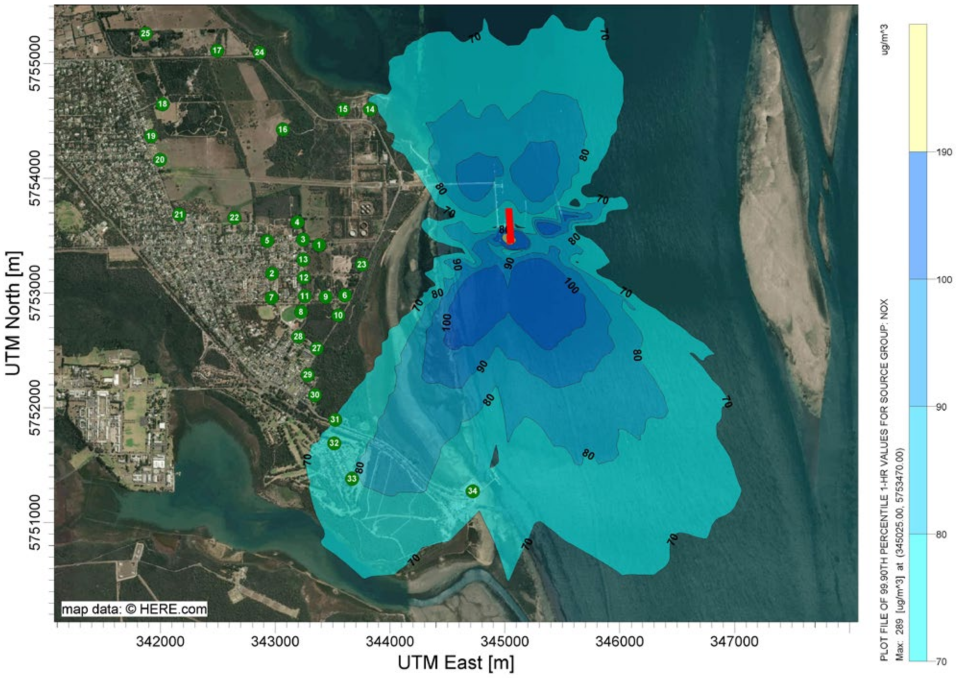


Figure 12-6: Liquid-fuelled engines scenario, NO_2 concentration results, 99.9th percentile including background (μg/m³)

12.9 Mitigation measures

Table 12-7 summarises the mitigation measures developed to mitigate and manage potential air quality impacts of the Project.

Relevant mitigation measures to reduce air quality impacts are also described in the following sections of the EES:

- **Chapter 16** *Safety, hazard and risk*
- **Chapter 19** *Business*
- **Chapter 20** *Agriculture.*

Table 12-7: Mitigation measures – air quality

Mitigation measure ID	Mitigation measure	Works area	Project phase
MM-AQ01	**Dust suppression** Dust suppression will be used at construction areas as required using water sprays, water carts or other devices on: • unpaved work areas • sand, spoil and aggregate stockpiles • during the loading and unloading of dust generating materials.	Gas Import Jetty Works and Pipeline Works	Construction
MM-AQ02	**Restricted vehicle movements** After arrival at the Project site, vehicles, plant and equipment will remain within the construction footprint and on public roads and designated tracks to the extent practical, unless undertaking survey and property management activities as agreed with the landholder.	Gas Import Jetty Works and Pipeline Works	Construction
MM-AQ03	**Crushed rock on access tracks** Where necessary to prevent dust generation and agreed with relevant stakeholders, crushed rock will be placed on existing permanent unsealed access tracks.	Pipeline Works	Construction
MM-AQ04	**Speed restrictions** Vehicle speed will be restricted to 40 km/hr on the construction right of way (ROW) and access tracks.	Pipeline Works	Construction
MM-AQ05	**Covering vehicle loads** Construction vehicles with potential for loss of loads (such as dust or litter) will be covered when using public roads.	Gas Import Jetty Works and Pipeline Works	Construction
MM-AQ06	**Weather monitoring** Weather conditions will be monitored for extreme heat and/or wind events using systems such as the Bureau of Meteorology forecasts and works will be assessed to determine if they need to be modified if conditions are likely to result in air quality impacts at sensitive receptors.	Gas Import Jetty Works and Pipeline Works	Construction
MM-AQ07	**Dust monitoring** Observational monitoring of dust along the construction right of way (ROW) and facilities will be undertaken. If dust is observed to be causing a hazard, then MM-AQ01 will be implemented. If dust levels cannot be contained works will be modified or stopped until the dust hazard is reduced to a manageable level.	Gas Import Jetty Works and Pipeline Works	Construction

Mitigation measure ID	Mitigation measure	Works area	Project phase
MM-AQ08	**Odorous soils management** In the event that odorous soils (other than acid sulfate soils) are uncovered during construction, the following measures will be undertaken: a. Cessation of ground disturbance at the location and within the immediate vicinity. b. Assessment of site contamination and determination of appropriate management actions in consultation with suitably qualified personnel. c. If odorous material is found to be contaminated, EPA Victoria will be notified as soon as reasonably possible. d. Acid sulfate soils will be managed in accordance with mitigation measures described in **Chapter 10** *Contamination and acid sulfate soils* (MM-C02 and MM-C03).	Gas Import Jetty Works and Pipeline Works	Construction
MM-AQ09	**Equipment maintenance** Plant and equipment will be maintained in good condition to minimise spills and air emissions that may cause nuisance.	Gas Import Jetty Works and Pipeline Works	Construction and operation
MM-AQ10	**Maintenance of the FSRU burners** Maintenance of the FSRU burners in the boilers and engines will be undertaken regularly as per manufacturer's specifications.	Gas Import Jetty Works	Operation
MM-AQ11	**Monitoring FSRU air emissions** An air quality monitoring programme will be designed and implemented to confirm FSRU emission rates comply within tolerances of the design specifications.	Gas Import Jetty Works	Operation

12.10 Conclusion

During the Project's construction, the main air quality impacts would be through the creation of dust (PM_{10}). Sensitive receptors near the construction works may be exposed to nuisance dust for relatively short periods of time with an IAQM risk rating of medium (without mitigation) from earthworks and trackout activities. These impacts would be localised and short-term given the linear progression of construction along the pipeline alignment. There are no forecast human health impacts from construction-generated dust with the implementation of the mitigation measures set out in **Section 12.9** of this chapter.

Construction air quality impacts would be managed through:

- dust suppression during construction activities, including:
  - watering of potential dust-generating sources
  - placing crushed rock on access tracks
  - restricting vehicle movements on unsealed surfaces
  - covering stockpiles and fine materials during transport as required
- monitoring of weather conditions for potential dust-generating conditions and undertaking additional measures as required
- ensuring equipment and plant are maintained in good condition to minimise combustion emissions.

All modelled operational scenarios demonstrated there were no exceedances of SEPP (AQM) design criteria at any of the sensitive receptor locations, with all predicted concentrations well below the criteria. This indicates the FSRU can operate in compliance with the SEPP (AQM) and the Environment Protection Act.

There were some exceedances of the SEPP (AQM) design criteria over water within approximately 50 metres of the FSRU for NO_2 and approximately 200 metres of the FSRU for formaldehyde, at a number of areas over water to the south and east of the FSRU and a small area of the Crib Point foreshore. While there are air exceedances of the SEPP (AQM) design criteria over water for NO_2, people would unlikely be affected due to the mostly transient nature of human activities near the jetty and the requirement, based on safety, for an exclusion zone from port operations at the jetty. Maximum predicted ground level formaldehyde concentrations are approximately 15 per cent of the Protective Action Criteria, indicating there would be no adverse health impacts to workers or receptors in the vicinity of the FSRU.

The operation of the Project would require a licence and/or Works Approval for the FSRU air emissions as the scheduled premises threshold is exceeded for NOx, CO, VOC and particulates when the FSRU operates on gas with three boilers at 100 per cent load. This EPA Victoria licence would require the FSRU to operate in compliance with set air emission limits as well as conditions requiring monitoring, reporting and auditing.

With implementation of the identified mitigation measures, potential impacts on air quality would be minimised during construction and would meet the SEPP (AQM) design criteria at sensitive receptors during operation.

In response to the social, economic, amenity and land use draft evaluation objective, impacts of the Project on air quality have been assessed and mitigation measures have been identified to reduce or minimise these impacts.