AMBIENT AIR SCREENING REPORT

LONG ISLAND POINT

2018/19

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1.0 Introduction

Esso Australia Pty Ltd (EAPL) is the operator for the Gippsland Basin Joint Venture (GBJV) with BHP Billiton Petroleum (Bass Strait) Pty Ltd (BHPB), and undertakes activities to produce oil and gas from the Gippsland Basin in Bass Strait.

Long Island Point (LIP) plays a vital role in Bass Strait oil and gas production. Situated near Hastings, 75 kilometres southeast of Melbourne, the facility carries out the final stage in the processing of liquid petroleum gas (LPG) and stores crude oil prior to distribution to refineries. The propane and butane products are stored in either refrigerated or pressurised storage tanks before transportation by pipeline or road tanker to commercial customers in Victoria and the rest of Australia, or by ship to customers across the Asia–Pacific region. Ethane is sent via pipeline from Long Island Point to Qenos. There are no ethane storage facilities at Long Island Point, and production is controlled to produce sufficient ethane for normal operations by the customer. The crude oil tank farm accepts crude oil from Longford Plants and stores it before transportation by pipeline to the refineries in Melbourne and Geelong, or by ship overseas.

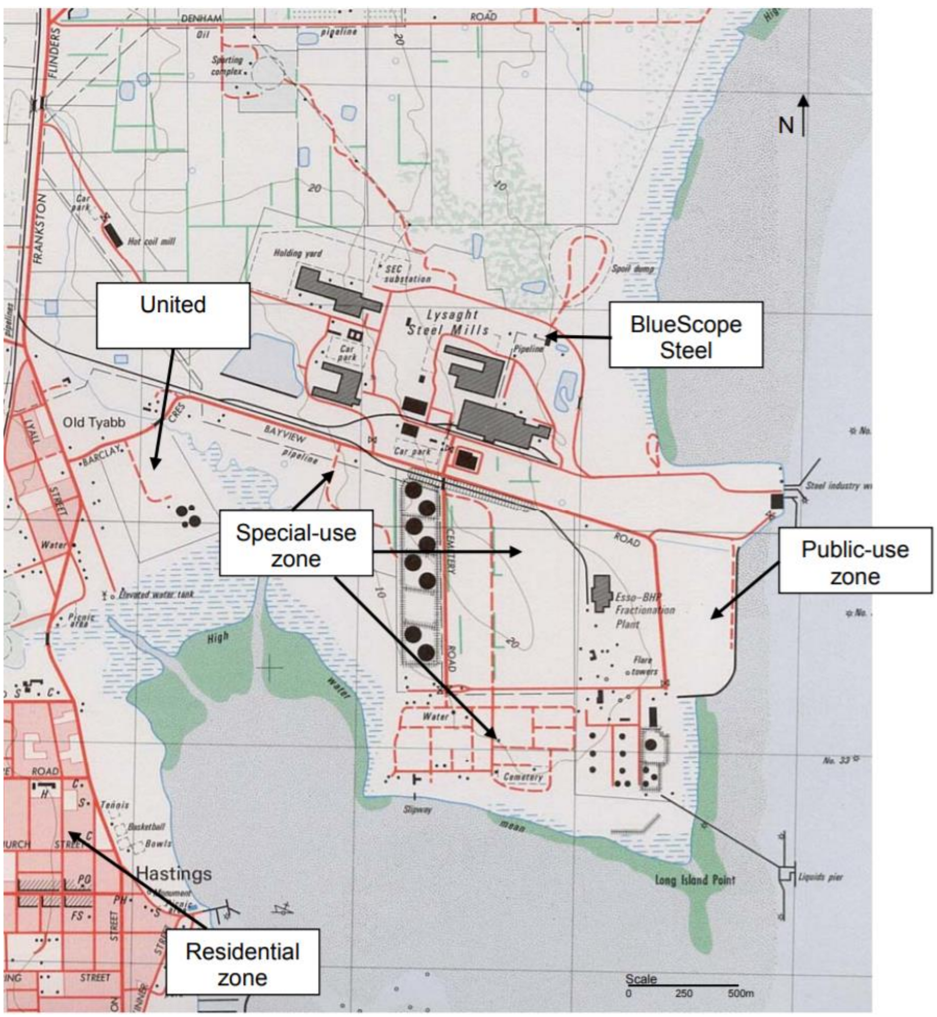

Figure 1: An overview of the Long Island Point facility and neighbouring areas

1.1 Objective

A previous risk screen on the impacts of smoke from process upset or alternate plant conditions assessed the level of risk to public health to be low but with moderate uncertainty. In order to verify this an ambient air screening study was developed.

The purpose of this report is to verify whether the risk to public health is low as previously assessed. The key objective of this monitoring program is to understand the level of environmental contaminants potentially affecting public health from smoke resulting from LIP plant operations.

1.2 Legal Framework

At the time of writing, a number of regulations form the legal framework which govern the discharge of air emissions from a premises. The *National Environment Protection Council (NEPC) Act 1994* (Cth) allows the National Environment Protection Council to make National Environment Protection Measures (NEPMs) with participating jurisdictions (e.g. the Commonwealth, States and Territories). NEPMs protect and manage a variety of environmental matters as prescribed by the NEPC Act. Currently, the NEPM for Ambient Air Quality (NEPMAAQ) established in 1998, sets standards for seven key air pollutants (CO, NO_2, O_3, SO_2, Pb and particles as PM_{10} and $PM_{2.5}$). These are standards are expressed in Victoria through the State Environment Protection Policy (SEPP) Ambient Air Quality (AAQ). The SEPP (AAQ) sets air quality objectives for Victoria and adopts the requirements of the NEPMAAQ. The SEPP (AAQ) is subordinate legislation made under the provisions of the *Environment Protection (EP) Act 1970* and aims to safeguard the environmental values and human activities (beneficial uses) that need protection in the State of Victoria from the effect of pollution and waste, such as:

- human health and wellbeing;
- ecosystem protection;
- visibility;
- useful life and aesthetic appearance of buildings, structures, property and materials;
- aesthetic enjoyment; and
- local amenity.

Under the EP Act, the requirements in environmental regulations, works approvals, licences, etc., must be consistent with SEPPs. The EP Act establishes the powers, duties and functions of the EPA Victoria. These include the administration and regulation of SEPPs. It is, however, the SEPP Air Quality Management (AQM) which establishes the framework for managing emissions into the air environment in Victoria from all sources of air pollutants, so that the air quality objectives outlined in SEPP (AAQ) are met.

Incorporated under the SEPP (AQM), three Protocols for Environmental Management (PEMs) exist which aim to carry forward the requirements of Schedule F from the SEPP (AQM). Best practice will be the main guiding principle in using the requirements of this PEM. The Long Island Point facility is classed as a Stationary Source which enables the use of flares as a safety mechanism. LIP adopts the protocols outlined in the PEM: Minimum Control Requirements for Stationary Sources (EPA publication 829) for emission management. As the LIP facility operates three safety relief flares, it follows Schedule F-11 of this PEM which states:

> *"All flare systems shall operate smokelessly under routine plant operating conditions and shall employ a staged design to promote smokeless combustion or shall be equipped with a steam or air suppression system."*

Additionally, it is also stated in the protocol that it *"excludes water suppressed flares at Esso's Longford oil and gas plant, the Long Island Point fractionation plant and pit flares equipped with water suppression systems"*.

Complimentary to this, LIP's EPA licence is a major piece of environmental regulation containing specific site based discharges of waste. The facility has been issued an Environmental Licence (2163) as required for all scheduled premises under the *Environment Protection (Scheduled Premises) Regulations 2017* under Section 20 of the Environment Protection Act 1970 which allows LIP, as a scheduled premise, to discharge, handle, treat or dispose of waste to the environment subject to the conditions of the Licence. This Licence allows LIP to discharge wastes to air (under LI_DA1), as per Table 1, and part of the site's Licence conditions include management of key risks on site which are contained within the Operations Integrity Management System (OIMS) under the LIP Environment Monitoring Plan (6-5 Environmental Management).

Table 1: Summary of the relevant EPA Licence Conditions for LIP under the Environment Protection Act 1970.

Licence Condition	**Description**
LI_DA1	Discharge of waste to air must be in accordance with the 'Discharge to Air' Table.
LI_DA2	Visible emissions to air other than steam must not be discharged from the premises, except as permitted by this Licence.

The LIP facility's Licence Conditions allow for premises-wide discharges, i.e. bubble limits (a 'bubble limit' for air emissions which means that the limit applies for emissions across the whole site, not on a stack-by-stack basis).

Table 2: LIP EPA Licence 'discharge to air' table outlining the maximum discharge rates.

Source		**Indicator Description**			
Description	**Units**	**CO**	**NO_2**	**SO_2**	**Total VOCs**
Premises-wide discharges (bubble limits)	t/yr	843	1436	263	946

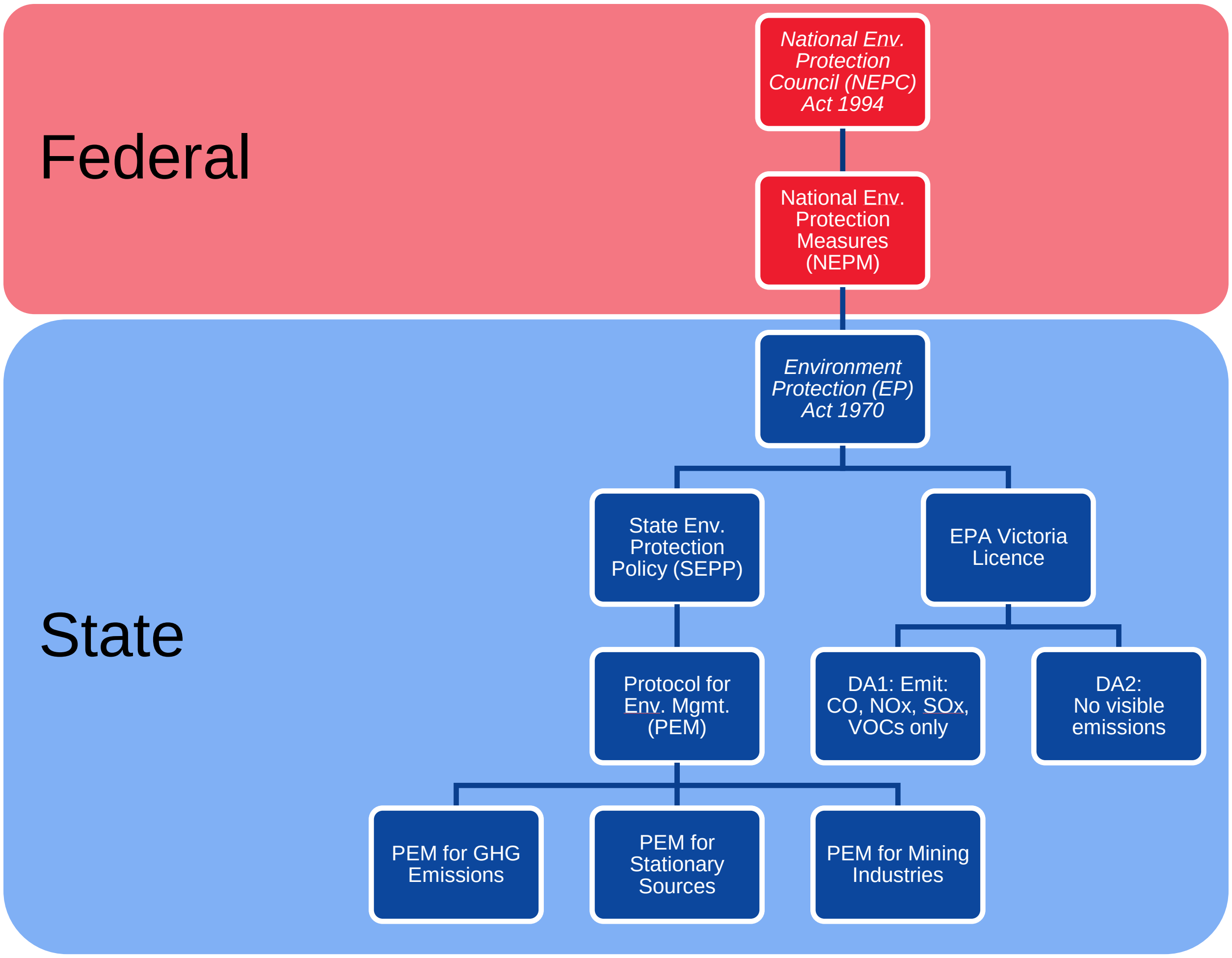

Figure 2: A summary of the relevant ambient air legislation that regulates the emissions of waste into air.

A summary of the relevant legal frameworks is outlined in Figure 2. The licence conditions outlined in Table 1 discuss maximum discharge rates as a result of flaring to mitigate against potential environmental and safety consequence. The site's licence does not prescribe any regulation around emissions of particulate matter (PM).

1.3 Health Impacts of Particulate Matter

Particulate matter refers to particles which are suspended in the air which can be either solid and liquid particles or a mixture of both. $PM_{2.5}$ refers to particles which are less than or equal to 2.5 microns in aerodynamic equivalent diameter. Due to their fine size, they are inhalable and, as a result, are linked to a number of adverse health impacts.

There is evidence that indicates that air pollution is associated with adverse health effects (Brook et al. 2014; WHO 2006; Lim et al. 2012; US EPA 2009; Burnett et al. 2014). The most compelling evidence of these relate premature mortality and effects on the respiratory and cardiovascular system. Outdoor air pollution and particulate matter since 2013 is now recognized as carcinogenic by the International Agency for Research on Cancer (IARC, 2016).

Particulate matter can penetrate deep in to the lung and its effects are mainly on the cardiovascular and respiratory system. On a global scale, ambient particulate matter is estimated to be responsible for approximately 4.1 million premature deaths (7.5% of global deaths) – largely caused by chronic lung diseases and lung cancer, heart disease and stroke and respiratory infections (GBD Risk Factors Collaborators, 2017).

Outdoor air pollution is a complex mixture of pollutants that often have similar sources which generally result in a high correlation between pollutants. This can make it difficult to determine the health effects attributable to individual air pollutants. However, PM_{10} and $PM_{2.5}$ are of most concern in Victoria, as these pollutants are present in the highest concentrations with relation to the air quality standards and they have well-documented adverse health effects such as premature mortality, and acute and chronic respiratory morbidity (WHO, 2006; Jerrett et al., 2009; Peng et al., 2013).

2.0 Ambient Air Monitoring Program Plan

A recommendation to undertake an ambient air monitoring trial was taken to the LIP ALT for their endorsement.

2.1 Project Justifications

2.1.1 Quantifying Impact

CO, NOx, SOx, VOCs and particulates are all produced during hydrocarbon combustions – all of which are hazardous to human health. However, CO, NOx, SOx and VOCs are measured via stack testing as a licence requirement to operate by the EPA Victoria and, as a result, were not recommended to be monitored during the trial monitoring period. In order to gain an understanding of the impact to public health, it was recommended that $PM_{2.5}$ concentrations are measured on-site at LIP, as particulate matter is produced when hydrocarbons are combusted. Particulate matter from hydrocarbon combustion is typically less than 1 micron in aerodynamic equivalent diameter, and, as such $PM_{2.5}$ should be monitored to capture these products of combustion. In order to verify the findings from the 2017 Risk Screen which assessed the risk to public health to be low, it was recommended an ambient air monitoring screening trial be implemented to determine the concentration of $PM_{2.5}$ in the air. The criteria for the trial was established to lower the degree of uncertainty of the potential risk for public health issues from smoke around Hastings.

2.2 Ambient Air Monitoring Program Considerations

The trial monitoring period was constrained by a number of factors and considered the following technicalities, including:

- Site location placement to best capture data;
- Placement within site boundary to avoid interference with the device and careful consideration to hazardous areas and areas used by operations;
- Accessibility of the device;
- Operability of the device;
- Continuous monitoring to measure discrete events to enable separation of baseline, normal operations and alternate conditions (i.e. unscheduled flaring events);
- Criteria and guidelines established by the NEPM, EPA Victoria and SEPP;
- Recommendations from the Hazelwood Mine Fire and other reports/literature;
- Power supply on-site; and
- Data management.

2.2.1 Modelling versus Monitoring

A number of internal and external sources support the idea that monitoring provides real data, compared to modelling $PM_{2.5}$ emissions to determine potential public health impacts. Models always apply some level of conservativeness or estimates and, as a result, often produce results which might not be accurate.

2.2.2 Timing of the Trial

This study was conducted over February 2019 to capture the annual emergency shut-down critical function test (ESD CFT) scheduled for February 14. It was recommended to commence the trial at least one week prior to the event to enable the monitors to measure enough baseline conditions prior to alternate plant conditions caused by the ESD CFT.

2.2.3 Project Schedule

A summary of the trial schedule is outlined in Figure 3.

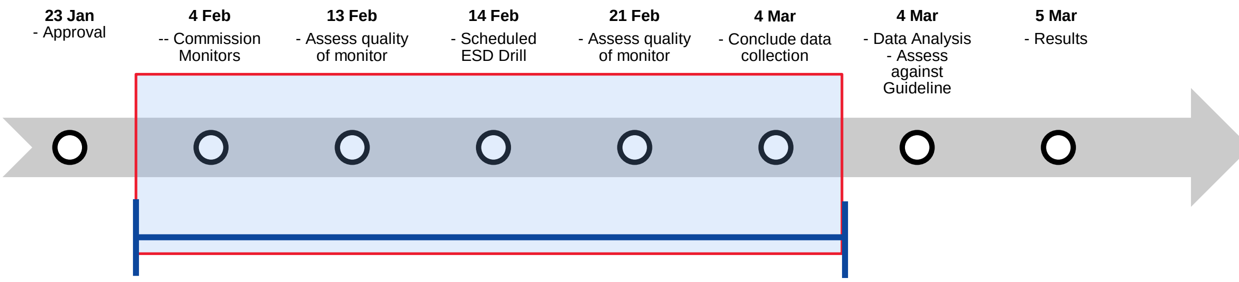

Figure 3: A summary of the project schedule for the ambient air monitoring trial.

2.2.4 Monitoring Feasibility

Due to the close proximity of the flares to the site's fenceline (Figure 5) and the associated restrictions on monitoring locations, monitor locations were assessed against wind roses from LIP. A wind rose was developed utilizing historic site data (01/01/16 – 28/10/17) and verified against the wind rose referenced in the LIP Safety Case which was extracted from the BOM Cerberus wind station. It indicated a high proportion of north-westerly winds and southerly winds as illustrated in Figure 4. After analysis of the prevailing winds, monitors were placed north and north-east of the LIP flares (locations 1 and 2 in Figure 6), and on the north end of the jetty (location 3 in Figure 6).

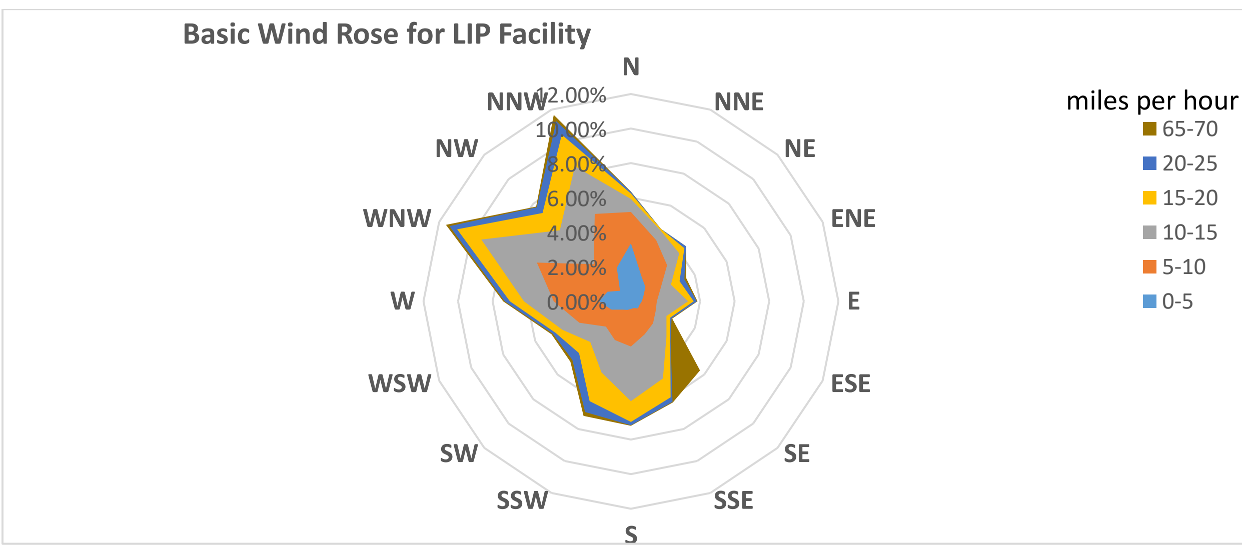

Figure 4: A wind rose was developed using historic site data from Long Island Point. Note: The legend is in units of mph or mi/hr

Figure 5: An overview of the Long Island Point facility, fenceline and site boundary.

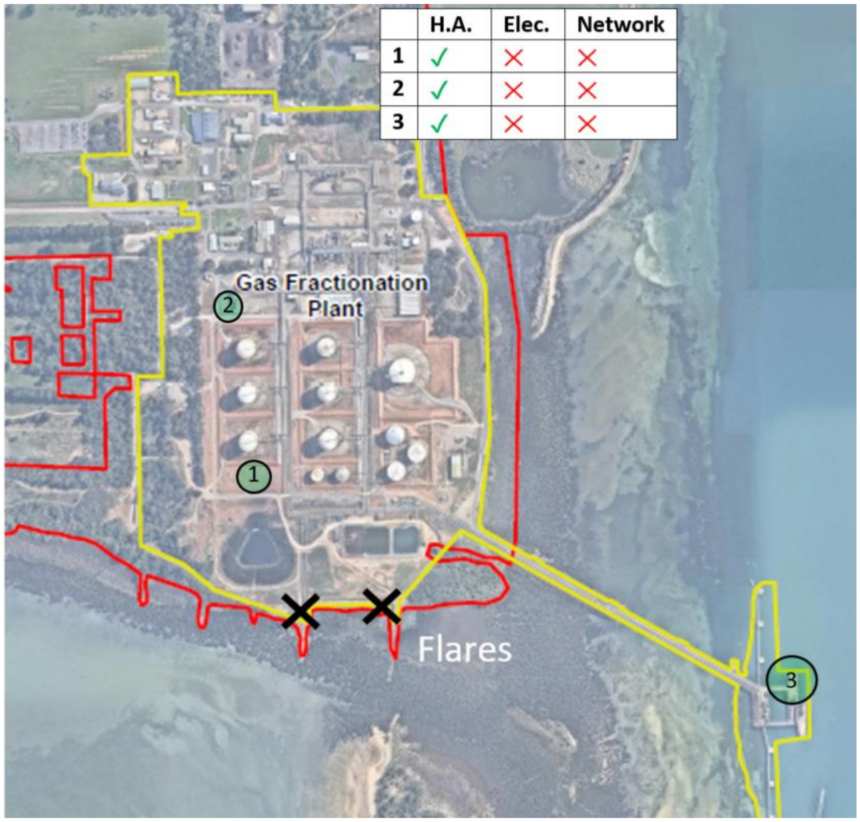

Figure 6: An overview of the three monitoring locations around LIP. Note: H.A. refers to hazardous area, Elec. refers to electricity supply and Network refers to computer network access.

The exact locations and device ID numbers to track data from the vendor's website are outlined in Table 3.

Table 3: Summary of the device ID and photos.

Location	Photo
Location 1 – North of flares Device ID: 4252 Device No: 16862	
Location 2 – West of plant Device ID: 4241 Device No: 16721	

Location 3 – Jetty Device ID: 5369 Device No: 41792	 

2.2.5 DustTrak 8533 Monitor Technical Basis

A summary of the monitors implemented are listed below:

Device: TSI DustTrak 8533 Aerosol Monitor

Measurement: Measures particle matter size (PM) and concentration profiles

Working Principle: Light-scattering laser photometry

Portability: Portable desktop unit with solar power capability and battery operated

Concentration Range: 0.001 to 400 mg/m^3, Guideline 0.008 mg/m^3

Data Management: Manual data logging functions

Common Usage: Indoor and outdoor air quality investigations

2.3 Recommended $PM_{2.5}$ Emission Guidelines for Analysis

The EPA Victoria uses an air quality index (AQI) summary to give an overall measurement of air quality at each air monitoring site. Note: while the area surrounding LIP does not have fixed monitoring stations, portable monitoring stations do exist which provide an indicative reading of air quality. The lower the index, the better the air quality is. The EPA Victoria at the time of writing uses five AQI categories as outlined in Table 4.

Table 4: Summary of the five AQI categories indicating the quality of air.

Category	**Index Range**	**$PM_{2.5}$ Concentration (24 hour averaging period) (µg/m^3)**	**$PM_{2.5}$ Concentration (1 hour averaging period) (µg/m^3)**
Very good (VG) air quality	0 – 33	0 – 8.2	0 – 13.1
Good (G) air quality	34 – 66	8.3 – 16.4	13.2 – 26.3
Fair (F) air quality	67 – 99	16.5 – 25	26.4 – 39.9
Poor (P) air quality	100 – 149	25.1 – 37.4	40 – 59.9
Very poor (VP) air quality	150 or greater	37.5 or greater	60 or greater

These values are determined by calculating the pollutant averages (i.e. depending on the pollutant, the data monitored is averaged over different time periods to calculate an average pollutant concentration measurement) and then by calculating a pollutant's index which is its average pollutant concentration expressed as a percentage of the relevant air standard:

$$Index = \frac{Pollutant\ Concentration}{Pollutant\ Standard\ Level} \times 100$$

The pollutant standard levels are outlined in Table 5. The highest pollutant index is taken as the air quality index summary for that air monitoring station for that hour.

Table 5: Summary of the pollutants monitored by EPA, the standard level, averaging time and the calculation method.

Pollutant	**Standard level**	**Source**	**Averaging time**	**Calculation method**
Ozone	100 ppb	Air NEPM	1 hour	Note A
Nitrogen dioxide	120 ppb	Air NEPM	1 hour	Note A
Sulfur dioxide	200 ppb	Air NEPM	1 hour	Note A
Carbon monoxide	9 ppm	Air NEPM	8 hours	Note B
Particles (PM10)	50 µg/m^3	Air NEPM	24 hours	Note C
Particles (PM2.5)	25 µg/m^3	Air NEPM	24 hours	Note D
Visibility reduction	2.35	SEPP AAQ	1 hour	Note A

Note: Calculation methods are from EPA website.

As a result, is it recommended to target a result less than 8.25 µg/m^3 on a 24-hr averaging time basis for $PM_{2.5}$ and less than 16.5 µg/m^3 on a 1-hr averaging time basis for PM_{10} in order to maintain a high 'very good (VG) air quality' standard, as set out by the regulator (assuming PMs have the highest pollutant index). This is summarized in Table 6.

Table 6: Summary of the calculated recommended target maximum particulate matter emissions from LIP.

Factors	**Units**	**PM2.5**
		Averaging Time
		24 hour
Recommended Guideline	(µg/m^3)	**8.2**
Air NEPM Standard Level	(µg/m^3)	25
Pollutant Index		33
Very Good AQI Cut-off		33

These values have been calculated in accordance with the procedure outlined by the Environment Protection Authority Victoria. It should be noted that the NEPM monitoring protocol does not apply to monitoring or controlling peak concentrations from major sources such as industry or near major roads. Instead, the air NEPM Standard Levels were designed to be measured at locations generally representative of exposure of the population, i.e. do not apply at peak sites or hot-spots. However, *in order to mitigate against any possible human health issues, the more conservative of the two approaches should be adopted.* Since the NEPM Standard Levels are based on the understanding of the health effects of the pollutants at the time of making the NEPM, the recommended guidelines adapted from the EPA Victoria AQI guidelines should be utilized as these levels are lower than the proposed limits set by the NEPM.

Further to this, the surveillance spreadsheet shows the EPA AirWatch recommended guidelines and air quality indicators which have been shown on the $PM_{2.5}$ charts.

3.0 Results

3.1 Data and Quality

The data collected is presented in the chart Figure 7. Data was successfully collected through the sampling period. There was a period of 3 ½ days when the jetty monitor was out of service and no data was collected, but this was rectified.

During the sampled period, there were three occasions when the 24hr rolling average reached the threshold between fair and poor air quality. Analysis of activities at site and wind direction was undertaken to identify if site activities contributed to these results. It is important to note that ambient air quality conditions are potentially impacted by a range of activities and not necessarily linked to flaring activity.

3.2 LIP Plant Activities

The key LIP plant activity undertaken during the monitoring period was the Critical Function Test of the Emergency Shutdown System. This simulates an emergency shutdown of the plant to confirm that the shutdown system functions as required, and it a key part of meeting performance standard requirements as outlined under the LIP MHF Safety Case. The test was conducted on 14th February 2019 and resulted in some flaring over a period of approximately 6 hours while the plant was restarted from the emergency shutdown state and process stability was resumed.

During the monitoring period, process upsets led to some minor additional flaring at the plant. These did not result in prolonged periods of black smoke and notification to the EPA (just increased flows of hydrocarbons to the flare system). There was limited instances of ethane flaring with some increased propane to flare mainly over periods on 1-3 March, 2019.

3.3 External Impacts

A number of potential external influences on ambient air quality were identified as part of the analysis. This screening analysis is intended to help identify potential LIP flaring impacts on ambient air quality, so the majority of external impacts are sources of error in the analysis. They include the following:

- *Shipping movements within Westernport Bay.* As the Long Island Point plant boarders Westernport Bay, the potential for emissions from ships was considered. There are several docks receiving large vessels in the Port of Hastings, with the Cribb Point Liquid Berth, Long Island Point Jetty, and the BlueScope Steel Wharves being the closest to the LIP facility. Shipping movements were reviewed for the LIP jetty as operations but not for other docks.
- *General transport movements.* Vehicles including cars, trucks, buses and boats can all impact ambient air quality. Vehicle movements include both on-site movements where company and contractor vehicles are used within the LIP facility and external parties visiting the LIP jetty, truck loading facility, neighbours and using public roads in the vicinity of Hastings. No attempt to quantify impacts of general transport movements was undertaken as part of this analysis.

- *Industrial and neighbourhood emissions.* The LIP plant is located in an industrial area with a number of neighbouring industries located to the north and west of the facility. No attempt to quantify impacts of other industry or the general neighbourhood community has been conducted.
- *Wood fires.* The analysis was conducted during late summer and limited impacts of wood fires used for heating are anticipated. It was noted however that a number of bushfires occurred in the state of Victoria during the monitoring period, including a significant fire in the Bunyip State Park located to the east of Melbourne.

3.4 Detailed Results Review & Conclusion

Analysis of the 24 hour rolling average PM2.5 concentrations showed a strong correlation between the data collected at all three monitoring locations. A tighter correlation was shown between locations 1 (south of the refrigerated storage) and 2 (west of the fractionation trains) which is to be expected given that these locations are physically closer together than either to the jetty location.

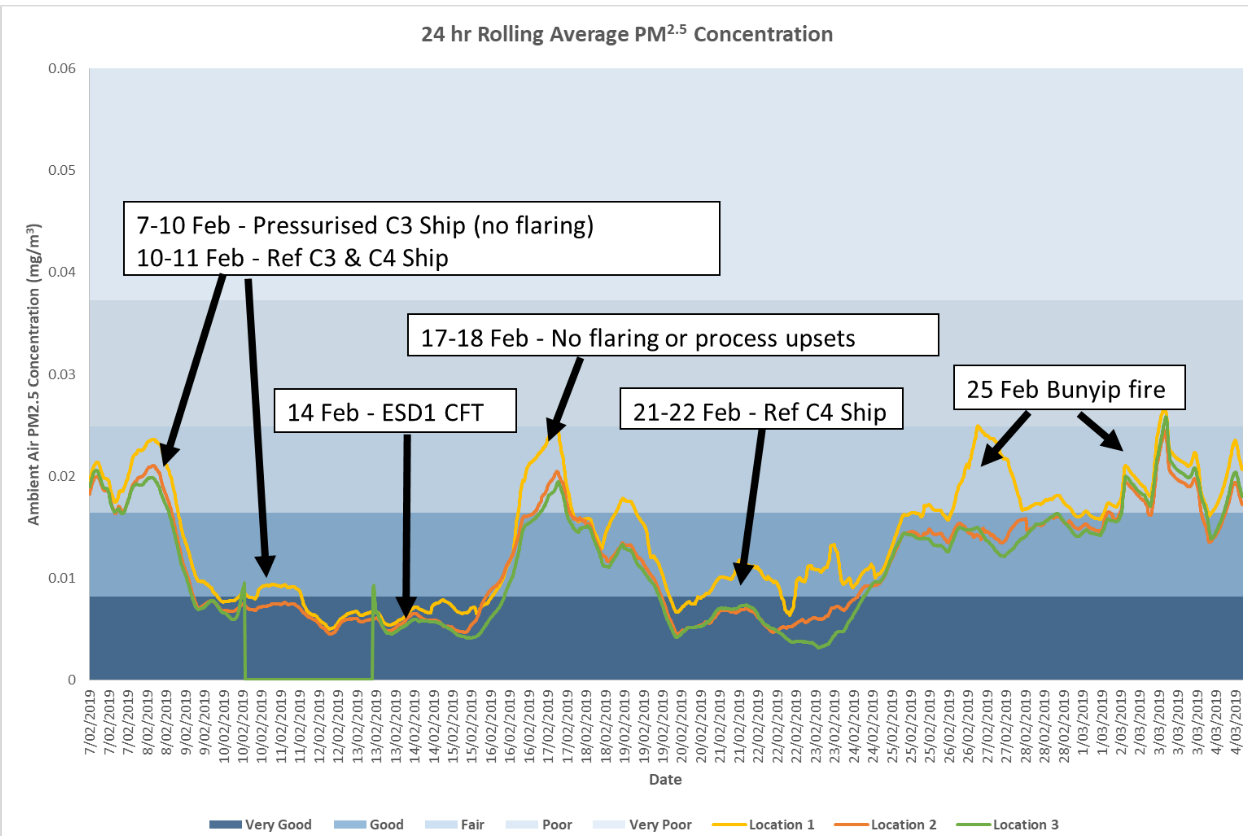

Figure 7: Results of ambient air monitoring.

Key observations from the monitoring were:

- Emissions peaks were noted to correspond to several, but not all shipping movements noted at the LIP jetty.

- It was noted that peaks corresponded to the early and later stages of the fire in the Bunyip State Forrest.
- No peak in emissions was noted during the ESD CFT when flaring did occur at the facility. During this time the wind was predominantly from the west, which would have pushed particulates past monitoring location 1.
- A period of higher ambient emissions conditions were noted around 17-18 February with no identified source at site, indicating that other activities external to LIP were likely the cause.

The results obtained through the ambient air screening do not show an identified correlation between ambient air quality and site flaring. They therefore support the previous assessment that the risk associated with ambient air quality at the site is low.