ASPECT INDUSTRIAL ESTATE

Construction Air Quality Management Plan

Prepared for:

Mirvac Projects Pty Ltd
Level 28, 200 George Street
Sydney NSW 2000

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Mirvac Projects Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.19127-R01-v1.4	25 November 2022	Sahar Bagheri	Varun Marwaha	Varun Marwaha
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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Mirvac Projects Pty Ltd (Mirvac) to prepare a Construction Air Quality Management Plan (CAQMP) for the Aspect Industrial Estate (AIE) (Development Site) located in Mamre Road, Kemps Creek, New South Wales (NSW).

The Air Quality and Odour Impact Assessment (AQIA) for construction of the AIE was finalised by SLR in October 2020 (SLR 2020), which was required under Condition B44 of Development Consent for State Significant Development 10448 (SSD 10448).

This CAQMP is prepared by a suitably qualified and experienced person (as required by the development consent – refer to **Appendix D**) for the whole AIE and generally adheres to the requirements stipulated in the overarching Construction Environmental Management Plan (CEMP).

1.1 Development Overview

The site is located within the suburb of Kemps Creek, which falls within the Penrith LGA. It is in the Mamre Road Precinct within the broader Western Sydney Employment Area (WSEA) and is currently surrounded by rural land uses.

The site is bounded by Mamre Road to the west and agricultural uses to the north, south and east. The historic land uses on the site include rural residential, grazing, dairy farming, poultry farming and horticulture. This land is identified for future employment land, as this site and the broader Mamre Road Precinct has recently been rezoned to, primarily, IN1 General Industrial under the WSEA State Environmental Planning Policy (SEPP).

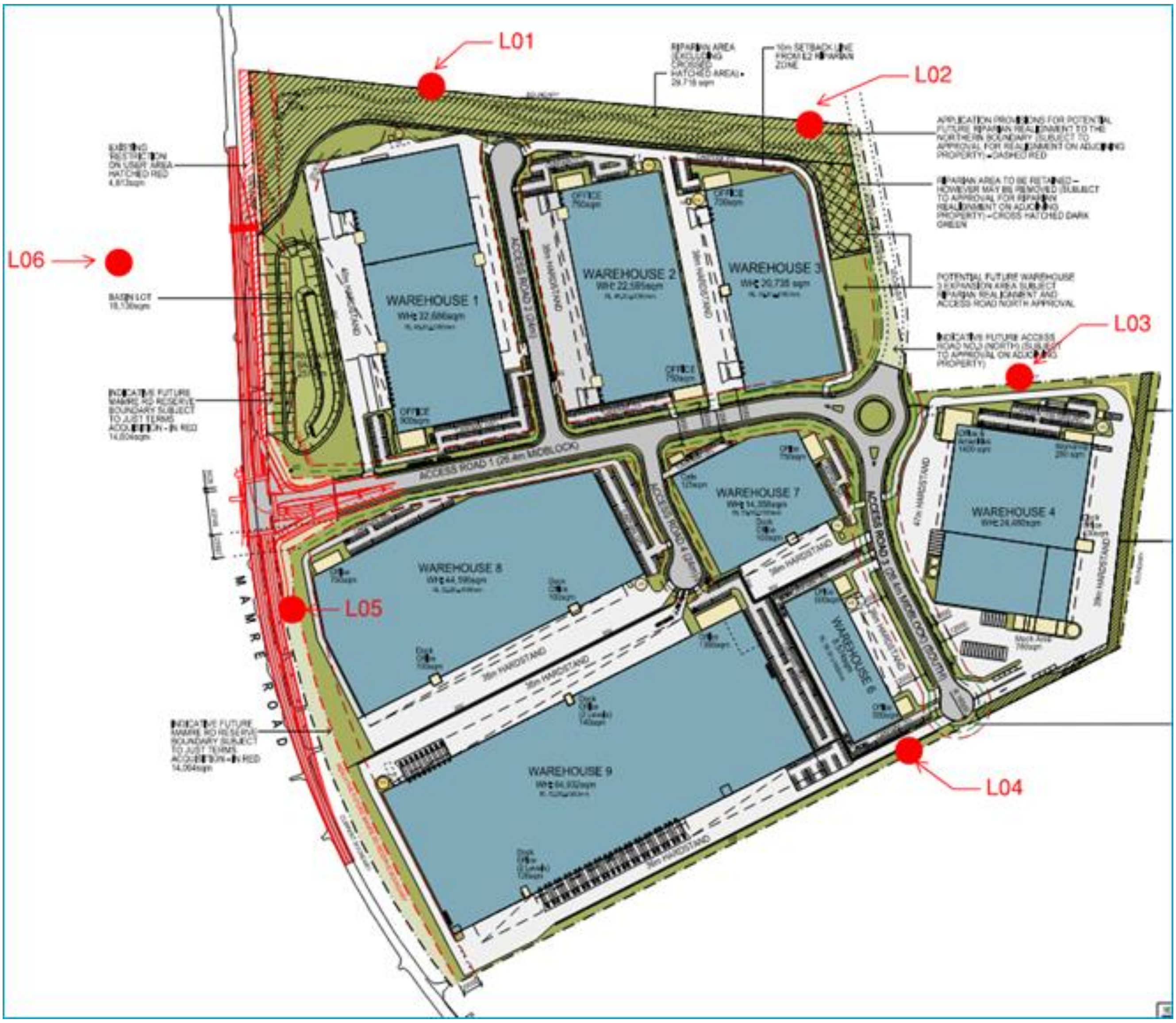
The Development Consent for the AIE was granted for the AIE 'Concept Proposal', 'Stage 1 Development' and all subsequent development stages. The Concept Proposal essentially comprises a 'Master Plan' to guide the staged development of AIE and core development controls that will form the basis for design and assessment of future development applications for the site. It includes:

- buildings, internal road network layout, building locations, gross floor area (GFA), car parking, concept landscaping, building heights, setbacks and built form parameters.
- Detailed Stage 1 Development of the AIE including:
  - Pre-commencement works including demolition and removal of existing rural structures, site remediation works as defined within the Remediation Action Plan, and heritage salvage works (if applicable).
  - Subdivision construction works including creation of roads and access infrastructure, clearing of existing vegetation, realignment of existing creek and planting, on-site bulk earthworks, construction of boundary retaining wall, delivery of stormwater infrastructure, trunk service connections, utility infrastructure, boundary stormwater management, fencing and landscaping, construction and dedication of internal road network to Penrith City Council, and construction and operation of signalised intersection with Mamre Road.
  - Building works including construction and fit out of two warehouse and distribution buildings in Stage 1 on Warehouses 1 and 3 which will operate 24 hours/day, seven days/week and construction and fit out of a café, which will operate 12 hours/day, seven days/week.
  - Subdivision of Stage 1, and Signage.

This CAQMP has been prepared to cover the construction of AIE (**Figure 1**) by Construction Contractor.

For the purposes of this document, the development is described in Environmental Impact Statement, Aspect Industrial Estate - State Significant Development Application (EIS) prepared by Urbis (2020), including all specialist assessments and other appendices.

Figure 1 Aspect Industrial Estate Masterplan



1.2 Objectives of the CAQMP

The objectives of this CAQMP are as follows:

- Maintain acceptable levels of amenity for surrounding residents during construction activities;
- Ensure compliance with relevant ambient air quality criteria for particulate matter at surrounding receptor locations;

- Maintain an effective response mechanism to deal with issues and complaints relating to dust emissions from the construction works;
- Outline roles and responsibilities in relation to the management of dust emissions during construction; and
- Promote environmental awareness among employees and subcontractors.

2 Statutory Requirements

The Development Consent (SSD 10448) requirements stipulated for the construction of AIE, and where they have been addressed in this CAQMP, are shown in **Table 1**.

Table 1 Assessment against SSD 10448 Conditions

Conditions	Response / Section Reference
Condition D54 (Dust Minimisation)	
The Applicant must take all reasonable steps to minimise dust generated during all works authorised by this consent.	**Section 8**
Condition D55 (Dust Minimisation)	
During construction, the Applicant must ensure that: (a) exposed surfaces and stockpiles are suppressed by regular watering; (b) all trucks entering or leaving the sire with loads have their loads covered; (c) trucks associated with the development do not track dirt onto the public road network; (d) public roads used by these trucks are kept clean; and (e) land stabilisation works are carried out progressively on site to minimise exposed surfaces.	**Section 8**
Condition D56 (Construction Air Quality Management Plan)	
Prior to the commencement of construction, the Applicant must prepare a Construction Air Quality Management Plan (CAQMP) to the satisfaction of the Planning Secretary. The CAQMP must form part of the CEMP required by condition E2 and must:	
(a) be prepared by a suitably qualified and experienced person(s);	**Appendix D**
(b) detail and rank all emissions from all construction activities, including particulate emissions;	**Section 7.1**
(c) describe a program that is capable of evaluating the performance of the construction and determining compliance with key performance indicators;	**Section 12**
(d) identify the control measures that will be implemented for each emission source; and	**Section 8**
(e) nominate the following for each of the proposed controls:	
(i) key performance indicator;	**Section 13**
(ii) monitoring method;	**Section 12**
(iii) location, frequency, and duration of monitoring;	**Section 12**
(iv) record keeping;	**Section 12**
(v) complaints register;	**Section 11**
(vi) response procedures; and	**Section 11**
(vii) compliance monitoring.	**Section 6 of the CEMP**
Condition D58 (Odour Management)	
The Applicant must ensure the development does not cause or permit the emission of any offensive odour (as defined in the POEO Act).	**Section 8**

Conditions	Response / Section Reference
Condition E1 (Environmental Management)	
Management plans required under this consent must be prepared in accordance with relevant guidelines, and include:	
a) detailed baseline data;	**Section 6.2**
b) details of:	
(i) the relevant statutory requirements (including any relevant approval, licence or lease conditions);	**Section 2**
(ii) any relevant limits or performance measures and criteria; and	**Section 5**
(iii) the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	**Section 10**
c) a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	**Section 9**
d) a program to monitor and report on the:	
(i) impacts and environmental performance of the development; and	**Sections 12**
(ii) effectiveness of the management measures set out pursuant to paragraph (c) above;	**Section 13**
e) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	**Section 13**
f) a program to investigate and implement ways to improve the environmental performance of the development over time;	**Section 6 of the CEMP**
g) a protocol for managing and reporting any:	
(i) incident and any non-compliance (specifically including any exceedance of the impact assessment criteria and performance criteria);	**Section 13**
(ii) complaint;	**Section 13**
(iii) failure to comply with statutory requirements; and	**Section 13**
h) a protocol for periodic review of the plan.	**Section 15**
Note: the Planning Secretary may waive some of these requirements if they are unnecessary or unwarranted for particular management plans	
Condition E8 (Revision of Strategies, Plans and Programs)	
Within three months: a) the submission of a Compliance Report under condition E14; b) the submission of an incident report under condition E10; c) the approval of any modification of the conditions of this consent; or d) the issue of a direction of the Planning Secretary under Condition C.2(b) which requires a review. the strategies, plans and programs required under this consent must be reviewed, and the Planning Secretary must be notified in writing that a review is being carried out.	**Section 6 of the CEMP**

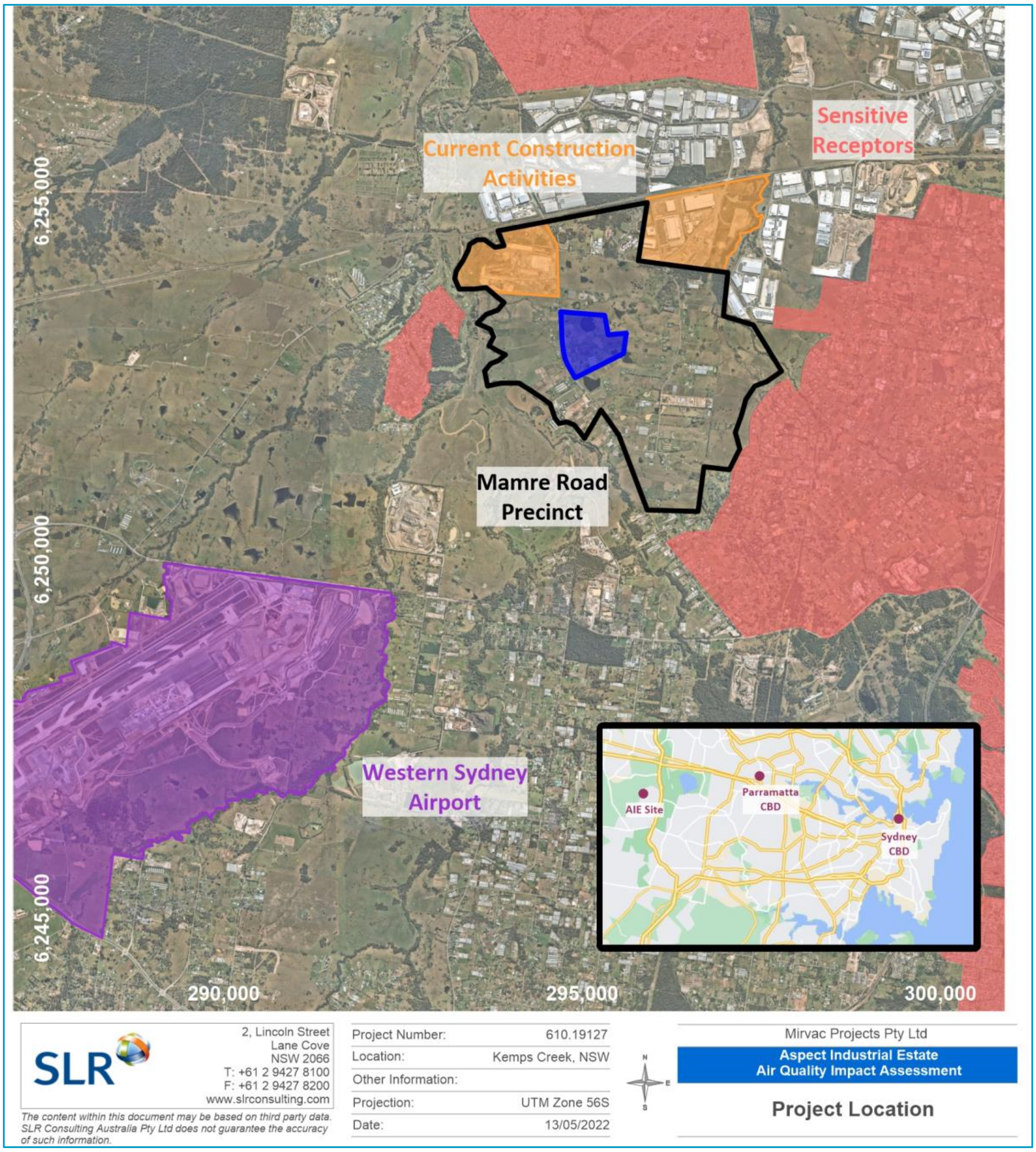
Conditions	Response / Section Reference
Condition E9 (Revision of Strategies, Plans and Programs)	
If necessary to either improve the environmental performance of the development, cater for a modification or comply with a direction, the strategies, plans and programs required under this consent must be revised, to the satisfaction of the Planning Secretary. Where revisions are required, the revised document must be submitted to the Planning Secretary for approval within six weeks of the review. *Note: This is to ensure strategies, plans and programs are updated on a regular basis and to incorporate any recommended measures to improve the environmental performance of the development.*	**Section 6 of the CEMP**
Appendix 5 (Air Quality and Odour – Construction)	
CEMP to include standard air quality control measures, contingency plans and response procedures and suitable reporting and performance monitoring procedures.	**Section 9**
CEMP to include standard odour mitigation measures for construction including keeping excavation surfaces moist, converting excavation faces and/or stockpiles, use of soil vapour extraction systems and regular monitoring of discharges as appropriate.	**Section 9**

3 Project Overview

3.1 Surrounding Land Uses

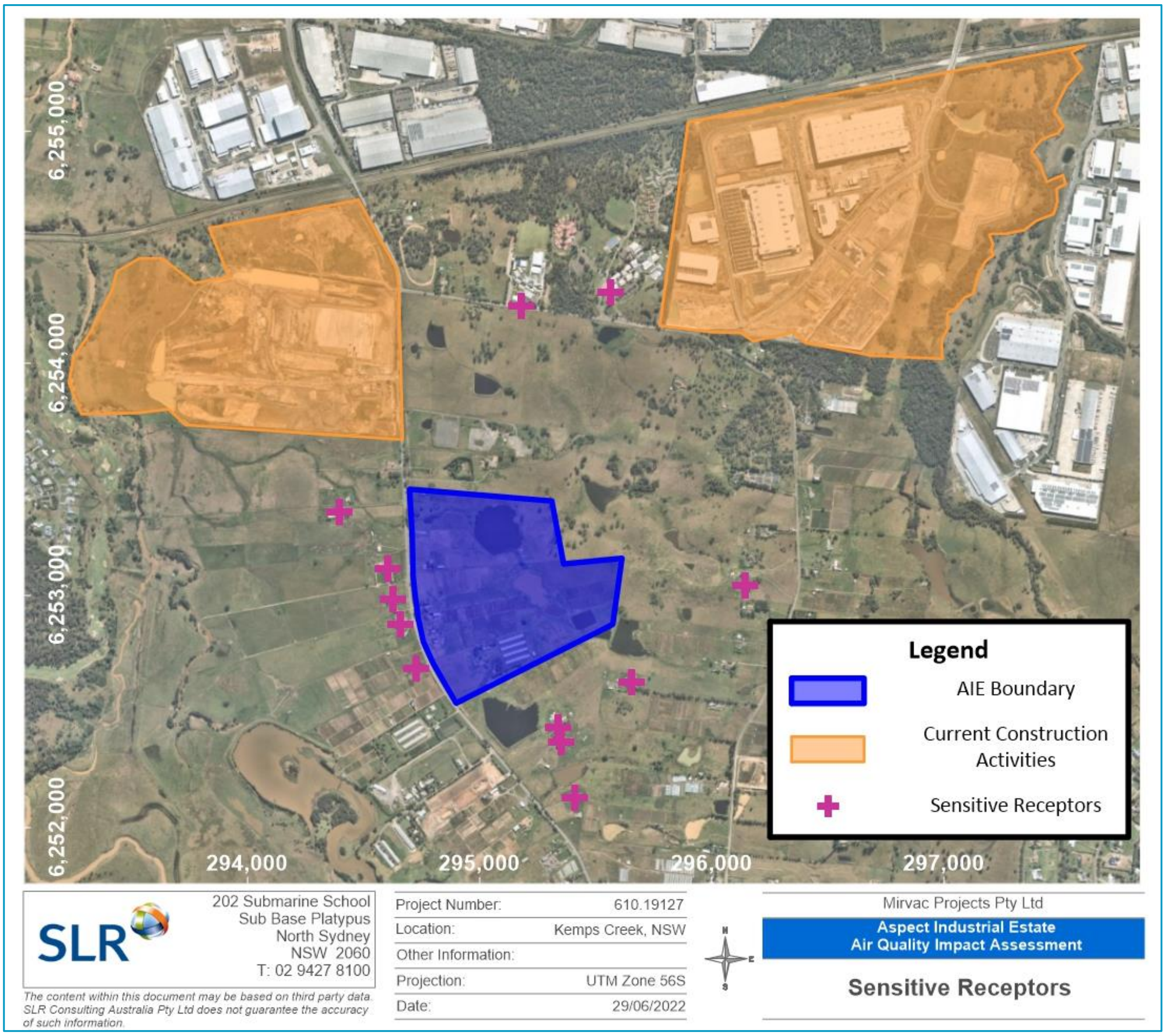
The AIE Site is located within the Mamre Road Precinct, which is a part of the wider Western Sydney Employment Area (WSEA). The regional location of the AIE Site is shown in **Figure 2**. AIE is surrounded by other rural properties with multiple existing residences located within 100 m of the nearest Site boundary. The closest sensitive receptors that have potential to be affected by air emissions during construction and operations are shown in **Figure 3**.

Figure 2 Regional Location of AIE



There are other projects in the area such as Kemps Creek Industrial Estate, Oakdale West Estate and Oakdale South Estate, which may have the potential for cumulative air quality impacts in the airshed.

Figure 3 Location of the Sensitive Receptors



3.2 Construction Activities

Based on information provided by Mirvac, construction at AIE is scheduled to commence in mid-2022 and be completed over a duration between 2-3 years, subject to authority approvals and inclement weather delays. The construction activities will be staged and are summarised in **Table 2**.

Table 2 Construction Staging and Activities

Stage	Indicative Dates	Indicative Duration	Activities
Stage 1 – BEW & Infrastructure	June 2022 – August 2022	8-12 weeks	Site establishment and Demolition works
	June 2022 – December 2023	12-18 months	Excavation activities, Road works and Utilities
	September 2022 - August 2024	24 months	General Construction works (to continue concurrently to excavation activities)

3.3 Construction Hours

Construction hours will be in accordance with Conditions D41 and D42 of Development Consent SSD 10448, which are reproduced below:

D41. The Applicant must comply with the hours detailed in Table 4, unless otherwise agreed in writing by the Planning Secretary

Table 4: Hours of Work

Activity	Day	Time
Earthworks and Construction	Monday – Friday Saturday	7 am to 6 pm 8 am to 1 pm
Operation	Monday – Sunday	24 hours

D42. Works outside of the hours identified in condition D32 may be undertaken in the following circumstances:

- *a) works that are inaudible at the nearest sensitive receivers;*
- *b) works agreed to in writing by the Planning Secretary;*
- *c) for the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or*
- *d) where it is required in an emergency to avoid the loss of lives, property or to prevent environmental harm.*

The construction hours will be provided to all staff and contractors in the induction. The movements of staff and contractors will be recorded for this project.

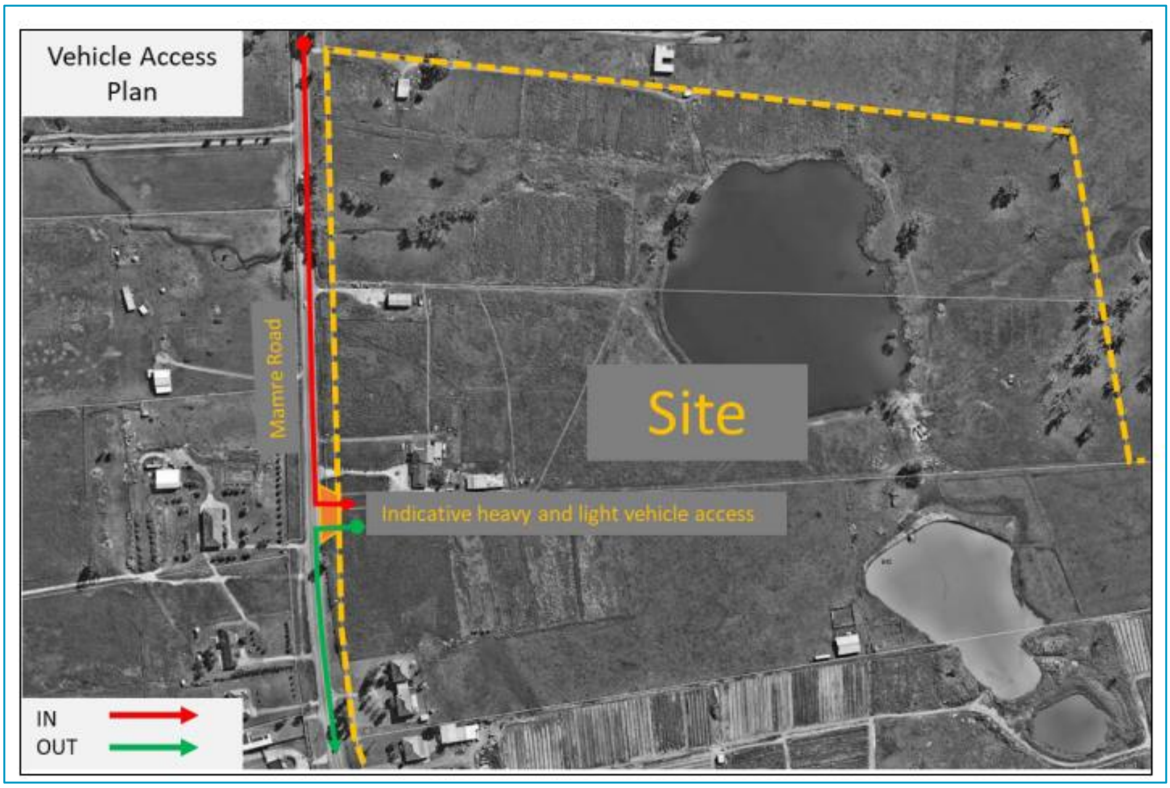
3.4 Construction Contact Details

Key contacts for the Construction Air Quality Management Plan are detailed in the CEMP.

3.5 Construction Site Access

The AIE would be accessed via a new signalised intersection with Mamre Road. The location of this signalised intersection is consistent with Transport for NSW's Mamre Road Upgrade community updates and strategic design documentation (Urbis 2020). Detail of the intersection is shown at **Figure 4**.

Figure 4 Indicative Site Access Plan



Source: Ason 2020

4 Potential Sources of Air Emissions

During the construction works, fugitive dust emissions are considered to be the primary emission type, which could give rise to nuisance and/or health impacts for the surrounding sensitive areas. The key potential sources of dust associated with construction of AIE have been identified as:

- Dust emissions from earthworks activities (e.g. excavation and loading of soils to trucks);
- Wind-generated dust from disturbed surfaces and stockpiles;
- Wheel-generated dust and particulate matter emissions in diesel exhaust emissions from on-site plant and equipment and construction traffic movements; and
- Particulate matter associated with exhaust emissions from increased/congested traffic emissions on the local road network due to road closures or diversions (if any).

In addition to the construction activities being carried out at any point in time, a number of other environmental factors may also affect the generation and dispersion of dust emissions, including:

- Wind direction - determines whether dust and suspended particles are transported in the direction of the sensitive receptors;
- Wind speed - governs the potential suspension and drift resistance of particles;
- Surface type - more erodible surface material types have an increased soil or dust erosion potential;
- Surface material moisture - increased surface material moisture reduces soil or dust erosion potential;
- Other external factors such as current works being undertaken by others outside of the defined Project boundaries and current climatic (dry) weather conditions;
- Rainfall or dew - rainfall or heavy dew that wets the surface of the soil reduces the risk of dust generation.

The Environmental Impact Statement (EIS) for the construction and operation of the whole AIE was prepared by Urbis in November 2020 (Urbis 2020). Appendix DD (Air Quality Impact Assessment) of the EIS states that the main emissions to air during the construction phase will be emissions of fugitive dust. The potential for dust to be emitted during the construction works will be directly influenced by the nature of activities being performed at any given time. Generally, the activities that are most likely to lead to short-term emissions of dust include grading, loading and unloading of materials, wheel-generated dust and combustion emissions from construction equipment, wheel-generated dust from truck travelling on unpaved surfaces and wind erosion of exposed surfaces.

The construction activities are broadly divided into four categories i.e., demolition, earthworks, construction (building) and track out. Potential air quality impacts associated with construction of AIE, and the relative risk ratings are addressed in **Section 7**.

5 Relevant Pollutants and Air Quality Criteria

5.1 Pollutants of Concern

As identified in **Section 4**, potential air pollutants of interest for the construction of AIE are:

- Products of fuel combustion (including particulates) from vehicles on existing and future roads in the area;
- Nuisance dust from construction of Kemps Creek Industrial Estate, Oakdale West and South Estates.

The following sections outline the potential health and amenity issues associated with the above pollutants of concern, while **Section 5.2** identifies the relevant air quality assessment criteria.

5.1.1 Particulate Matter

Airborne contaminants that can be inhaled directly into the lungs can be classified on the basis of their physical properties as gases, vapours or particulate matter. In common usage, the terms “dust” and “particulates” are often used interchangeably. The health effects of particulate matter are strongly influenced by the size of the airborne particles. Smaller particles can penetrate further into the respiratory tract, with the smallest particles having a greater impact on human health as they penetrate to the gas exchange areas of the lungs. Larger particles primarily cause nuisance associated with coarse particles settling on surfaces.

The term “particulate matter” refers to a category of airborne particles, typically less than 30 microns (µm) in diameter and ranging down to 0.1 µm and is termed total suspended particulate (TSP). Particulate matter with an aerodynamic diameter of 10 microns or less is referred to as PM_{10}. The PM_{10} size fraction is sufficiently small to penetrate the large airways of the lungs, while $PM_{2.5}$ (2.5 microns or less) particulates are generally small enough to be drawn in and deposited into the deepest portions of the lungs. Potential adverse health impacts associated with exposure to PM_{10} and $PM_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

5.1.2 Products of Combustion

Emissions associated with road traffic and the combustion of fossil fuels (diesel, petrol, AVGAS etc.) will include carbon monoxide (CO), oxides of nitrogen (NO_x), particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2) and volatile organic compounds (VOCs).

CO is an odourless, colourless gas formed from the incomplete burning of fuels in motor vehicles. It can be a common pollutant at the roadside and highest concentrations are found at the kerbside with concentrations decreasing rapidly with increasing distance from the road. CO in urban areas results almost entirely from vehicle emissions and its spatial distribution follows that of traffic flow. The incomplete combustion of fuel in diesel powered vehicles can generate particulate in the form of black soot.

Oxides of nitrogen (NO_X) is a general term used to describe any mixture of nitrogen oxides formed during combustion. In atmospheric chemistry, NO_X generally refers to the total concentration of nitric oxide (NO) and nitrogen dioxide (NO_2). NO is a colourless and odourless gas that does not significantly affect human health. However, in the presence of oxygen, NO can be oxidised to NO_2 which can have significant health effects including damage to the respiratory tract and increased susceptibility to respiratory infections and asthma. NO will be converted to NO_2 soon after leaving the engine exhaust.

Engine exhausts can also contain emissions of sulfur dioxide (SO_2) due to impurities in the fuel. The sulfur content in diesel fuel has significantly reduced over the years and currently ambient SO_2 concentrations in Australian cities are typically well below regulatory criteria.

5.1.3 Deposited Dust

Section 5.1.1 is concerned in large part with the health impacts of particulate matter. Nuisance dust impacts need also to be considered, mainly in relation to deposited dust. Dust can cause nuisance by settling on surfaces and possessions, affecting visibility and contaminating tank water supplies. High rates of dust deposition can also adversely affect vegetation by blanketing leaf surfaces.

5.2 Ambient Air Quality Criteria

The NSW EPA criteria have been adopted, as discussed below.

5.2.1 Particulate Matter and Products of Combustion

State air quality guidelines specified by the NSW Environmental Protection Agency (EPA) for the pollutants identified in **Section 5.1** are published in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA 2017a) (hereafter 'Approved Methods'). The ground level air quality impact assessment criteria listed in Section 7 of the Approved Methods have been established by NSW EPA to achieve appropriate environmental outcomes and to minimise associated risks to human health as published in the Approved Methods. They have been derived from a range of sources and are the defining ambient air quality criteria for NSW and are considered to be appropriate for use in this assessment.

A summary of the relevant impact assessment criteria for particulate matter is provided in **Table 3**.

Table 3 NSW EPA Criterion for Particulate Matter

Pollutant	Averaging Period	Concentration
CO	15 minutes	87 ppm
	1 hour	25 ppm
	8 hours	9 ppm
NO_2	1 hour	12 pphm
	Annual	3 pphm
PM_{10}	24 Hours	50 µg/m^3
	Annual	25 µg/m^3
$PM_{2.5}$	24 Hours	25 µg/m^3
	Annual	8 µg/m^3
SO_2	10 minutes	25 pphm
	1 hour	20 pphm
	24 hours	8 pphm
	Annual	2 pphm

Source: EPA 2017a

Furthermore, on 18 May 2021, the National Environment Protection Council (NEPC) varied the National Environment Protection (Ambient Air Quality) Measure standard for NO_2, $PM_{2.5}$, and SO_2 based on the latest scientific understanding of the health risks arising from this pollutant, as follows:

The updated values for NO_2 include:

- 1-hour average of 165 µg/m^3; and
- annual average of 31 µg/m^3.

The updated values for $PM_{2.5}$ include:

- a 24-hour maximum of 20 µg/m^3; and,
- an annual average of 7 µg/m^3.

And the updated value for SO_2 includes:

- 1-hour average of 215 µg/m^3

5.2.2 Deposited Dust

The relevant criterion for nuisance dust deposition is provided in **Table 4**. The rate of dust deposition is measured by means of a collection gauge, which catches the dust settling over a fixed surface area and over a period of about 30 days.

Table 4 NSW EPA Criterion of Nuisance Dust Deposition

Pollutant	Averaging Period	Assessment Criteria (g/m^2/month)
Deposited dust	Annual	2 (maximum increase in deposited dust level) 4 (maximum total deposited dust level)

Source: EPA 2017a

5.3 Local Government Air Quality Toolkit

The NSW EPA has developed the Local Government Air Quality Toolkit (EPA 2018), in response to requests from local Council officers for information and guidance on the common air quality issues they manage. Guidance is available under Part 3 of the Local Government Air Quality Toolkit for Construction Sites.

This document lists the common sources of emissions, and mitigation and management measures to control airborne dust levels from construction sites and has been consulted in the development of this CAQMP.

6 Existing Environment

6.1 Local Meteorology

The Bureau of Meteorology (BoM) maintains and publishes data from weather stations across Australia. The closest such station recording wind speed and wind direction data is the Horsley Park Automatic Weather Station (AWS), located approximately 5.5 km east of the AIE Site (Station ID 67119). For this assessment, it is assumed that the wind conditions recorded at the Horsley Park AWS are representative of the wind conditions experienced at the AIE Site. Full analysis of the wind roses and rainfall data can be found in **Appendix A**. The long term and short-term seasonal wind roses and long-term rainfall patterns observed at the Horsley Park AWS indicate that:

- Winds that would blow fugitive dust emissions from the demolition/construction works in AIE towards the nearest sensitive receptors located to the west and south of the proposed construction activities, occur rarely during autumn and winter and are more likely to occur during summer and spring.
- The long-term wind and rainfall patterns suggest that construction activities at the Development Site have the greatest potential to impact on surrounding sensitive receptors during the months of May (autumn), and July (winter) to September (spring).

6.2 Background Air Quality

Air quality monitoring is performed by the NSW Department of Planning, Industry and Environment (DPIE) at a number of monitoring stations across NSW. The nearest such station is located at St Marys, approximately 4.5 km northwest of the AIE Site. The St Marys AQMS was commissioned in 1992 and is located on a residential property off Mamre Road, St Marys. It is situated in the centre of the Hawkesbury Basin and is at an elevation of 29 m. The St Marys AQMS monitors the concentration levels of following air pollutants:

- Oxides of nitrogen (NO, NO_2 and NO_X); and
- Fine particles ($PM_{2.5}$ and PM_{10}); and

A summary of the monitored pollutant concentrations for the last five years (2017-2021) is presented in **Table 5** and the data are presented graphically in **Figure 5** to **Figure 7**.

Table 5 Summary of Air Quality Monitoring Data at St Marys AQMS (2017– 2021)

Pollutant	NO_2		PM_{10}		$PM_{2.5}$	
	Maximum 1-hour	Annual	Maximum 24-hour	Annual	Maximum 24-hour	Annual
	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
2017	75.9	8.7	49.8	16.2	38.2	7.0
2018	75.9	10.3	100.5	19.4	80.5	7.8
2019	67.7	8.2	159.8	24.7	88.3	9.8
2020	69.7	8.0	260.3	18.9	82.5	7.6
2021	67.7	8.2	54.9	16.2	40.3	5.8
Criterion	**246**	**62**	**50**	**25**	**25**	**8**

Figure 5 Measured 1-Hour Average NO_2 Concentrations at St Marys AQMS (2017– 2021)

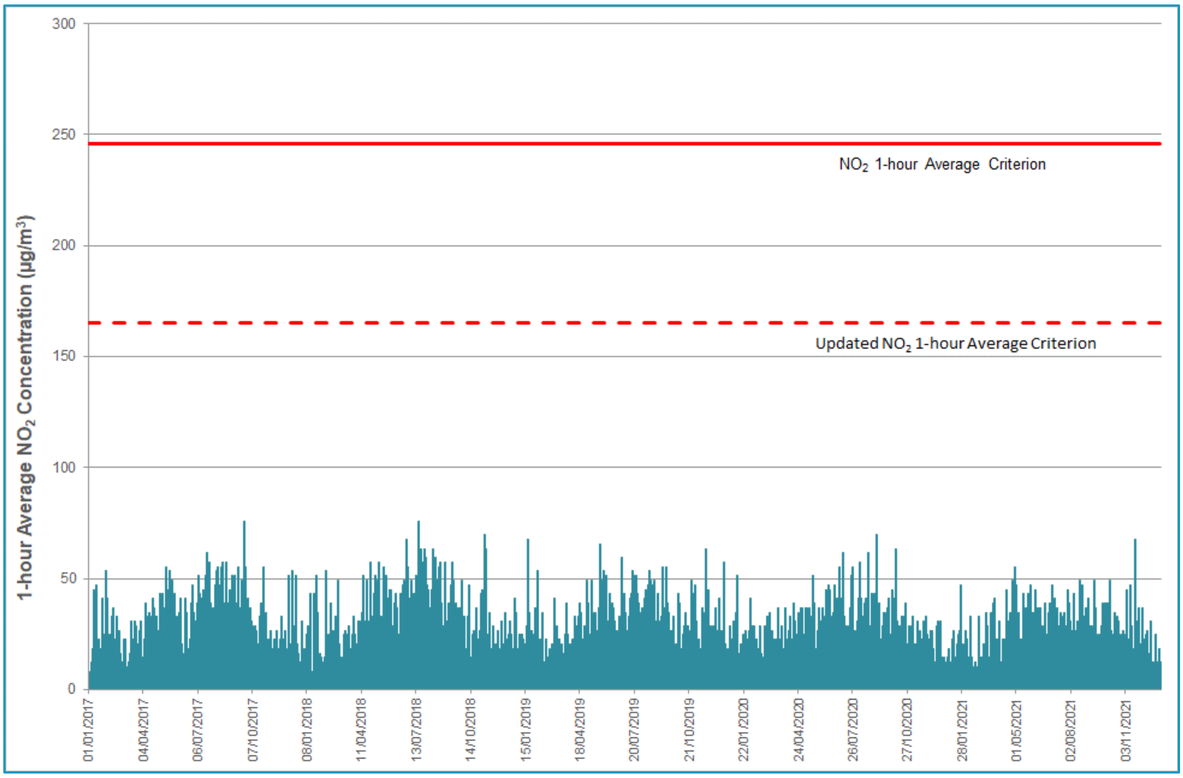


Figure 6 Measured 24-Hour Average PM_{10} Concentrations at St Marys AQMS (2017 – 2021)

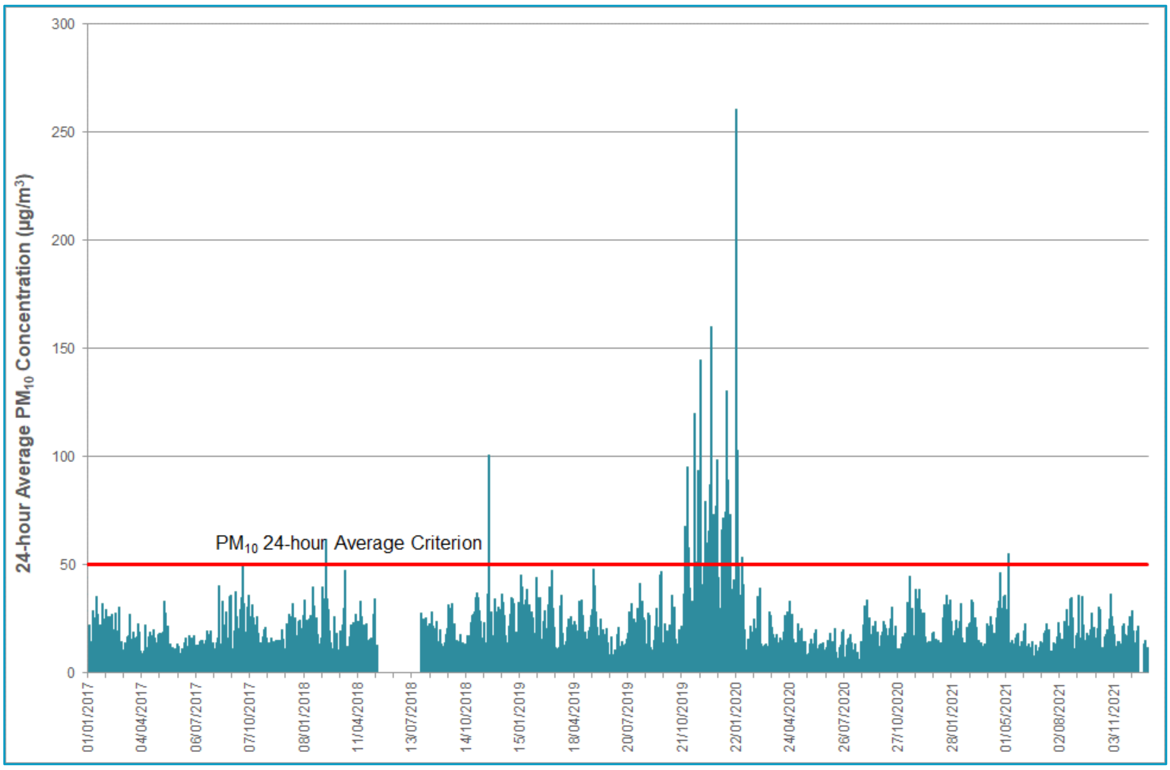
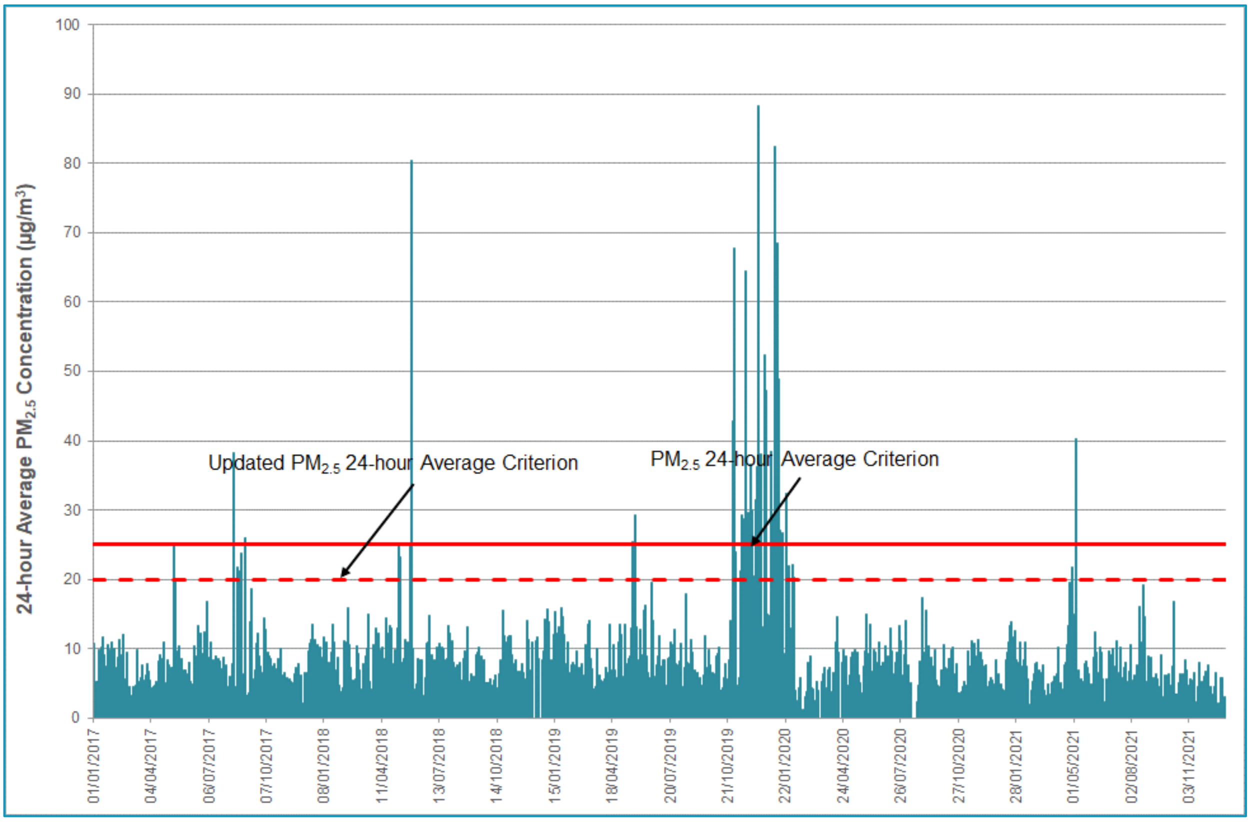


Figure 7 Measured 24-Hour Average $PM_{2.5}$ Concentrations at St Marys AQMS (2017– 2021)



The monitoring data for NO_2 indicate that the respective air quality criteria (short term and long term) for this pollutant are easily achieved at the St Marys AQMS site.

A review of the ambient air quality data presented in **Table 5**, and **Figure 5** to **Figure 7** shows that generally, the 1-hour average NO_2 and the 24-hour average PM_{10} and $PM_{2.5}$ concentrations recorded by the St Marys AQMS are below the relevant guidelines, however isolated exceedances (normally on less than ten days per year) have been recorded in most years. The exception to this was the November 2019 to January 2020 period, when unprecedented and extensive bushfires within NSW resulted in an extended period of very elevated particulate concentrations across Sydney that were significantly above the 24-hour average guidelines. A review of the available compliance monitoring reports indicates that the intermittent exceedance days recorded during the other years were also primarily due to exceptional events such as bushfire emergencies, dust storms and hazard reduction burns.

In summary, even though the air quality is generally good in the Sydney region, there is potential for short term elevations in background particulate concentrations associated with regional events such as bushfires and dust storms etc to elevate local ambient particulate concentrations at the Development Site. Care needs to be taken to minimise emissions of dust from the construction works during these periods, to avoid exacerbating these particulate pollution events.

7 Assessment of Dust Emissions During Construction

The key potential health and amenity issues associated with construction of AIE are:

- Elevated suspended particulate concentrations (PM_{10}); and
- Nuisance due to dust deposition (soiling of surfaces) and visible dust plumes that may potentially be observed to be leaving the site.

7.1 Construction Impact Assessment Methodology

Quantitatively assessing impacts of fugitive dust emissions from construction projects using predictive modelling is seldom considered appropriate, primarily due to the uncertainty in the details of the construction activities, including equipment type, number, location and scheduling, which are unlikely to be available at the time of the assessment. Furthermore, they are also likely to change as construction progresses. In comparison, the equipment and operations of a mine or quarry are determined during the planning stages and more likely to remain consistent for long periods (several months or years).

Instead, it is considered appropriate to conduct a qualitative assessment. Potential impacts of dust emissions associated with proposed demolition and construction activities at the Development Site have been performed based on the methodology outlined in the Institute of Air Quality Management (UK) (IAQM) document, "*Assessment of dust from demolition and construction*" (Holman et al 2014). This guidance document provides a structured approach for classifying construction sites according to the risk of air quality impacts, to identify relevant mitigation measures appropriate to the risk (see **Appendix B** for full methodology).

The IAQM approach has been used widely in Australia for the assessment of air quality impacts from construction projects and the identification of appropriate mitigation measures, which has been accepted by regulators across all states and territories for a variety of construction projects.

The IAQM method uses a four-step process for assessing dust impacts from construction activities:

- **Step 1**: Screening based on distance to the nearest sensitive receptor; whereby the sensitivity to dust deposition and human health impacts of the identified sensitive receptors is determined.
- **Step 2**: Assess risk of dust effects from activities based on:
  - the scale and nature of the works, which determines the potential dust emission magnitude; and
  - the sensitivity of the area surrounding dust-generating activities.
- **Step 3**: Determine site-specific mitigation for remaining activities with greater than negligible effects.
- **Step 4**: Assess significance of remaining activities after management measures have been considered.

7.2 Risk Assessment

A risk assessment was completed by SLR in 2020 (SLR 2020), that assess the air quality risks associated with the construction of the AIE site.

Table 6 presents the risk of air quality impacts from uncontrolled construction activities at the AIE derived using the risk matrix provided in **Appendix B**, based on the identified receptor sensitivity and sensitivity of the area.

Table 6 Preliminary Risk of Air Quality Impacts from Construction Activities (Uncontrolled)

Impact	Sensitivity of Area	Dust Emission Magnitude				Preliminary Risk			
		Demolition	Earthworks	Construction	Trackout	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Low	Medium	Large	Large	Large	Low Risk	Low Risk	Low Risk	Low Risk
Human Health	Low					Low Risk	Low Risk	Low Risk	Low Risk

The results indicate that there is a low risk of adverse dust soiling and human health impacts occurring at the off-site sensitive receptor locations if no mitigation measures were to be applied to control emissions during the earthworks, construction and trackout phases of the works.

Based on the dust emission magnitudes and the preliminary risk from these activities, the activities are ranked as (highest risk to lowest risk):

(a) Earthworks

(b) Construction

(c) Track out

(d) Demolition

For almost all construction activity, the IAQM Methods notes that the aim should be to prevent significant effects on receptors through the use of effective mitigation, and experience shows that this is generally possible.

8 Assessment of Odour Emissions During Construction

To assess the odour nuisance risk, a qualitative odour assessment methodology has been adopted for this assessment. The following broad risk-based approach prescribed by the Institute of Air Quality Management (Bull et al 2018) has been adopted:

- **Nature of Impact**: does the impact result in an adverse or beneficial environment?
- **Receptor Sensitivity**: how sensitive is the receiving environment to the anticipated impacts? This may be applied to the sensitivity of the environment in a regional context or specific receptor locations.
- **Magnitude**: what is the anticipated scale of the impact?

The integration of sensitivity with impact magnitude is used to derive the predicted **significance** of that change. Full details of the methodology can be found in **Appendix C**.

In regard to the odour nuisance impacts, by addressing the FIDOL (Frequency, Intensity, Duration, Offensiveness and Location) factors, the potential for odour impacts from this source at the sensitive receptors may be evaluated.

- Frequency - the surrounding sensitive receptors located to the north, east, and west of the Site (see **Section 3.1**) have a low potential to experience odour impacts since no obvious odour sources are available within the AIE Site. al southerly, westerly, and easterly winds occur less than 8% of the time, therefore there is a *low* likelihood that the surrounding receptors would experience frequent potential odour impacts from the AIE Site.
- Intensity – based on the activities within the AIE Site, the odour intensity from is expected to be negligible at the surrounding receptors. Given this, odours from the Site are likely to be of *low* intensity and generally of intermittent nature.
- Duration - Given that conducive wind directions only occur approximately 8% of the time, the potential duration of any odour impacts is concluded to be *low*.
- Offensiveness – Given the nature of the activities held at the AIE Site, the very low intensity odours that may be detectable beyond the boundary of the Site would be expected to have a *low* level of offensiveness.
- Location - the impact of location on the acceptability of odours from the Site has been accounted for by the surrounding receptors sensitivity classifications detailed above in this section (*high*).

Given the above, the potential impact of odour emissions from the AIE Site is considered to be ***negligible*** (ie Impact is predicted to cause no significant consequences) for the Development Site (see **Table 7**).

Table 7 Impact Significance – Odour from AIE Site

Potential Odour Exposure Impact	Receptor Sensitivity		
	Low	Medium	High
Very Large	Moderate adverse	Substantial adverse	Substantial adverse
Large	Slight adverse	Moderate adverse	Substantial adverse
Medium	Negligible	Slight adverse	Moderate adverse
Small	Negligible	Negligible	Slight adverse
Negligible	Negligible	Negligible	Negligible

In line with the IAQM method, it is concluded that the overall effect is **'not significant'**.

9 Mitigation Measures

Development Consent SSD 10448 requires that the Applicant must take all reasonable steps to minimise dust generated during all works authorised by this consent. The potential for dust emissions during construction of AIE and the potential impact (as discussed in **Section 4**) on surrounding sensitive receptors are anticipated to be largely controllable through a range of mitigation measures, including good site management, good housekeeping measures, appropriate vehicle maintenance and applying appropriate dust mitigation measures where required. The dust mitigation measures to be implemented during construction of AIE are detailed in **Table 8**, which are consistent with those stipulated in the CAQMP for the AIE (SLR 2020).

Table 8 Dust and Odour Mitigation Measures

	Activity
1	**Communications**
1.1	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.
1.2	Display the head or regional office contact information.
1.3	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority.
2	**Site Management**
2.1	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
2.2	Make the complaints log available to the local authority when asked.
2.3	Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.
3	**Monitoring**
3.1	Perform daily on-site and off-site inspections where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This includes regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of site boundary.
3.2	Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority, when asked.
3.3	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
3.4	Agree dust deposition, dust flux, or real-time PM_{10} continuous monitoring locations with the local authority. Where possible commence baseline monitoring at least three months before work commences on site or, if a large site, before work on a phase commences.
4	**Preparing and Maintaining the Site**
4.1	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.
4.2	Erect solid screens or barriers around dusty activities or the site boundary that is at least as high as any stockpiles on site.
4.3	Keep site fencing, barriers and scaffolding clean using wet methods.
4.4	Cover, seed or fence stockpiles to prevent wind erosion
5	**Operating Vehicle/Machinery and Sustainable Travel**
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable
5.2	Ensure all vehicles switch off engines when stationary – no idling vehicles

	Activity
5.3	Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable
6	**Operations**
6.1	Employ water carts and water sprays as required to suppress dust emissions on internal roads, stockpiles and open areas.
6.2	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate
6.3	Use enclosed chutes and conveyors and covered skips
6.4	Minimise drop heights from loading shovels and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate
7	**Waste Management**
7.1	Avoid bonfires and burning of waste materials.
7.2	Avoid storing waste material on site for extended periods of time to prevent odour generation
7.3	Store waste in enclosed containers
8	**Construction**
8.1	Avoid scabbling (roughening of concrete surfaces) if possible
8.2	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
8.3	Progressively stabilise land as construction progress to minimise exposed surfaces.
9	**Trackout**
9.1	Use water-assisted dust sweeper(s) on the access and local roads to remove, as necessary, any material tracked out of the site. The access roads will be kept clean.
9.2	Avoid dry sweeping of large areas.
9.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
9.4	Record all inspections of haul routes and any subsequent action in a site log book.
9.5	Implement a wheel washing system, with rumble grids to dislodge accumulated dust and mud from the wheels, at all the entry/exit points of the site.

10 Performance Objectives

As required by condition D56 (e), **Table 9** summarises the performance objectives identified to assess the effectiveness of the control measures shown in **Section 9**.

Table 9 Summary of Parameters to Assess the Effectiveness of Control Measures

Parameter	Visible Dust	Odours	Dust Deposition	Complaints
Key Performance Indicator	No visible dust leaving the AIE Boundary	No odours detected at the boundary of the Project Site	<4g/m^2/month	No complaints related to dust or other air quality issues
Monitoring Method	Visual inspection/observations	Field observations	Dust Deposition gauges	-
Location, frequency, and duration of monitoring	Daily onsite inspection	Daily onsite inspection	**Section 12**	-
Record keeping	In a logbook			
Response Procedures	**Section 13**			
Compliance Monitoring	-	-	**Section 12**	-

11 Complaints Handling and Response Procedure

Any complaint received in relation to the environmental performance or management of the development shall be managed and reported in accordance with **Section 3.6** of the CEMP.

12 Air Quality Monitoring Program

As discussed in **Section 7**, the risk of construction dust emissions causing nuisance impacts at off-site sensitive receptor locations is concluded to be low. It is also noted that any impacts will be temporary and managed through the implementation of appropriate mitigation measures (see **Section 8**).

A summary of the proposed on-site air quality monitoring programme at AIE is shown in **Table 10**. The ideal recommended locations of these monitors are shown in **Figure 8**.These locations will be finalised in consultation with various stakeholders, and matters such as land access for installation and monthly change over, siting in accordance with appropriate Australian Standards (including AS3580.1.1 Methods for sampling and analysis of ambient air. Guide to siting air monitoring equipment), personnel safety, equipment safety will be taken into consideration when finalising these locations.

Monitoring, including laboratory analysis and record keeping, is to be conducted in accordance with AS3580.10.1 Methods for sampling and analysis of ambient air. Determination of particulate matter—Deposited matter—Gravimetric method. All monitoring data will be documented within a log book and reported in monthly dust monitoring reports reflecting the activities recorded in the log book.

Daily observations of any identified visible dust emissions from the site (onsite and offsite on each boundary) will be made by the site supervisor, or their delegate in a logbook, including the intensity of the observations, wind speeds estimates (or observations from Horsley Park Automatic Weather Station[1]), rainfall, any known regional impacts (eg bushfires or regional dust events) and any observable triggers of dust emissions from site. High wind speed and low rainfall have a great potential for fugitive dust emissions during construction. Wind erosion of dust from exposed surfaces (ie, during the construction phase of the development) is usually initiated when wind speeds exceed the threshold friction velocity for a given surface or material, however a general rule of thumb is that wind erosion can be expected to occur above 5 m/s (USEPA 2006). Furthermore, dry periods (usually mid-winter to mid spring periods) cause elevated fugitive dust. A full analysis of the wind conditions and rainfall data can be found in **Appendix A**.

Table 10 Summary of On-Site Monitoring Programme

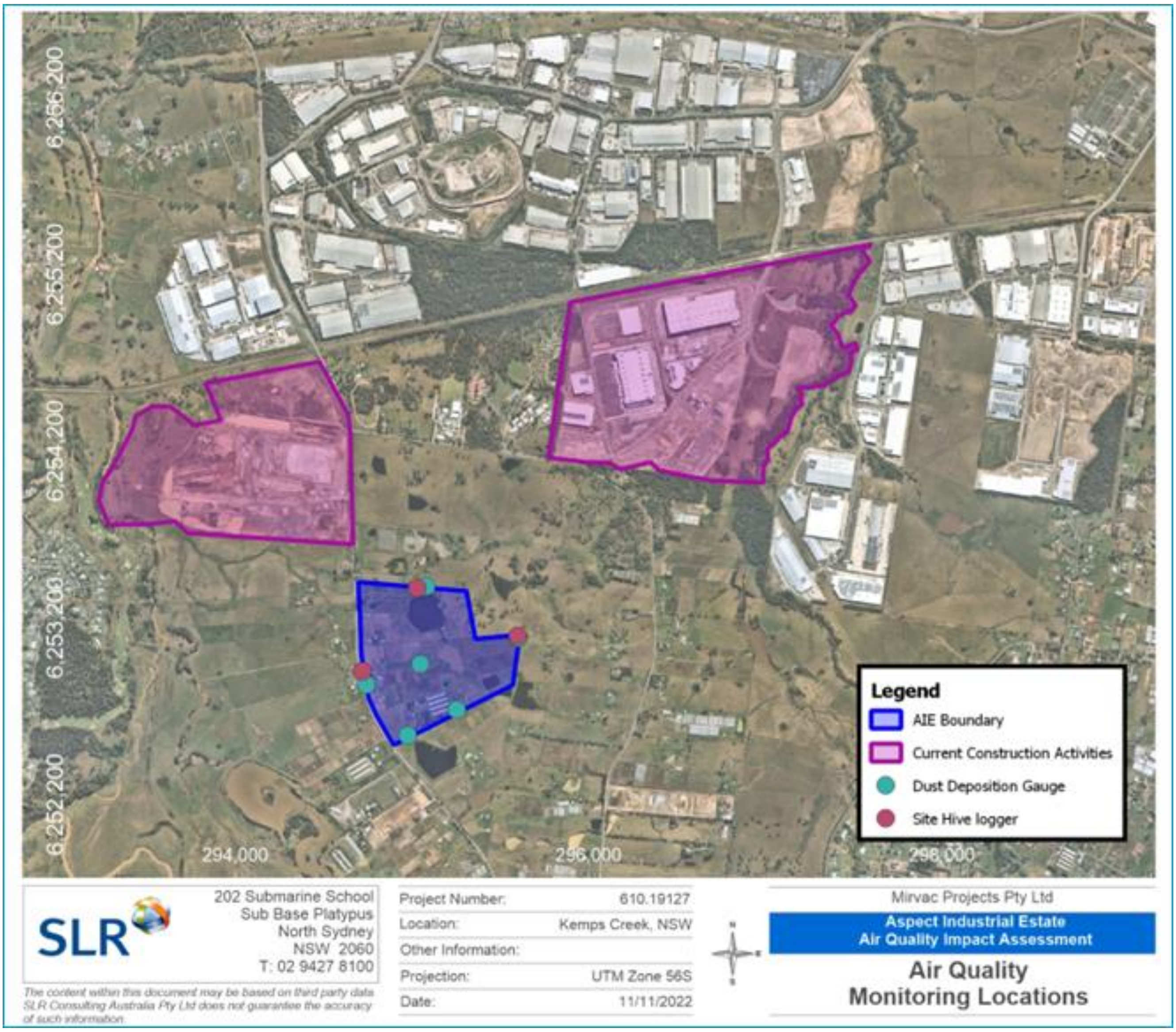
Pollutant	Equipment Used	Number of Monitoring Sites	Criterion (Averaging Period)
Deposited dust	Dust Deposition Gauges (DDGs)	5	4 g/m^2/month (annual average)
Particulate matter	Site Hive logger	3	50 $\mu g/m^3$ (24-hr average)
Visible emissions	None	Each boundary	Daily recorded observations of visible dust by the site supervisor (or delegate)

[1] http://www.bom.gov.au/climate/dwo/IDCJDW2062.latest.shtml

Pollutant	Equipment Used	Number of Monitoring Sites	Criterion (Averaging Period)
Nuisance Dust	In consultation with a suitably qualified air quality professional at the complaint location (or as near as practicable)	-	4 g/m²/month (annual average)

Note: A summary or monitoring and reporting is included in Section 5 of the CEMP for quick reference.

Figure 8 Air Quality Monitoring Locations for AIE Construction



It is noted that other construction activities may also be ongoing simultaneously with the construction of AIE (located to the northeast and northwest of the Site), that is likely to result in cumulative air quality impacts. Based on the 5-year wind roses (2017 to 2021) presented in **Appendix A**, north-easterly and north-westerly winds that carry fugitive dust from surrounding construction sites to the AIE site occur less than 8% of the time.

13 Contingency Plan

As discussed in **Section 9**, a range of standard dust controls will be used to manage and mitigate the effects of fugitive dust during construction of the AIE. Additional mitigation may also be required in the event that:

- Monitoring indicates that significant dust emissions are occurring;
- Weather conditions are changing such that dust emissions are more likely; and / or
- Complaints are received regarding dust.

If the recommended mitigation measures fail in controlling dust emissions and dust emissions may cause significant adverse effects on the surrounding receptors beyond the AIE boundary, the dust generating activities shall be stopped until sufficient mitigation can be put in place.

The air quality contingency management plan for the construction of AIE is shown in **Table 11**.

Table 11 Air Quality Contingency Management Plan for the Construction of AIE

Key Element	Trigger / Response	Condition Green	Condition Amber	Condition Red
Visible dust leaving the site	Trigger	Daily inspections show that there is no visible dust leaving the site.	Daily inspections show that there is visible dust leaving the site.	Daily inspections show that there is visible dust leaving the site multiple times during a day OR from multiple locations within the site.
	Response	Continue monitoring program as normal.	Review and investigate construction activities and respective control measures. Where appropriate, implement additional remedial measures, such as: • *Deployment of additional water sprays, water trucks etc*	Undertake an investigation of the dust generating activities, and if necessary, temporarily halt the dust generating activities

Key Element	Trigger / Response	Condition Green	Condition Amber	Condition Red
Dust deposition reading of >4g/m^2/month	Trigger	Dust deposition rates are less than 4 g/m^2/month at all the dust gauges.	Dust deposition rate greater than 4 g/m^2/month is recorded by any of the dust gauges	Dust deposition rates greater than 4 g/m^2/month are recorded by two or more dust gauges for two months in a row.
	Response	Continue monitoring program as normal.	• AIE Project Manager to analyse data to try to identify the source(s) of dust. Consideration should be given to the differences between the monitoring closer to other construction sites compared to those further away for identification of potential cumulative impacts. • Construction Contractor to review operations to reduce dust emissions from the identified key source(s). Implement any additional mitigation measures as required, such as additional watering.	• AIE Project Manager to review and investigate construction activities and respective control measures for the monitoring period. • If it is concluded that construction activities at AIE were directly responsible for the exceedance (i.e. the exceedance event was not caused due to high regional dust levels or local non-project dust source), Construction Contractor to submit an incident report to government agencies.
Intense Meteorological Conditions	Trigger	Normal Meteorological Conditions	Forecast winds greater than 5 m/s and dry conditions.	Forecast winds greater than 10 m/s and dry conditions.
	Response	Continue monitoring program as normal.	• Limit the activities that generate dust within 200 m of downwind sensitive activities. • Additional visual inspection of exposed areas and activities. • Assess the need for additional controls such as increased water application rates.	Stop activities that generate dust up to 200 m downwind of the construction activities, until wind eases.

Key Element	Trigger / Response	Condition Green	Condition Amber	Condition Red
Complaints received regarding nuisance dust	Trigger	There are no complaints received during the construction	An air-quality related complaint is received from a nearby resident	Further complaints (more than 2) are received from the same complainant after the additional mitigation measures have been implemented

	Response	Continue monitoring program as normal.	• Report the complaint to the regulator, in line with complaints handling procedure (See **Section 11**).
			• Review timing of the complaint compared to known site activities to identify if particular site activities (or lack of activity in the case of mitigation measures) are contributing to the complaints.
			• Review and investigate construction activities and increase dust suppression measures (additional watering, covering stockpiles etc), where appropriate.
				• Review monitoring data from the existing monitors to investigate the likelihood of onsite activities contributing.
				• The investigation should take into account (but not limited to) regional dust/particulate data, prevailing wind data on the day/time of complaints, onsite activities at the time of complaints and offsite activities at the time of complaints.
				• Conduct real time air quality monitoring at the complaint location (or as near as practicable) including meteorology if required. This monitoring should be conducted in consultation with a suitably qualified air quality professional.
				• Identify the following from any monitoring conducted:
				  • Monitoring method;
				  • Location, frequency and duration of monitoring;
				  • Assessment against compliance with criteria identified in **Section 5.2**;
				  • Recommendations for further mitigation.

Key Element	Trigger / Response	Condition Green	Condition Amber	Condition Red
Real-time suspended particulate matter monitoring (TSP and PM_{10})	Trigger	Running 24-hour average PM_{10} concentrations < 40 µg/m^3	• Running 24-hour average PM_{10} concentrations >40 µg/m^3 but <50 µg/m^3	• Running 24-hour average PM_{10} concentrations >50 µg/m^3
	Response	Continue monitoring program as normal.	AIE Project Manager to review and investigate construction activities and respective control measures. Where appropriate, implement additional remedial measures, such as: • Deployment of additional water sprays, water trucks etc • Relocation or modification of dust-generating sources • Record findings of investigations and actions taken to reduce dust levels • Continue to closely monitor dust levels to ensure they are decreasing • If elevated dust levels are due to regional dust event (fire, dust storm etc) – still take action to minimise dust from the Development Site to minimise cumulative impacts, but also record details of the cause of the elevated background levels.	• AIE Project Manager to review and investigate construction activities and respective control measures for the monitoring period, in an air pollution incident report. • If it is concluded that construction activities at the Development Site were directly responsible for the exceedance (ie the exceedance event was not caused due to high regional dust levels or local non-project dust source), Construction Contractor to submit an incident report to government agencies.

Note: This contingency management plan is replicated in Section 5 of the CEMP for quick reference.

14 Roles and Responsibilities

Overall roles and responsibilities relating to the project are outlined in Section 3.2 of the overarching CEMP. The key responsibilities specifically for dust management are as follows:

Contractor's Project Manager

- Ensuring appropriate resources/plant/personnel are available for the implementation of this CAQMP;
- Assessing data from inspections and providing project-wide advice to ensure consistent approach and outcomes are achieved;
- Providing necessary training for project personnel to cover air quality management;
- Reviewing and update of this CAQMP;
- Assessing and engaging (as required) additional mitigation controls to best manage the risks of elevated dust levels before commencing works each day and ensuring that the appropriate controls are implemented and effective;
- Reviewing weather forecasts daily and current observations of meteorological conditions (as recorded at Horsley Park AWS);
- Throughout the day, visually assessing the dust levels and the effectiveness of any dust controls that have been implemented, which may include engaging additional resources to reduce or mitigate the risk of dust leaving the site;
- Ceasing particular scopes of works as required in the event of excessive dust generation due to extreme weather conditions or inadequately controlled construction activities (eg high winds, surface dirt accumulation, etc.); and
- In the event that an air quality complaint is received, the procedure in Section 3.6 of the CEMP will be implemented (see **Section 11**).

Environmental Coordinator

- Undertaking dust monitoring program; and
- Review that control measures are working in accordance with the CAQMP.

All Workers on Site

- Observing any dust emission control instructions and procedures that apply to their work;
- Taking action to prevent or minimise dust emission incidents; and
- Identifying and reporting dust emission incidents.

15 Review and Improvement of the CAQMP

Reviews, investigations, and improvements to this plan shall be undertaken in accordance with **Section 6** of the CEMP.

16 References

- DEC 2006, Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales, Department of Environment and Conservation NSW, December 2006.
- DPIE 2021, NSW Air Quality Statement 2020, available online at https://www.environment.nsw.gov.au/topics/air/nsw-air-quality-statements/annual-air-quality-statement-2020, accessed 15 February 2021.
- EPA 2017, Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, Environment Protection Authority NSW, January 2017.
- EPA 2018, Local Government Air Quality Toolkit, Module 3 – Guidelines for Managing Air Pollution, Part 3 – Guidance Notes for Construction Sites, available online at https://www.epa.nsw.gov.au/your-environment/air/air-nsw-overview/local-government-air-quality-toolkit, accessed on 17 July 2018.
- OEH 2017a, NSW Annual Compliance Report 2015, National Environment Protection (Ambient Air Quality) Measure, published by Office of Environment and Heritage, OEH 2017/0211, May 2017.
- OEH 2017b, NSW Air Quality Statement 2016 – Towards Cleaner Air, published by Office of Environment and Heritage, OEH 2017/0013, January 2017.
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- SLR 2020, Aspect Industrial Estate, Air Quality Impact Assessment SSD 10448, October 2020.
- URBIS 2020, Environmental Impact Statement Aspect Industrial Estate, State Significant Development Application, prepared for: Mirvac, P0013978, November 2020.
- Ason 2020, Preliminary Construction Traffic Management Plan, Prepared for Mirvac, 1029, May 2020.
- USEPA 2006, AP42 Fifth Edition, Volume I, Chapter 13: Miscellaneous Sources, 13.2.5 – Industrial Wind Erosion, November 2006.

APPENDIX A

WIND ROSES AND RAINFALL DATA ANALYSIS

Wind Conditions

Local wind speed and direction influence the dispersion of air pollutants. Wind speed determines both the distance of downwind transport and the rate of dilution as a result of 'plume' stretching. Wind direction, and the variability in wind direction, determines the general path pollutants will follow and the extent of crosswind spreading. Surface roughness (characterised by features such as the topography of the land and the presence of buildings, structures and trees) will also influence dispersion.

The Bureau of Meteorology (BoM) maintains and publishes data from weather stations across Australia. The closest such station recording wind speed and wind direction data is the Horsley Park Automatic Weather Station (AWS), located approximately 5.5 km east of the AIE Site (Station ID 67119). For this assessment, it is assumed that the wind conditions recorded at the Horsley Park AWS are representative of the wind conditions experienced at the AIE Site.

Annual and seasonal wind roses for the years 2017 to 2021 compiled from data recorded by the Horsley Park AWS are presented in **Figure A1**. Wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points (degrees from North). The bar at the top of each wind rose diagram represents winds blowing from the north (i.e. northerly winds), and so on. he length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds. Thus, it is possible to visualise how often winds of a certain direction and strength occur over a long period, either for all hours of the day, or for particular periods during the day.

The 'Beaufort Wind Scale' (consistent with terminology used by the BoM) presented in **Table A1** was used to describe the wind speeds experienced at Aspect Industrial Area.

Table A1 Beaufort Wind Scale

Beaufort Scale #	Description	m/s	Description on land
0	Calm	0-0.5	Smoke rises vertically
1	Light air	0.5-1.5	Smoke drift indicates wind direction
2-3	Light/gentle breeze	1.5-5.3	Wind felt on face, leaves rustle, light flags extended, ordinary vanes moved by wind
4	Moderate winds	5.3-8.0	Raises dust and loose paper, small branches are moved
5	Fresh winds	8.0-10.8	Small trees in leaf begin to sway, crested wavelets form on inland waters
6	Strong winds	>10.8	Large branches in motion, whistling heard in telephone wires; umbrellas used with difficulty

Source: http://www.bom.gov.au/lam/glossary/beaufort.shtml

The annual wind roses for the years 2017 to 2021 (**Figure A1**) indicate that predominant wind directions in the area are consistently from the southwest quadrant. Very low frequencies of winds from the north-eastern quadrant were recorded across all years. The annual frequency of calm wind conditions was recorded to be approximately 19.6% for all the years between 2017 and 2021. Also, a review of the annual wind roses (**Figure A1**) indicates that:

- Winds that would blow fugitive dust emissions from the demolition/construction works towards the nearest sensitive receptors located to the south and west of the proposed construction activities occur approximately 7% of the time.

The seasonal wind roses for the years 2017 and 2021 (**Figure A1**) indicate that:

- In summer, wind speeds ranged from calm to fresh winds (between 0.5 m/s and 9.8 m/s). The majority of winds originated from eastern and south eastern quadrants, with very few winds from western directions. Calm wind conditions were recorded approximately 17.6% of the time during summer.
- In autumn, wind speeds ranged from calm to fresh winds (between 0.5 m/s and 9.1 m/s). The majority of winds originated from southwest quadrant, with very few winds from other directions. Calm wind conditions were observed to occur approximately 21.7% of the time during autumn.
- In winter, wind speeds ranged from calm to fresh winds (between 0.5 m/s and 10.1 m/s). The majority of winds originated from southwest quadrant, with very few winds from east and south directions. Calm wind conditions were observed to occur approximately 20.2% of the time during winter.
- In spring, wind speeds ranged from calm to fresh winds (between 0.5 m/s and 10.0 m/s). The frequency of winds are generally even in all directions. Calm wind conditions were observed to occur approximately 18.8% of the time during spring.

Wind erosion of dust from exposed surfaces (ie, during the construction phase of the development) is usually initiated when wind speeds exceed the threshold friction velocity for a given surface or material, however a general rule of thumb is that wind erosion can be expected to occur above 5 m/s (USEPA 2006). The frequency of wind speeds for the period of 2017-2021 is presented in **Figure A2**. The plot showed that the frequency of wind speeds exceeding 5 m/s for the period 2017-2021 at Horsley Park AWS was approximately 6%.

Figure A1 Annual Wind Roses for Horsley Park (2017 to 2021)

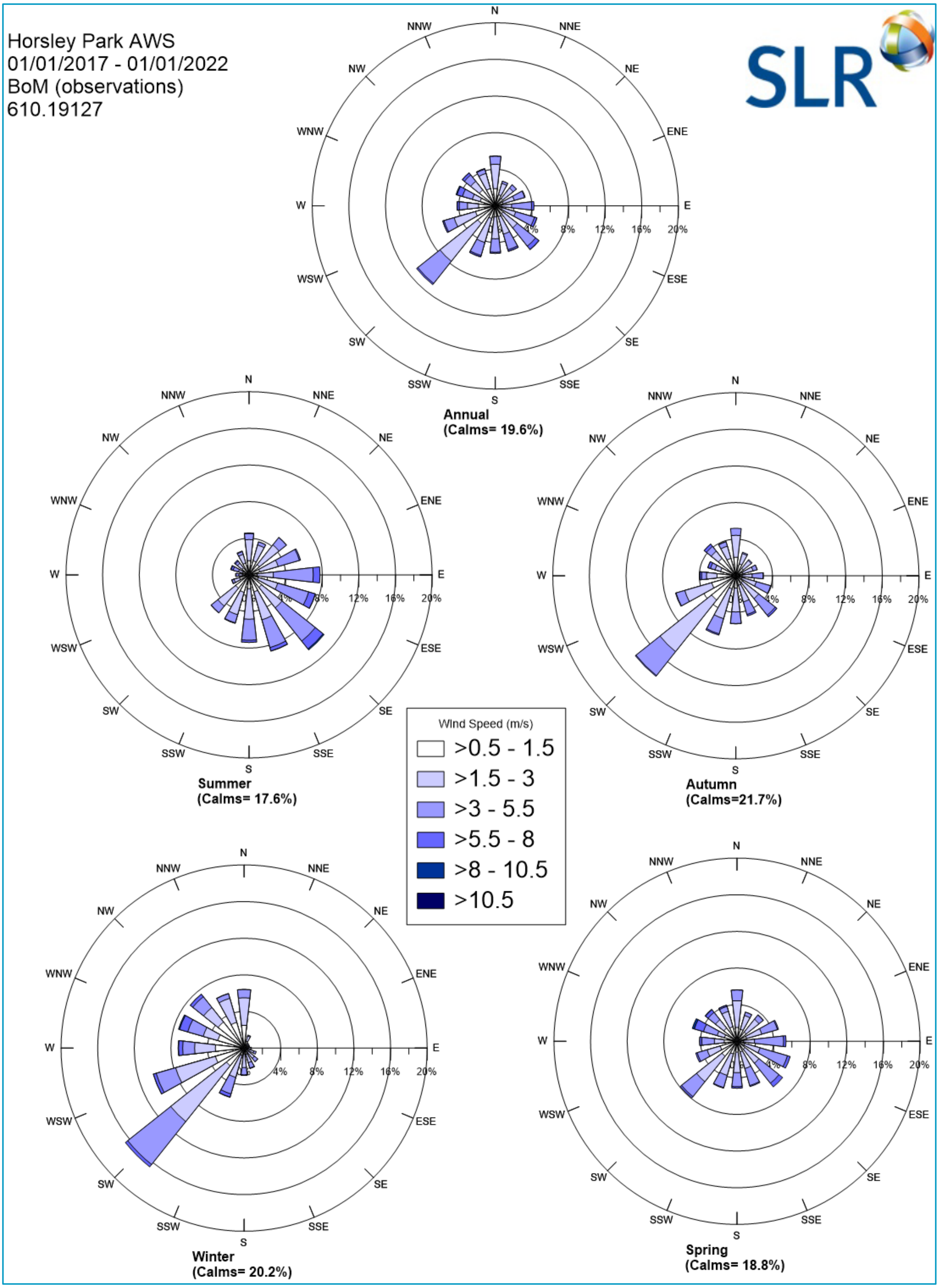
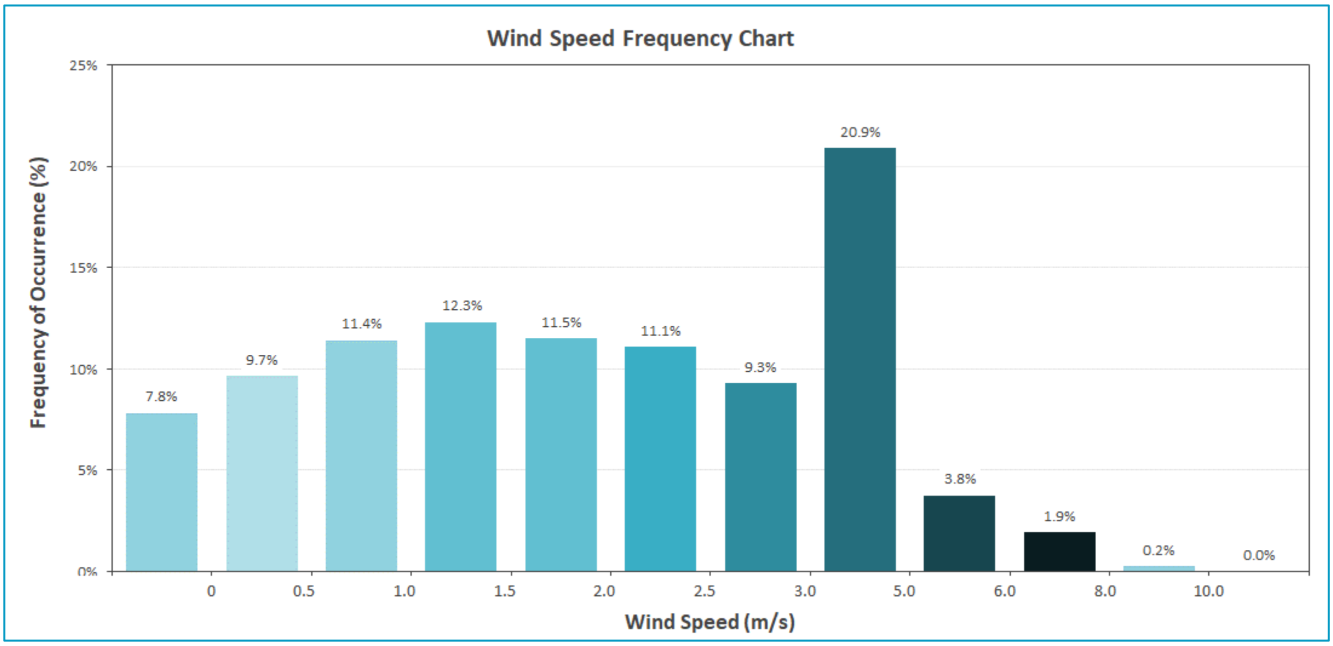


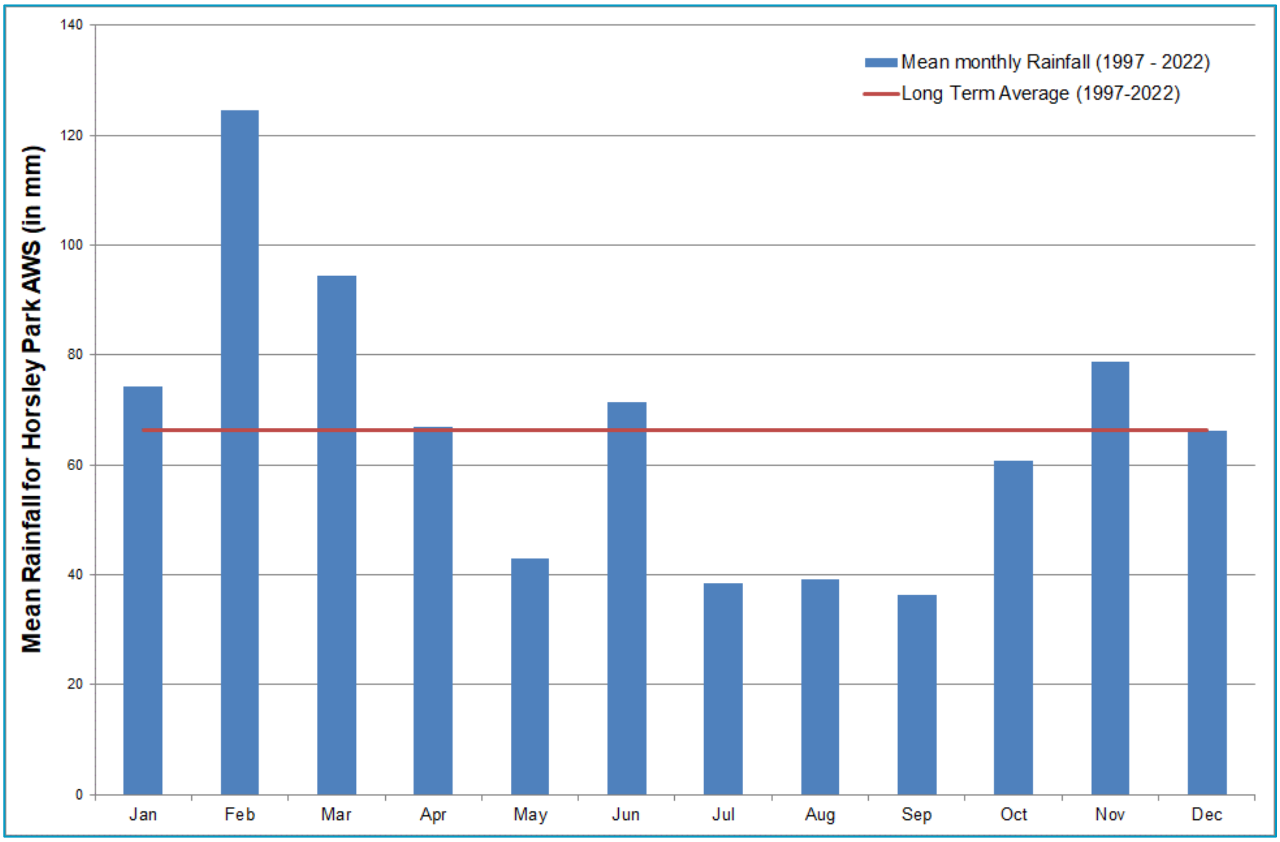
Figure A2 Wind Speed Frequency Chart for Horsley Park AWS – 2017-2021



Rainfall

Dry periods (no rainfall) have the greatest potential for fugitive dust emissions during construction. The long term monthly rainfall averages recorded at Horsley Park AWS rain gauge are shown in **Figure A4**. It is noted that generally rainfall is relatively low in mid-winter to mid spring periods. This rainfall pattern suggests that dust emissions from the demolition/construction activities at AIE site have the greatest potential to impact on receptors during May and for the period of July to September.

Figure A3 Long term Mean Rainfall for Horsley Park AWS – 1997 to 2022



APPENDIX B

CONSTRUCTION PHASE RISK ASSESSMENT METHODOLOGY

Step 1 – Screening Based on Separation Distance

As noted in **Section 3.1**, a number of sensitive receptors (residential) are located within 100 m from the nearest AIE Site boundary.

The IAQM screening criteria for further assessment is the presence of a 'human receptor' within:

- 350 m of the boundary of the site; or
- 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

As a 'human receptor' is located within 350 m of the boundary of the site, and within 500 m of the site entrance, further assessment is required. For the purpose of this assessment, the number of sensitive receptors is estimated to be between 10 and 100 within 100 m of the AIE Site boundary.

Step 2a – Assessment of Scale and Nature of the Works

Step 2a of the assessment provides "dust emissions magnitudes" for each of four dust generating activities; demolition, earthworks, construction, and track-out (the movement of site material onto public roads by vehicles). The magnitudes are: *Large*; *Medium*; or *Small*, with suggested definitions for each category. The definitions given in the IAQM guidance for earthworks, construction activities and track-out, which are most relevant to this Development, are as follows:

Demolition *(Any activity involved with the removal of an existing structure [or structures]. This may also be referred to as de-construction, specifically when a building is to be removed a small part at a time)*:

- ***Large***: Total building volume >50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level;
- ***Medium***: Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level; and
- ***Small***: Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.

Earthworks *(Covers the processes of soil-stripping, ground-levelling, excavation and landscaping)*:

- ***Large***: Total site area greater than 10,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), more than 10 heavy earth moving vehicles active at any one time, formation of bunds greater than 8 m in height, total material moved more than 100,000 t.
- ***Medium***: Total site area 2,500 m^2 to 10,000 m^2, moderately dusty soil type (e.g. silt), 5 to 10 heavy earth moving vehicles active at any one time, formation of bunds 4 m to 8 m in height, total material moved 20,000 t to 100,000 t.

- ***Small***: Total site area less than 2,500 m^2, soil type with large grain size (e.g. sand), less than five heavy earth moving vehicles active at any one time, formation of bunds less than 4 m in height, total material moved less than 20,000 t, earthworks during wetter months.

Construction *(Any activity involved with the provision of a new structure (or structures), its modification or refurbishment. A structure will include a residential dwelling, office building, retail outlet, road, etc)*:

- ***Large***: Total building volume greater than 100,000 m^3, piling, on site concrete batching; sandblasting.
- ***Medium***: Total building volume 25,000 m^3 to 100,000 m^3, potentially dusty construction material (e.g. concrete), piling, on site concrete batching.
- ***Small***: Total building volume less than 25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).

Track-out *(The transport of dust and dirt from the construction / demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network)*:

- ***Large***: More than 50 heavy vehicle movements per day, surface materials with a high potential for dust generation, greater than 100 m of unpaved road length.
- ***Medium***: Between 10 and 50 heavy vehicle movements per day, surface materials with a moderate potential for dust generation, between 50 m and 100 m of unpaved road length.
- ***Small***: Less than 10 heavy vehicle movements per day, surface materials with a low potential for dust generation, less than 50 m of unpaved road length.

In order to provide a conservative assessment of potential impacts, it has been assumed that if at least one of the parameters specified in the 'large' definition is satisfied, the works are classified as large, and so on.

Based on the above, dust emission magnitudes have been categorised as presented in **Table B1**.

Table B1 Categorisation of Dust Emission Magnitude

Activity	Dust Emission Magnitude	Basis
Demolition	Medium	**IAQM Definition:** Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level. **Relevance to this Project:** *Total volume of the buildings to be demolished within the AIE Site is estimated to be approximately 50,000 m^3.*
Earthworks	Large	**IAQM Definition:** Total site area greater than 10,000 m^2, potentially dusty soil type (eg clay, which will be prone to suspension when dry due to small particle size), more than 10 heavy earth moving vehicles active at any one time, formation of bunds greater than 8 m in height, total material moved more than 100,000 t. **Relevance to this Project:** *Total area of the AIE Site is estimated to be approximately 558,000 m^2.*
Construction	Large	**IAQM Definition:** Total building volume greater than 100,000 m^3, piling, on site concrete batching; sandblasting. **Relevance to this Project:** *Multiple warehouses buildings are proposed at the AIE Site, the total building volume is estimated to be approximately 2,745,000 m^3 (total buildings are of 274,500 m^2 and average height of 10 m).*
Trackout	Large	**IAQM Definition:** More than 50 heavy vehicle movements per day, surface materials with a high potential for dust generation, greater than 100 m of unpaved road length. **Relevance to this Project:** *It is estimated that more than 50 heavy vehicles movements per day will occur during the peak construction period.*

Step 2b – Risk Assessment

Assessment of the Sensitivity of the Area

Step 2b of the assessment process requires the sensitivity of the area to be defined. The sensitivity of the area takes into account:

- The specific sensitivities that identified sensitive receptors have to dust deposition and human health impacts;
- The proximity and number of those receptors;
- In the case of PM_{10}, the local background concentration; and
- Other site-specific factors, such as whether there are natural shelters such as trees to reduce the risk of wind-blown dust.

Individual receptors are classified as having *high*, *medium* or *low* sensitivity to dust deposition and human health impacts (ecological receptors are not addressed using this approach). The IAQM method provides guidance on the sensitivity of different receptor types to dust soiling and health effects as summarised in **Table B2**. It is noted that user expectations of amenity levels (dust soiling) is dependent on existing deposition levels.

Table B2 IAQM Guidance for Categorising Receptor Sensitivity

Value	High Sensitivity Receptor	Medium Sensitivity Receptor	Low Sensitivity Receptor
Dust soiling	Users can reasonably expect a high level of amenity; or The appearance, aesthetics or value of their property would be diminished by soiling, and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods as part of the normal pattern of use of the land.	Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or The appearance, aesthetics or value of their property could be diminished by soiling; or The people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land.	The enjoyment of amenity would not reasonably be expected; or Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land.
	Examples: Dwellings, museums, medium and long term car parks and car showrooms.	*Examples: Parks and places of work.*	*Examples: Playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.*
Health effects	Locations where the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).	Locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).	Locations where human exposure is transient.
	Examples: Residential properties, hospitals, schools and residential care homes.	*Examples: Office and shop workers, but will generally not include workers occupationally exposed to PM10.*	*Examples: Public footpaths, playing fields, parks and shopping street.*

According to the IAQM methods, the sensitivity of the identified individual receptors (as described above) is then used to assess the *sensitivity of the area* surrounding the active construction area, taking into account the proximity and number of those receptors, and the local background PM_{10} concentration (in the case of potential health impacts) and other site-specific factors. Additional factors to consider when determining the sensitivity of the area include:

- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local meteorological data which accurately represent the area and if relevant, the season during which the works will take place;
- any conclusions drawn from local topography;
- the duration of the potential impact (as a receptor may be willing to accept elevated dust levels for a known short duration, or may become more sensitive or less sensitive (acclimatised) over time for long-term impacts); and
- any known specific receptor sensitivities which go beyond the classifications given in the IAQM document.

Based on the criteria listed in **Table B2**, the sensitivity of the identified receptors in this study is concluded to be *high* for health impacts and *high* for dust soiling, as they include residential areas where people may be reasonably expected to be present continuously as part of the normal pattern of land use.

The IAQM guidance for assessing the sensitivity of an area to dust soiling is shown in **Table B3**. The sensitivity of the area should be derived for each of activity relevant to the project (ie construction and earthworks).

Table B3 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Soiling Effects

Receptor Sensitivity	Number of receptors	Distance from the source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Note: Estimate the total number of receptors within the stated distance. Only the *highest level* of area sensitivity from the table needs to be considered. For example, if there are 7 high sensitivity receptors < 20m of the source and 95 high sensitivity receptors between 20 and 50 m, then the total of number of receptors < 50 m is 102. The sensitivity of the area in this case would be high.

A modified version of the IAQM guidance for assessing the *sensitivity of an area* to health impacts is shown in **Table B4**. For high sensitivity receptors, the IAQM methods takes the existing background concentrations of PM_{10} (as an annual average) experienced in the area of interest into account and is based on the air quality objectives for PM_{10} in the UK. As these objectives differ from the ambient air quality criteria adopted for use in this assessment (i.e. an annual average of 19.1 $\mu g/m^3$ for PM_{10}) the IAQM method has been modified slightly.

This approach is consistent with the IAQM guidance, which notes that in using the tables to define the *sensitivity of an area*, professional judgement may be used to determine alternative sensitivity categories, taking into account the following factors:

- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local meteorological data which accurately represent the area, and if relevant the season during which the works will take place;
- any conclusions drawn from local topography;
- duration of the potential impact; and
- any known specific receptor sensitivities which go beyond the classifications given in this document.

Table B4 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Health Effects

Receptor sensitivity	Annual mean PM_{10} conc.	Number of receptors [a,b]	Distance from the source (m)				
			<20	<50	<100	<200	<350
High	>25 µg/m³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	21-25 µg/m³	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	17-21 µg/m³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<17 µg/m³	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>25 µg/m³	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	21-25 µg/m³	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	17-21 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<17 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Notes:

(a) Estimate the total within the stated distance (e.g. the total within 350 m and not the number between 200 and 350 m); noting that only the highest level of area sensitivity from the table needs to be considered.

(b) In the case of high sensitivity receptors with high occupancy (such as schools or hospitals) approximate the number of people likely to be present. In the case of residential dwellings, just include the number of properties.

The nearest sensitive receptor is located within 350 m from the nearest AIE boundary. Based on the classifications shown in **Table B3** and **Table B4**, the sensitivity of the area to dust soiling and to health effects may both be classified as '*low*'. This categorisation has been made considering the individual receptor sensitivities derived above, the annual mean background PM_{10} concentration of 19.1 µg/m^3 recorded at St Marys AQMS (see **Section 6.2**) and the anticipated number of sensitive receptors present in the vicinity of the AIE.

Risk Assessment

The dust emission magnitude from Step 2a and the receptor sensitivity from Step 2b are then used in the matrices shown in **Table B5** (earthworks and construction), **Table B6** (track-out) and **Table B7** (demolition) to determine the risk category with no mitigation applied.

Table B5 Risk Category from Earthworks and Construction Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table B6 Risk Category from Track-out Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Table B7 Risk Category from Demolition Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

APPENDIX C

ODOUR RISK ASSESSMENT METHODOLOGY

Nature of Impact

Predicted impacts may be described in terms of the overall effect upon the environment:

- **Beneficial**: the predicted impact will cause a beneficial effect on the receiving environment.
- **Neutral**: the predicted impact will cause neither a beneficial nor adverse effect.
- **Adverse**: the predicted impact will cause an adverse effect on the receiving environment.

Receptor Sensitivity

Sensitivity may vary with the anticipated impact or effect. A receptor may be determined to have varying sensitivity to different environmental changes, for example, a high sensitivity to changes in air quality, but low sensitivity to noise impacts. Sensitivity may also be derived from statutory designation which is designed to protect the receptor from such impacts.

Sensitivity terminology may vary depending upon the environmental effect, but generally this may be described in accordance with the following broad categories - Very high, High, Medium and Low.

Table C1 outlines the methodology used in this study to define the sensitivity of receptors to air quality impacts.

Table C1 Receptor Sensitivity to Odours

Sensitivity	Criteria
High	Surrounding land where: • users can reasonably expect enjoyment of a high level of amenity; and • people would reasonably be expected to be present here continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. Examples may include residential dwellings, hospitals, schools/education and tourist/cultural.
Medium	Surrounding land where: • users would expect to enjoy a reasonable level of amenity, but wouldn't reasonably expect to enjoy the same level of amenity as in their home; or • people wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. Examples may include places of work, commercial/retail premises and playing/recreation fields.
Low	Surrounding land where: • the enjoyment of amenity would not reasonably be expected; or • there is transient exposure, where the people would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. Examples may include industrial use, farms, footpaths and roads.

Magnitude

Magnitude describes the anticipated scale of the anticipated environmental change in terms of how that impact may cause a change to baseline conditions. Magnitude may be described quantitatively or qualitatively. Where an impact is defined by qualitative assessment, suitable justification is provided in the text.

Table C2 Magnitude of Impacts

Magnitude	Description
Very Large	Impact is predicted to cause significant consequences on the receiving environment (may be adverse or beneficial)
Large	Impact is predicted to possibly cause statutory objectives/standards to be exceeded (may be adverse)
Medium	Predicted impact may be tolerated for most of the days, but maybe intolerable for some days.
Small	Predicted impact may be tolerated.
Negligible	Impact is predicted to cause no significant consequences.

Significance

The risk-based matrix provided below illustrates how the definition of the sensitivity and magnitude interact to produce impact significance.

Table C3 Impact Significance Matrix

Potential Odour Exposure Impact	Receptor Sensitivity		
	Low	Medium	High
Very Large	Moderate adverse	Substantial adverse	Substantial adverse
Large	Slight adverse	Moderate adverse	Substantial adverse
Medium	Negligible	Slight adverse	Moderate adverse
Small	Negligible	Negligible	Slight adverse
Negligible	Negligible	Negligible	Negligible

Where the overall effect is greater than “slight adverse”, the effect is likely to be considered significant. Note that this is a binary judgement: either it is “significant”, or it is “not significant”. Concluding that an effect is significant should not mean, of itself, that a development proposal is unacceptable, and the planning application should be refused; rather, it should mean that careful consideration needs to be given to the consequences, scope for securing further mitigation, and the balance with any wider environmental, social and economic benefits that the proposal would bring.

APPENDIX D

CURRICULUM VITAE OF AUTHOR

CURRICULUM VITAE

VARUN MARWAHA

ASSOCIATE

Air Quality, Asia-Pacific

QUALIFICATIONS

BEng	2006	Bachelor of Engineering - Chemical, University of Sydney

EXPERTISE

- Air Quality Dispersion modelling using a variety of software applications
- Meteorological and Ambient air quality monitoring & assessment for legislative compliance
- Australian state and federal regulatory compliance – Air Quality
- Opportunities and constraints reporting
- Detailed knowledge of air quality/meteorological interactions

Varun is an Associate Air Quality Consultant working within the Air Quality team. He has over 10 years of environmental and process engineering experience.

Varun has acquired a broad environmental experience including air quality (including odour) impact assessments, emission inventories (including National Pollutant Inventory), air quality dispersion modelling (including Ausplume, CALPUFF and CAL3QHCR), air quality monitoring (including odour), meteorological monitoring, meteorological modelling (The Air Pollution Model [TAPM] & CALMET), greenhouse gas assessments and overall project management.

Varun has conducted numerous environmental audits and prepared NPI reports for a range of industries including power stations throughout Australia.

Varun is a Certified Air Quality Professional (CAQP) and a Certified Practicing Project Manager (CPPM), and is respected for his contribution to the air quality industry.

PROJECTS

Sentosa Gateway Project, Singapore

The project involved the assessment of air impacts due to road traffic tunnel from Sentosa Island to mainland Singapore. The project proposed to build a tunnel for the outbound traffic from Sentosa with tunnel exits located on Lower Delta Road and Keppel Road. The emissions were quantified and modelled using CAL3QHCR and CALPUFF modelling suites to predict the roadside impacts. The project also included assessment of other sources of pollutants in the region for the cumulative assessment

Sydney Harbour Bridge, Sydney, NSW, Australia

Compliance Monitoring (Lead, PM_{10} and TSP). The project involves repainting the iconic Sydney Harbour Bridge. The process includes stripping the old paint (containing lead), preparation of the surface and repainting. The monitoring was conducted for lead concentration in the air along with the concentration of particulate (PM_{10} and TSP) was required. For lead monitoring, membrane filters were used and for particulate monitoring High Volume air samplers (HVAS) were employed.

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CURRICULUM VITAE VARUN MARWAHA

Capital Metro Project, Canberra, ACT, Australia (2018-2019)	The project involved preparation of Air Quality Impact Assessment (AQIA) for the proposed ACT Light Rail Stage 1 – Gungahlin to Civic Project, a 12 kilometre light rail service linking the fast- developing area of Gungahlin in the north, to the City. The emissions due to the operation of light rail network were quantified and compared to the existing regional air emissions levels. It was demonstrated that the regional emissions were likely to decrease significantly when compared with the current situation.
Proposed Residential Development, RMS	Road Traffic Impact Assessment. The project involved assessment of roadside impacts on the proposed residential development due to road traffic on a busy motorway. The aim of the project was to determine the maximum impacts and validating against the monitored roadside data. The emissions were quantified and modelled using CAL3QHCR modelling suite to predict the roadside impacts. The project also included assessment of other sources of pollutants in the region for the cumulative assessment. The modelling skills were put to test when integrating predicted results from several modelling suites (CAL3QHCR and CALPUFF)
Proposed Haul Roads (Fortescue Metals Group), WA, Australia	The project involved assessment of two possible options for building haul roads in separate directions. The aim of the project was to determine mine access route from the nearest transport facility. The emissions were quantified and modelled using CALPUFF modelling suite to predict the roadside impacts on the nearest receptors on each haul road route.
Confidential Highway Project, QLD, Australia	Emissions estimation and modelling for an air quality impact assessment for a proposed new highway in Queensland. Work included the estimation of vehicle emissions for the operational phase using the COPERT-Australia emissions modelling software and dispersion modelling of the road and tunnel emissions using CAL3QHCR and CALPUFF dispersion models.
MEMBERSHIPS	Clean Air Society of Australia and New Zealand (CASANZ)
	Member of Engineers Australia (EA)
	Institute of Chemical Engineers (IChemE)
ACCREDITATION	Certified Air Quality Professional (CAQP), CASANZ
	Certified Practicing Project Manager (CPPM), UNE
TRAINING	Advanced CALPUFF Course – Clean Air Society of Australia and New Zealand (CASANZ), 2008
	The Role of Meteorology in Dispersion Modelling – CASANZ, 2011
	Diploma of Project Management – University of New England, 2012

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