Elizabeth Enterprise Precinct - Stage 1

Air Quality Impact Assessment

Mirvac Projects Pty Ltd

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R1-v1.0	4 March 2025	F Jafarigol	V Marwaha	V Marwaha

Basis of Report

This report has been prepared by SLR Consulting Australia (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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1.0 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Mirvac Projects Pty Ltd (Mirvac) to prepare an Air Quality Impact Assessment (AQIA) to accompany an Environment Impact Statement (EIS) for the proposed construction of Stage 1 of the Elizabeth Enterprise Project (EEP) (SSD-19618251).

The Site is a proposed warehousing and distribution development to be located at 1669-1723 Elizabeth Drive, Kemps Creek (the Site).

SLR delivered an AQIA report (610.30481-R01-v1.6-20241220) on 20 December 2024 (the Original AQIA). In the original AQIA (2024), the construction impacts were assessed using qualitative risk based approach. Following a review of the original AQIA, DPHI requested that a quantitative construction assessment be prepared in accordance with the Approved Methods.

On 26 August 2024, the NSW Department of Planning, Housing and Infrastructure (DPHI) also issued amended Secretary's Environmental Assessment Requirements (SEARs). Although there were no changes to the air quality related SEARs, they requested:

> *"including an assessment of air quality impact at sensitive receivers during construction and operation in accordance with NSW Environment Protection Authority guidelines and details of mitigation, management and monitoring measures"*

This report assesses the air quality impacts of construction activities related to SSD-19618251 (the Project). It presents the methodology and findings of a quantitative (modelling) assessment of construction stage air emissions, details the mitigation measures proposed to be adopted during the construction stage and recommends air quality monitoring and additional management measures to reduce likelihood of exceedances of air quality criteria at surrounding receptors.

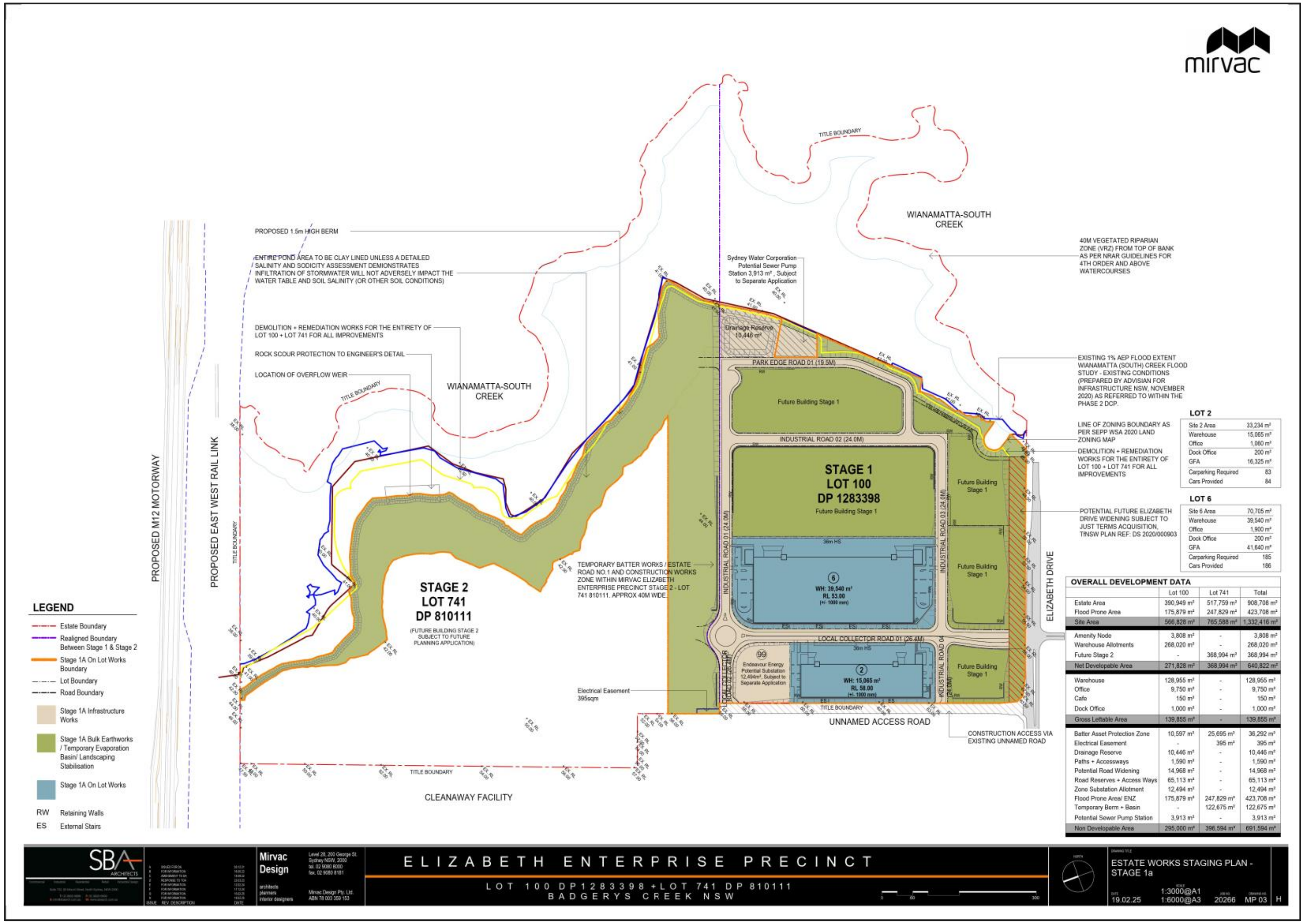
2.0 Project Overview

2.1 Site Location

The Site is located at 1669-1723 Elizabeth Drive, Kemps Creek. The Site location is shown in **Figure 1**. The proposed site layout is shown in **Figure 2**. Elizabeth Enterprise Precinct Stage 1 (the site) is legally described as Lot 100 DP 1283398 and Lot 741 DP 810111, located within the Penrith Local Government Area (LGA) at 1669-1723 Elizabeth Drive, Badgerys Creek.

Figure 1 Site Location

Figure 2 Site Layout



2.2 Potential Sources of Emissions to Air

The main air quality impacts associated with construction stage impacts relate to emissions of fugitive dust during bulk earthworks. The potential for dust to be emitted during bulk earthworks 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:

- Onsite material handling and processing
- Wheel generated dust from onsite vehicle movements
- Wind erosion from exposed areas.

Temporary elevations in local dust levels are most likely to occur when bulk earthworks are undertaken during periods of low rainfall and/or windy conditions. The impact of elevated dust emissions is dependent upon the potential for particulates to become and remain airborne prior to being deposited as dust or experienced as an ambient particulate concentration.

A number of environmental factors may 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 - determines 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.
- Rainfall or dew - rainfall or heavy dew that wets the surface of the soil reduces the risk of dust generation.

2.3 Pollutants of Interest

SLR Consulting has conducted a large number of assessments for construction across Australia. The results of these assessments have indicated that the key pollutants for determining compliance with relevant air quality criteria from these types of operations are suspended particulate matter (TSP, PM_{10} and $PM_{2.5}$) and dust deposition.

While emissions of pollutants associated with the combustion of diesel fuel, including nitrogen oxides (NO_x), sulphur dioxide (SO_2), carbon monoxide (CO) and Volatile Organic Compounds (VOC_s), will be generated by the proposed construction activities for the Project, these emissions are unlikely to compromise air quality goals at the closest receptors, given the nature and scale of the operation. They have therefore not been considered further.

Suspended 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.

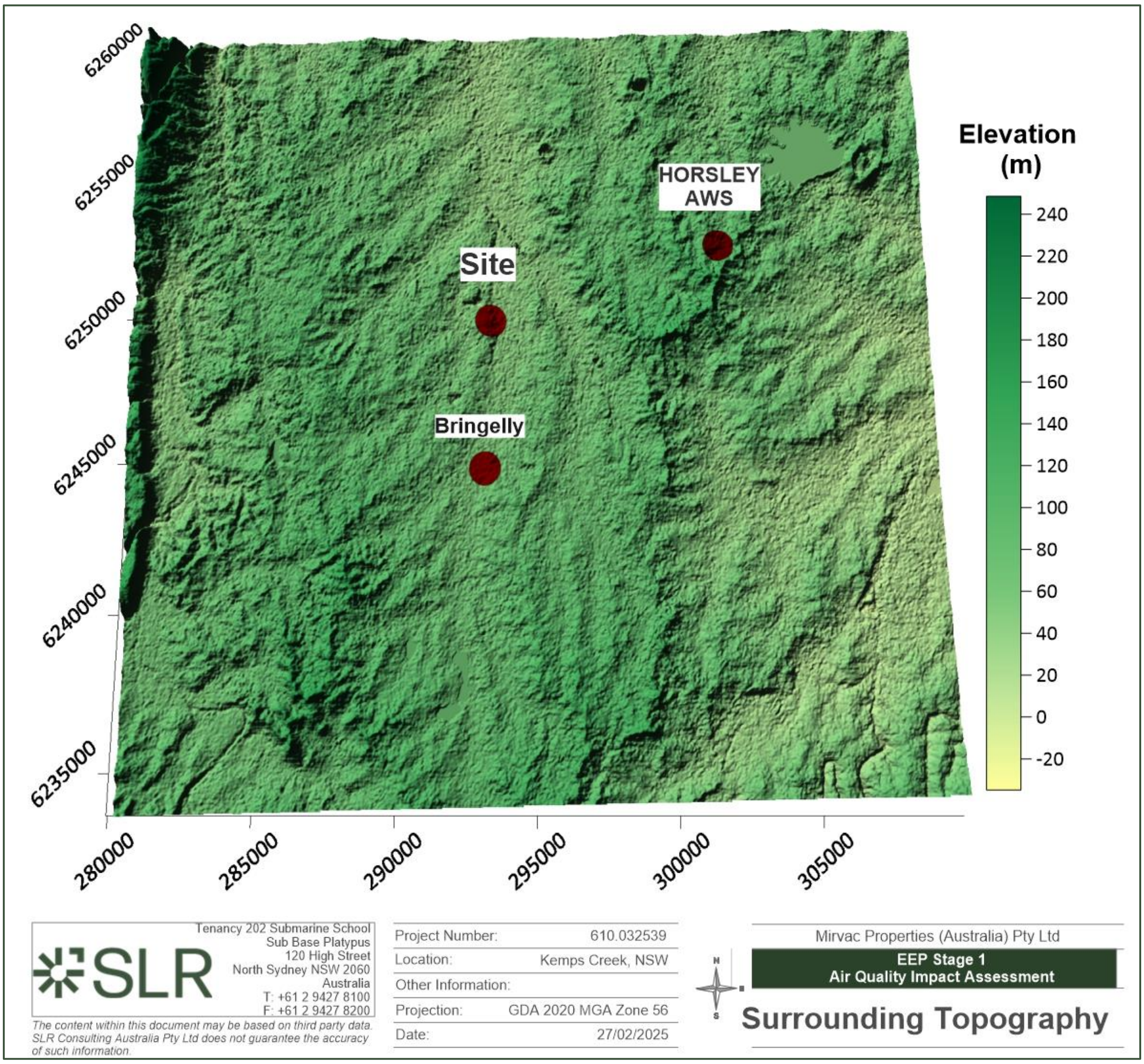
3.0 Existing Air Environment

3.1 Surrounding Topography

Local topography is important in air quality studies as local atmospheric dispersion can be influenced by night-time katabatic (downhill) drainage flows from elevated terrain or channelling effects in valleys or gullies.

The topography of the Site and near surrounds is relatively flat, with an elevation of the approximately 45 m Australian Height Datum (AHD). A pseudo-three-dimensional representation of the region surrounding the Site is presented in **Figure 3**. The locations of Horsley automatic weather station (AWS) and Bringelly air quality monitoring station (AQMS) are also indicated.

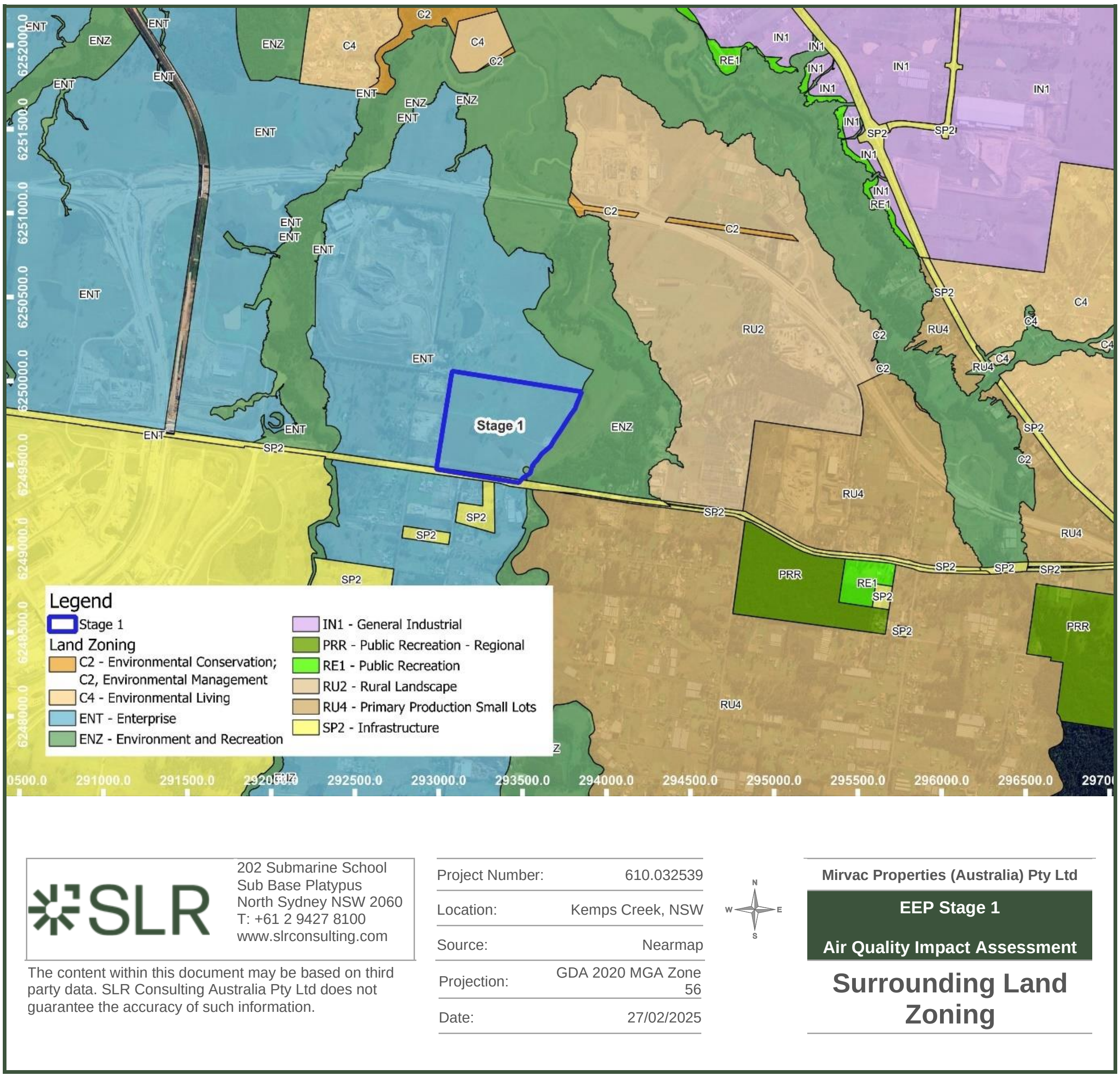
Figure 3 Regional Topography



3.2 Surrounding Land Uses

As shown in **Figure 4**, The "Stage 1" area is zoned as C2 - Environmental Management. It is surrounded by Enterprise (ENT), Infrastructure (SP2), and Rural Landscape (RU2) zones, suggesting a mix of industrial, infrastructure, and conservation land uses. Given its proximity to enterprise and infrastructure areas, there may be potential for limited development, but environmental regulations could impose constraints.

Figure 4 Surrounding Land Zoning



3.3 Sensitive Receptors

There are several residential and commercial receptors located in all directions from the Site, with the closest sensitive receptor is located approximately 30 m to the south. **Table 1** outlines the location of the sensitive receptors included in the assessment and their approximate distance to the nearest Site boundary.

Figure 5 Surrounding Receptors

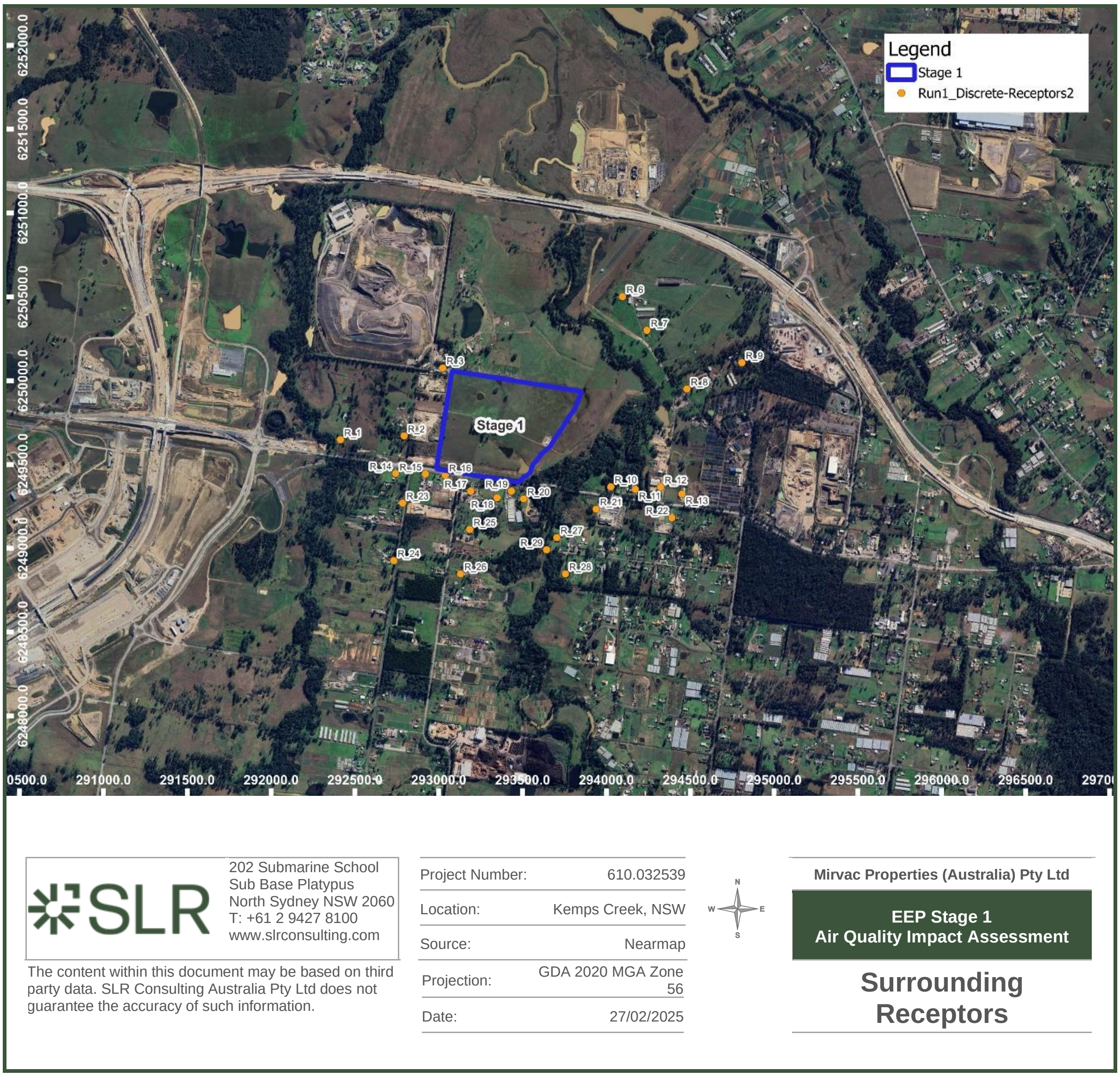


Table 1 Sensitive Receptor Locations

Map ID	Easting (m)	Northing (m)	Base Elevation (m)	Approximate Distance from Closest Site Boundary (m)
R1	292,414	6,249,648	51	580
R2	292,793	6,249,670	63	220
R3	293,024	6,250,075	58	60
R6	294,096	6,250,501	42	640
R7	294,241	6,250,300	43	530
R8	294,480	6,249,950	46	620
R9	294,808	6,250,107	57	970
R10	294,026	6,249,366	42	430
R11	294,172	6,249,352	46	570
R12	294,323	6,249,365	41	720
R13	294,450	6,249,324	41	820
R14	292,743	6,249,446	64	240
R15	292,920	6,249,443	63	70
R16	293,039	6,249,436	61	30
R17	293,190	6,249,341	62	100
R18	293,348	6,249,301	56	110
R19	293,434	6,249,341	50	60
R20	293,506	6,249,295	46	110
R21	293,938	6,249,233	43	460
R22	294,390	6,249,182	45	870
R23	292,784	6,249,269	64	290
R24	292,731	6,248,926	53	620
R25	293,185	6,249,112	63	320
R26	293,130	6,248,847	63	590
R27	293,704	6,249,063	45	390
R28	293,756	6,248,847	47	680
R29	293,643	6,248,991	45	450

3.4 Local Meteorology

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) affects the degree of mechanical turbulence, which also influences the rate of dispersion of air pollutants.

The Bureau of Meteorology (BoM) maintains and publishes data from weather stations across Australia. The closest such station to the Site is Horsley Park Equestrian Centre Automatic Weather Station (AWS) (Station no. 67119), which is located approximately 5 km to the east of the Site. Considering the distance, terrain and land cover between the Site and Horsley Park Equestrian Centre AWS, wind conditions at the AWS are likely to be a reasonable representation of those at the Site.

The Horsley Park Equestrian Centre AWS was commissioned in 1997, sits at an elevation of 100 m and has data available for the following parameters:

- wind speed (m/s) and wind direction (degrees)
- temperature (°C)
- rainfall (mm)
- relative humidity (%).

A review of the long-term climate data collected at this station is provided in the following sections.

3.4.1 Rainfall

Rainfall statistics for Horsley Park Equestrian Centre AWS are summarised in **Figure 6**. The average monthly rainfall is distributed evenly throughout the year. The lowest mean monthly rainfall of 37.6 mm/month was recorded during September. The highest average monthly rainfall of 122.3 mm/month occurred in February. The maximum mean number of rain days occurs in December, with an average of 12.2 rain days recorded in this month. Maximum rainfall of 461.8 mm and minimum rainfall of 0 mm have been recorded.

3.4.2 Relative Humidity

Available humidity statistics (9 am and 3 pm monthly averages) for Horsley Park Equestrian Centre AWS are summarised in **Figure 7**. Morning humidity levels range from an average of around 61% in mid spring to around 81% in early autumn. Afternoon humidity levels are lower at around 42% in early spring, and around 55% in mid-winter.

3.4.3 Temperature

Available temperature statistics for Horsley Park Equestrian Centre AWS are summarised in **Figure 8**. Mean maximum temperatures range from 17.6°C in winter to 29.9°C in summer, while mean minimum temperatures range from 5.9°C in winter to around 18.0°C in summer. Maximum temperatures of 47°C and minimum temperatures of -2.3°C have been recorded.

Figure 6 Monthly Rainfall Data for Horsley Park Equestrian Centre AWS

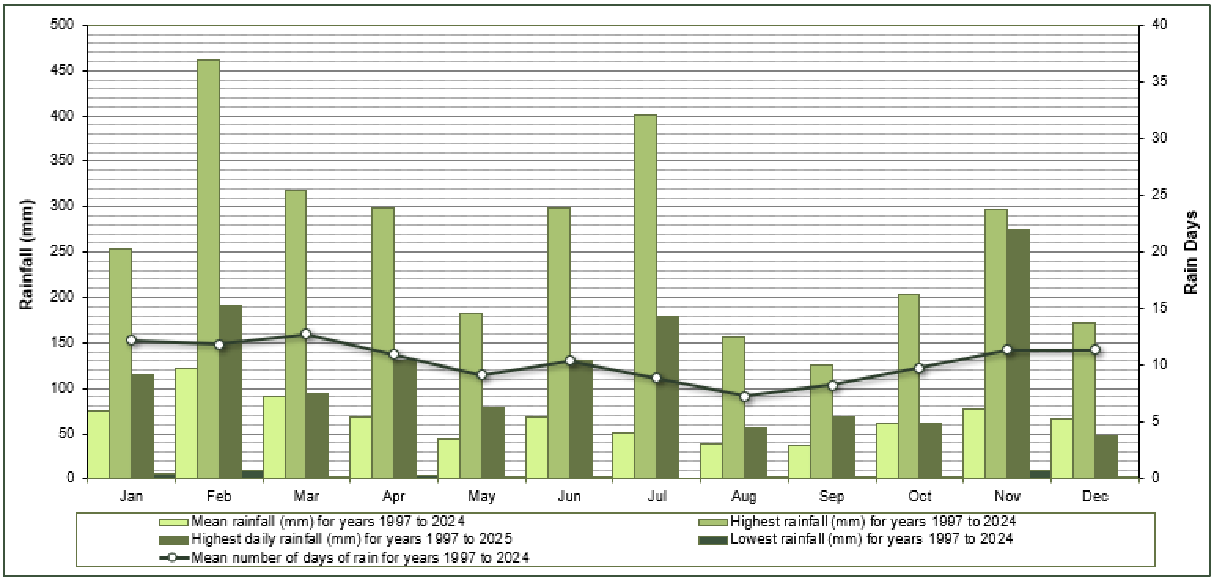


Figure 7 Humidity Data for Horsley Park Equestrian Centre AWS

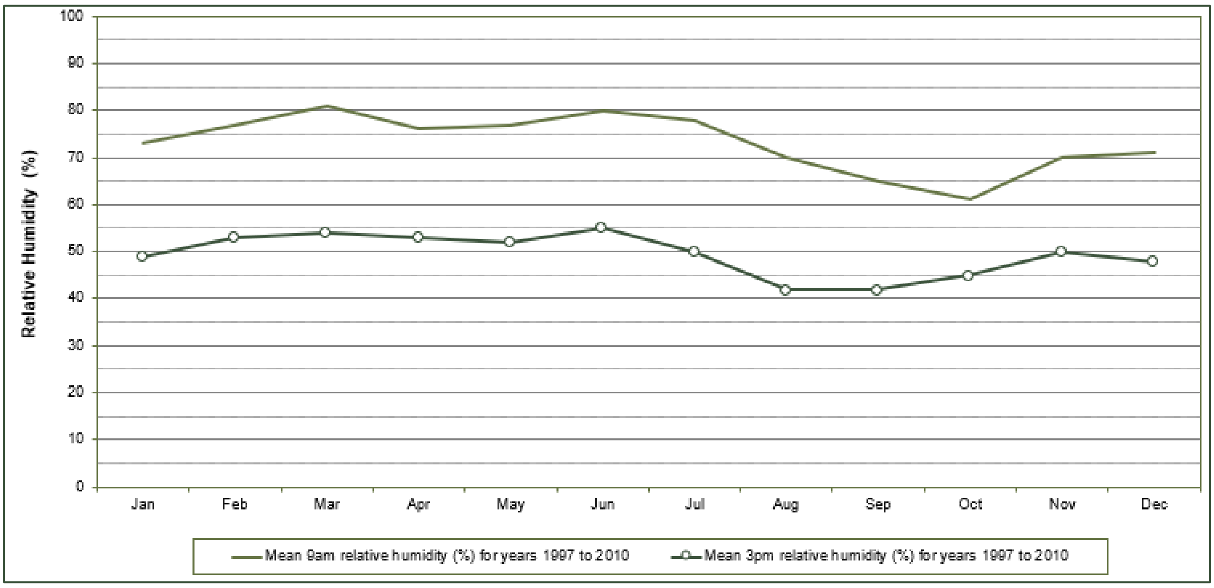
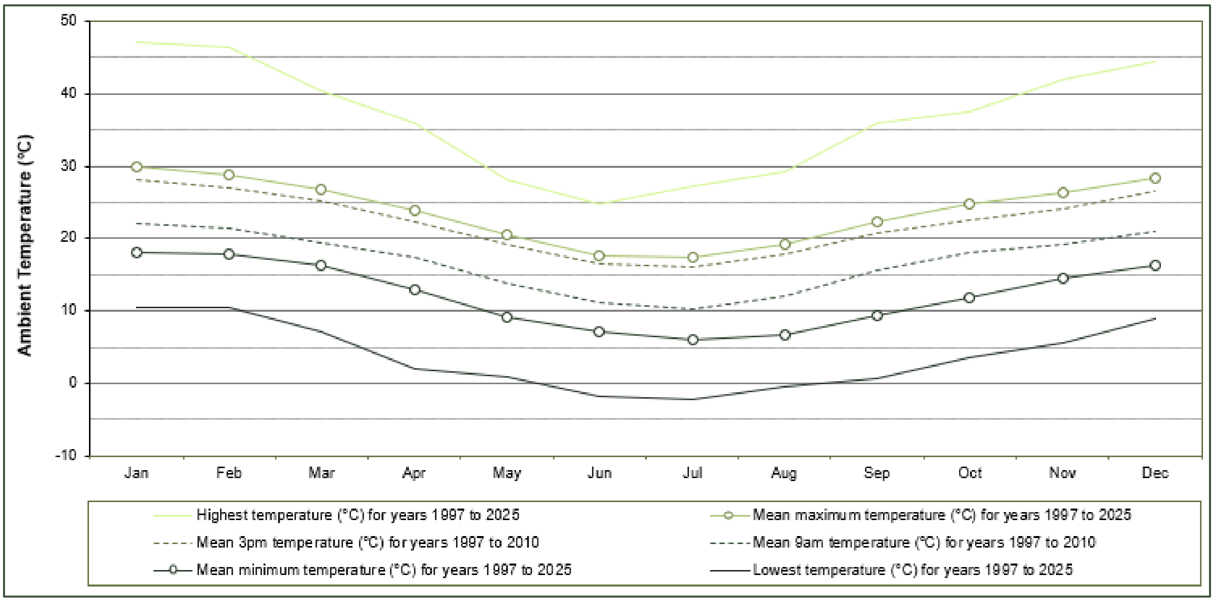


Figure 8 Temperature Data for Horsley Park Equestrian Centre AWS



3.4.4 Wind Speed and Direction

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.

Annual and seasonal wind roses for the five-year period from 2020 to 2024, compiled from data recorded by the Horsley Park Equestrian Centre AWS are presented in **Figure 9**. 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. The 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.

There are times when the wind is calm (defined as being from zero to 0.5 metres/second), and the percentage of the time that winds are calm are shown as a note on the wind rose. **Table 2** outlines the wind scale used to describe the wind speed.

Table 2 Wind Scale Descriptions

Description	km/h	m/s	Description on land
Calm	0-1.8	0-0.5	Smoke rises vertically
Light air	1.8-5.5	0.5-1.5	Smoke drift indicates wind direction
Light breeze	5.4-10.8	1.5-3	Wind felt on face, leaves rustle, light flags extended, ordinary vanes moved by wind
Gentle breeze	10.8-19.8	3-5.5	Leaves and small twigs in constant motion; light flags extended.

Description	km/h	m/s	Description on land
Moderate winds	19.8-28.8	5.5-8.0	Raises dust and loose paper, small branches are moved
Fresh winds	28.8-37.8	8.0-10.5	Small trees in leaf begin to sway, crested wavelets form on inland waters
Strong winds	>37.8	>10.5	Large branches in motion, whistling heard in telephone wires; umbrellas used with difficulty

The annual wind rose indicates that winds blow from all directions, with the least frequent winds coming from the northeastern quadrant and the most frequent winds coming from the southwestern quadrant. Calm wind conditions (wind speed less than 0.5 m/s) were recorded to occur 18.5% of the time throughout the investigated period. The average seasonal wind roses for the year 2020-2024 indicate that:

- In summer, winds blow from all directions except the northwestern quadrant, where winds occur infrequently. Calms were recorded approximately 16% of the time during the summer months.
- In autumn, winds predominantly blow from the southwestern quadrant, with the least frequent winds originating from the northeastern quadrant. Calms were recorded approximately 20% of the time during the autumn months.
- In winter, winds predominantly blow from the southwestern and northwestern quadrant, with the least frequent winds originating from the northeastern and southeastern quadrants. Calms were recorded 21% of the time.
- In spring, winds blow almost evenly from all directions. Calms were recorded approximately 16% of the time during spring.

Wind erosion of dust from exposed surfaces 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 approximately 5.5 m/s. The frequency of wind speeds for the period of 2020-2024 is presented in **Figure 10**. The plot shows that the frequency of wind speeds exceeding 5.5 m/s for the period 2020-2024 at Horsley Park Equestrian Centre AWS was approximately 2% of the time.

Figure 9 Horsley Park Equestrian Centre AWS Seasonal and Annual Wind Roses (2020 – 2024)

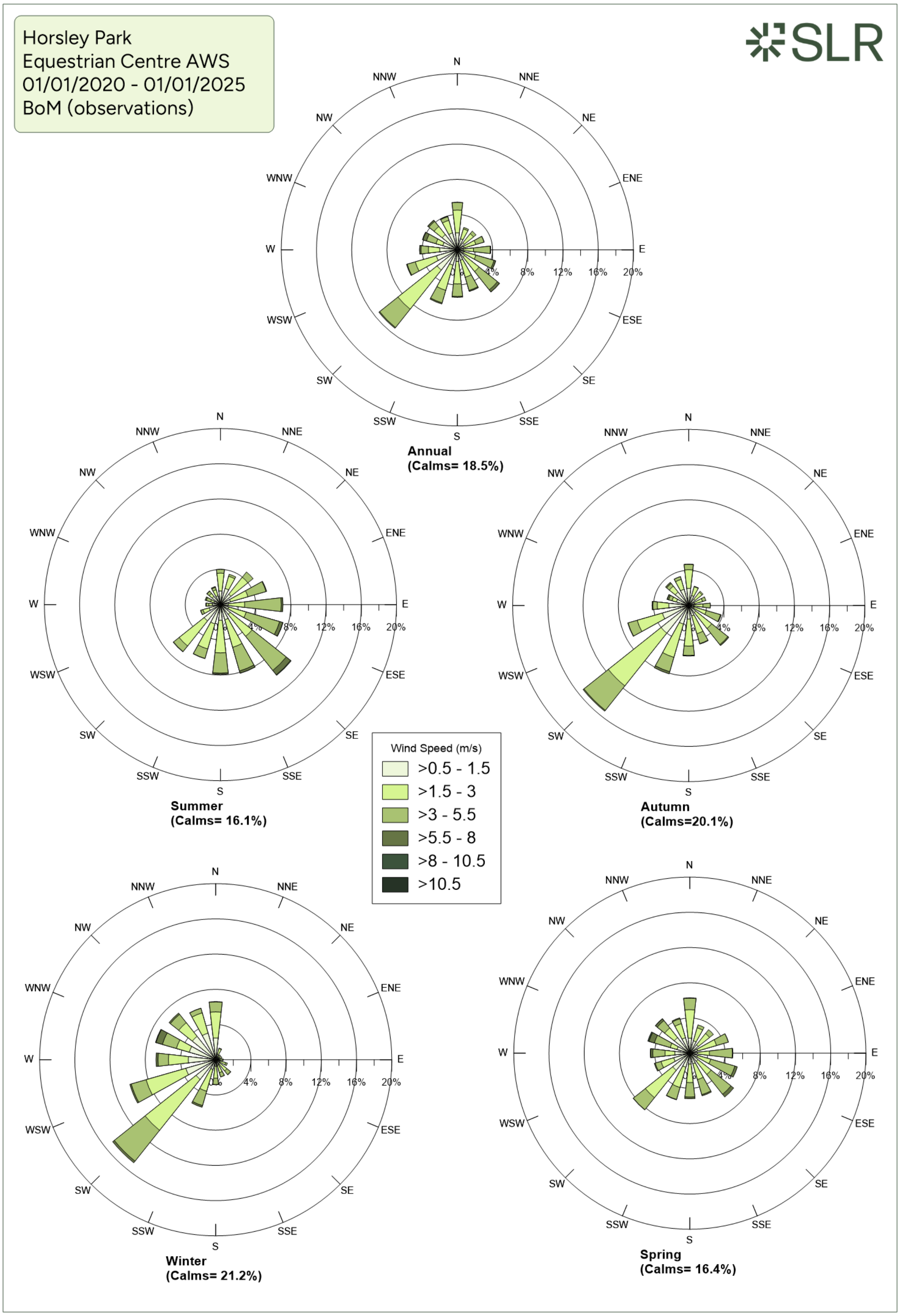
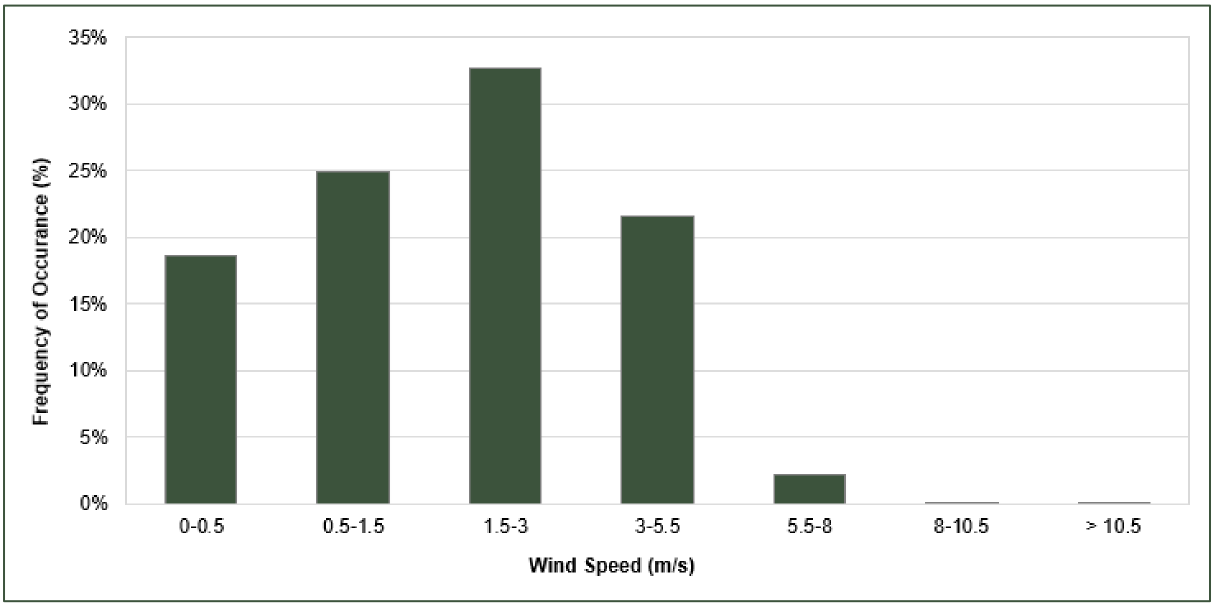


Figure 10 Wind Speed Frequency Chart for Horsley Park Equestrian Centre AWS – 2020-2024



3.5 Regional Air Quality

Air quality monitoring is performed by the NSW Department of Climate Change, Energy, the Environment and Water (DCCEW) at a number of monitoring stations across NSW. The closest station to the Site is the Bringelly Air Quality Monitoring Station (AQMS), located approximately 7.5 km to the southwest (see Section 3.1).

The following air pollutants are monitored at this station:

- Fine particles as $PM_{2.5}$
- Fine particles as PM_{10}

A summary of the monitored pollutant concentrations for the last five years (2020-2024) is presented in **Table 3** and the data are presented graphically in **Figure 11** to **Figure 12**.

No TSP monitoring is conducted by the Bringelly AQMS. In the absence of any monitoring data for TSP, daily varying ambient TSP concentrations have been estimated from the PM_{10} concentrations recorded by the Bringelly AQMS using a PM_{10}/TSP ratio of 0.4 [1], which is typical for industrial areas in Australia. Therefore, for cumulative analysis purposes, the annual average background TSP concentration was estimated to be 37.5 µg/m^3.

No background dust deposition monitoring is conducted by the Bringelly AQMS.

In the absence of suitably representative dust deposition monitoring data, a background dust deposition rate of 2 g/m^2/month has been assumed for this assessment, which is typical for residential/industrial areas in Australia. This results in the cumulative assessment criterion of 4 g/m^2/month being the defining criterion for the Project.

[1] This is conservative as when this ratio is determined from the total PM_{10} and TSP emissions to area in Sydney as detailed in the 2013 Calendar Year Air Emissions Inventory for the Greater Metropolitan Region in NSW, the ratio is 0.6, which would result in a concentration was estimated to be 25.0 µg/m^3. This includes the following sources of emissions: natural, commercial, domestic-commercial, industrial, off-road mobile, on-road mobile.

Table 3 Summary of Air Quality Monitoring Data at Bringelly AQMS (2020-2024)

Pollutant	PM_{10}		$PM_{2.5}$	
Averaging Period	Maximum 24-hour	Annual	Maximum 24-hour	Annual
Units	µg/ m³	µg/ m³	µg/ m³	µg/ m³
2020	241.8 (11)	18.1	78.1 (12)	8.2
2021	69.0 (1)	15.0	57.4 (3)	7.2
2022	28.7	11.9	17.8	5.0
2023	53.2 (1)	15.7	45.4 (3)	6.7
2024	58.1 (1)	15.9	17.2	6.6
Criteria	50	25	25	8
# numbers in brackets represent number of exceedances of relevant criteria recorded each year.				

Exceedances of the 24-hour average PM_{10} criteria were recorded by the Bringelly AQMS each year over the period analysed except for 2022. $PM_{2.5}$ criteria exceedances were recorded by in the years 2020, 2021, and 2023. Exceedances of the annual average $PM_{2.5}$ criterion were also recorded for the years 2019 and 2020. Exceedances of the annual average $PM_{2.5}$ criterion were also recorded for 2020.

A review of the available compliance monitoring reports indicates that the PM_{10} and $PM_{2.5}$ exceedances during these years were primarily due to exceptional events such as bushfire emergencies, dust storms and hazard reduction burns (NSW DPIE 2020) (NSW DPE 2021). The high number of exceedances recorded in 2020 were due to bushfire smoke that affected Sydney and the surrounding areas for a significant number of days in early 2020 (the 'Black Summer' bushfire event). The NEPM compliance report for 2023 shows that the single PM_{10} exceedance in 2023 was a non-exceptional exceedance due to local dust (DCCEEW 2025). The NEPM compliance report for 2024 has not been published at the time of this assessment and the cause of the single PM_{10} exceedance in 2024 is unknown.

Figure 11 Measured 24-Hour Average PM_{10} Concentrations at Bringelly AQMS (2020-2024)

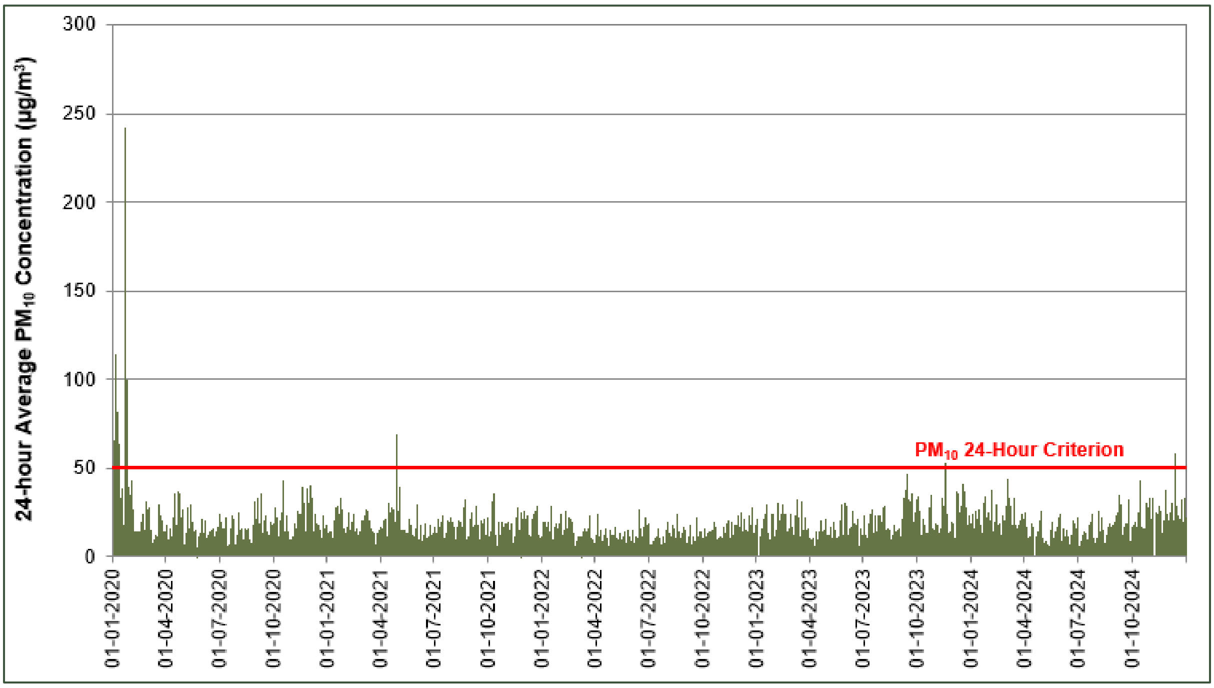
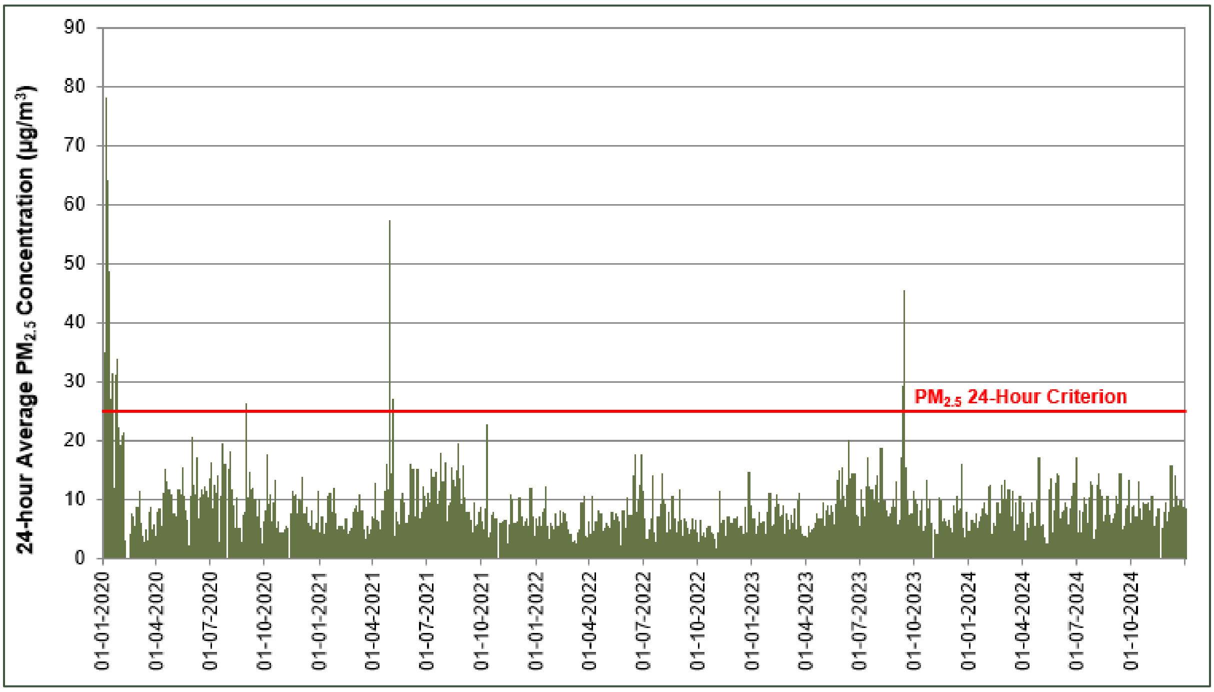


Figure 12 Measured 24-Hour Average $PM_{2.5}$ Concentrations at Bringelly AQMS (2020-2024)



4.0 Assessment Methodology

The assessment of air emissions from the proposed construction Project has been performed quantitatively using dispersion modelling techniques.

The dispersion modelling was performed using the CALPUFF dispersion model (Version 6). The CALPUFF dispersion model is approved by NSW EPA for the modelling of air quality impacts in NSW and it has been used in numerous air quality impact assessments in NSW and across Australia.

CALPUFF is a transport and dispersion model that ejects “puffs” of material emitted from modelled sources, simulating dispersion and transformation processes along the way. In doing so it typically uses the fields generated by a meteorological pre-processor CALMET, Temporal and spatial variations in the meteorological fields selected are explicitly incorporated in the resulting distribution of puffs throughout a simulation period.

The primary output files from CALPUFF contain hourly concentrations or deposition values evaluated at selected receptor locations. The CALPOST post-processor is then used to process these files, producing tabulations that summarise results of the simulation for user-selected averaging periods.

4.1 Meteorological Modelling

Meteorological mechanisms govern the dispersion, transformation and eventual removal of pollutants from the atmosphere. The extent to which pollution will accumulate or disperse in the atmosphere is dependent on the degree of thermal and mechanical turbulence within the earth’s boundary layer. Dispersion comprises vertical and horizontal components of motion. The stability of the atmosphere and the depth of the surface-mixing layer define the vertical component. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field. The wind speed determines both the distance of downwind transport and the rate of dilution as a result of plume ‘stretching’. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness. The wind direction, and the variability in wind direction, determines the general path pollutants will follow, and the extent of crosswind spreading.

Pollution concentration levels therefore fluctuate in response to changes in atmospheric stability, to concurrent variations in the mixing depth, and to shifts in the wind field (Oke 1988).

To adequately characterise the dispersion meteorology of the Site, information is needed on the prevailing wind regime, mixing height and atmospheric stability and other parameters such as ambient temperature, rainfall and relative humidity.

In order to determine a representative meteorological year for use in dispersion modelling, five years of meteorological data (2020-2024) from the closest meteorological monitoring station (i.e. Horsley Park Equestrian Centre AWS) were analysed against the five-year average meteorological conditions. Specifically, the following parameters were analysed:

- frequency and distribution of the predominant wind directions
- monthly average wind speeds observed
- monthly average temperatures.

Based on this analysis, it was concluded that the year 2021 was representative of the last five years of meteorological conditions experienced at the Site and hence the 2021 calendar year was adopted for use in this assessment. A summary of the analysis is presented in **Appendix A**.

Details of the meteorological modelling completed are provided below. A summary of the meteorological model domain details is provided in **Table 4.** Evaluation of the processed meteorological data is provided **Appendix B**.

4.1.1 TAPM

In order to calculate all required meteorological parameters required by the dispersion modelling process, meteorological modelling using The Air Pollution Model (TAPM, v 4.0.4) has been performed. TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model which may be used to predict three-dimensional meteorological data and air pollution concentrations.

TAPM model predicts wind speed and direction, temperature, pressure, water vapour, cloud, rainwater and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate site-specific hourly meteorological observations at user-defined levels within the atmosphere. A full description of TAPM is available in the model user manual (CSIRO, 2008).

TAPM model may assimilate actual local wind observations so that they can optionally be included in a model solution. However, given that TAPM is known to under-predict calm wind conditions, the wind speed and direction observations obtained from the nearest BoM and stations have also been used in the subsequent CALMET component of the modelling as described in Section 4.2.

The dispersion modelling requires twelve months of hourly timestep meteorological data. The Air Pollution Model (TAPM) was used to generate site-representative data for input into CALMET for further processing of the fine scale three-dimensional wind field data required for the CALPUFF dispersion model.

4.1.2 CALMET

In the simplest terms, CALMET is a meteorological model that develops hourly wind and other meteorological fields on a three-dimensional gridded modelling domain that are required as inputs to the CALPUFF dispersion model. Associated two dimensional fields such as mixing height, surface characteristics and dispersion properties are also included in the file produced by CALMET. The interpolated wind field is then modified within the model to account for the influences of topography, sea breeze, as well as differential heating and surface roughness associated with different land uses across the modelling domain. These modifications are applied to the winds at each grid point to develop a final wind field. The final hourly varying wind field thus reflects the influences of local topography and land uses.

A full description of the CALMET/CALPUFF model is available in the CALPUFF manual (SRC 2011).

The CALMET domain was modelled with a resolution of 0.05 km. The TAPM-generated 3-dimensional meteorological data (1 km resolution) was used as the ‘initial guess’ wind field and the local topography and available surface weather observations in the area were used to refine the wind field predetermined by TAPM.

Table 4 TAPM and CALMET Modelling Domain Details

Model and Domain Settings	Details	Model and Domain Settings	Details
TAPM		CALMET	
5 nested grids	25 x 25 x 35 grid points	Domain size	10 km x 10 km
Grid point resolutions	30 km, 10 km, 3 km, 1 km, 300 m	Receptor grid	50 m resolution
Domain origin centre point	E: 295,164 N: 6,253,975 Zone: 56S	Domain origin southwest corner	E: 289,500 N: 6,245,500 Zone: 56S
Period	31/01/12 2020 to 01/01/2022	Period	31/01/12 2020 to 01/01/2022
Modelled with wind assimilation data for Badgerys Creek AWS and Horsley Park Equestrian Centre AWS. Further details on model settings can be provided as required.		Initial guess field	3D output from TAPM

4.2 Dispersion Modelling

CALPUFF was used for the dispersion modelling and is widely used in Australia as a suitable model for a range of applications and conditions including odour modelling assessments.

As with any air dispersion model, CALPUFF requires inputs in three major areas:

- emission rates and source details
- meteorology
- terrain and surface details, as well as specification of specific receptor locations.

A summary of the model details is provided in **Table 5**.

Table 5 CALPUFF Domain Details and Model Settings

Item	Details
Domain details	50 m resolution for 10 km by 10 km domain
Receptor details	50 m resolution gridded receptors and 25 discrete receptors
Emissions data	Varys by emission source. Refer to **Section 5.0** for details.
Further details on model settings can be provided as required.	

Model Configuration

Emissions from the activities at the Project were represented by a series of volume sources, while wind erosion from exposed areas was represented by area sources.

The estimated particulate emissions were modelled as:

- Fine Particulates (FP < 2.5 µm);
- Course Matter (2.5 µm<CM<10 µm); and

- the Rest (RE>10 µm).

These parameters were then grouped using CALPOST to predict $PM_{2.5}$, PM_{10} and TSP concentrations at surrounding receptor locations. This approach provides the most realistic treatment of the differing size fractions, with the lighter, finer particulate matter being dispersed further than the heavier size fraction which settles out of the air more rapidly.

Based on the sensitivity of each activity to wind speed, an hourly varying emission file representing hourly FP, CM and RE emissions for each source was generated using the annual average emission rate estimated for each activity. Details of the algorithm used to generate the variable emission files are presented in **Appendix D**.

4.3 Adopted Background for this Assessment

The purpose of assessing background air quality is to determine the concentrations of air pollutants currently experienced at surrounding receptors, with the predicted concentrations from the Project added to these background concentrations to identify the likely future cumulative air quality impacts.

For the purposes of assessing potential cumulative off-site air quality impacts, an estimation of ambient air quality concentrations is required. In accordance with the Approved Methods, the background data used in this AQIA is based on the same year as the meteorological year used in the modelling (ie 2021).

The representative background ambient air quality concentrations adopted for use in this assessment are summarised in **Table 6**.

Table 6 Adopted Background Data

Pollutant	Averaging Period	Regional Background	Notes
TSP	Annual	37.5.0 µg/ m^3	Calculated from PM_{10} concentrations at Bringelly AQMS during 2021 during a PM_{10}/TSP ratio of 0.4
PM_{10}	24-hour	Daily varying (Maximum 69.0 µg/ m^3)	As monitored at Bringelly AQMS during 2021
	Annual	15.0 µg/ m^3	As monitored at Bringelly AQMS during 2021
$PM_{2.5}$	24-hour	Daily varying	As monitored at Bringelly AQMS during 2021
	Annual	7.2 µg/ m^3	As monitored at Bringelly AQMS during 2021
Deposited dust	Annual	2 g/m^2/month	Estimated. Not monitored at Bringelly AQMS

4.4 Accuracy of Modelling

All atmospheric dispersion models, including CALPUFF, represent a simplification of the many complex processes involved in the dispersion of pollutants in the atmosphere. To obtain good quality results it is important that the most appropriate model is used and the quality of the input data (meteorological, terrain, source characteristics) is adequate.

The main sources of uncertainty in dispersion models, and their effects, are discussed below:

- Oversimplification of physics: This can lead to both under-prediction and over-prediction of ground level pollutant concentrations. Uncertainties are greater in

Gaussian plume models as they do not include the effects of non-steady-state meteorology (i.e., spatially- and temporally varying meteorology).

- Uncertainties in emission rates: Ground level concentrations are proportional to the pollutant emission rate. In addition, most modelling studies assume constant worst-case emission levels or are based on the results of a small number of stack tests, however operations (and thus emissions) are often quite variable. Accurate measurement of emission rates and source parameters requires continuous monitoring.
- Uncertainties in wind direction and wind speed: Wind direction affects the direction of plume travel, while wind speed affects plume rise and dilution of plume. Uncertainties in these parameters can result in errors in the predicted distance from the source of the plume impact, and magnitude of that impact. In addition, aloft wind directions commonly differ from surface wind directions. The preference to use rugged meteorological instruments to reduce maintenance requirements also means that light winds are often not well characterised.
- Uncertainties in mixing height: If the plume elevation reaches 80% or more of the mixing height, more interaction will occur, and it becomes increasingly important to properly characterise the depth of the mixed layer as well as the strength of the upper air inversion.
- Uncertainties in temperature: Ambient temperature affects plume buoyancy, so inaccuracies in the temperature data can result in potential errors in the predicted distance from the source of the plume impact, and magnitude of that impact.
- Uncertainties in stability estimates: Gaussian plume models use estimates of stability class, and 3D models use explicit vertical profiles of temperature and wind (which are used directly or indirectly to estimate stability class for Gaussian models). In either case, uncertainties in these parameters can cause either under-prediction or over-prediction of ground level concentrations. For example, if an error is made of one stability class, then the computed concentrations can be off by 50% or more.

The US EPA makes the following statement in its Modelling Guideline (US EPA 2005) on the relative accuracy of models:

“Models are more reliable for estimating longer time-averaged concentrations than for estimating short-term concentrations at specific locations; and the models are reasonably reliable in estimating the magnitude of highest concentrations occurring sometime, somewhere within an area. For example, errors in highest estimated concentrations of ±10 to 40% are found to be typical, i.e., certainly well within the often-quoted factor-of-two accuracy that has long been recognised for these models. However, estimates of concentrations that occur at a specific time and site are poorly correlated with actually observed concentrations and are much less reliable.”

5.0 Emission Estimation

This section describes the scenarios assessed (**Section 5.1**), the methodology used to estimate emissions (**Section 5.2**) and the emissions inventory for the Project (**Section 5.3**).

5.1 Scenarios Assessed

Only one scenario is quantified to assess the pollutant emissions due to the construction activities of the Project. A summary of the emission sources assessed in is shown in **Table 7**.

Table 7 Summary of the Scenarios Assessed

Scenario	Emission Sources	Pollutants
Construction	Material handling, wheel generated dust, wind erosion	TSP, PM_{10}, $PM_{2.5}$ and deposited dust

This scenario assesses the emissions due to construction activities within the Project Application Area. The construction activities for the proposed Project would be conducted in phases. A summary of the proposed activities within the respective phases is shown in **Table 8**. The timelines for the construction phases are indicative and will be refined during contract negotiations.

Table 8 Summary of the Project Construction Activities

Phase	Estimated Duration (weeks)
Site Establishment	12
Demolition and removal of existing structures	12
Vegetation clearing and dam dewatering	12
Excavation/civil	64
Road and intersection works	64
Building Construction	220

It is noted that although the longest running construction phase with dust generating activities will be ‘Excavation/civil’ (~64weeks), which will run in conjunction with road and intersection works (~64 weeks).

5.2 Methodology

Particulate emissions from the construction activities have been calculated using default or calculated emission factors for the relevant emission sources. Emission factors were sourced from the National Pollutant Inventory (NPI) *EETM for Mining* version 3.1 (DSEWPC, 2012), or from the US EPA AP-42 Emission Factor Handbook (USEPA, 2006) where suitable factors do not exist within the NPI documentation.

The NPI *EETM for Mining* (DSEWPC, 2012) and US EPA AP 42 contain emission factors for TSP and PM_{10}. No emission factors for $PM_{2.5}$ are provided within the NPI *EETM for Mining* and only limited emission factors for $PM_{2.5}$ are provided in US EPA AP 42.

Limited research has been undertaken to assess the fraction of PM_{10} from the wide range of sources which would be emitted as $PM_{2.5}$. Research has been conducted by the Midwest Research Institute (MRI) on behalf of the Western Regional Air Partnership (WRAP) with findings published within the document entitled *'Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors'* (MRI, 2006). This document provides seven proposed $PM_{2.5}/PM_{10}$ ratios for fugitive dust source categories as presented in **Table 9**.

Table 9 Proposed Particle Size Ratios for AP-42

Fugitive Dust Source	AP-42 Section	Proposed $PM_{2.5}/PM_{10}$ Ratio
Paved roads	13.2.1	0.15
Unpaved roads (public & industrial)	13.2.2	0.1
Construction & demolition	-	
Aggregate handling and storage piles	13.2.4	0.1
Industrial wind erosion	13.2.5	0.15
Agricultural tilling	-	0.2
Open area wind erosion	-	0.15

The $PM_{2.5}$ / PM_{10} ratios presented in **Table 9** have been used within this assessment to calculate the emissions of $PM_{2.5}$ attributable to this Project. The most appropriate ratio has been applied to each of the sources.

The emission factors used for the estimation of TSP, PM_{10} and $PM_{2.5}$ emissions from the construction activities at the Project are presented in Error! Reference source not found..

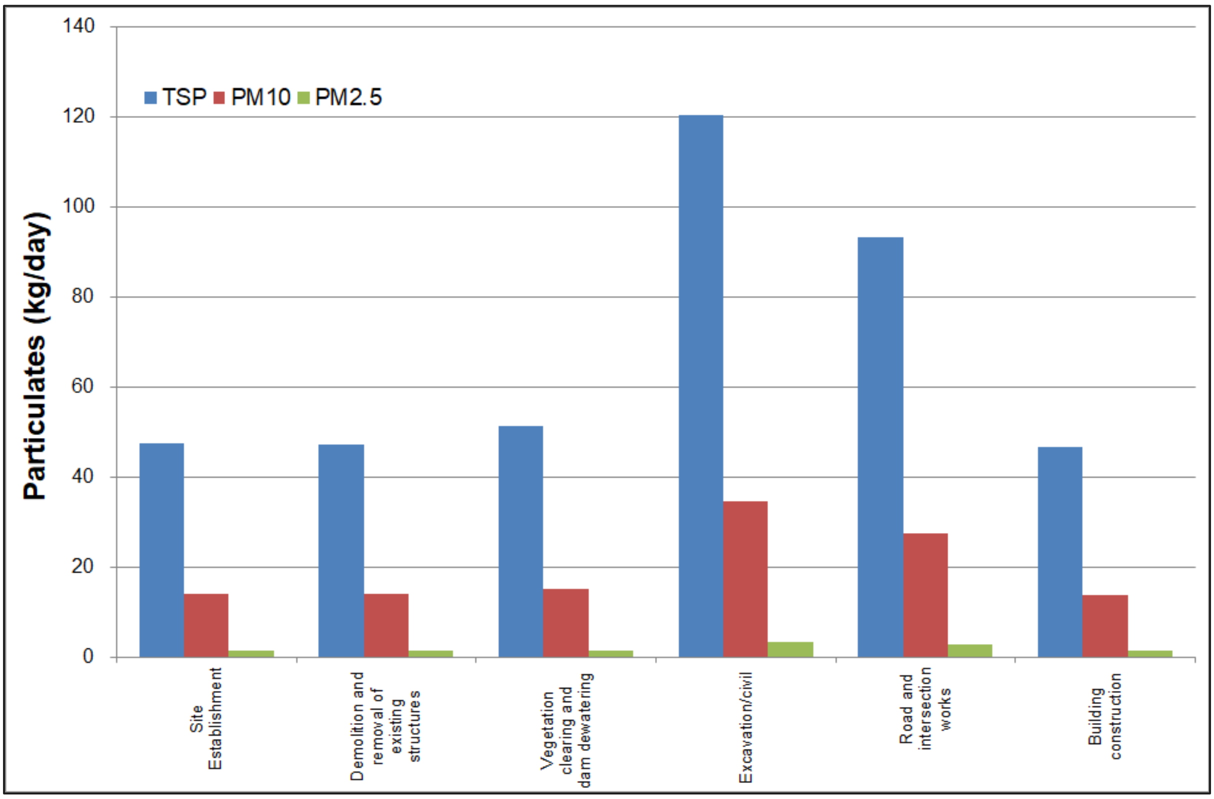
5.3 Emissions Inventory

The emissions for the various construction phases have been calculated and a summary of these is shown in **Table 10** and **Figure 13**.

Table 10 A Summary of the Emissions Inventory for each Phase

Phase	TSP (kg/phase)	PM_{10} (kg/phase)	$PM_{2.5}$ (kg/phase)
Site Establishment	3,408	1,016	102
Demolition and removal of existing structures	3,398	1,012	101
Vegetation clearing and dam dewatering	3,697	1,083	108
Excavation/civil	46,201	13,247	1,325
Road and intersection works	35,765	10,571	1,057
Building construction	61,420	18,150	1,815
TOTAL	**292,717**	**114,493**	**14,920**

Figure 13 A Summary of the Emissions Inventory for each Phase (per day)



It is noted that the highest emissions are estimated during the 'Excavation/Civil' phase. This is largely attributed to the material handling and wheel generated emissions occurring due to the transport of material.

To estimate emissions to air during each phase it is considered appropriate to estimate the total emissions on a per day basis. The recalculated particulate emissions are shown in **Table 11**.

Table 11 A Summary of the Uncontrolled Emissions Inventory for each Phase (per day)

Phase	TSP (kg/day)	PM_{10} (kg/day)	$PM_{2.5}$ (kg/day)
Site Establishment	47	14	1
Demolition and removal of existing structures	47	14	1
Vegetation clearing and dam dewatering	51	15	2
Excavation/civil	120	34	3
Road and intersection works	93	28	3
Building construction	47	14	1

It is noted that on a per day basis, the particulate emissions are likely to be highest during the 'Earthworks' and 'road intersection' phases construction.

Based on the estimated emissions and the schedule of phases during the construction of the Project and taking into account the likely proximity of these works to the receptor locations, it is considered appropriate to assess the potential air quality impacts of the two highest contributing construction phases ('Earthworks' and 'Road & Intersection') in conjunction with each other.

Particulate emissions generated during the phases are assumed to occur at the maximum potential intensity for all days of the modelled year. In this way, all potential combinations of worst case emissions and meteorology have been examined. This is considered to be a highly conservative approach. A summary of the modelled particulate emissions is shown in **Table 12**.

Table 12 A Summary of the Modelled Emissions Inventory (per year)

Phase	TSP (kg/year)	PM_{10} (kg/year)	$PM_{2.5}$ (kg/year)
Excavation/civil	43,915	12,591	1,259
Road and intersection works	33,995	10,048	1,005
Wind Erosion	95,249	47,624	7,144
TOTAL	173,159	70,263	9,408

6.0 Assessment of Predicted Air Quality Impacts

The sections below present a summary of the air quality impacts predicted by the modelling at the sensitive receptors identified in Section 3.3.

Isopleth plots showing the incremental impact predicted due to the Project emissions (ie excluding background levels) for each pollutant are presented in **Appendix E**. These plots do not represent the dispersion pattern for any individual time period but rather illustrate the maximum concentration that was predicted to occur at each model calculation point given the range of meteorological conditions occurring over the 2021 modelling period.

6.1 Particles as $PM_{2.5}$

6.1.1 Maximum 24-Hour Average $PM_{2.5}$ Concentrations

Table 13 presents a summary of the predicted maximum incremental and maximum cumulative impacts 24-hour average $PM_{2.5}$ impacts at the sensitive receptors.

Table 13 Summary of 24-Hour $PM_{2.5}$ Cumulative Impact Analysis

Receptor ID	Maximum 24-Hour Average $PM_{2.5}$ Concentrations (µg/m³)		Additional Exceedances
	Incremental Impact	Cumulative Impact	
R1	1.2	57.7	0
R2	2.5	58.1	0
R3	1.9	58.0	0
R6	3.4	57.5	0
R7	3.8	57.5	0
R8	2.2	57.4	0
R9	1.5	57.4	0
R10	5.0	57.4	0
R11	4.4	57.4	0
R12	4.0	57.4	0
R13	3.2	57.4	0
R14	2.0	57.7	0
R15	3.1	57.9	0
R16	3.7	58.0	0
R17	3.2	57.8	0
R18	3.3	57.7	0
R19	4.0	57.8	0
R20	3.3	57.6	0
R21	2.9	57.4	0
R22	2.3	57.4	0

Receptor ID	Maximum 24-Hour Average $PM_{2.5}$ Concentrations (µg/m³)		Additional Exceedances
	Incremental Impact	Cumulative Impact	
R23	2.0	57.6	0
R24	1.1	57.5	0
R25	2.2	57.6	0
R26	1.6	57.5	0
R27	1.7	57.5	0
R28	1.3	57.4	0
R29	1.6	57.5	0
Criterion		**25**	-

Table 13 shows that there are predicted exceedances of the criterion, however impacts are dominated by the background $PM_{2.5}$. There are no additional exceedances due to the Project.

As discussed in **Section 4.3**, daily varying background concentrations were adopted from the Bringelly AQMS for contemporaneous analysis of the cumulative assessment. In accordance with the Approved Methods, a contemporaneous analysis of the maximum predicted concentrations at the worst impacted receptor (R10) was performed and is presented in **Table 14**. This analysis shows that the contribution of Project Site towards the maximum cumulative $PM_{2.5}$ 24-hour average concentrations does not result in additional exceedances of the criterion.

Table 14 24-hour Average $PM_{2.5}$ Contemporaneous Analysis Summary (Receptor R10)

Date	$PM_{2.5}$ 24-Hour Average (µg/³)			Date	$PM_{2.5}$ 24-Hour Average (µg/m³)		
	Highest Background	Project Site Increment	Total		Background	Highest Project Site Increment	Total
27/04/2021	57.4	0.0	57.4	17/07/2021	2.7	5.0	7.7
4/05/2021	27.3	0.8	28.1	16/07/2021	4.5	3.1	7.6
3/05/2021	25.7	0.0	25.7	13/11/2021	2.2	3.0	5.2
9/10/2021	22.8	0.2	23.0	3/08/2021	5.0	2.7	7.7
21/08/2021	19.7	0.2	19.9	25/07/2021	3.4	2.6	6.0
23/07/2021	18.0	0.0	18.0	12/09/2021	6.3	2.5	8.8
10/10/2021	17.6	0.0	17.6	29/10/2021	7.2	2.5	9.7
28/04/2021	17.0	0.0	17.0	24/07/2021	7.7	2.4	10.1
29/04/2021	16.6	0.1	16.7	14/11/2021	2.6	2.3	4.9
29/04/2021	16.6	0.1	16.7	20/09/2021	5.6	1.9	7.5
31/07/2021	16.3	0.2	16.5	24/09/2021	5.8	1.9	7.7

Date	$PM_{2.5}$ 24-Hour Average (µg/³)			Date	$PM_{2.5}$ 24-Hour Average (µg/m³)		
	Highest Background	Project Site Increment	Total		Background	Highest Project Site Increment	Total
2/06/2021	16.2	0.1	16.3	20/07/2021	11.4	1.8	13.2

6.1.2 Annual Average $PM_{2.5}$ Concentrations

Table 15 presents the incremental and cumulative annual average $PM_{2.5}$ concentrations predicted at each of the identified receptors.

Table 15 Predicted Incremental and Cumulative Annual Average $PM_{2.5}$ Concentrations

Receptor ID	Annual Average $PM_{2.5}$ Concentrations (µg/m³)		
	Incremental Impact	Cumulative Impact	Additional Exceedance
R1	0.1	7.4	0
R2	0.3	7.6	0
R3	0.5	7.7	0
R6	0.2	7.5	0
R7	0.3	7.5	0
R8	0.2	7.4	0
R9	0.1	7.4	0
R10	0.2	7.5	0
R11	0.2	7.4	0
R12	0.2	7.4	0
R13	0.1	7.4	0
R14	0.2	7.5	0
R15	0.4	7.6	0
R16	0.6	7.9	0
R17	0.6	7.8	0
R18	0.5	7.8	0
R19	0.6	7.9	0
R20	0.4	7.7	0
R21	0.2	7.4	0
R22	0.1	7.4	0
R23	0.2	7.5	0
R24	0.1	7.4	0
R25	0.3	7.5	0
R26	0.2	7.4	0
R27	0.1	7.4	0
R28	0.1	7.3	0

Receptor ID	Annual Average $PM_{2.5}$ Concentrations (µg/m^3)		
	Incremental Impact	Cumulative Impact	Additional Exceedance
R29	0.1	7.4	0
Criterion		**8**	

Table 15 shows that the cumulative annual average $PM_{2.5}$ concentrations are predicted to to be below the annual average $PM_{2.5}$ criterion of 8 µg/m^3 at all the receptors modelled. It is noted that the emission estimation adopted a number of assumptions to ensure short term impacts are not under estimated. For example, the bulk earth works and road intersection works along with wind erosion for the whole Project area are assumed to be occurring at all the time.

6.2 Particles as PM_{10}

6.2.1 Maximum 24-Hour Average PM_{10} Concentrations

Table 16 presents a summary of the predicted maximum incremental and maximum cumulative impacts 24-hour average PM_{10} impacts at the sensitive receptors.

Table 16 Summary of 24-Hour PM_{10} Cumulative Impact Analysis

Receptor ID	Maximum 24-Hour Average PM_{10} Concentrations (µg/m^3)		Additional Exceedances
	Incremental Impact	Cumulative Impact	
R1	10.9	71.6	0
R2	22.8	74.6	0
R3	17.3	74.1	0
R6	21.3	69.6	0
R7	22.6	69.7	0
R8	13.4	69.2	0
R9	9.3	69.1	0
R10	30.5	69.2	0
R11	26.8	69.1	0
R12	23.7	69.1	0
R13	18.8	69.1	0
R14	18.4	71.6	0
R15	28.6	73.3	0
R16	34.3	74.6	5
R17	26.6	72.9	2
R18	31.0	72.3	3
R19	38.9	72.8	3
R20	32.0	71.2	1

Receptor ID	Maximum 24-Hour Average PM_{10} Concentrations (µg/m³)		Additional Exceedances
	Incremental Impact	Cumulative Impact	
R21	17.9	69.2	0
R22	13.6	69.1	0
R23	18.2	71.0	0
R24	10.1	70.0	0
R25	17.7	70.7	0
R26	12.4	69.9	0
R27	16.4	69.5	0
R28	12.0	69.4	0
R29	15.4	69.6	0
Criterion		**50**	-

Table 16 shows that there are predicted additional exceedances of the criterion at some receptors.

As discussed in **Section 4.3**, daily varying background concentrations were adopted from the Bringelly AQMS for contemporaneous analysis of the cumulative assessment. In accordance with the Approved Methods, a contemporaneous analysis of the maximum predicted concentrations at the worst impacted receptor (R16) was performed and is presented in **Table 17. Figure 14** shows the daily cumulative impact predicted. It is noted that the highest 24-hour average PM_{10} increment (ie Project only) is predicted at receptor R19, however R16 has the highest number of predicted additional exceedances and is therefore considered the worst impacted receptor for the purpose of contemporaneous analysis.

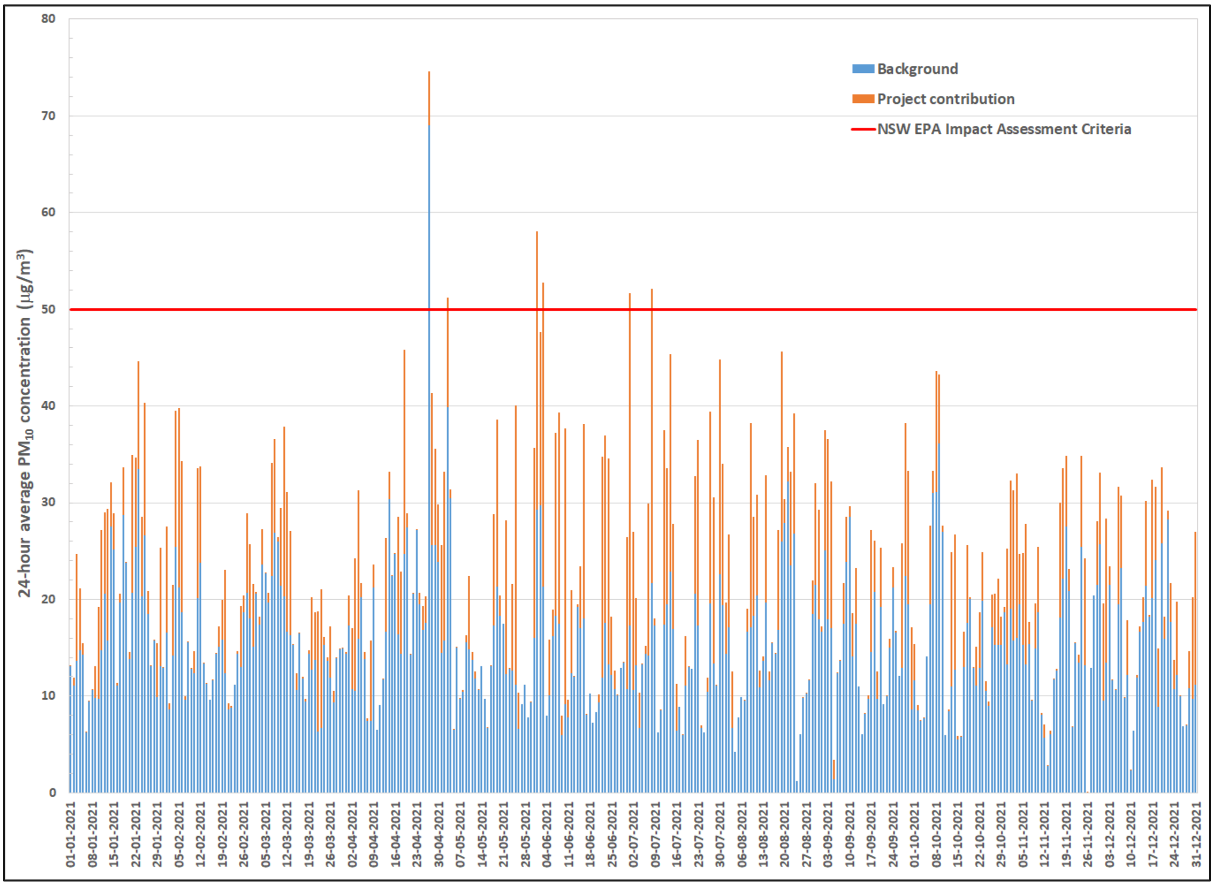
This analysis shows that the contribution of Project towards the maximum cumulative PM_{10} 24-hour average concentrations results in a number of additional exceedances of the criterion. **Figure 14** provides a plot of the dispersion pattern for the maximum impacts in the project area for the 24-hour averaging period. As illustrated, the incremental impacts associated with the Project are higher in the winter months.

Table 17 24-hour Average PM_{10} Contemporaneous Analysis Summary (Receptor R16)

Date	PM_{10} 24-Hour Average (µg/m³)			Date	PM_{10} 24-Hour Average (µg/m³)		
	Highest Background	Project Increment	Total		Background	Highest Project Increment	Total
27/04/2021	69.0	5.6	74.6	1/07/2021	17.3	34.3	51.6
3/05/2021	39.9	11.3	51.2	3/06/2021	21.3	31.4	52.7
9/10/2021	36.1	7.2	43.3	8/07/2021	21.7	30.4	52.1
23/01/2021	33.5	11.2	44.7	25/05/2021	11.2	28.9	40.1
21/08/2021	32.2	3.6	35.8	1/06/2021	29.3	28.8	58.1
8/10/2021	31.1	12.5	43.6	10/06/2021	9.2	28.5	37.7

Date	PM_{10} 24-Hour Average (µg/m³)			Date	PM_{10} 24-Hour Average (µg/m³)		
	Highest Background	Project Increment	Total		Background	Highest Project Increment	Total
7/10/2021	31.0	2.3	33.3	22/06/2021	11.9	22.9	34.8
4/05/2021	30.5	0.9	31.4	14/07/2021	22.9	22.5	45.4
14/04/2021	30.4	2.8	33.2	30/07/2021	22.6	22.2	44.8
2/06/2021	29.7	17.9	47.6	8/06/2021	17.5	21.8	39.3
1/06/2021	29.3	28.8	58.1	24/06/2021	13.3	21.3	34.6
18/01/2021	28.7	5.0	33.7	19/04/2021	24.7	21.1	45.8

Figure 14 Daily Contemporaneous Analysis (R16)



6.2.2 Annual Average PM_{10} Concentrations

Table 18 presents the incremental and cumulative annual average PM_{10} concentrations predicted at each of the identified receptors.

Table 18 Predicted Incremental and Cumulative Annual Average PM_{10} Concentrations

Receptor ID	Annual Average PM_{10} Concentrations (µg/m^3)		
	Incremental Impact	Cumulative Impact	Additional Exceedances
R1	1.0	16.3	
R2	2.8	18.1	
R3	3.9	19.2	
R6	1.8	17.1	
R7	1.9	17.2	
R8	1.3	16.6	
R9	0.9	16.2	
R10	1.8	17.0	
R11	1.4	16.7	
R12	1.1	16.4	
R13	0.9	16.2	
R14	2.0	17.3	
R15	3.5	18.8	
R16	5.6	20.9	
R17	4.8	20.1	
R18	4.6	19.9	
R19	5.5	20.7	
R20	3.6	18.9	
R21	1.5	16.7	
R22	0.8	16.1	
R23	1.9	17.2	
R24	1.2	16.4	
R25	2.4	17.7	
R26	1.4	16.7	
R27	1.2	16.5	
R28	0.7	16.0	
R29	1.0	16.3	
Criterion		**25**	

Table 18 shows that the cumulative annual average PM_{10} concentrations at the receptor are below the annual average PM_{10} criterion of 25 µg/ m^{3}at all receptors.

6.3 Particles as TSP

6.3.1 Annual Average TSP Concentrations

Table 19 presents the incremental and cumulative annual average TSP concentrations predicted at each of the identified receptors.

Table 19 Predicted Incremental and Cumulative Annual Average TSP Concentrations

Receptor ID	Annual Average TSP Concentrations (µg/m^3)		
	Regional Background	Incremental Impact	Cumulative Impact
R1	37.5	2.1	39.6
R2	37.5	6.3	43.8
R3	37.5	9.3	46.8
R6	37.5	3.8	41.3
R7	37.5	4.1	41.6
R8	37.5	2.7	40.2
R9	37.5	1.8	39.3
R10	37.5	3.8	41.3
R11	37.5	3.0	40.5
R12	37.5	2.4	39.9
R13	37.5	1.8	39.3
R14	37.5	4.5	42.0
R15	37.5	8.5	46.0
R16	37.5	14.1	51.6
R17	37.5	11.6	49.1
R18	37.5	11.3	48.8
R19	37.5	13.6	51.1
R20	37.5	8.8	46.3
R21	37.5	3.2	40.7
R22	37.5	1.7	39.2
R23	37.5	4.3	41.8
R24	37.5	2.6	40.1
R25	37.5	5.6	43.1
R26	37.5	3.2	40.7
R27	37.5	2.6	40.1
R28	37.5	1.5	39.0
R29	37.5	2.3	39.8
Criterion		**90**	

Table 19 indicate that the predicted cumulative concentrations at both receptors are below the annual average TSP criterion of 90 µg/ m^3. As noted in Section 6.1.2, the assumptions made for the emission estimation are expected to have resulted in an over estimation of annual predictions by potentially over 30%.

6.4 Dust Deposition

Table 20 shows the annual average dust deposition rates predicted at each of the identified receptors.

Table 20 Predicted Annual Average Dust Deposition Rates

Receptor ID	Annual Average Dust Deposition Rate (g/m²/month)		
	Regional Background	Incremental Impact	Cumulative Impact
R1	2.0	0.1	2.1
R2	2.0	0.3	2.3
R3	2.0	0.5	2.5
R6	2.0	0.2	2.2
R7	2.0	0.2	2.2
R8	2.0	0.2	2.2
R9	2.0	0.1	2.1
R10	2.0	0.2	2.2
R11	2.0	0.2	2.2
R12	2.0	0.2	2.2
R13	2.0	0.2	2.2
R14	2.0	0.2	2.2
R15	2.0	0.3	2.3
R16	2.0	0.6	2.6
R17	2.0	0.5	2.5
R18	2.0	0.5	2.5
R19	2.0	0.7	2.7
R20	2.0	0.4	2.4
R21	2.0	0.2	2.2
R22	2.0	0.1	2.1
R23	2.0	0.2	2.2
R24	2.0	0.1	2.1
R25	2.0	0.2	2.2
R26	2.0	0.1	2.1
R27	2.0	0.1	2.1
R28	2.0	0.1	2.1
R29	2.0	0.1	2.1
Criterion			**4**

Table 20 indicates that the predicted incremental and cumulative annual average dust deposition rates at both receptors are below the criterion of 2 g/m^2/month (incremental increase in dust deposition) and below 4 g/m^2/month (cumulative dust deposition).

7.0 Dust Mitigation Measures

The results of the dispersion modelling indicate potential exceedances of both short-term (24-hour) and long term (annual average) particulate averages criteria for PM_{10} and exceedances of the long-term particulate averages criterion for $PM_{2.5}$. It is noted that conservative assumptions made to ensure short term impacts are not underpredicted are expected to have resulted in potentially significant over estimation of long-term impacts. Therefore, if appropriate measures are put in place to ensure compliance with the relevant short-term criteria, exceedances of long-term criteria are unlikely.

Control measures already quantified for the purpose of this AQIA and proposed to be adopted for the Project are listed in **Appendix C** .

Dust mitigation and management measures recommended by the Original AQIA are listed in **Table 21** to **Table 24**. It is noted that benefits gained from all mitigation measures recommended by the Original AQIA could not be quantified.

These mitigation measures may be adopted in a site-specific Air Quality Management Plan (AQMP). AQMPs cover all sources of emissions, such as those identified in **Section 5.0** of this AQIA, including wind erosion, wheel generated dust, extraction, material handling and processing of extracted material.

Table 21 Recommended Dust Mitigation Measures for the Project

	Activity
1	Display the name and contact details of person(s) account-able for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.
2	Display the head or regional office contact information.
3	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site.
Site Management	
4	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.
5	Make the complaints log available to the local authority when asked.
6	Record any exceptional incidents that cause dust and/or air emissions, either on- or off-site, and the action taken to resolve the situation in the logbook.
Monitoring	
7	Undertake periodic on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked.
8	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.
9	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.
Preparing and Maintaining the Site	
10	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.
11	Fully enclose site or specific operations where there is a high potential for dust production and the site is actives for an extensive period
12	Where possible, avoid site runoff of water or mud.
13	Keep site fencing, barriers and scaffolding clean using wet methods.

	Activity
14	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.
15	Cover, seed, or fence stockpiles to prevent wind whipping.
Operating Vehicle/Machinery and Sustainable Travel	
16	Ensure all vehicles switch off engines when stationary - no idling vehicles.
17	Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where practicable.
18	Impose and signpost a maximum-speed-limit of 15 kph on surfaced and 10 kph on un-surfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).
Operations	
19	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
20	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
21	Use enclosed chutes and conveyors and covered skips.
22	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
23	Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.
Waste Management	
24	Avoid bonfires and burning of waste materials.

Table 22 Mitigation Measures Specific to Earthworks

Activity
Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.
Only remove the cover in small areas during work and not all at once.

Table 23 Mitigation Measures Specific to Construction

Activity
Avoid scabbling (roughening of concrete surfaces) if possible.
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.
Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.
For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.

Table 24 Mitigation Measures Specific to Trackout

Activity
Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
Avoid dry sweeping of large areas.
Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
Record all inspections of haul routes and any subsequent action in a site log book.
Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.
Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permit.
Access gates to be located at least 10 m from receptors where possible.

8.0 Summary

This report has predicted the dispersion of TSP, PM_{10} and $PM_{2.5}$ emissions from bulk earthworks and road intersection works proposed for the Project construction at the Site.

The emission estimation was based on a conservative scenario assuming activities in two phases to occur concurrently. The dispersion modelling has shown that exceedances of short term PM_{10} criteria are predicted to occur.

Considering the following factors, overestimation of predicted concentrations by the model is likely:

- Inability to quantify benefits gained from some of the proposed mitigation measures (e.g. speed reduction, reducing the intensity of dust generating activities on days with elevated background pollutant concentrations or weather conditions conducive to dust impacts, etc.)
- Overestimation of annual impacts by scaling up activities from 64 weeks to 52 weeks.
- Assessment of all activities within earthworks and road intersection phases operating simultaneously for at all times.
- Limitation of the CALPUFF model in predicting nearfield pollutant concentrations.
- Limitation of dispersion modelling to representatively predict reduced pollutant dispersion due to rainfall.

Based on the conservative nature of this assessment, and the low number of additional exceedances predicted at the surrounding receptors, it is concluded that with the recommended mitigation measures in place, the proposed construction activities can be completed without any significant impact on the surrounding receptors.

9.0 References

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Appendix A Selection of Representative Meteorological Data

Elizabeth Enterprise Precinct - Stage 1

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Meteorological Year Selection

Once emitted to atmosphere, the emissions will:

- Rise according to the momentum and buoyancy of the emission at the discharge point relative to the prevailing atmospheric conditions.
- Be advected from the source according to the strength and direction of the wind at the height which the plume has risen in the atmosphere.
- Be diluted due to mixing with the ambient air, according to the intensity of turbulence.
- (Potentially) be chemically transformed and/or depleted by deposition processes.

Dispersion is the combined effect of these processes. Dispersion modelling is used as a tool to simulate the air quality effects of specific emission sources, given the meteorology typical for a local area together with the expected emissions. Selection of a year when the meteorological data is atypical means that the resultant predictions may not appropriately represent the most likely air quality impacts. Therefore, in dispersion modelling, one of the key considerations is the representative nature of the meteorological data used.

The year of meteorological data used for the dispersion modelling was selected by reviewing the most recent five years of historical surface observations at (2019 to 2023 inclusive) to determine the year that is most representative of average conditions. Wind direction and wind speed were compared to averages for the region to determine the most representative year.

It is noted that comparison of meteorological data was conducted prior to January 2025, therefore 2024 has not been included in the comparison.

Data collected from 2019 to 2023 is summarised in **Figure A-1** to **Figure A-2**. Examination of the data indicates the following:

Figure A-1 indicates relatively similar wind roses for all years analysed.

Figure A-2 indicates that 2021 exhibit wind speeds that are lower than the 5-year average which will result in a conservative assessment due to reduced dispersion.

Given the above, the year 2021 was selected as the representative year of meteorology.

Figure A-1 Frequency of Winds at Horsley Park Equestrian Centre AWS for 2019 – 2023

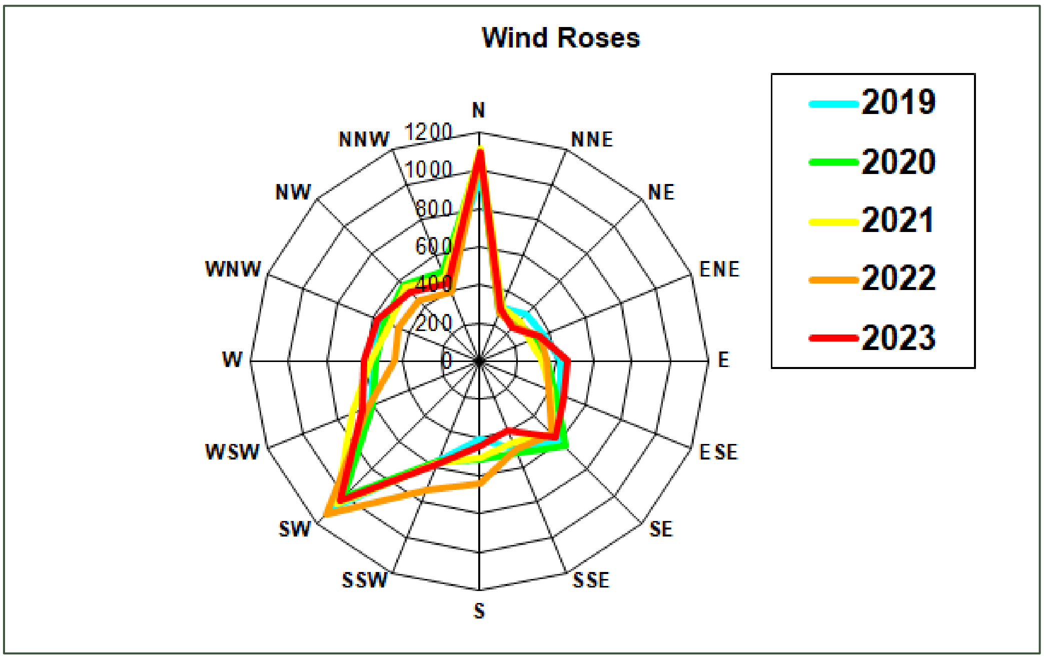
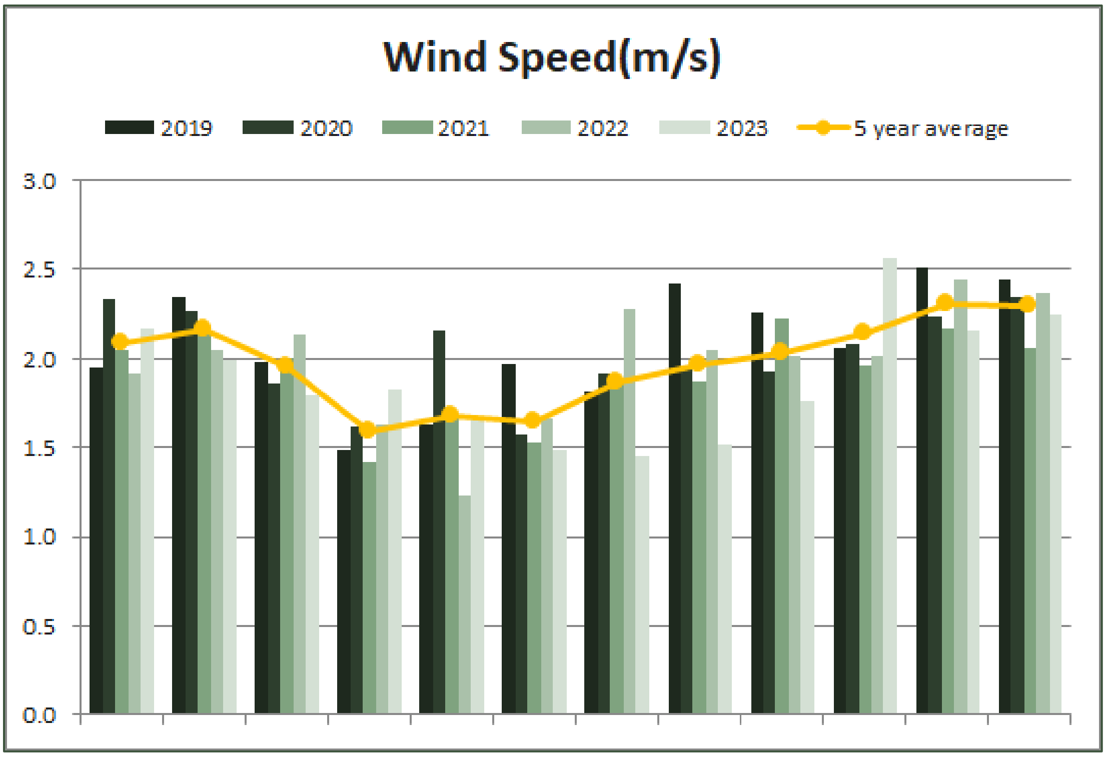


Figure A-2 Monthly Average Wind Speed at Horsley Park Equestrian Centre AWS for 2018 – 2023



Appendix B Evaluation of Meteorological Data

Elizabeth Enterprise Precinct - Stage 1

Air Quality Impact Assessment

Mirvac Projects Pty Ltd

SLR Project No.: 610.032539

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Evaluation of Meteorological Data

The primary meteorological data parameters relevant for dispersion modelling are typically:

- wind (wind speed and direction)
- turbulence (atmospheric stability)
- mixing height (depth of turbulent layer)

A review of the meteorological data used in the dispersion modelling for the above parameters is provided below.

Wind Speed and Wind Direction

A summary of the annual wind behaviour predicted by CALMET for 2021 (extracted at the Site) is presented as wind roses in Figure B-1 and as a wind speed distribution plot in Figure B-2. These plots show that winds in the study area were predicted to be predominantly gentle to strong during 2021. Calm wind conditions were predicted to occur approximately 10% of the time throughout the modelling period. It is noted that the moderate winds and low percentage of calm wind conditions will assist pollutant dispersion, resulting in lower pollution concentrations at the surrounding receptors.

The seasonal wind roses indicate that typically:

- In summer and autumn, winds blow from all directions except for the northwestern quadrant from which a very low frequency of winds originate. On average, calm winds are experienced 6.6% of the time during summer and 12.0% during autumn.
- In winter, winds predominantly blow from northeastern and southwestern quadrants. On average, calm winds are experienced 13.9% of the time during winter.
- In spring, winds blow from all direction except for northern direction from which a low frequency of winds blow. On average, calm winds are experienced 7.1% of the time during spring.

A comparison of the wind roses presented in Figure B-1 with the Horsley Park Equestrian Centre AWS wind roses presented in Figure B-2 shows that the frequency of south-westerly winds is lower at the Site during autumn and winter and similar to the AWS the rest of the year while the frequency of the north-easterly winds is higher at the Site throughout the year. Based on the wind roses, the seasons with the greatest potential for air quality impacts at the nearest sensitive receptors (located to the north of the site) would be summer and autumn.

Figure B-1 CALMET-Predicted Seasonal Wind Roses for the Site – 2021

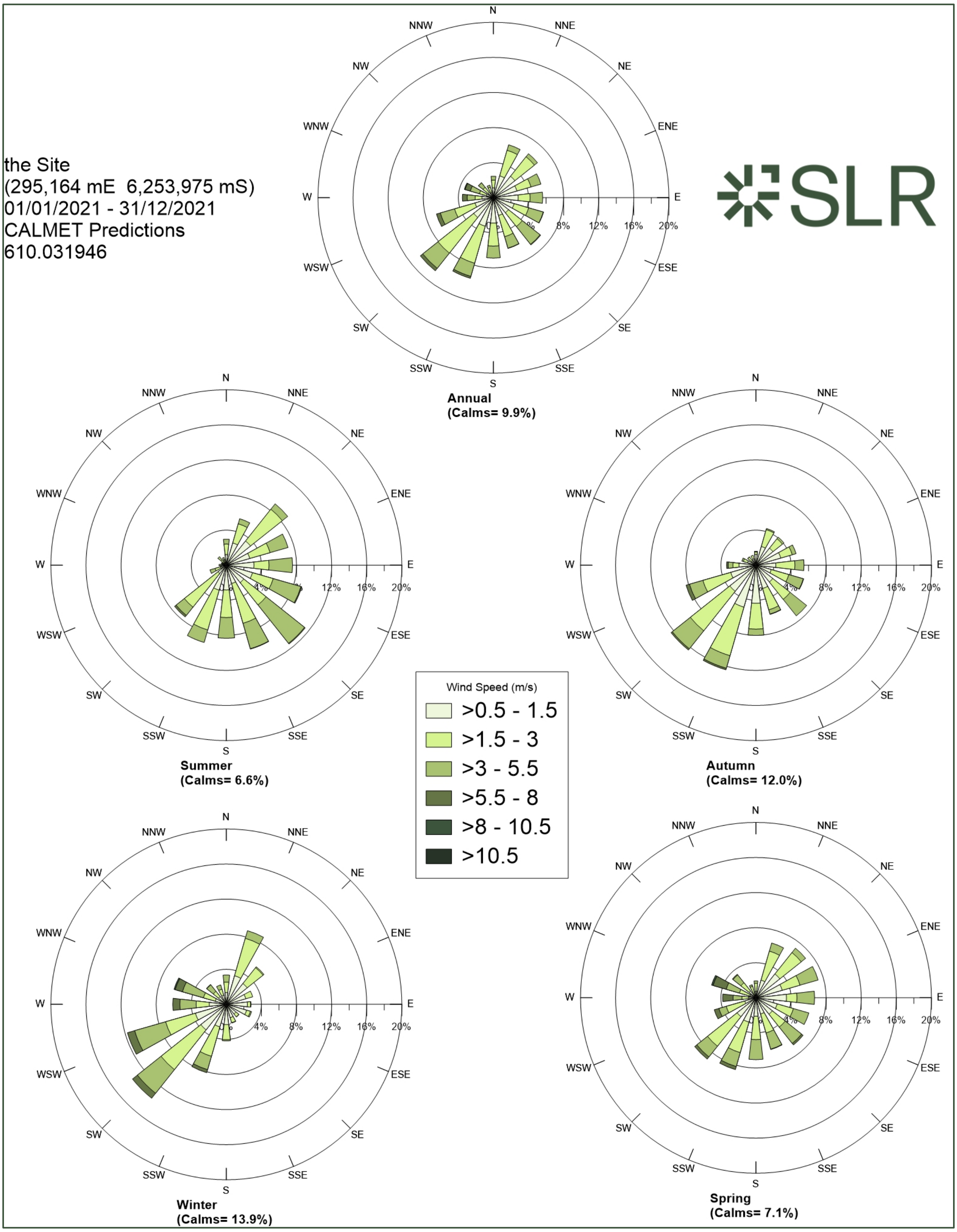
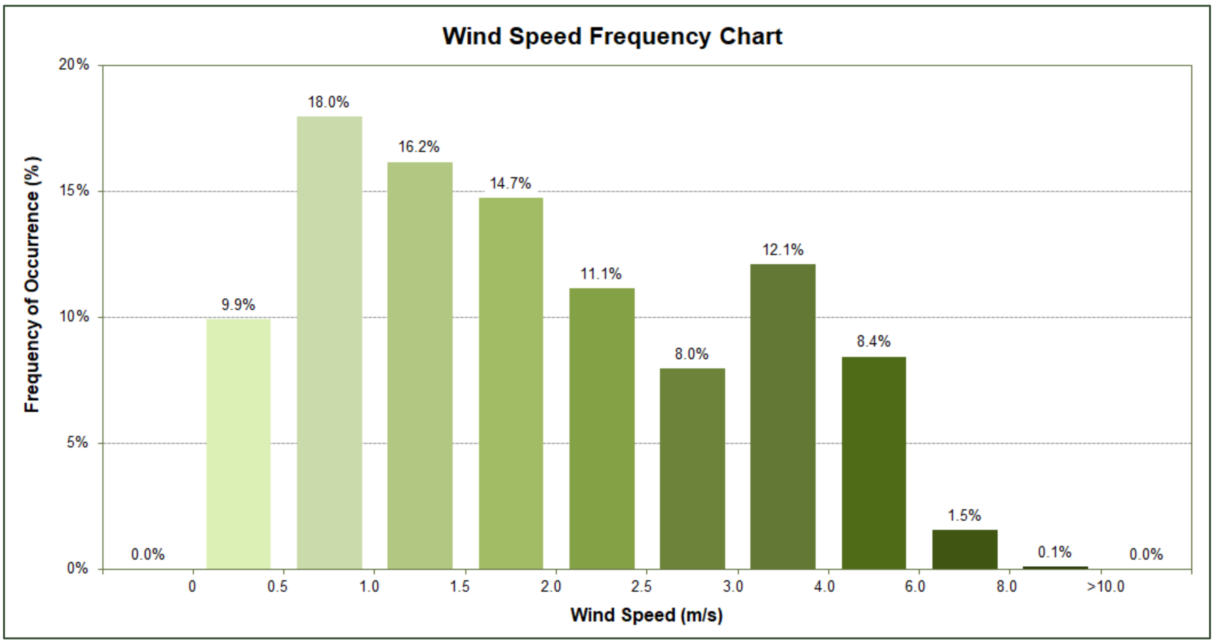


Figure B-2 Annual Wind Speed Frequencies at the Site (CALMET Predictions, 2021)



Atmospheric Stability

Atmospheric stability refers to atmospheric turbulence and the tendency of the atmosphere to resist or enhance vertical motion. Depending on conditions the atmospheric stability can either inhibit or promote pollutant dispersion. The Pasquill-Gifford scheme provides six stability classes, A to F, to categorise the degree of atmospheric stability as follows:

- A = Extremely unstable conditions
- B = Moderately unstable conditions
- C = Slightly unstable conditions
- D = Neutral conditions
- E = Slightly stable conditions
- F = Moderately stable conditions

The meteorological conditions defining each PGT stability class are shown in Figure B-3.

Unstable conditions are favourable for dispersion, while stable conditions are unfavourable for dispersion.

The dispersion modelling in CALPUFF used a more advanced atmospheric stability scheme (based on micro meteorology). Stability class data was extracted from the meteorological dispersion modelling data set for the meteorological data evaluation.

Table B-1 Meteorological Conditions Defining PGT Stability Classes

Surface Wind Speed (m/s)	Daytime Insolation			Night-Time Conditions	
	Strong	Moderate	Slight	Thin overcast or > 4/8 low cloud	<= 4/8 cloudiness
< 2	A	A - B	B	E	F
2 - 3	A - B	B	C	E	F

3 - 5	B	B - C	C	D	E
5 - 6	C	C - D	D	D	D
> 6	C	D	D	D	D

Source: (NOAA 2018)

Notes:

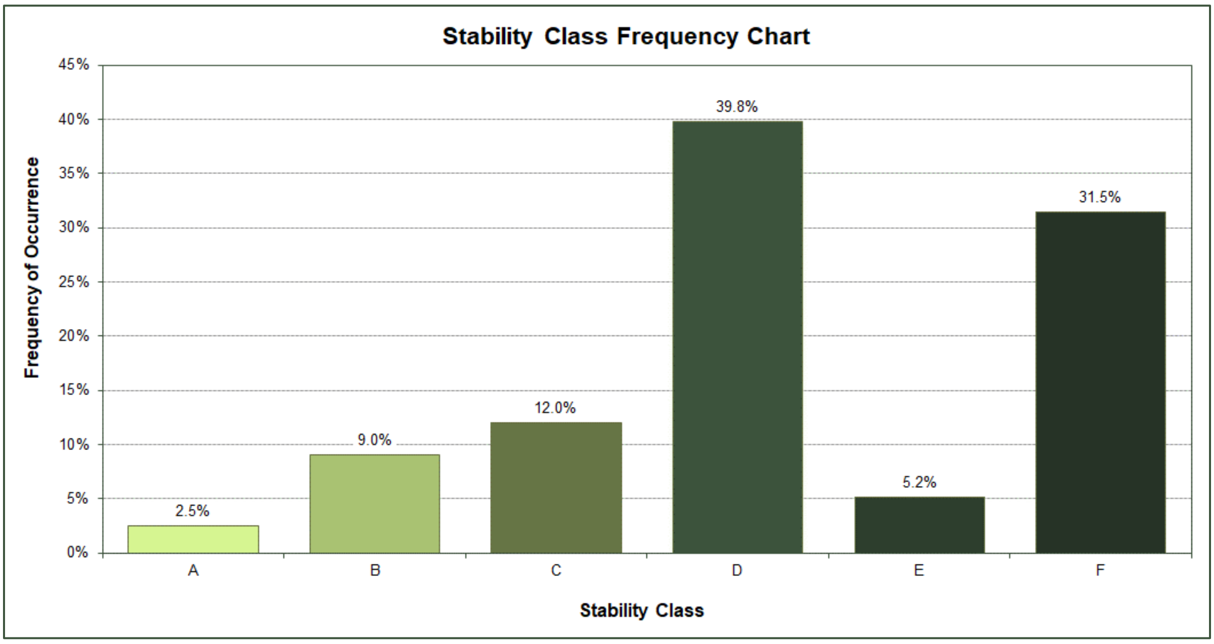
1. Strong insolation corresponds to sunny midday in midsummer in England, slight insolation to similar conditions in midwinter.

2. Night refers to the period from 1 hour before sunset to 1 hour after sunrise.

3. The neutral category D should also be used, regardless of wind speed, for overcast conditions during day or night and for any sky conditions during the hour preceding or following night as defined above.

The frequency of each stability class predicted by CALMET at the Site during the modelling period is presented in Figure B-3. The results indicate a high frequency of conditions typical to Stability Class D and F. Stability Class D is indicative of neutral conditions, conducive to a moderate level of pollutant dispersion due to mechanical mixing. Stability Class F is indicative of calm conditions, that typically indicates poorer dispersion of pollutants.

Figure B-3 Predicted Stability Class Frequencies at the Site (CALMET predictions, 2021)



Mixing Heights

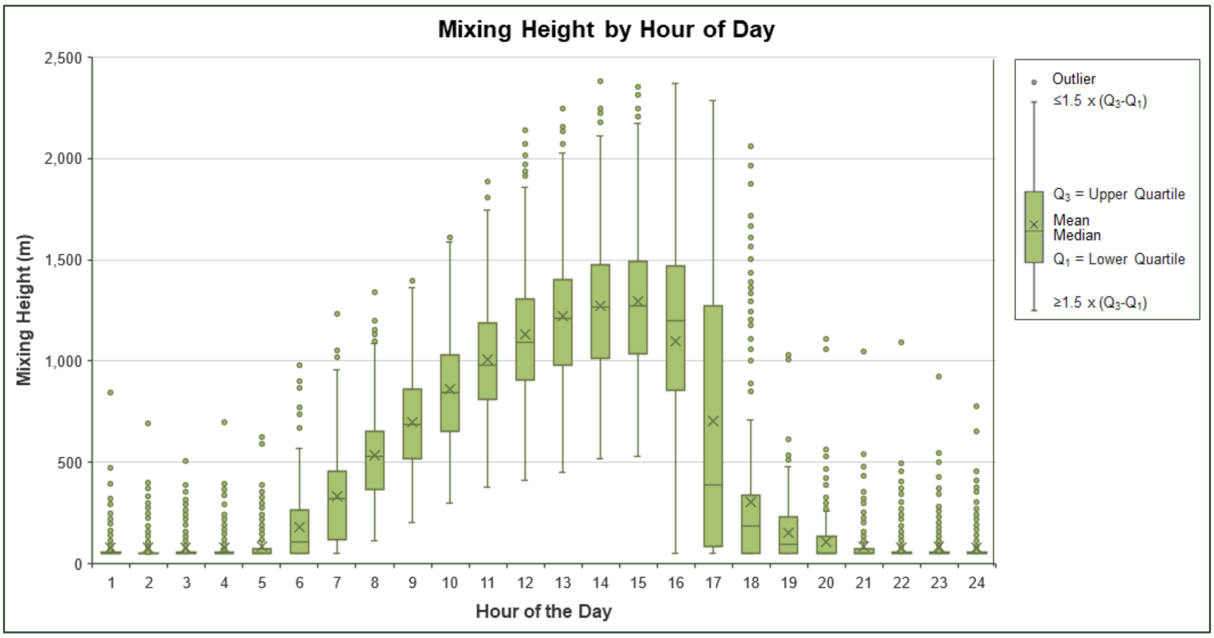
The mixing height is the depth of the atmospheric mixing layer between ground level and an elevated temperature inversion. Depending on conditions, vertical dispersion is typically limited by the mixing height. This is an important parameter in dispersion modelling since the mixing height largely sets the vertical profile the dispersion can take place in.

Mixing heights have a diurnal variation in response to mixing from convection due to insolation and grow from sunrise to around midday. Followed by a decline until sunset when there typically is a rapid decline. If a plume penetrates through, or is released above, the mixing height the pollutants will be trapped aloft with no mixing to ground level (unless in specific conditions such as fumigation). Similarly, if a plume is trapped below a low mixing height (inversion layer) the vertical dispersion will be limited, and higher ground-level concentrations are likely to occur.

Diurnal variations in maximum and average mixing heights predicted by CALMET at the Site during the 2021 modelling period are illustrated in Figure B-4.

As would be expected, an increase in mixing depth during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground-based temperature inversions and growth of the convective mixing layer.

Figure B-4 Predicted Mixing Heights at the Site (CALMET predictions, 2021)



Appendix C Emission Factors and Assumptions for Emissions Estimation

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Particulate matter emissions from the Project have been estimated using published emission factors for the relevant emission sources. Emission factors were sourced from the following documents:

- National Pollutant Inventory Emissions Estimation Technique Manual (NPI EETM) for Mining Version 3.1 (DSEWPC 2012)
- US EPA AP42 Section 11.9 Western Surface Coal Mining (US EPA 1998)
- US EPA AP42 Section 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (US EPA 2004)
- US EPA AP42 Section 13.2.2 Unpaved Roads (US EPA 2006a)
- US EPA AP42 Section 13.2.4 Aggregate Handling and Storage Piles (US EPA 2006b)
- US EPA AP42 Section 13.2.5 Industrial Wind Erosion (US EPA 2006)
- Proposed Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors (Cowherd, Donaldson and Hegarty 2010)
- National Pollutant Inventory Emissions Estimation Technique Manual (NPI EETM) for Combustion engines Version 3.0 June 2008 (DEWHA 2008)

A summary of the emission factor equations used to estimate emissions from each activity at the Site are presented in **Table C-1**.

The assumptions applied to the relevant equations are provided as follows:

- Material properties refer to **Table C-2.**
- Vehicle properties and exposed areas refer to **Table C-3**.

Dust control measures are presented in **Table C-5**.

Estimated emission rates are presented in **Table C-6**.

Table C-1 Summary of Emission Factor/ Equations Used to Estimate Emissions

Activity	Emission Factor			Units	Source	Notes
	TSP	PM_{10}	$PM_{2.5}$			
Scraper stripping topsoil and cut material	EFTSP = 0.029	$EFPM_{10}$ = 0.0073	$EFPM_{2.5}$ = 0.0015	kg/t	EFTSP: (US EPA 1998) $EFPM_{10}$: (DSEWPC 2012) $EFPM_{2.5}$: (Cowherd, Donaldson and Hegarty 2010)	As detailed in Section 1.1.13 of the NPI EETM for Mining (DSEWPC 2012), the PM_{10} emission factor was derived from the application of PM_{10}/TSP ratio for the scraper in travel mode (i.e. 25%).
Unloading and unloading (material transfer)	$EF_{TSP} = \frac{0.74 \times 0.0016 \times \frac{U}{2.2}^{1.3}}{\frac{M}{2}^{1.4}}$	$EF_{PM10} = \frac{0.35 \times 0.0016 \times \frac{U}{2.2}^{1.3}}{\frac{M}{2}^{1.4}}$	$EF_{PM2.5} = \frac{0.053 \times 0.0016 \times \frac{U}{2.2}^{1.3}}{\frac{M}{2}^{1.4}}$	kg/t	EFTSP & $EFPM_{10}$: (DSEWPC 2012) $EFPM_{2.5}$: (US EPA 2006b)	U1.3/2.2 = wind speed factor = 1.0 Refer to **Table C-2** for moisture (M) assumptions

Activity	Emission Factor			Units	Source	Notes
	TSP	PM_{10}	$PM_{2.5}$			
Dozer	$EF_{TSP} = 2.6 \times \frac{s^{1.2}}{M^{1.3}}$	$EF_{PM10} = 0.34 \times \frac{s^{1.5}}{M^{1.4}}$	$EFPM_{2.5} = 0.105 \times EFPM_{10}$	kg/h	EFTSP & $EFPM_{10}$: (DSEWPC 2012) $EFPM_{2.5}$: (Cowherd, Donaldson and Hegarty 2010)	Refer to **Table C-2** for silt (s) and moisture (M) assumptions
Crushing	EFTSP = 0.0027	$EFPM_{10} = 0.0012$	$EFPM_{2.5} = 0.148 \times TSP$	kg/t	(US EPA 2004)	The $PM_{2.5}$ emission factor was derived from the application of $PM_{2.5}/PM_{10}$ ratio of tertiary crushing (controlled) emission factors
Screening	EFTSP = 0.029	$EFPM_{10} = 0.0043$	$EFPM_{2.5} = 0.068 \times EFPM_{10}$	kg/t	(US EPA 2004)	The $PM_{2.5}$ emission factor was derived from the application of $PM_{2.5}/PM_{10}$ ratio of tertiary screening (controlled) emission factors

Activity	Emission Factor			Units	Source	Notes
	TSP	PM_{10}	$PM_{2.5}$			
Grader	$EF_{TSP} = 0.0034 \times S^{2.5}$	$EF_{PM10} = 0.3375 \times \frac{S^{1.5}}{M^{1.4}}$	$EFPM_{2.5} = 0.148 \times EFPM_{10}$	kg/vkt	(US EPA 1998)	As detailed in Table 11.9-2 of AP42 Section 11.9, the $PM_{2.5}$ emission factor was derived from the scaling factor for $PM_{2.5}$/TSP
Vehicle Movements on Unpaved Roads	$EF_{TSP} = \left(\frac{0.4536}{1.6093}\right) \times 4.9 \times \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	$EF_{PM10} = \left(\frac{0.4536}{1.6093}\right) \times 1.5 \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	$EF_{PM2.5} = \left(\frac{0.4536}{1.6093}\right) \times 0.15 \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	kg/VKT	(US EPA 2006a)	Refer to **Table C-2** for surface silt (s) and vehicle weight (W) assumptions
Wind Erosion of Exposed Areas	EFTSP = 0.4	$EFPM_{10} = 0.5 \times EFTSP$	$EFPM_{2.5} = 0.075 \times EFTSP$	kg/ha/hr	EFTSP & $EFPM_{10}$: (DSEWPC 2012) $EFPM_{2.5}$: (US EPA 2006)	Refer to **Table C-4** for assumptions.

Activity	Emission Factor			Units	Source	Notes
	TSP	PM_{10}	$PM_{2.5}$			
Where: M = material moisture content (%) s = material silt content (or surface silt content in unpaved roads) (%) U = wind speed (m/s) W = mean vehicle weight (tonnes) S = mean vehicle speed (km/h)						

Table C-5 Control Measures

Control Measure	Control Efficiency
Water carts used while scrapers stripping	50%
Water carts used while scraper travels	75%
Water carts used during material transfer activities	75%
Water carts used on haulage routes (Level 2 watering (>2 L/m^2/h)	75%
Water carts used with dozer activities*	50%
Water carts used with grader activities	50%
Water carts used on exposed area	50%
Source: (DSEWPC 2012) *Assumed to be similar to scrapers stripping.	

Haul Road Watering to Supress Wheel Generated Dust

The NPI EETM for Mining indicates emission control of wheel generated dust as follows:

- Level 1 watering (2 L/m^2/h): 50% control
- Level 2 watering (>2 L/m^2/h): 75% control

Site specific watering emission control C expressed as a percentage can be estimated from typical evaporation rates for the area and haul road traffic rate using the following equation (Air & Waste Management Association 2000):

$$C = 100 - \frac{0.8pdt}{i}$$

where p is the average hourly daytime evaporation rate, d is the average hourly daytime traffic rate, t is the time (hours) between water application and i is the application intensity (L/m2).

BoM[2] publish total evaporation maps for Australia showing the amount of water which evaporates from an open pan. Annual average and seasonal average evaporation rates for the area in which the Project is situated are calculated from these maps which indicate the following:

- approximate total annual average evaporation rate: 1600 mm, or 0.18 mm/h
- approximate total summer average evaporation rate: 600 mm, or 0.28 mm/h

Using water carts and water sprays to supress dust emissions will achieve less control in areas with greater evaporation than areas with less evaporation. Greater rates of watering are likely to be required in summer when evaporation rates are increased to achieve adequate dust control.

From the evaporation rates above, if a conservative traffic rate of 40 movements per hour and 1 hour between water applications, a control of greater than 90% is calculated for the Site haul roads (including for the summer months) with a watering rate of less than 1 L/m^2/h.

[2] Australian Climate Averages - Evaporation (Climatology 1975-2005), , http://www.bom.gov.au/jsp/ncc/climate_averages/evaporation/index.jsp?period=sum#maps, accessed February 2025

This control rate would increase with more frequent water application, likely lower traffic rates, and the anticipated watering rate of less than 2 L/m^2/h. However, for modelling purposes, a 75% control factor was conservatively applied to the unpaved haul road wheel generated dust estimates.

Appendix D Variable Emission file

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Mirvac Projects Pty Ltd

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Variable Emission File – Calculation Steps

A brief summary of the steps used in calculating the hourly varying emission rates for each source are presented below.

Step 1: Calculate annual average emission rate (kg/year) for FP, CM and RE

FPannual = $PM_{2.5}$, annual	(FP) Fine Particulate – particulate of size less than 2.5 µm
CMannual = PM_{10}, annual – $PM_{2.5}$, annual	(CM) Coarse Particulate – particulate of size between 10 µm and 2.5 µm
REannual = TSPannual - PM10, annual	(RE) Rest Particulate – particulate of size greater than 10 µm

Step 2: Identify the operating hours for each activity

Step 3: Classify the sensitivity of each type of activity to wind speed

Wind insensitive: activities with emission factor that is independent of wind speed (e.g. blasting)

Wind sensitive: activities with emission factor that is a function of (wind speed/2.2)1.3 (e.g. loading)

Wind erosion: emission from exposed areas/stockpiles

Step 4: Identify the number of sources associated with each activity

Note that each wind erosion source is modelled as an independent source.

Step 5: Calculate the hourly average emission rate for each activity per source

$FP_{AC,i,h} = \frac{FP_{annual,i} \times 1000}{N_{days} \times OH_i \times 3600 \times N_{s,i}} \times WSFactor_{i,h}$	
$CM_{AC,i,h} = \frac{CM_{annual,i} \times 1000}{N_{days} \times OH_i \times 3600 \times N_{s,i}} \times WSFactor_{i,h}$	WHERE: FPAC,I,H- FINE PARTICULATES EMISSION RATE FOR ACTIVITY I (G/S) AT HOUR H CMAC,I,H- FINE PARTICULATES EMISSION RATE FOR ACTIVITY I (G/S) AT HOUR H CMAC,I,H- FINE PARTICULATES EMISSION RATE FOR ACTIVITY I (G/S) AT HOUR H OHI-DAILY OPERATING HOURS (1- 24) FOR ACTIVITY I NDAYS -NUMBER OF DAYS IN THE METEOROLOGICAL DATA FILE NS,I -NUMBER OF SOURCES ASSOCIATED WITH ACTIVITY I WSH-WIND SPEED AT THE HOUR N -NUMBER OF HOURS IN THE METEOROLOGICAL DATA FILE
$RE_{AC,i,h} = \frac{RE_{annual,i} \times 1000}{N_{days} \times OH_i \times 3600 \times N_{s,i}} \times WSFactor_{i,h}$	
FOR WIND INSENSITIVE ACTIVITIES $WSFactor_{i,h} = 1$	
FOR WIND SENSITIVE ACTIVITIES $WSFactor_{i,h} = \frac{\left(\frac{WS_h}{2.2}\right)^{1.3}}{\frac{\sum_{j=1}^{n}\left(\frac{WS_j}{2.2}\right)^{1.3}}{n}}$	
FOR WIND EROSION ACTIVITIES $WSFactor_{i,h} = \frac{(WS_h)^3}{\frac{\sum_{j=1}^{n}(WS_j)^3}{n}}$	

Note: If the activity was modelled as area source, the equation on the left column of the table needs to be divided by the area of that activity.

<u>Step 6: Calculate hourly average emission rate for each source</u>

To calculate the emission rate for a particular source for a particular hour, add up the calculated emission rate for each activity associated with source.

For example, if Source 1 is associated with Activity 1, Activity 2 and Activity 3, then:

ERS1,h,FP = FPAC,1,h+ FPAC,2,h+ FPAC,3,h

ERS1,h,CM = CMAC,1,h+ CMAC,2,h+ CMAC,3,h

ERS1,h,RE = REAC,1,h+ REAC,2,h+ REAC,3,h

Appendix E Isopleths

Elizabeth Enterprise Precinct - Stage 1

Air Quality Impact Assessment

Mirvac Projects Pty Ltd

SLR Project No.: 610.032539

4 March 2025

Figure E 1 Predicted 24-hour Average Incremental PM_{10} Isopleth Plot

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The content within this document may be based on third party data. SLR Consulting Australia Pty Ltd does not guarantee the accuracy of such information.

Project Number:	610.032539
Location:	Kemps Creek, NSW
Source:	Nearmap
Projection:	WGS 84 \ UTM Zone 56
Date:	04/03/2025

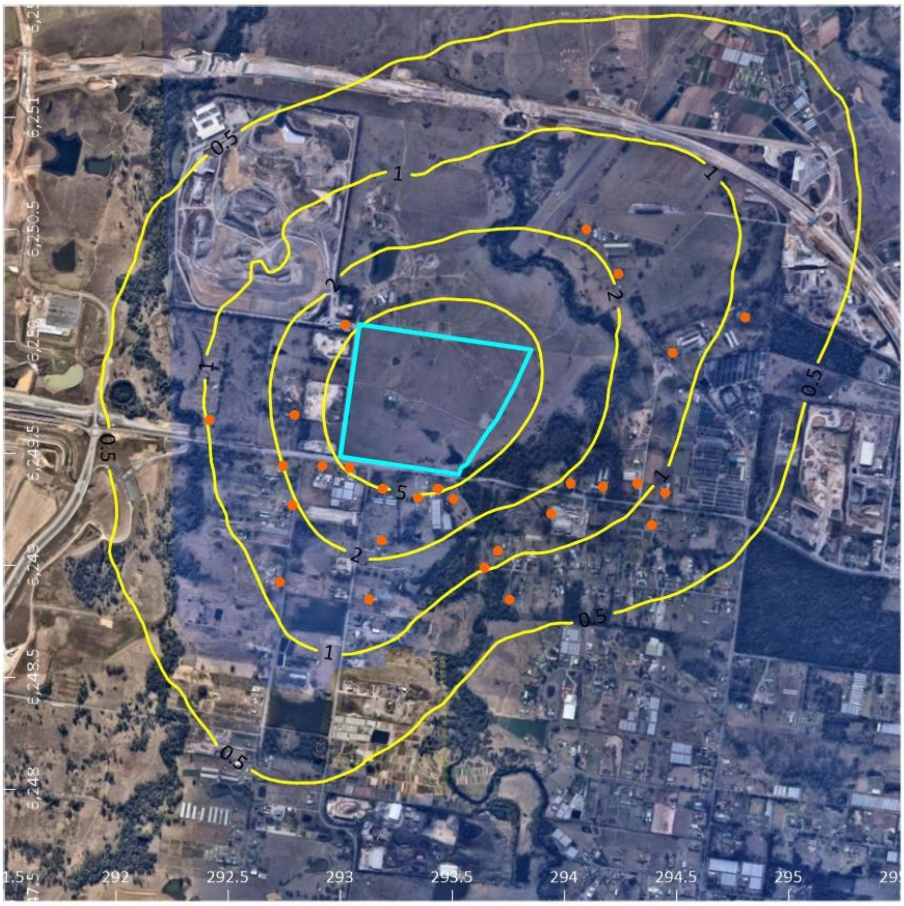
Mirvac Projects Pty Ltd

EEP Stage 1
Air Quality Impact Assessment

Construction

Pollutant:	PM10	Averaging Period:	24-hour	Unit:	µg/m³

Figure E 2 Predicted Annual Average Incremental PM_{10} Isopleth Plot



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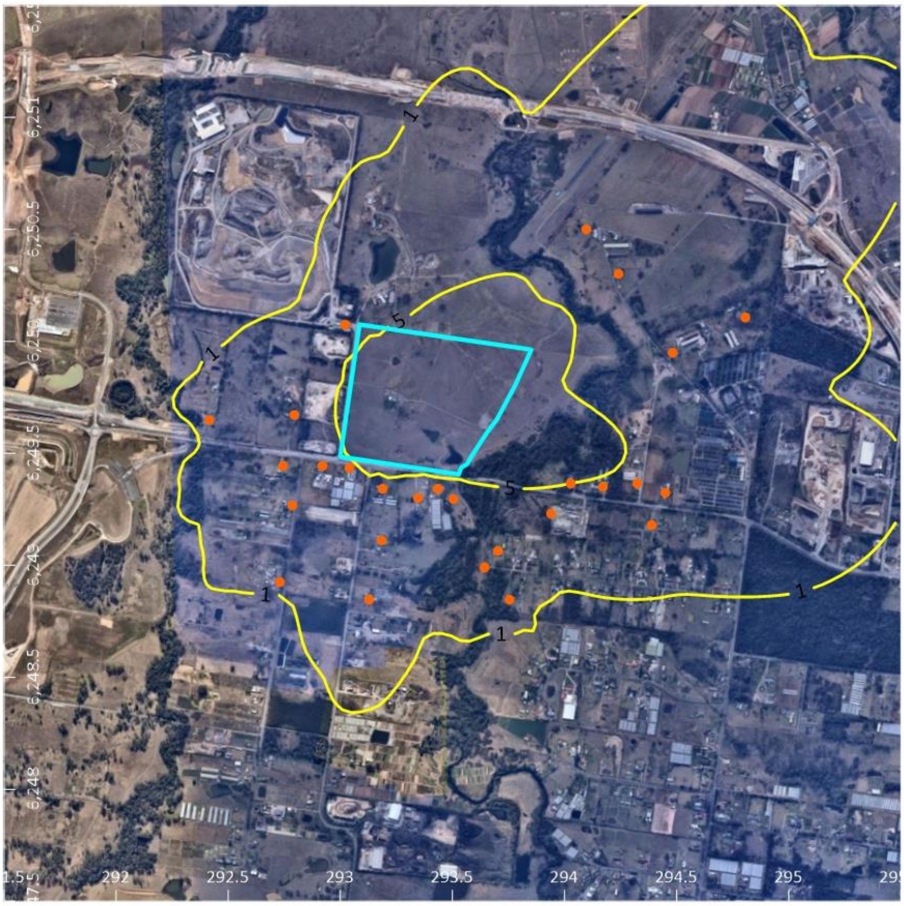
EEP Stage 1
Air Quality Impact Assessment

Construction

Pollutant:	PM10	Averaging Period:	Annual	Unit:	µg/m³

Figure E 3 Predicted 24-hour Average Incremental $PM_{2.5}$ Isopleth Plot



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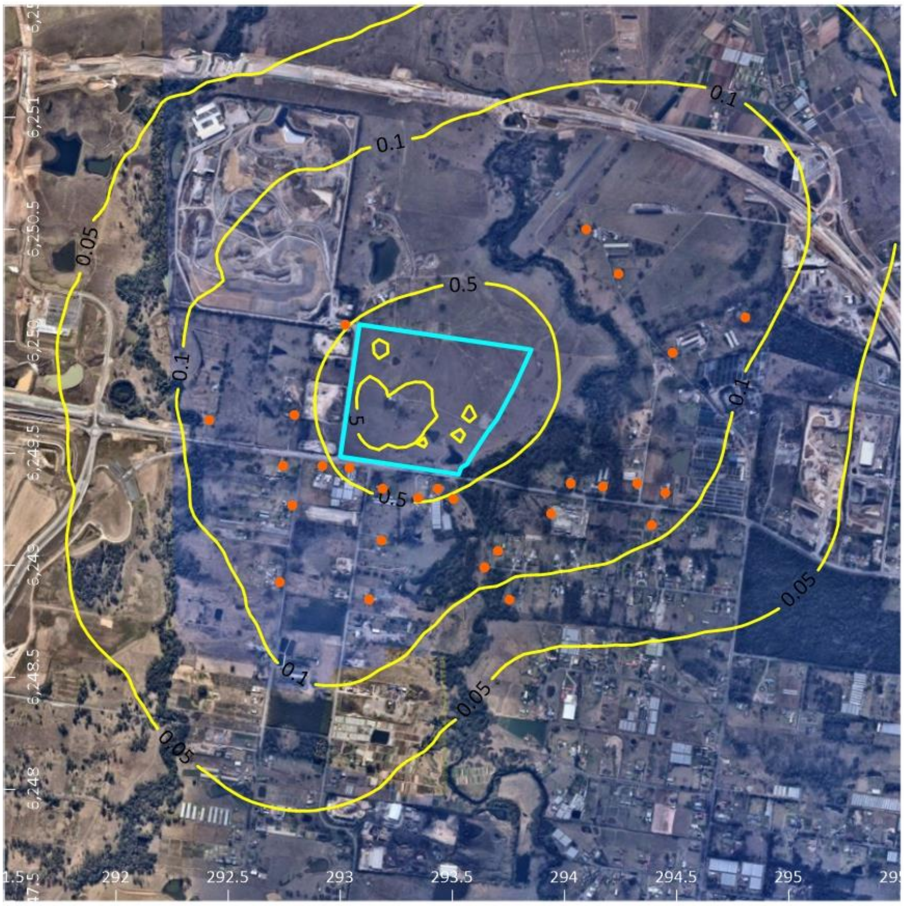
EEP Stage 1
Air Quality Impact Assessment

Construction

Pollutant:	PM2.5	Averaging Period:	24-hour	Unit:	µg/m³

Figure E 4 Predicted Annual Average Incremental $PM_{2.5}$ Isopleth Plot



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Date:	04/03/2025

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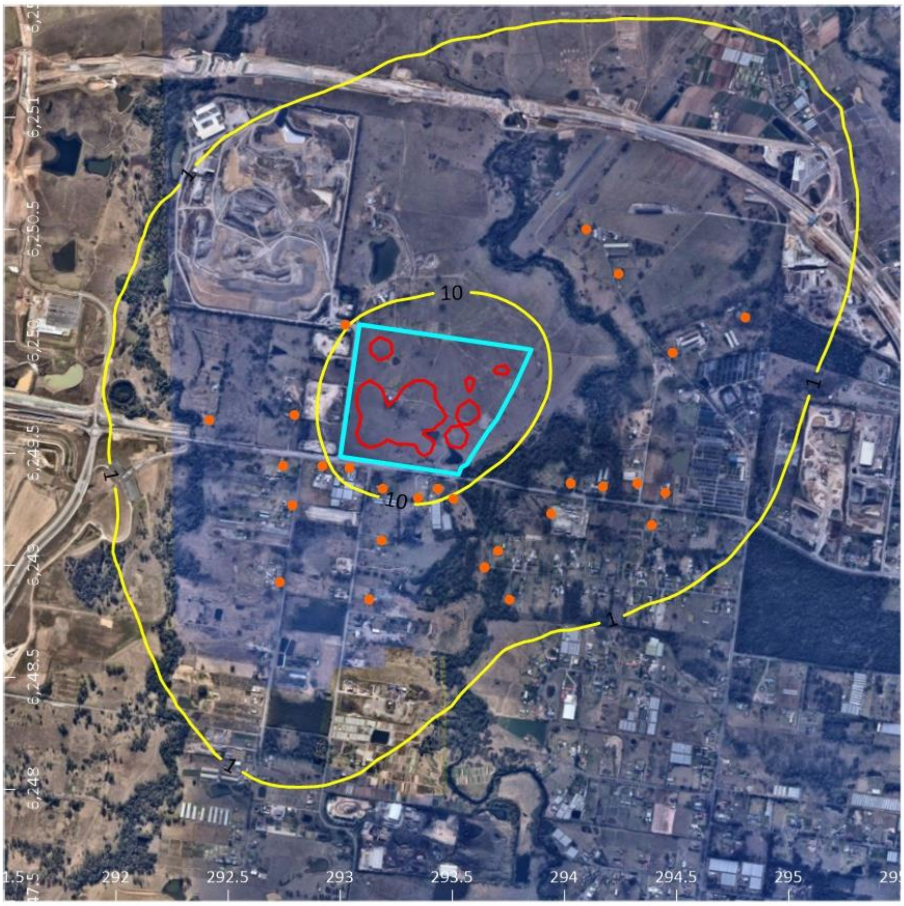
EEP Stage 1
Air Quality Impact Assessment

Construction

Pollutant:	PM2.5	Averaging Period:	Annual	Unit:	µg/m³

Figure E 5 Predicted Annual Average Incremental TSP Isopleth Plot



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Location:	Kemps Creek, NSW
Source:	Nearmap
Projection:	WGS 84 \ UTM Zone 56
Date:	04/03/2025

N W E S

Mirvac Projects Pty Ltd

EEP Stage 1
Air Quality Impact Assessment

Construction

Pollutant:	TSP	Averaging Period:	Annual	Unit:	µg/m³

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