



225-245 Martin Road, Bradfield Bulk Earthworks, Rehabilitation & Quarrying - SSD-97711727

Air Quality Impact Assessment

Goodman Property Services (Aust) Pty Ltd

The Hayesbery
1-11 Hayes Road
Rosebery NSW 2018

Prepared by:

SLR Consulting Australia Pty Ltd

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v1.0	11 March 2026	Kate Barker Ali Naghizadeh	Graeme Starke	Graeme Starke

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 Goodman Property Services (Aust) 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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Acronyms and Abbreviations

%	percent
>	greater than
<	less than
°C	degrees Celsius
µg	microgram
µg/m ³	microgram per cubic metre
µm	microns
AHD	Australian Height Datum
AMO	Aeronautical Meteorological Observer
Approved Methods	<i>Approved Methods for Modelling and Assessment of Air Pollutants in NSW (2022)</i>
Approved Methods for Sampling	<i>Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (2022)</i>
AQIA	Air Quality Impact Assessment
AQMS	Air Quality Monitoring Station
AWS	Automatic Weather Station
BoM	Bureau of Meteorology
CASANZ	Clean Air Society of Australia and New Zealand
CAQP	Certified Air Quality Professional
CAQMP	Construction Air Quality Management Plan
CO	carbon monoxide
CO ₂	carbon dioxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEEW	Department of Climate Change, Energy, the Environment, and Water
DoP	Department of Planning
DPE	NSW Department of Planning and Environment (now Department of Planning, Housing and Infrastructure)
DPHI	Department of Planning, Housing and Infrastructure
EIS	Environmental Impact Statement
ENZ	environment and recreation zoned land
EPL	Environment Protection Licence
EV	electric vehicles
g	gram
GFA	gross floor area
GLA	gross lettable area
GMR	Greater Metropolitan Area



g/VKT	grams per vehicle kilometre travelled
ha	hectares
HDV	heavy duty vehicles
IPG	Ingham Property Group
km	kilometre
km/hr	kilometres per hour
kw	kilowatts
LDV	light duty vehicles
m	metres
mm	millimetres
m/s	metre per second
m ²	square metres
m ³	cubic metre
mg/m ³	milligram per cubic metre
NEPC	National Environment Protection Council
NEPM AAQ	National Environment Protection (Ambient Air Quality) Measure
NO	nitric oxide
NO ₂	nitrogen dioxide
NO _x	oxides of nitrogen
NPI	National Pollutant Inventory (Australia)
NSW	New South Wales
NSW EPA	Environmental Protection Authority
O ₃	ozone
OLM	Ozone Limited Method
PM ₁₀	particulate matter with an equivalent aerodynamic diameter of 10 microns or less
PM _{2.5}	particulate matter with an equivalent aerodynamic diameter of 2.5 microns or less
RAQST	Roadside Air Quality Screening Tool
POEO Act	Protection of the Environment Operations Act
pphm	parts per hundred million (10 ⁸)
ppm	parts per million (10 ⁶)
REF	Review of Environmental Factors
SEPP	State Environmental Planning Policy
SEARs	Secretary's Environmental Assessment Requirements
SLR	SLR Consulting Australia Pty Ltd
SO ₂	sulphur dioxide



SSD	State Significant Development
SSDA	State Significant Development Application
TARP	Trigger Response Action Plan
TfNSW	Transport for New South Wales
TSP	total suspended particulate matter
VOCs	volatile organic compounds
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VKT	vehicle kilometres travelled
WHO	World Health Organization



Non-Technical Executive Summary

SLR Consulting Australia Pty Ltd was commissioned by Goodman Property Services (Aust) Pty Ltd (Applicant), on behalf of Goodman Western Sydney Pty Limited as trustee for the Goodman Western Sydney Trust (Owner), to prepare an air quality impact assessment report for the bulk earthworks for the development located at 225 – 245 Martin Road, Bradfield, 2556.

The main potential sources of air emissions were identified as fugitive particulate matter (PM₁₀, PM_{2.5}, TSP, and dust deposition) from the proposed bulk earthworks activities. The potential for off-site dust impacts during the bulk earthworks was assessed through a Level 2 quantitative modelling approach using TAPM/CALMET/CALPUFF in general accordance with NSW EPA Approved Methods. Cumulative impacts from surrounding approved and proposed developments were also considered.

The results of this assessment, which was based on a conservative scenario assuming all activities occur concurrently, indicate that exceedances of short term and long term PM_{2.5} and PM₁₀ criteria could potentially occur if sufficient mitigation measures are not adopted by the Site. It is noted the predicted concentrations are likely an overestimation of actual concentrations due to conservative emissions estimation assumptions and conservative assumption regarding overlapping concurrent construction activities across the Badgerys Creek Precinct.

Construction mitigation measures have been recommended for inclusion in a Construction Air Quality Management Plan. It is recommended that real-time monitoring of ambient air quality be performed throughout the construction period and that the Site utilises a Trigger Action Response Plan (TARP) based on 1-hour average PM₁₀ concentrations and wind directions with a range of actions to minimise the potential for adverse effects at the sensitive receptors be adopted.

Greenhouse gas emissions have been estimated for Scope 1 and Scope 3 emissions. Scope 2 emissions due to electricity consumption is likely to be well below 5% of the total inventory and below materiality threshold. The annual emissions of 25,331 t CO₂-e per annum (scope 1 and scope 3 combined) represent 0.0005% of the global emissions estimated for 2024 of 53.2 Gt CO₂-e (EC 2025).

It is concluded that with an appropriate ambient air quality monitoring plan and TARP in place, as well as greenhouse gas reduction strategies, the proposed construction activities can be completed without any significant impact on the surrounding receptors.



1.0 Introduction

1.1 Project Overview

This Air Quality Impact Assessment (AQIA) has been prepared by SLR Consulting Australia Pty Ltd (SLR) to address the site-specific Secretary's Environmental Assessment Requirements (SEARs) received in respect of the proposed State Significant Development Application (SSDA) No. 97711727. The proposed development includes Rehabilitation, Quarrying and Bulk Earthworks and is being undertaken by Goodman Property Services (Aust) Pty Ltd (Applicant) on behalf of Goodman Western Sydney Pty Limited as trustee for the Goodman Western Sydney Trust (Owner). The development is located at 225 – 245 Martin Road, Bradfield, 2556 (the Site).

This SSDA seeks approval for the following:

- Site Preparation works only (i.e. no buildings, retaining walls or other infrastructure works).
- Rehabilitation of areas disturbed by historic mining and brick-making operations under major project approval MP10_0014 and MP10_0033.
- Bulk Earthworks to the site to align with the Connecting to Country and Precinct Plan principles including both the disturbed and undisturbed portions to capture the following proposed works:
 - Rehabilitation of Pits 1 & 2 using predominantly on-site fill (Engineered fill import required).
 - Preparation of the remaining site area to Bulk Earthwork Levels (BEL) (not including detailed trimming) for the proposed industrial development as considered under SSDA 97688711.
- Quarrying and Export of Bringelly Shale and Clay from select areas of Pit 1 & 2 to rectify the previous approved pit designs to ensure they are geotechnically stable to suit the proposed industrial masterplan.
- Vegetation Removal of 6.97 hectares (ha) over land that is not certified under the Growth Centre SEPP.
 - Species being cleared involve species protected under both the BC Act and EPBC Act.
 - EPBC Act Referral completed on a precautionary measure given small amount of EPBC listed communities.
- Demolition of any remaining structures on the site.
- Rehabilitation of identified and unidentified contamination and, if required, the construction of a containment cell in the proposed northeastern corner of the site (currently identified as Lot 55 of DP 3050). The containment cell is proposed to trigger Designated Development threshold due to the proposed upper limit storage volume of 100,000 m³
- Relocation of the Jemena Gas main predominantly burdening Lot 3 of DP1278780.
- If required through an Aboriginal Cultural Heritage Assessment Report (ACHAR), relocation and reburial of artefacts.



Additionally, this SSDA application seeks to rely on already existing authority approvals issued under MP10_0014 (subject to any applicable modifications). These are as follows:

- Mining Lease 1771
- Environmental Protection Licence 684
- Ground Water Access Licence WAL24346
- Ground Water Supply Works Approval No. 10WA109463

It is important to note that a number of the proposed activities being sought for approval under this SSDA have previously been assessed and approved under MP10_0014. The existing DA relates to approximately 70 ha of Net Developable Area (NDA), with the new portion of site approx. 36ha NDA. Cumulatively the area is approx. 116ha NDA.

It is important to note that a number of the proposed activities being sought for approval under this SSDA have previously been assessed and approved under MP10_0014. The existing DA relates to approximately 70 ha of Net Developable Area (NDA), with the new portion of site approx. 36 ha NDA. Cumulatively the area is approx. 116 ha NDA.

1.1.1 Related Applications/Activities

SSDA 97688711 – 14 warehouse buildings, Active Open Space & amenities precinct (including a café) and internal site infrastructure works

The SSDA seeks approval for the construction, fit-out (including office and standard warehouse racking) and operation of 14 warehouse buildings, active open space & amenities precinct (including a café) and internal site infrastructure works.

This application assumes the bulk earthworks are completed under SSDA 97711727.

Part 5 Activity – External Works Lead in Roads and Services

The Applicant is proposing access to the Site via the following route which will be upgraded to be in accordance with the Precinct Plan.

Part 1 - Martin Road / Elizabeth Drive intersection upgrades

- It is expected that these works will be approved by way of amendment to the existing Part 5 approval by Transport for New South Wales ('TfNSW').
- It is understood that TfNSW will construct the work with a target completion date of December 2029.

Part 2 -4 - Martin Road / East West Collector Road / Lawson Road Upgrades

- Further to Part 1, access to the site is proposed to be constructed concurrently as follows:
 - Part 2 – Access from the Martin Road / Elizabeth Drive intersection will continue down Martin Road and join the future East / West Collector road identified within the Precinct Plan through Lot 36 DP 3050.
 - The portion of road between the Intersection and future East / West Collector road will be upgraded with a temporary access strategy that is consistent with Condition DS5 of the Precinct Plan.



- Part 3 – The East / West Collector road through Lot 36 DP 3050 is proposed to be delivered in ultimate form consistent with the Precinct Plan, connecting Martin Road and Lawson Road.
 - Part 4 – From the East / West Collector Road connection on Lawson Road, the portion of Lawson Road South through to the Site will be upgraded in ultimate form consistent with the Precinct Plan.
- It is expected that these works are completed by December 2029, based on a commencement date of June 2028.

It is the Applicants expectation that the above-mentioned works (Part 1-4) are completed prior to the receipt of the first building Occupation Certificate (expected December 2029).

Notwithstanding the above, the Applicant notes that access to the site under SSD 97711727 will continue to be via Martin Road based on the intersection upgrades completed under MP10_0014.

1.2 Site Overview

The Site is identified as 225-245 Martin Road Bradfield. The key features of the Site are as follows.

Description	Site detail
Land Configuration	Lot 1 DP 1278780 Lot 2 DP 1278780 Lot 3 DP 1278780 Lot 55 DP 3050 Lot 56 DP 3050
Existing land use(s)	The Site is currently an operational Quarry and historically had a Brickmaking Facility. The structures and hardstand areas used for the quarry operations are located in the central portion of the Site, connected by an internal road network. In addition, three pits are located along the southern and southeast portion of the Site.
Surrounding Land Use	Surrounding land uses include: • North: Land to the north is predominantly characterised by a mix of rural, agricultural, landscape industries and, residential properties accessed by Lawson and Martin Roads. It is noted that several sites are subject to existing SSDAs for industrial / warehouse developments. Both Martin and Lawson Roads intersect with Elizabeth Drive, a major Arterial Road that provides access to the WSI site and the broader regional road network including the M7, Northern Road and the future M12. • South: The land to the south is currently rural however is subject to the IPG Master Plan which was approved on 11 July 2025. The approved Master Plan covers 184 hectares and aims to support over 12,400 jobs. Inghams Property Group has allocated around 625,467 sqm for employment space, focusing on advanced manufacturing, logistics, and community services. The plan includes a mix of industrial and commercial zones, a local centre, and accessible public green spaces near the Western Sydney International Airport. • Further to the south-west of the, is Bradfield City Centre, a 114-hectare planned urban development adjacent to Western Sydney International



Description	Site detail
	Airport. Designed to be a hub for innovation, advanced industries, and economic growth, it has the potential to create 20,000 jobs and provide 10,000 homes, including affordable housing. The Bradfield City Master Plan prioritises sustainability, integrating green spaces, climate-resilient infrastructure, and a commitment to achieving net-zero emissions. • East: Further east of the Wianamatta-South Creek which bounds the site, is the suburb of Kemps Creek. This land is characterised by a mix of open space, rural, agricultural, emerging urban development, and residential properties that are non-initial precincts under the WSAP but intended for employment generating uses • West: To the immediate west of the Site, bound by Badgerys Creek, is Western Sydney International Airport (WSI). Located in Badgerys Creek, WSI is a major federal infrastructure project designed to accommodate Sydney's future aviation needs. Set to commence operations in 2026, WSI will initially handle 10 million passengers annually and operate 24/7. Badgerys Creek Road also travels in a north-south direction to the west of the site. It provides a north-south connection between Elizabeth Drive and the Northern Road.
Site Access and road network	The Site is currently accessible from Martin Road which is located at the north-eastern boundary.

The Site location is depicted in the aerial photo shown in **Figure 1-1**.

The bulk earthworks plan is shown in **Figure 1-2**.

The surrounding land zoning is shown in **Figure 1-3**.



Figure 1-1 Aerial Photo





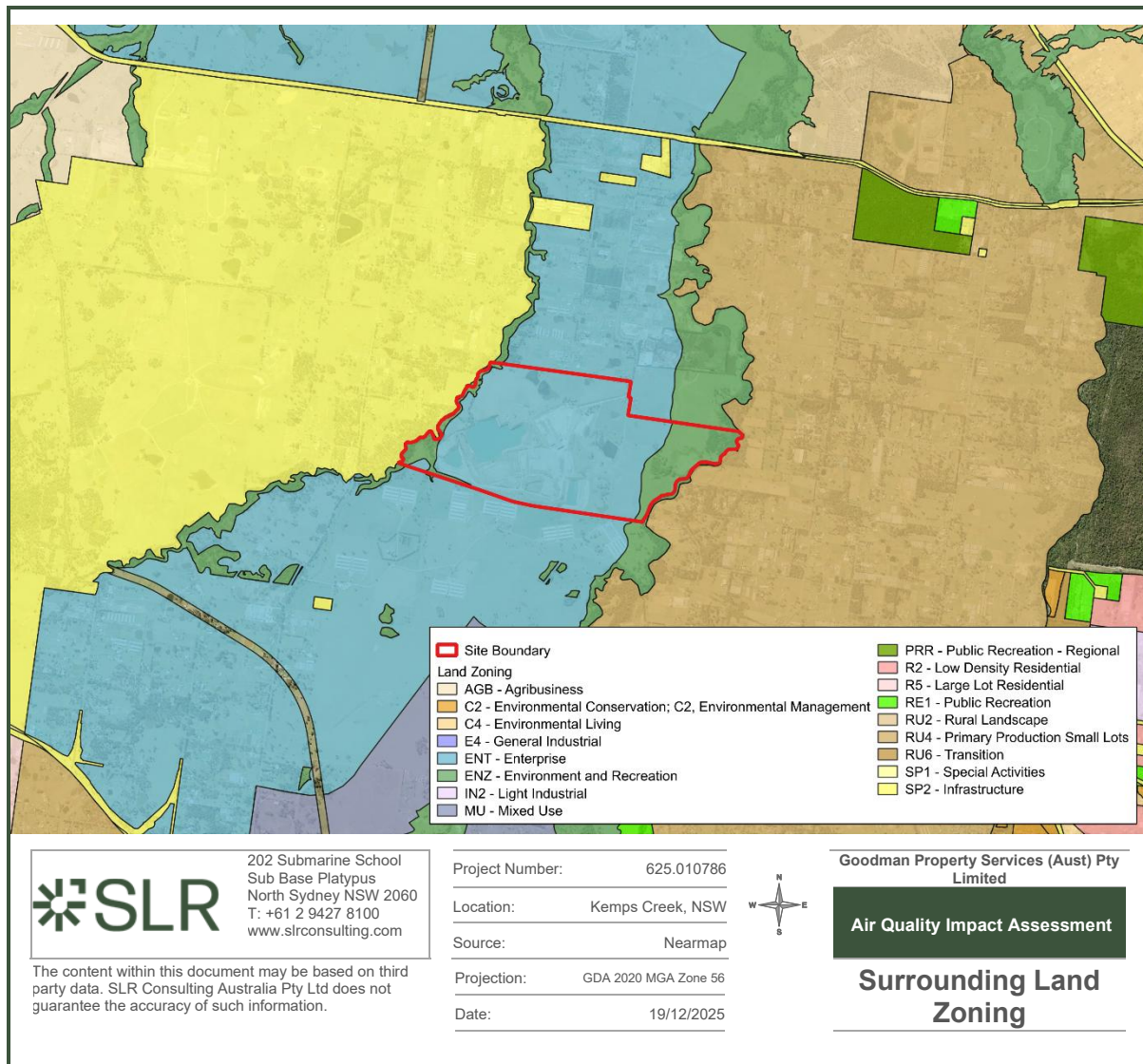


Figure 1-3 Surrounding Land Zoning



1.3 Overview of Report

This report assesses the air quality impacts of Bulk Earthworks activities related to SSD-97711727. It presents the methodology and findings of a quantitative (modelling) assessment of construction 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.

This assessment has been prepared with consideration of the following policies and guidelines:

- *Protection of the Environment Operations (Clean Air) Regulation 2022* (NSW Parliament 2022).
- *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW* (NSW EPA 2022b) (the Approved Methods for Sampling).
- *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (NSW EPA 2022) (the Approved Methods).

1.3.1 Approach to Construction Assessment

The key potential air quality issue identified for the construction activities proposed at the Site is particulate matter emissions associated with bulk earth works.

To assess potential peak impacts associated with bulk earthworks emissions from the Site, a quantitative assessment in general accordance with the NSW EPA's *Approved Methods for Modelling and Assessment of Air Pollutants in NSW* publication (NSW EPA 2022) (hereafter referred to as the Approved Methods), has been prepared.

Section 2.1 of the Approved Methods outlines a two-tiered approach to Air Quality Impact Assessments (AQIA):

- Level 1, which is a basic screening using worst-case assumptions.
- Level 2, a more detailed assessment with refined techniques and site-specific data.

If a Level 1 assessment shows that adverse impacts are unlikely, there is no need to proceed to Level 2. For this assessment, considering the type of emissions associated with bulk earth works, a Level 2 assessment using the TAMP/CALMET/CALPUFF modelling systems has been completed.

Assessing construction-related dust impacts through dispersion modelling presents several inherent difficulties. Most dispersion models were originally developed for continuous, well-defined point, line, or area emission sources. In contrast, construction activities—particularly those associated with large-scale warehousing developments—are variable, intermittent, and spatially dynamic. As a result, it is often not possible to represent the emissions with the degree of temporal and spatial precision that these models typically require.

A key limitation is the lack of robust, activity-specific emission factors for many construction processes. Earthworks, material handling, vehicle movements on unsealed surfaces, and wind-blown dust from exposed areas can each contribute to particulate emissions, but published emission rates are generally derived from limited datasets and may not reflect site-specific conditions such as soil type, moisture content, or construction methodology. Where such parameters cannot be confidently established, the resulting model inputs carry significant uncertainty.



Another challenge is that construction dust emissions are often highly dependent on short-term meteorological conditions, particularly wind speed and surface moisture. Most dispersion models operate on hourly input data and are not well suited to capturing rapid fluctuations in emissions caused by short-lived events such as loading, grading, or vehicle pass-bys. This mismatch can limit the reliability of modelled short-term concentrations.

Modelling is further complicated by the fact that construction sites act as diffuse sources rather than discrete emitters. Large warehousing projects may involve multiple concurrent activities spread across several hectares, making it difficult to define source geometry, source height, and emission timing with the level of specificity normally required for dispersion calculations.

This assessment also considers cumulative impacts from surrounding construction activities. However, as construction activities are temporary and often consist of multiple stages, each with varying durations and emission levels, dust emissions from a single construction site tend to fluctuate significantly over time and are influenced by the type of work being done and weather conditions. This variability impacts the uncertainty associated with cumulative construction dust assessments.

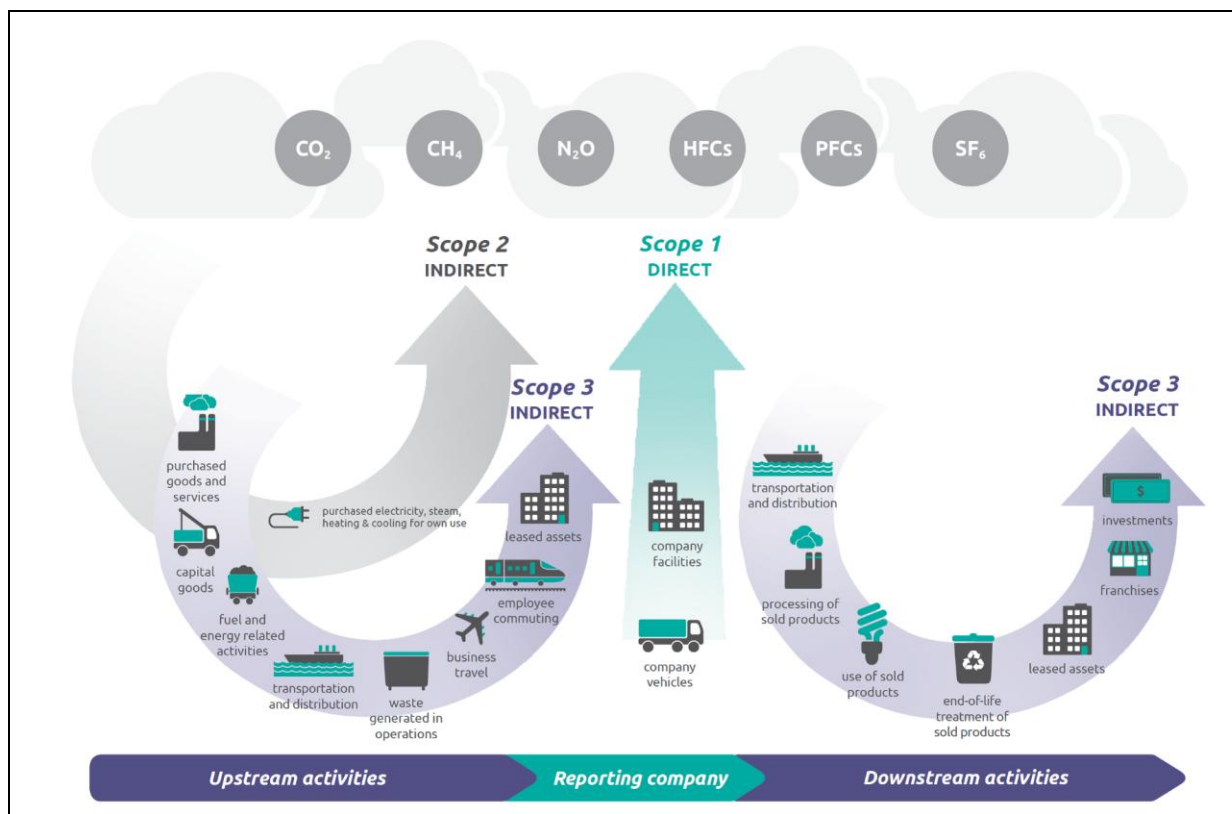
For the reasons detailed above the results of this assessment should be interpreted cautiously, as a risk assessment rather than as a statement of known impacts, and with full acknowledgement of input uncertainties and the inherent variability of construction activities.

1.4 Greenhouse Gas Emissions - Background

1.4.1 Scope 1, 2 and 3 Emissions

The internationally accepted method of reporting GHG emissions is to separate the emission sources into three categories, referred to as 'scopes'. The three scopes of GHG emissions as per the *National Greenhouse and Energy Reporting (NGER) (Measurement) Determination 2008*, are described below and summarised in **Figure 1-4**.





SOURCE: (WRI 2011)

Figure 1-4 Overview of GHG Protocol Scopes and Emissions

Scope 1 emissions

Scope 1 emissions are direct emissions where the point of emission release is owned/controlled by the organisation or project owner, such as:

- Emissions resulting from fuel combustion, e.g. from petrol fuelled vehicles, gas-fired boilers or diesel generators.
- Fugitive emissions during the extraction, production, processing and distribution of fossil fuels (e.g. methane emissions from coal mines, leakage from coal seam gas or natural gas extraction and processing).
- Industrial process emissions, e.g. the use of fuels as feedstocks, leakage of insulating or refrigerant GHGs from switchgear and cooling systems.
- Waste emissions, which result from the decomposition of organic material in an on-site landfill or on-site wastewater treatment plant.

Scope 2 emissions

Scope 2 emissions are GHG emissions that a company causes indirectly and come from where the energy it purchases and uses is produced. The main scope 2 emission relates to electricity usage, where the emissions arise principally at an electricity generator.



Scope 3 emissions

Scope 3 emissions refer to other indirect GHG emissions that occur outside the project footprint or control of the reporting organisation. For example:

- Emissions associated with the extraction, production, processing and distribution of fuels used by the project/organisation.
- Embodied CO₂-e emissions associated with material of construction and raw materials used by the project/organisation.
- Emissions associated with the transport, distribution and end use of sold products.
- Transmission losses within the distribution network associated with the electricity consumed by the project/organisation.

The purpose of differentiating between the scopes of emissions is to avoid the potential for 'double counting', which is where two or more organisations assume responsibility for the same emissions.

Reporting under the NGER Act requires that organisations report scope 1 and scope 2 emissions, but not scope 3 emissions.

1.4.2 Global Warming Potentials

GHG emissions are generally reported in terms of carbon dioxide equivalent (CO₂-e). This is to provide a standardised unit for reporting due to different gases having varying effects of global warming impacts or global warming potential (GWP). The GWP refers to the GHG potential to trap heat in the atmosphere for a certain period (generally 100 years), relative to carbon dioxide (with a GWP of one).

At the time of writing, the most recent available *National Greenhouse Accounts Factors* published by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) assigns methane (as an example) a GWP of 28, which means for every tonne of methane emitted, it has the equivalent global warming effect as 28 tonnes of carbon dioxide (DCCEEW 2025a). Emissions that have had this equivalency applied are given units CO₂-e. As such, gases such as methane or nitrous oxide are relatively potent GHGs.

Table 1-1 presents the GWPs of the key GHGs that are associated with the proposed construction and have been used in calculating the emissions.

Table 1-1 GHG Global Warming Potentials

Gas	Chemical Formula	Global Warming Potential (GWP)
Carbon dioxide	CO ₂	1
Methane	CH ₄	28
Nitrous oxide	N ₂ O	265
Sulfur hexafluoride	SF ₆	23,500
Source: (DCCEEW 2025b)		



1.5 Secretary's Environmental Assessment Requirements

On 26 November 2025, the NSW Department of Planning, Housing and Infrastructure (DPHI) issued Secretary's Environmental Assessment Requirements (SEARs). The air quality related SEARs are outlined in (Table 1-2), they requested.

Table 1-2 Secretary's Environmental Assessment Requirements

Item	Description of Requirement	Section Reference (this report)
Key Issue	<i>Air Quality - including:</i> - a detailed assessment of potential construction air quality impacts, in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, and with a particular focus on dust emissions including PM_{2.5} and PM₁₀; - details of reasonable and feasible mitigation measures to minimise dust and emissions; - a greenhouse gas assessment of the development; and - details of proposed mitigation, management and monitoring measures, in particular, real-time air quality monitoring.	Assessment of construction impacts - Section 6.0 Construction mitigation measures, management, and monitoring - Section 6.5 Assessment of Greenhouse Gas - Section 7.0
Agency Feedback	<i>Liverpool City Council</i> <i>Air & Water Quality Management</i> <i>Consideration must be given to the incorporation of appropriate safeguards during site preparation, bulk earthworks and site remediation and validation to prevent the generation of wind-blown dust and contamination of overland flow and surface waters.</i>	Construction mitigation measures, management, and monitoring - Section 6.5
Agency Feedback	<i>NSW EPA</i> 3. Construction works 3.1. The EIS must include detail of the construction works including: 3.1.d. environment protection measures, including noise mitigation measures - in accordance with the Interim Construction Noise Guideline (DECC, 2009), dust control measures and erosion, and sediment control measures- in accordance with Managing urban stormwater: Soils and construction, vol. 1 (Landcom 2004). 4. Air Issues 4.1. The EIS must demonstrate the proposal's ability to comply with the relevant regulatory framework, specifically the POEO Act and the Protection of the Environment Operations (Clean Air) Regulation 2022. This consideration should include section 129 of the POEO Act concerning control of "offensive odour". 4.2. The EIS must include an air quality impact assessment (AQIA). The AQIA must be carried out in accordance with the document, Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2022). These are	Construction mitigation measures, management, and monitoring - Section 6.5 Based on a review of available data, it is not anticipated that odour would be a source of emissions from bulk-earthworks. Therefore this report does not include an odour assessment. However, mitigation of unexpected finds of odorous material is considered Section 6.5.



Item	Description of Requirement	Section Reference (this report)
	available at: https://www.epa.nsw.gov.au/yourenvironment/air/industrial-emissions/approved-methods-for-the-modelling-and-assessmentof-air-pollutants 4.3. The EIS must detail emission control techniques/practices that will be employed at the site and identify how the proposed control techniques/practices will meet the requirements of the POEO Act, POEO (Clean Air) Regulation (2022) and criteria within Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2022).	Air Quality Assessment – This report. Mitigation and monitoring measures are considered in Section 6.5. Adherence to these reduces likelihood of exceedance.
Agency Feedback	Western Sydney International (WSI) Airport Consideration of any impacts to the WSI owned land adjoining the site, including in relation to stormwater runoff / flooding, water quality, odour, air quality, and noise. This is to include an assessment for both during construction and operation to ensure there are no adverse impacts to WSI operations.	Western Sydney Airport is considered in Section 4.2.1 and as well as the impact assessment within this report (Construction assessment Section 6.0)
Agency Feedback	South Western Sydney Local health District (SWSLHD) Recommendation - Air quality should be considered relative to urban heat in South Western Sydney, as increased heat within cities aggravates air pollution. - Assessment of cumulative impacts should consider the activities of the airport. Rationale The potential exposures of emissions and particulate matter to workers and local residents should be assessed. Air pollution poses serious health risks, with South Western Sydney already experiencing some of the highest rates of respiratory-related hospitalisations in NSW.	Potential impacts to air quality due to urban heat are considered in Section 4.4.1 and Section 6.6. Potential cumulative impacts with Western Sydney Airport activities are considered in Section 4.2.1.



2.0 Identification of Potential Sources of Emissions to Air

The main air quality issues associated with construction works relate to emissions of fugitive dust. The potential for dust to be emitted during the construction works will be directly influenced by the nature of the activities being performed at any given time. Generally, the activities that are most likely to lead to short-term emissions of dust, include:

- Loading and unloading of materials.
- Earthmoving using scrapers and dozers.
- Crushing of materials.
- Wheel-generated dust and combustion emissions from construction equipment.
- Wheel-generated dust from trucks travelling on unpaved surfaces.
- Wind erosion of exposed surfaces.

Temporary elevations in local dust levels are most likely to be generated when construction activities 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 before being deposited as dust or experienced as an ambient particulate concentration.

A number of environmental factors may affect the generation, dispersion and impact 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; and
- Rainfall or dew - rainfall or heavy dew that wets the surface of the soil reduces the risk of dust generation.

Where diesel-powered mobile machinery and vehicles are used, localised elevations in ambient concentrations of combustion-related pollutants may also occur, however, the potential risk of the relevant impact assessment criteria for these pollutants to be exceeded in surrounding sensitive areas is considered to be low. Therefore, fugitive dust emissions are generally considered to have the greatest potential to give rise to downwind air quality impacts at construction sites.

2.1.1 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, PM₁₀ 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 (SO₂), carbon monoxide (CO) and Volatile Organic Compounds (VOCs), will be generated by the proposed construction activities for the Site,



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 $\text{PM}_{2.5}$ (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 $\text{PM}_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.



3.0 Relevant Legislation, Policy and Guidance

The following relevant Air Quality Policy and Guidance documents have been referenced within this assessment and have been used to identify the relevant air quality criteria.

3.1 Ambient Air Quality

3.1.1 State Environmental Planning Policy (Precincts—Western Parkland City) 2021

Chapter 4 of the WPC SEPP relates to the Western Sydney Aerotropolis. The aims of this section of the WPC SEPP are as follows:

- (a) *to facilitate development in the Western Sydney Aerotropolis in accordance with the objectives and principles of the Western Sydney Aerotropolis Plan,*
- (b) *to promote sustainable, orderly and transformational development in the Western Sydney Aerotropolis,*
- (c) *to ensure development is compatible with the long-term growth and development of the Western Sydney Airport (including in relation to the operation of the Airport 24 hours a day) and other critical transport infrastructure,*
- (d) *to promote employment and world-class innovation and provide for residential development in suitable locations,*
- (e) *to recognise the physical and cultural connection of the local Aboriginal community to the land and to incorporate local Aboriginal knowledge, culture and tradition into development,*
- (f) *to preserve land for future infrastructure development,*
- (g) *to protect, maintain and enhance, and to minimise the impact of development on, trees and vegetation, soil quality and the health of waterways and to contribute to the conservation of biodiversity,*
- (h) *to recognise and protect the ecological and cultural value of Wianamatta—South Creek.*

There are no air quality specific development standards or provisions identified in Chapter 4 of the WPC SEPP, however the broader environmental protection context defined in (g) above is considered relevant to this AQA.

3.1.2 Western Sydney Aerotropolis Development Control Plan

The *Western Sydney Aerotropolis Development Control Plan (2022)* (WSA DCP) was amended on 11 July 2025. It supports the implementation of the Precinct Plan by providing controls to guide development across the initial precincts in the Aerotropolis. Appendix D of the DCP contains details regarding supporting documentation for development applications. Regarding air quality and odour, the following is stated:

D.5 Air Quality and Odour Assessment

- *An Air Quality and Odour Assessment is required for agricultural uses and some agricultural produce industries and industrial uses. It is also required for sensitive uses in the proximity of agricultural, rural, and industrial uses.*
- *The assessment is to be undertaken by a suitably qualified Air Quality Professionals under the CAQP Scheme administered by the Clean Air Society of Australia and New Zealand (CASANZ) or Suitably qualified Environmental Practitioner under the CEnvP*



Scheme administered by the Environment Institute of Australia and New Zealand (EIANZ).

This AQIA has been reviewed by Graeme Starke, a Technical Director at SLR and registered CAQP (CASANZ).

3.1.3 Protection of the Environment Operations (POEO) Act 1997 & Amendment Act 2011

The POEO Act (and Amendment Act 2011) is a key piece of environment protection legislation administered by the EPA group which enables and establishes instruments for setting environmental standards, goals, protocols and guidelines.

The following sections of the POEO Act are of general relevance to the Site:

- Section 126 of the POEO Act requires that materials (e.g. raw ingredients and waste storage/disposal at the Site) are managed in a proper and efficient manner to prevent air pollution (e.g. odour).
- Section 128 of the POEO Act states:
 - The occupier of premises must not carry out any activity or operate any plant in or on the premises in such a manner to cause or permit the emission at any point specified in or determined in accordance with the regulation of air impurities in excess of [the standard of concentration and/or the rate] prescribed by the regulations in respect of any such activity or any such plant.
 - Where neither such a standard nor rate has been so prescribed, the occupier of any premises must carry on activity, or operate any plant, in or on the premises by such practicable means as may be necessary to prevent or minimise air pollution.

3.1.4 Protection of the Environment Operations (Clean Air) Regulation 2022

The POEO (Clean Air) Regulation 2022 (the Regulation) is the core regulatory instrument for air quality issues in NSW. In relation to industry, the Regulation:

- Sets maximum limits on emissions from activities and plants for a number of substances.
- Restricts the use of high sulphur liquid fuel.

3.1.5 NSW Environment Protection Authority Air Quality Policy and Guidance

The NSW Environmental Protection Agency (EPA) is the NSW regulatory authority responsible for air quality regulation and associated activities.

The NSW EPA document, Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (hereafter 'the Approved Methods') (NSW EPA 2022), lists the statutory methods for modelling and assessing air pollutants from stationary sources and specifies criteria that reflect the environmental outcomes adopted by the EPA. The Approved Methods are referred to in the POEO (Clean Air) Regulation 2022 for assessment of impacts of air pollutants. The air quality criteria set out in the Approved Methods have been reproduced and discussed in **Section 3.1.6**.



3.1.6 Ambient Air Quality Criteria

State air quality guidelines specified by the NSW EPA for the pollutants identified in **Section 3.1.5** are published in the Approved Methods. The 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 risks to human health. 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.

The impact assessment criteria listed in the Approved Methods for relevant pollutants are shown in **Table 3-1**.

As discussed in **Section 2.1.1**, the quantitative emissions estimation and dispersion modelling study performed has not included products of combustion as these emissions are unlikely to compromise air quality goals at the closest receptors. The criteria for NO₂, CO and SO₂ have been included in **Table 3-1**, to assess the existing background air quality in **Section 4.4**.

Table 3-1 NSW EPA Impact Assessment Criteria for Air Quality Assessment

Pollutant	Averaging Period	Ambient Air Quality Criterion	
		µg/m ³	ppm
Total suspended particulate (TSP)	Annual	90	-
Particulate matter less than 10 microns (PM ₁₀)	24-Hour	50	-
	Annual	25	-
Particulate matter less than 2.5 microns (PM _{2.5})	24-Hour	25	-
	Annual	8	-
Nitrogen dioxide (NO ₂)	1-hour	164	8
	Annual	31	1.5
Carbon monoxide (CO)	15-minutes	100,000	8,700
	1-hour	30,000	2,500
	8-hour	10,000	900
Sulfur dioxide (SO ₂)	1-hour	215	10
	24-hour	57	2

3.2 Greenhouse Gas

3.2.1 Commonwealth Policy and Legislation

Australia ratified the Paris Agreement in 2016, aiming to reduce greenhouse gas emissions by 26-28% below 2005 levels by 2030. In 2022, Australia updated its target to a 43% reduction by 2030 and pledged to achieve net zero emissions by 2050. In 2025, the Australian Government announced a new 2035 target to reduce emissions by 62–70% below 2005 levels, reflecting a significant step toward its long-term net zero goal. Other federal actions are briefly outlined below.



3.2.1.1 National Greenhouse and Energy Reporting Act (NGER Act)

The NGER Act introduces a single national framework for reporting and disseminating company information about GHG emissions, energy production, and energy consumption. Under the NGER Act, companies that meet threshold levels for GHG emissions, energy consumption or energy production are required to report their GHG emissions annually. The six GHGs that are reported under the NGER Act include the following compounds and groups of compounds:

- Carbon dioxide (CO₂)
- Methane (CH₄)
- Nitrous oxide (N₂O)
- Specified hydrofluorocarbons (HFCs)
- Specified perfluorocarbons (PFCs)
- sulfur hexafluoride (SF₆).

The current GHG reporting thresholds for individual facilities are as follows:

- Emission of more than 25,000 tonnes of carbon dioxide equivalent (t CO₂-e).
- Production of 100 terajoules (TJ) or more of energy, or
- Consumption of more than 100 TJ of energy per year.

Goodman currently reports its energy consumption and GHG emissions annually under the NGER Scheme.

3.2.1.2 Emissions Reduction Fund

To meet its targets set under the Kyoto Protocol and Paris Agreement, DCCEEW commissioned the Emissions Reduction Fund (ERF). The ERF was developed to provide incentives for Australian businesses, farmers, land holders and citizens to reduce their GHG emissions by adoption of more efficient practices and technologies.

Key elements of the ERF were as follows:

- Crediting emissions reductions that go beyond business-as-usual standards.
- Selling emission reductions in the form of Australian Carbon Credit Units (ACCUs).
- A Safeguard Mechanism that provides a framework for Australia's largest emitters to measure, report and manage emissions.

3.2.1.3 Safeguard Mechanism

The Safeguard Mechanism commenced in 2016. It was reformed in 2023 to ensure that covered facilities contribute to meeting Australia's reduction targets, while strengthening their competitiveness as the world moves to net zero. The reforms apply a decline rate to facilities' baselines so that they are reduced predictably and gradually over time on a trajectory consistent with achieving Australia's emission reduction targets of 43% below 2005 levels by 2030 and net zero by 2050 (see below).



The Safeguard Mechanism applies to industrial facilities emitting scope 1 covered emissions (including direct emissions from fugitive emissions and emissions from fuel combustion, waste disposal and industrial process such as cement and steel making) of more than 100,000 t CO₂-e per year, including:

- Mining
- Oil and gas production
- Manufacturing
- Transport
- Waste facilities.

Goodman reports its GHG emissions annually under the NGER Scheme, and if its Scope 1 emissions exceed 100,000 t CO₂-e per year it will be covered by the Safeguard Mechanism.

3.2.1.4 Australian Sustainability Reporting Standards

The core content of the final Australian Sustainability Reporting Standards (ASRSs) aligns with the content of the International Financial Reporting Standards (IFRS) Sustainability Disclosure Standards, and with the four-pillars approach originally included in the Task Force on Climate Related Financial Disclosures (TCFD) recommendations, as follows:

1 Governance:

- Disclosures on governance processes, controls and procedures used to monitor and manage climate-related financial risks and opportunities.

2 Strategy:

- Assessment and disclosure of material climate-related risks and opportunities affecting the entity's business model and value chain, including the effect on financial position, financial performance and cash flows.
- Disclosures on climate resilience including results of qualitative, and if applicable, quantitative assessment of their climate scenario analysis, including how the assessment was carried out and its time horizon.
- Disclosures on transition plans including information about offsets, target setting and mitigation strategies.

3 Risk management:

- Disclosures on material climate-related risks and opportunities to the business, as well as how the entity identifies, assesses and manages risk and opportunities.

4 Metrics and targets:

- Disclosure of Scope 1 and 2 (location-based) GHG emissions required from year one of reporting, including information on any eligible offsets and/or certificates accounted for.
- Disclosure of material Scope 3 GHG emissions required from year two of reporting onwards.
- Disclosure of emissions data against transition plans / reduction targets.
- Disclosure of metrics used by management to monitor material climate-related risks and opportunities, in addition to several cross-industry metrics that are disclosed regardless of whether they are monitored by management.



Any entity that is a registered corporation under the NGER Act (or required to make an application to register) and has scope 1 and 2 emissions above the NGER scheme publication threshold of 50,000 t CO₂-e/annum is a Group 1 entity, and is required to prepare a sustainability report with the first annual reporting period starting on or after 1 January 2025.

As presented in **Section 7.6**, the Project's scope 1 and 2 emissions are forecast to be above this threshold, therefore Goodman will be required to submit annual ASRS reports for the Project. The legislation requires that this reporting takes the form of an annual 'sustainability report', consisting of:

- A climate statement for the year;
- Notes to the climate statement;
- Any statements required by a legislative instrument relating to matters concerning environmental sustainability; and
- A directors' declaration.

The report must be provided to the members and lodged with the Australian Securities and Investments Commission (ASIC).

On 27 January 2025, the Auditing and Assurance Standards Board formally approved ASSA 5010 *Timeline for Audits and Reviews of Information in Sustainability Reports*, which outlines the timeline for phasing in assurance requirements. The assurance timeline outlines the extent to which information in sustainability reports for financial years commencing 1 January 2025 must be audited (reasonable assurance) and/or reviewed (limited assurance). In the first year of an entity's mandatory reporting, limited assurance is required over scope 1 and 2 emissions, governance and strategy (risk and opportunities identification). In the second and third year of an entity's mandatory reporting, limited assurance is required over disclosures. Reasonable assurance will be required over all disclosures by the fourth year of reporting.





Figure 3-1 ASRS Reporting and Assurance Timeline for Group 1 Entities



3.2.2 State Policy and Legislation

New South Wales (NSW) has legislated a climate policy aiming for 50% GHG reduction by 2030, 70% by 2035, and net zero by 2050, all relative to 2005 levels.

The Climate Change Policy (NSW EPA 2023) and Climate Change Action Plan 2023–26 (NSW EPA 2023) outline a comprehensive regulatory approach and set of actions to address the causes and consequences of climate change in NSW.



4.0 Existing Environment

4.1 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 is disturbed due to current mining activities with a maximum elevation of approximately 62 m Australian Height Datum (AHD). A pseudo-three-dimensional representation of the region surrounding the Site is presented in **Figure 4-1**. The locations of Badgerys Creek automatic weather station (AWS; refer **Section 4.3**) and Bringelly air quality monitoring station (AQMS; refer **Section 4.4**) are also indicated.

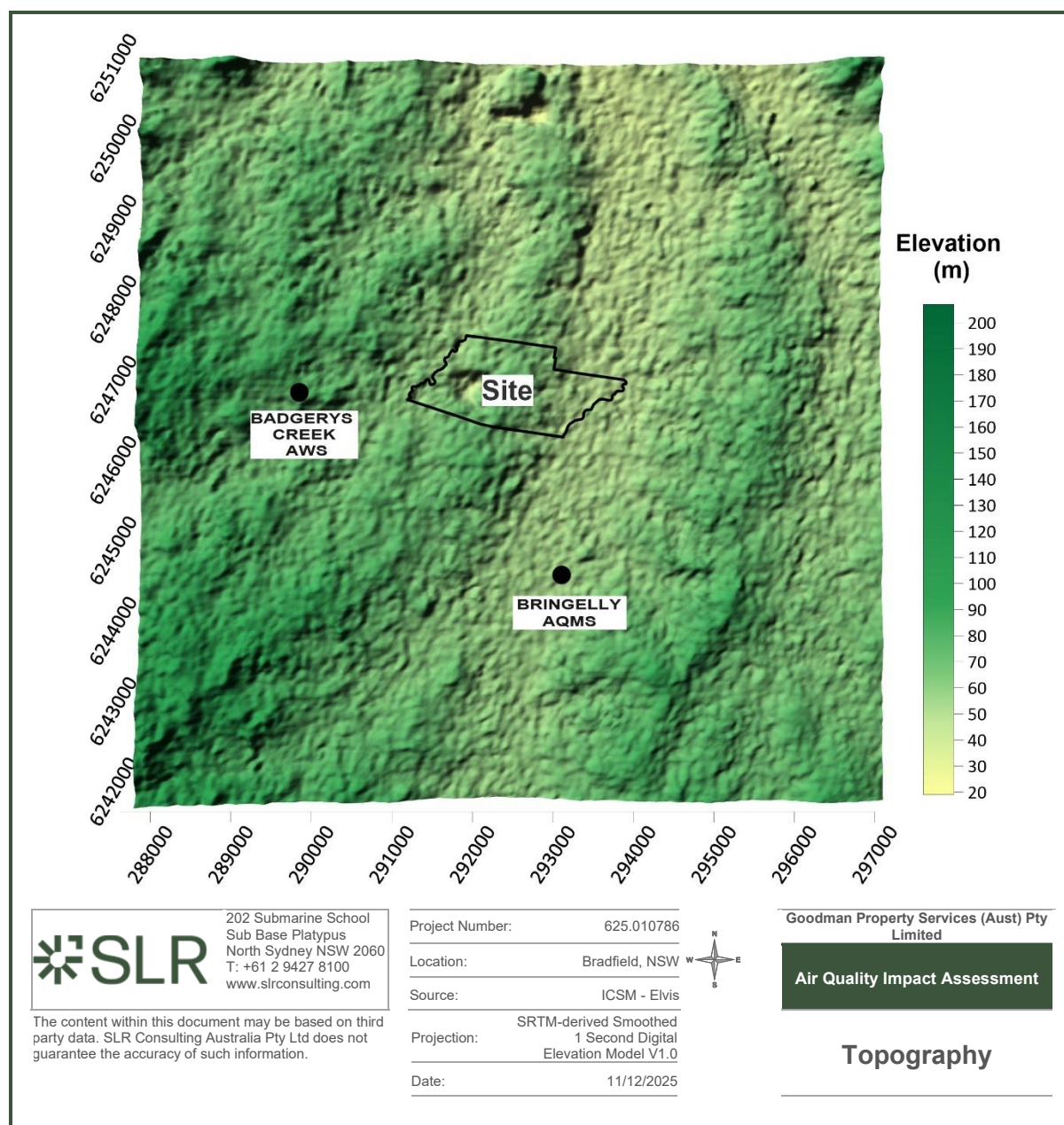


Figure 4-1 Regional Topography



4.2 Sensitive Receptors

There are several residential and commercial receptors located in all directions from the Site, with the closest sensitive receptor located approximately 20 m to the south. **Table 4-1** outlines the location of the sensitive receptors included in the assessment and their approximate distance to the nearest Site boundary.

The sensitive receptor locations are intended to be representative of all sensitive receptor locations, whether discretely identified or not.

It is noted that some surrounding locations have not been included as sensitive receptors due to current and proposed developmental activities contributing to dust generation in the area. Where a development has been considered as a source of emissions contributing to cumulative impacts, that location has been excluded from the assessment of incremental impacts as this is no longer a sensitive receptor.



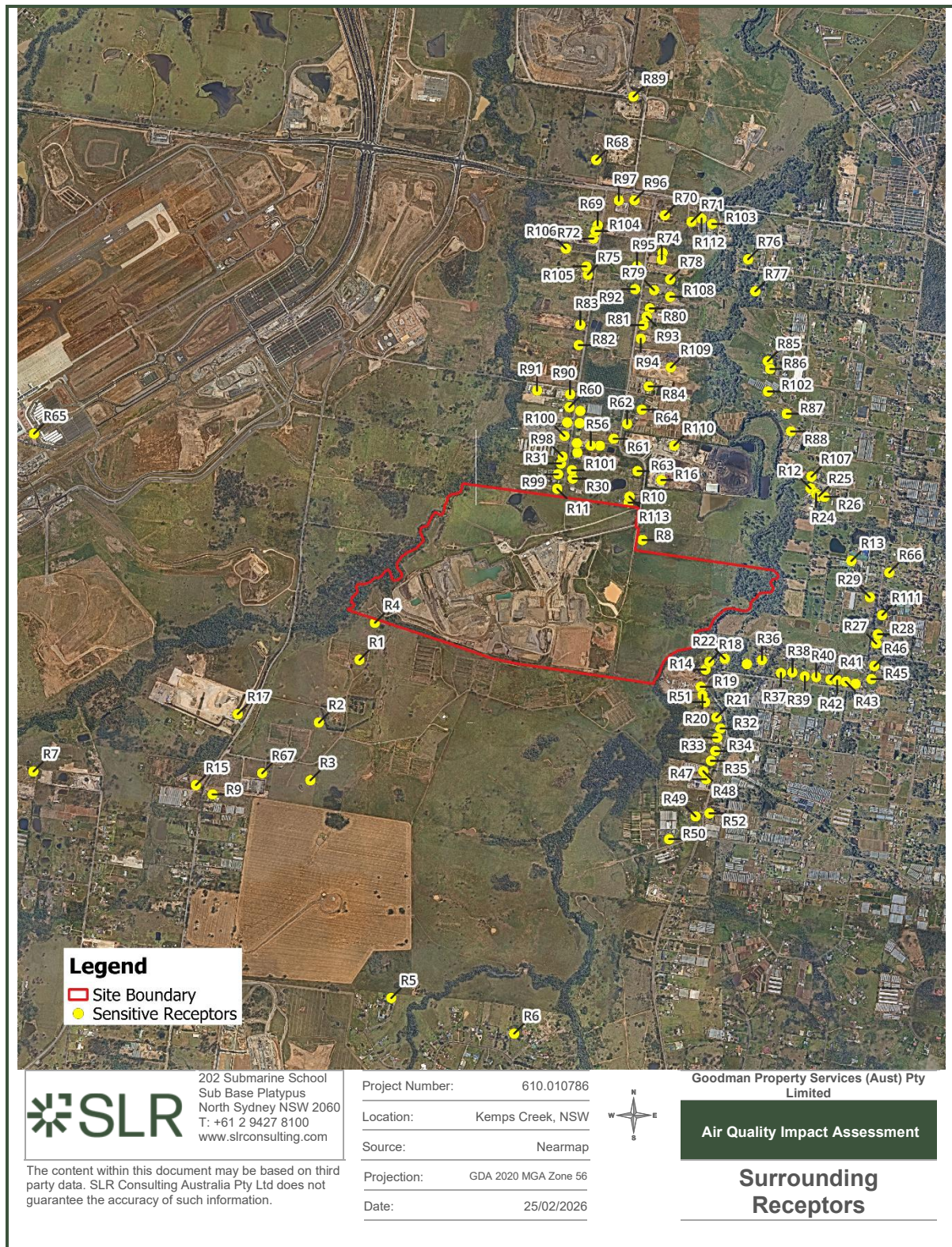


Figure 4-2 Surrounding Receptors



Table 4-1 Sensitive Receptor Locations

Map ID	Easting (m)	Northing (m)	Receptor Type	Distance from Closest Site Boundary (km)
R5	291,487	6,244,456	Residential	2.20
R6	292,252	6,244,235	Residential	2.28
R7	289,261	6,245,864	Residential	2.20
R8	293,050	6,247,304	Empty Lot	0.04
R9	290,376	6,245,722	Residential	1.42
R10	292,963	6,247,536	Residential	0.02
R11	292,520	6,247,622	Residential	0.05
R12	294,096	6,247,624	Residential	0.56
R13	294,349	6,247,173	Commercial	0.46
R14	293,442	6,246,498	Residential	0.16
R15	290,272	6,245,779	Industrial	1.44
R16	293,167	6,247,676	Industrial	0.22
R17	290,532	6,246,221	Construction	0.94
R18	293,466	6,246,546	Residential	0.14
R19	293,412	6,246,391	Residential	0.25
R20	293,423	6,246,339	Industrial	0.30
R21	293,510	6,246,200	Residential	0.44
R22	293,563	6,246,565	Residential	0.21
R23	293,699	6,246,532	Residential	0.32
R24	294,131	6,247,590	Residential	0.54
R25	294,148	6,247,575	Residential	0.54
R26	294,183	6,247,572	Residential	0.56
R27	294,505	6,246,659	Residential	0.72
R28	294,514	6,246,717	Residential	0.71
R29	294,464	6,246,947	Residential	0.58
R30	292,616	6,247,685	Residential	0.12
R31	292,543	6,247,779	Residential	0.21
R32	293,536	6,246,131	Residential	0.50
R33	293,515	6,246,075	Residential	0.52
R34	293,503	6,245,992	Residential	0.57
R35	293,476	6,245,931	Residential	0.60
R36	293,793	6,246,557	Residential	0.32
R37	293,912	6,246,476	Empty Lot	0.44



Map ID	Easting (m)	Northing (m)	Receptor Type	Distance from Closest Site Boundary (km)
R38	293,982	6,246,480	Residential	0.47
R39	294,059	6,246,456	Residential	0.54
R40	294,131	6,246,452	Residential	0.59
R41	294,219	6,246,435	Mixed Use	0.66
R42	294,261	6,246,431	Residential	0.69
R43	294,314	6,246,422	Residential	0.72
R44	294,376	6,246,410	Residential	0.77
R45	294,474	6,246,439	Residential	0.82
R46	294,492	6,246,520	Residential	0.79
R47	293,446	6,245,816	Industrial	0.68
R48	293,429	6,245,866	Residential	0.63
R49	293,380	6,245,585	Residential	0.86
R50	293,216	6,245,444	Residential	0.97
R51	293,440	6,246,296	Residential	0.34
R52	293,467	6,245,605	Residential	0.88
R53	292,645	6,247,847	Residential	0.29
R54	292,642	6,247,906	Empty Lot	0.35
R55	292,786	6,247,889	Residential	0.35
R56	292,729	6,247,890	Residential	0.34
R57	292,582	6,248,034	Residential	0.46
R58	292,659	6,248,029	Residential	0.47
R59	292,663	6,248,106	Residential	0.55
R60	292,596	6,248,129	Residential	0.56
R61	292,871	6,247,932	Mixed use	0.40
R62	292,955	6,248,025	Residential	0.51
R63	293,019	6,247,731	Residential	0.22
R64	293,046	6,248,113	Industrial	0.61
R65	289,265	6,247,964	Airport	2.22
R66	294,585	6,247,101	Commercial	0.69
R68	292,763	6,249,666	Empty Lot	2.11
R69	292,771	6,249,260	Residential	1.70
R70	293,189	6,249,322	Residential	1.82
R71	293,355	6,249,281	Residential	1.81
R72	292,745	6,249,178	Residential	1.62



Map ID	Easting (m)	Northing (m)	Receptor Type	Distance from Closest Site Boundary (km)
R75	292,710	6,248,953	Residential	1.39
R76	293,707	6,249,048	Residential	1.69
R77	293,752	6,248,849	Residential	1.53
R78	293,222	6,248,923	Industrial	1.43
R79	293,123	6,248,856	Residential	1.35
R80	293,095	6,248,743	Residential	1.24
R81	293,056	6,248,639	Residential	1.13
R82	292,654	6,248,515	Residential	0.95
R83	292,663	6,248,640	Residential	1.08
R84	293,089	6,248,258	Industrial	0.76
R85	293,829	6,248,415	Residential	1.21
R86	293,845	6,248,366	Residential	1.19
R87	293,947	6,248,088	Residential	0.97
R88	293,974	6,247,979	Residential	0.87
R89	292,994	6,250,060	Industrial	2.53
R90	292,600	6,248,208	Construction	0.64
R91	292,394	6,248,232	Construction	0.63
R92	293,004	6,248,862	Residential	1.34
R93	293,076	6,248,692	Commercial	1.18
R94	293,040	6,248,555	Residential	1.04
R95	293,016	6,249,005	Residential	1.49
R96	293,000	6,249,415	Residential	1.89
R97	292,903	6,249,414	Residential	1.87
R98	292,553	6,247,821	Residential	0.25
R99	292,525	6,247,712	Residential	0.14
R100	292,565	6,247,950	Industrial	0.38
R101	292,611	6,247,737	Residential	0.17
R102	293,830	6,248,227	Residential	1.08
R103	293,484	6,249,268	Residential	1.82
R104	292,759	6,249,224	Mixed use	1.67
R105	292,701	6,249,003	Residential	1.44
R106	292,574	6,249,114	Commercial	1.53
R107	294,101	6,247,698	Residential	0.63
R108	293,222	6,248,815	Empty Lot	1.33



Map ID	Easting (m)	Northing (m)	Receptor Type	Distance from Closest Site Boundary (km)
R109	293,226	6,248,376	Industrial	0.89
R110	293,247	6,247,890	Industrial	0.44
R111	294,541	6,246,836	Industrial	0.69
R112	293,418	6,249,301	Industrial	1.84
R113	292,969	6,247,573	Residential	0.06

4.2.1 Western Sydney International Airport

The WSI is identified as receptor R65 in this report and is located approximately 2km from the Site.

Construction impacts from the Site on the WSI are assessed in **Section 6.0**. Major construction of the WSI was completed in June 2025 so there will be no cumulative impacts due to construction activities.

Further quantitative assessment of cumulative air quality impacts associated with airport activities would provide limited value, given the limited opportunity for overlapping impacts due to the distances between Site and the WSI.

4.3 Local Meteorological Conditions

The Bureau of Meteorology (BoM) maintains and publishes data from weather stations across Australia. A description of the wider climate for a site assists in the interpretation of the air quality impacts by describing existing conditions. The closest such station recording long term wind speed and wind direction data is the Badgerys Creek AWS (Station 67108, elevation 81 m AHD) located approximately 1.3 km west of the Site.

Badgerys Creek AWS, has data available from 1995 to the present for the following parameters:

- Temperature (°C)
- Rainfall (mm)
- Relative humidity (%)
- Wind speed (m/s) and wind direction (degrees).

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

4.3.1 Temperature

Temperature statistics for Badgerys Creek AWS between 1995 and 2025 are summarised in **Figure 4-3**. Mean maximum temperatures range from 17.6°C in winter to 30°C in summer, while mean minimum temperatures range from 4.3°C in winter to 17.2°C in summer.



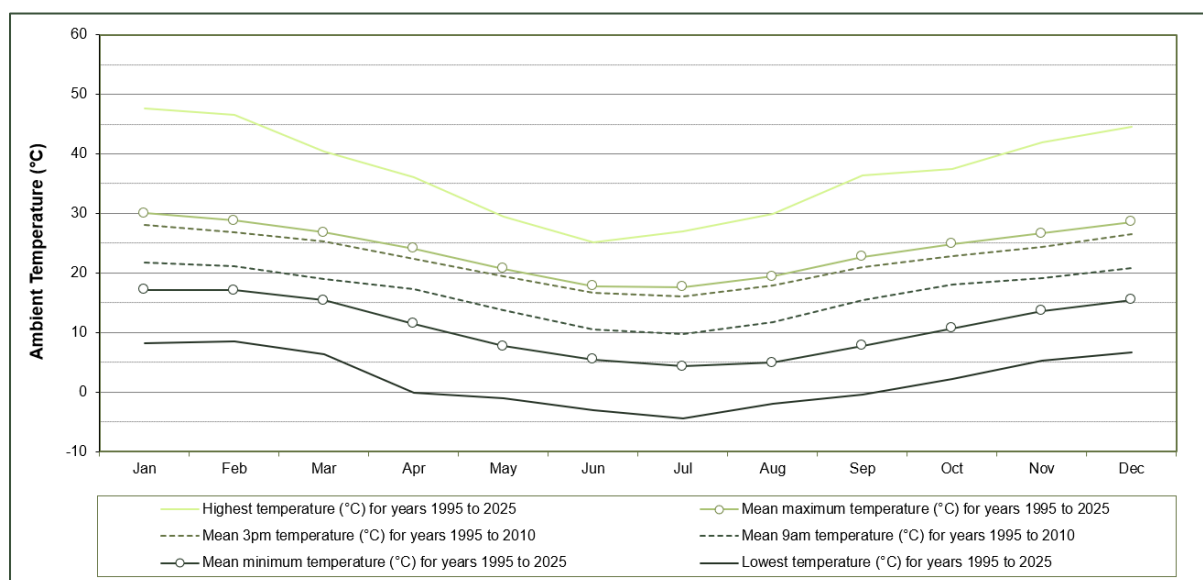


Figure 4-3 Temperature trends for Badgerys Creek AWS (1995 - 2025)

4.3.2 Rainfall

Rainfall statistics for Badgerys Creek AWS for the years 1995 to 2025 are summarised in **Figure 4-4**. The mean annual rainfall is 727.9 millimetres (mm). The average monthly rainfall is highest in summer with the highest average daily rainfall of 107 mm in February and an average of 11.4 rain days. The lowest monthly rainfall is 0 mm in December. The highest monthly rainfall recorded over the period examined was 561.4 mm recorded in March 2022. The maximum daily rainfall of 200 mm was recorded on 10th February 2020.

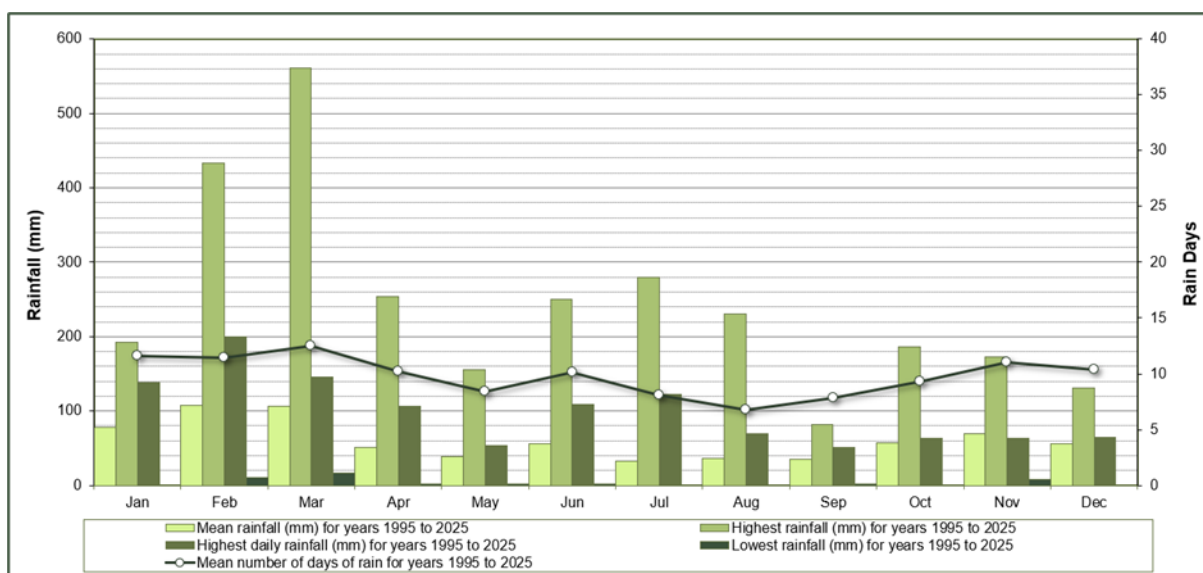


Figure 4-4 Monthly Rainfall Data for Badgerys Creek AWS (1995 – 2025)

4.3.3 Humidity

Available humidity statistics (9 am and 3 pm monthly averages) for Badgerys Creek AWS for the years 1995 to 2010 are summarised in **Figure 4-5**. Morning humidity levels range from an



average of around 84% in June to around 62% in October. Afternoon humidity levels are lower, at around 56% in June and dropping to around 44% in August.

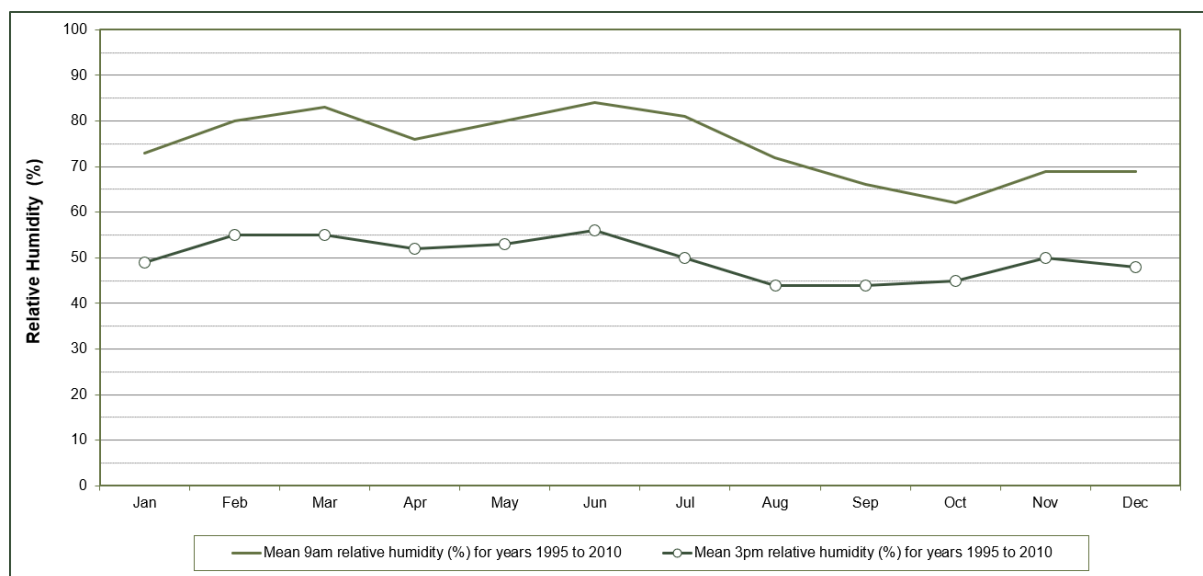


Figure 4-5 Humidity Data for Badgerys Creek AWS (1995 – 2010)

4.3.4 Wind

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, determine 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 years 2020-2024, compiled from data recorded by the Badgerys Creek AWS are presented in **Figure 4-6**. 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 periods during the day.

The annual wind rose for the years 2020-2024 shows that winds predominantly blow from the southwest quadrant. Wind speeds are mostly moderate (1.5 – 5.5 m/s), with occasional stronger winds, though speeds exceeding 8 m/s are relatively uncommon. Calm conditions occur 8.5% of the time, suggesting that while wind movement is generally steady, there are still periods of low air circulation.

The seasonal wind roses for the years 2020-2024 indicate that:

- In spring and summer, there are winds present from each direction with less frequent winds from the north-western quadrant but a higher frequency of wind from the southeastern quadrant in summer and northeastern quadrant in spring. On average, calm winds are experienced 9.3% of the time during spring and 7.1% of the time during summer.



- In autumn and winter, winds predominantly blow from the south-western quadrant, with the lowest frequency of winds from the northwest quadrant in autumn and the southeast quadrant in winter. On average, calm winds are experienced approximately 9% of the time during autumn and winter.



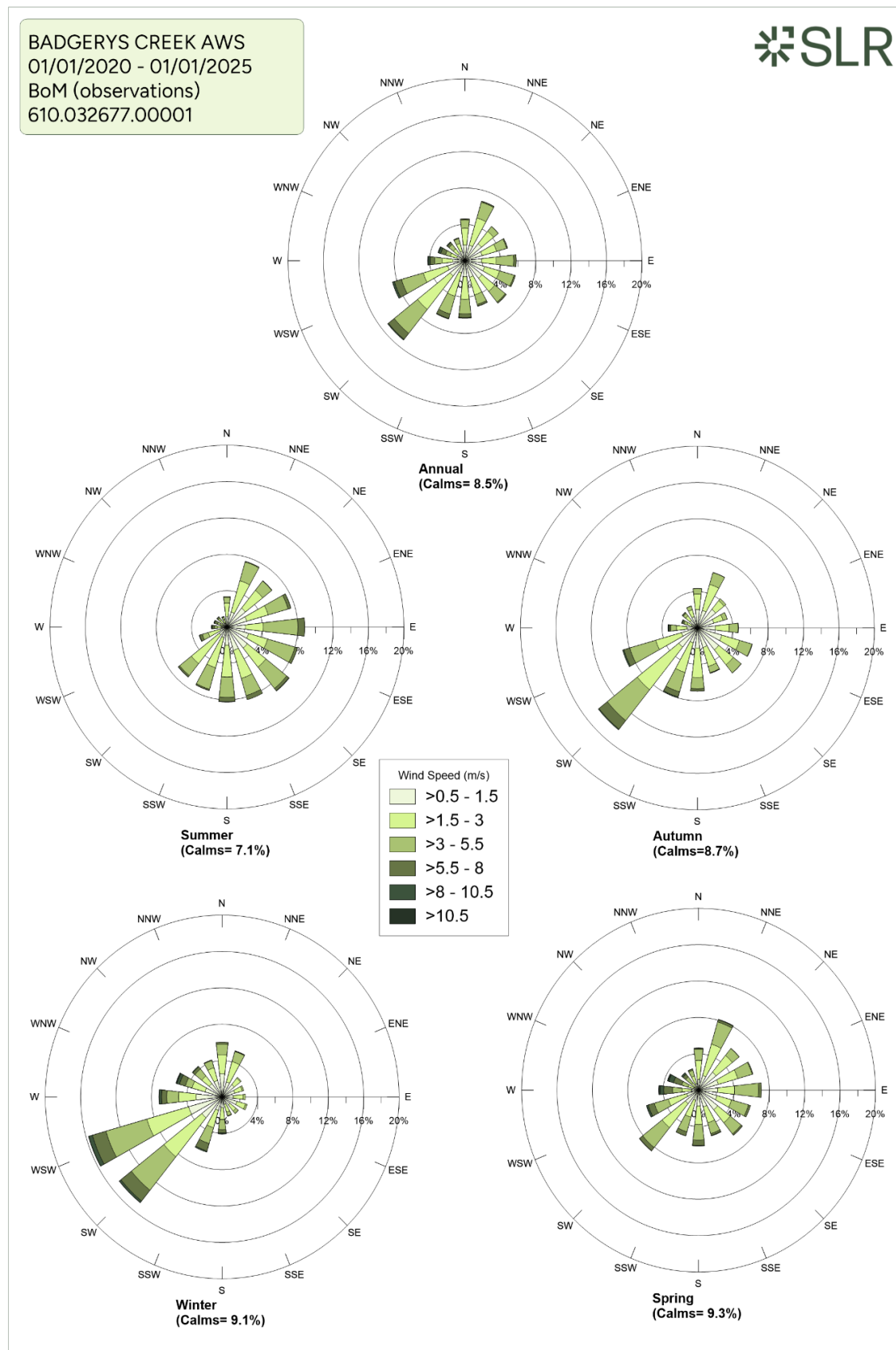


Figure 4-6 Badgerys Creek Annual and Seasonal Wind Roses 2020-2024



4.4 Background 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 2 km to the south of the Site (see **Figure 4-1**).

The following air pollutants are monitored at this station:

- NO, NO₂ & NO_x
- PM₁₀
- PM_{2.5}
- SO₂
- ozone (O₃).

A summary of the monitored pollutant concentrations for the last five years (2020-2024) is presented in **Table 4-2** and the data are presented graphically in **Figure 4-7** to **Figure 4-13**.

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 PM₁₀ concentrations recorded by the Bringelly AQMS using a PM₁₀/TSP ratio of 0.4¹, which is typical for industrial areas in Australia. Therefore, for cumulative analysis purposes, the annual average background TSP concentration was estimated to be 38.3 µg/m³.

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/m²/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/m²/month being the defining criterion for the Site.

Potential cumulative impacts from construction on surrounding sensitive receptors from the Site and surrounding likely construction developments is considered in **Section 5.4.2**.

4.4.1 Future Environmental Conditions

It is possible that future environmental conditions in the local area may be different than those described by this report. They can shift due to climate change, weather variability, urban development and land-use change, changes in pollution sources and emissions, and other changes that may occur to vegetation, soil and water systems. These environmental conditions may influence air pollution impacts at sensitive receptors.

When changes in these conditions occur in urban environments they can contribute to urban heat. Urban heat can contribute to worsened air quality

Temperature has a strong impact through these pathways:

- Enhanced Photochemistry - Higher temperatures accelerate the chemical reactions that create ozone from NO_x and VOCs.

¹ This is conservative as when this ratio is determined from the total PM₁₀ 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 25.5 µg/m³. This includes the following sources of emissions: natural, commercial, domestic-commercial, industrial, off-road mobile, on-road mobile.



- Increased Emissions - In addition, evaporative emissions (from fuels, solvents, industrial processes) rise with temperature.
- Reduced Atmospheric Dispersion - Heatwaves are often associated with stable atmospheric conditions, reduced wind speeds, and persistent high-pressure systems.
- Secondary Particle Formation - Higher temperatures promote the formation of secondary organic aerosols, contributing to PM_{2.5} mass.
- Changes in Human Behaviour - Increased electricity demand during hot weather can lead to higher emissions from fossil-fuel-based power generation.

Increased urban heat and worsened air quality can increase the risk of negative impacts posed to human health, infrastructure and the amenity of an area. Respiratory and cardiovascular issues may be exacerbated, resulting in increased hospital admissions, and may disproportionately affect vulnerable communities. Poor air quality during hot periods also stresses vegetation, reduces outdoor comfort and activity, and contributes to greater energy demand for cooling. Together, these effects compound overall urban heat risk and reduce local environmental quality.



Table 4-2 Summary of Air Quality Monitoring Data at Bringelly AQMS (2020-2024)

Pollutant	PM ₁₀		PM _{2.5}		NO ₂		SO ₂		O ₃
Averaging Period	Maximum 24-hour	Annual	Maximum 24-hour	Annual	Maximum 1-hour	Annual	Maximum 1-hour	Maximum 24-hour	Maximum 1-hour*
Units	µg m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³
2020	241.8 (11)	18.3	78.1 (12)	8.5	61.5	6.3	62.9	8.6	239.7
2021	69.0 (1)	15.3	57.4 (3)	7.2	49.2	7.1	25.7	5.7	199.0
2022	28.7	12.1	17.8	5.1	45.1	5.9	28.6	5.7	145.5
2023	53.2 (1)	16.2	45.4 (3)	7.0	51.3	6.2	25.7	8.6	216.1
2024	58.1 (1)	16.4	17.2	6.9	65.6	7.7	34.3	5.7	184.0
Criteria	50	25	25	8	164	31	215	57	-*
# numbers in brackets represent number of exceedances of relevant criteria recorded each year.									
* There is no 1-hour compliance criteria for O3 and DCCEEW does not provide 8-hour O3 rolling data prior to 2025 for Bringelly. However, 1-hour values can be considered conservative.									



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 in the years 2020, 2021, and 2023. 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.

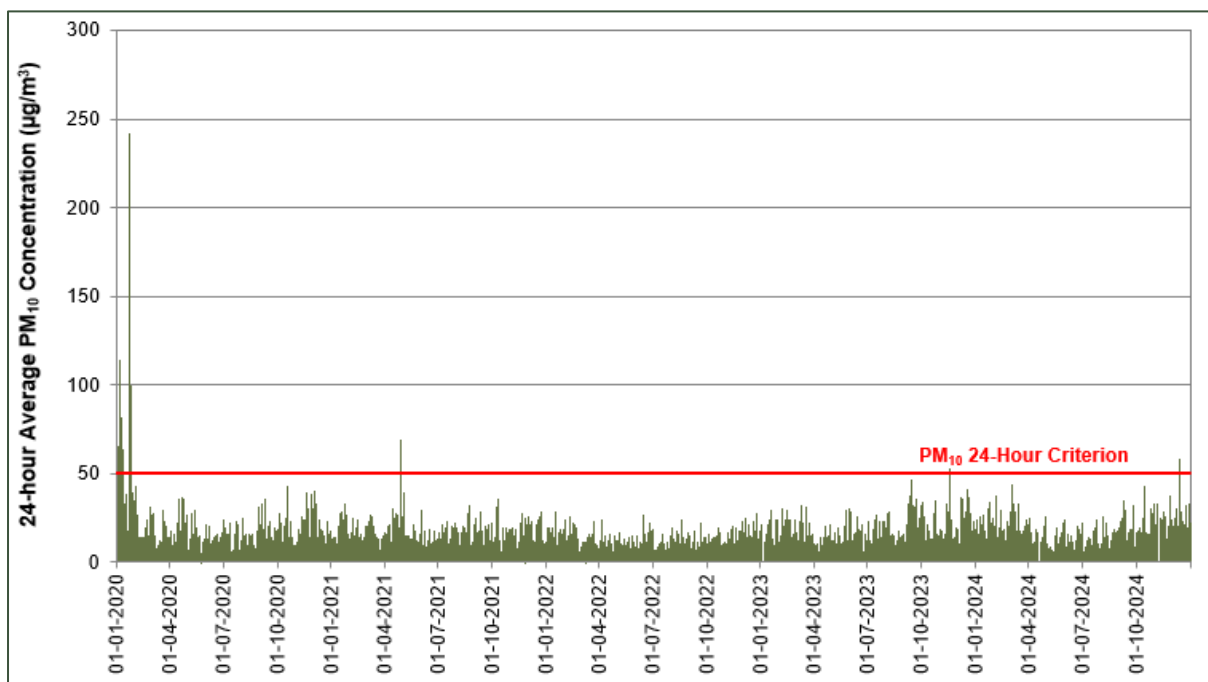


Figure 4-7 Measured 24-Hour Average PM_{10} Concentrations at Bringelly AQMS (2020-2024)



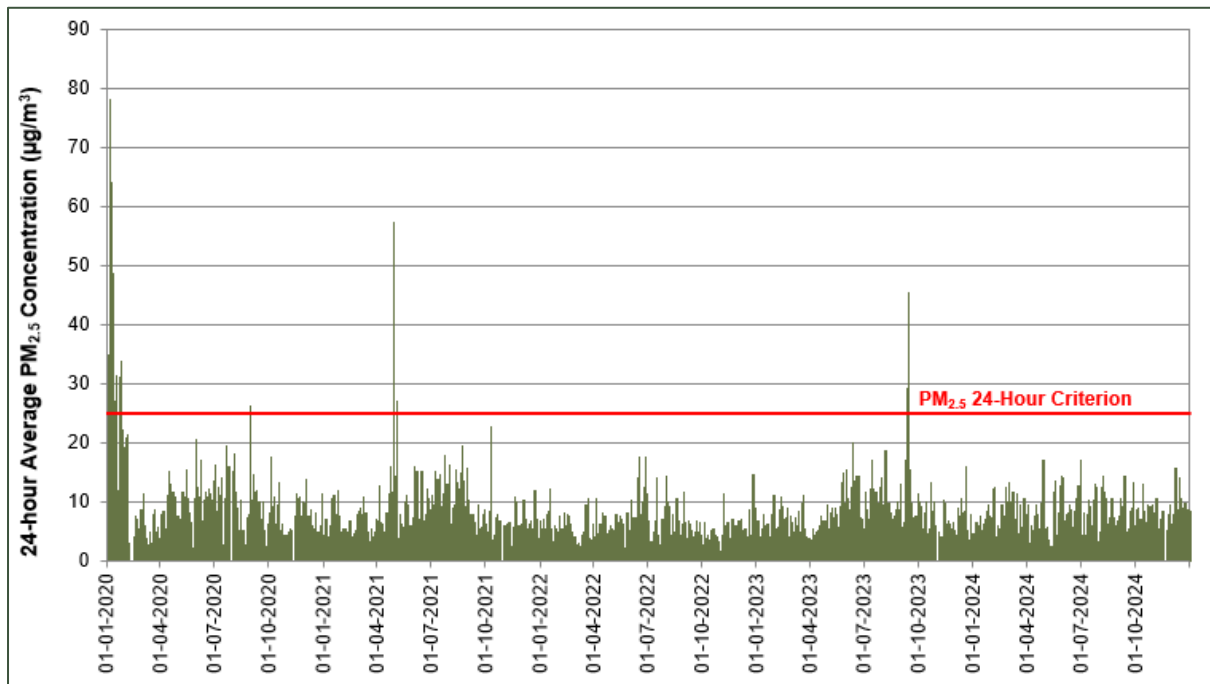


Figure 4-8 Measured 24-Hour Average PM_{2.5} Concentrations at Bringelly AQMS (2020-2024)

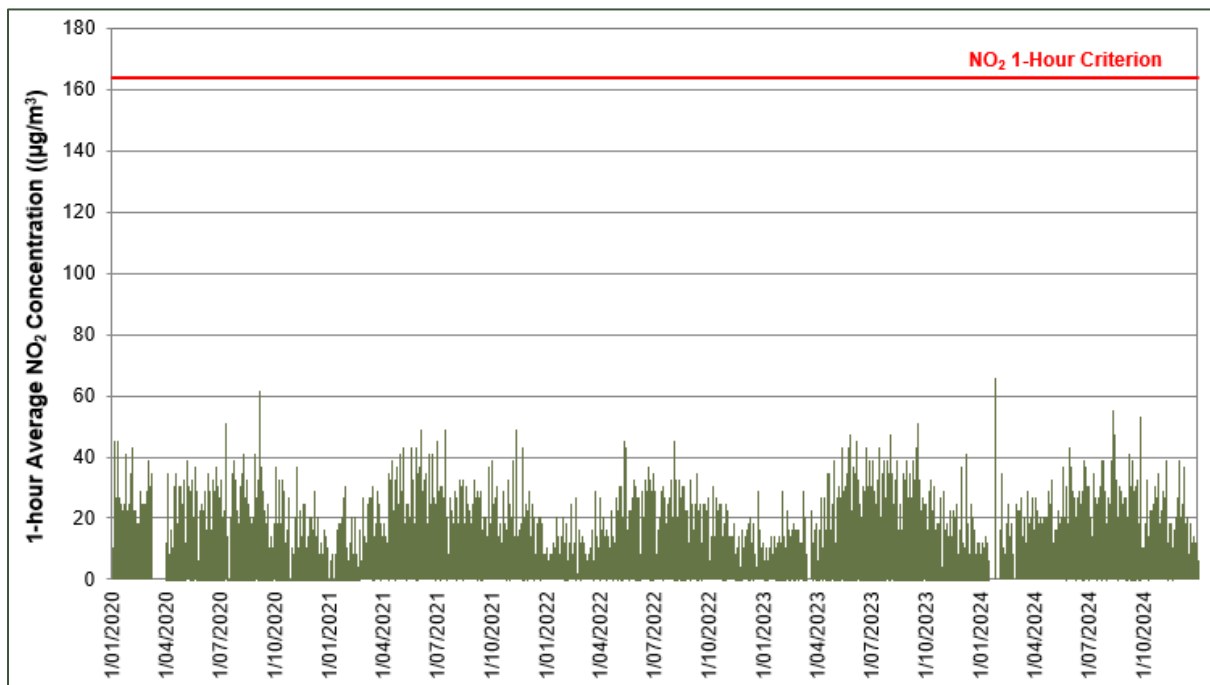


Figure 4-9 Measured 1-Hour Average NO₂ Concentrations at Bringelly AQMS (2020-2024)



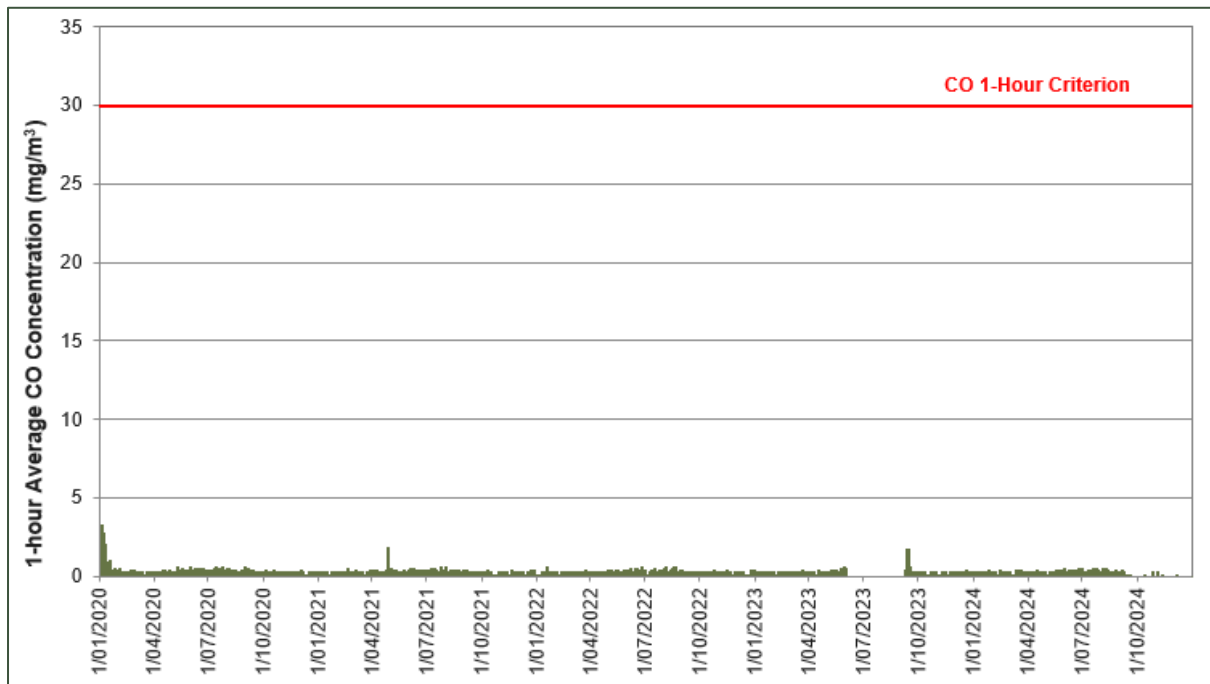


Figure 4-10 Measured 1-Hour Average CO Concentrations at Bringelly AQMS (2020-2024)

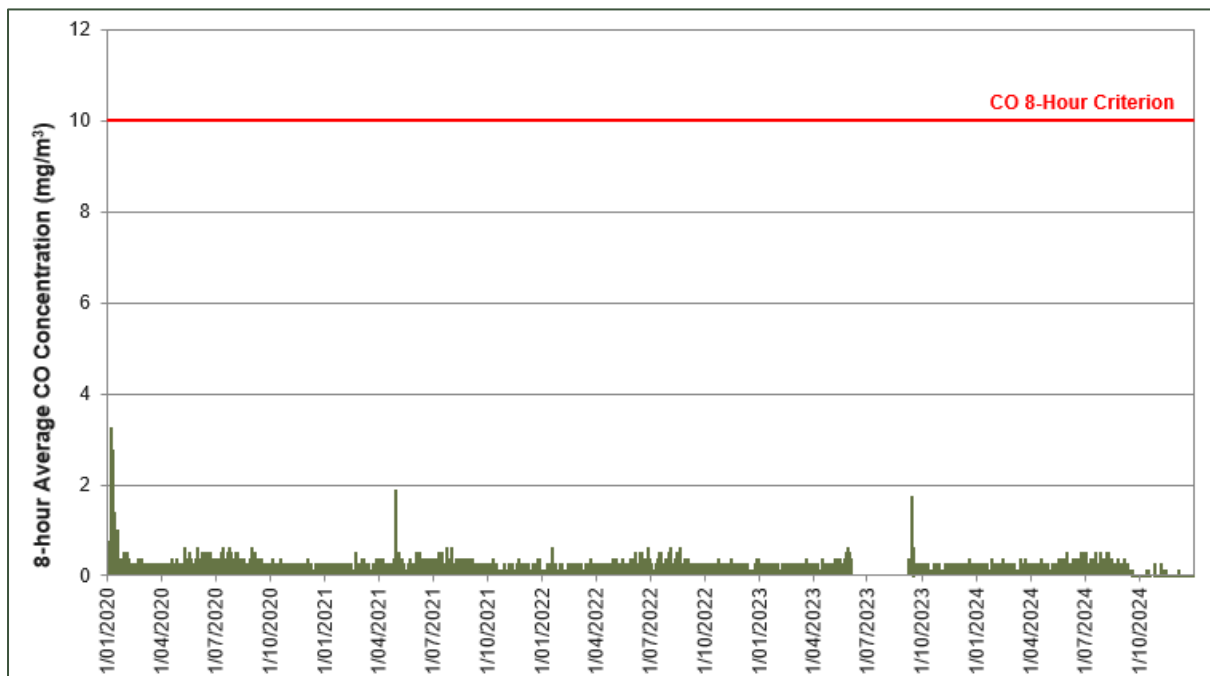


Figure 4-11 Measured 8-Hour Average CO Concentrations at Bringelly AQMS (2020-2024)



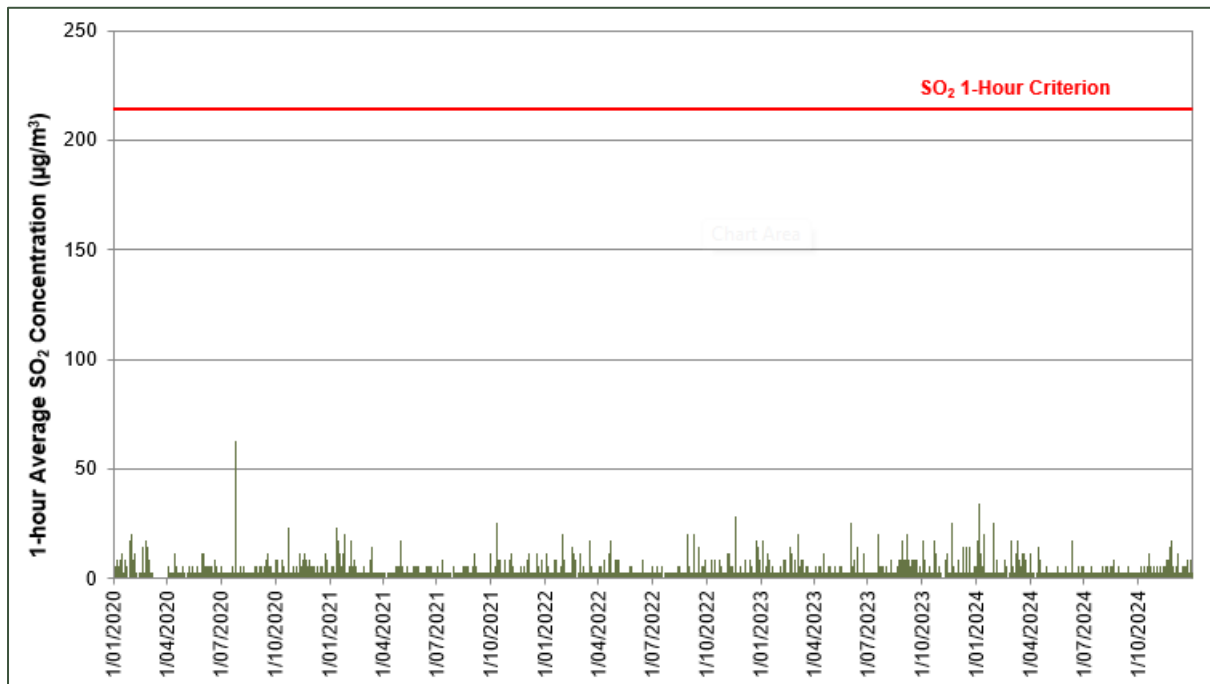


Figure 4-12 Measured 1-Hour Average SO₂ Concentrations at Bringelly AQMS (2020-2024)

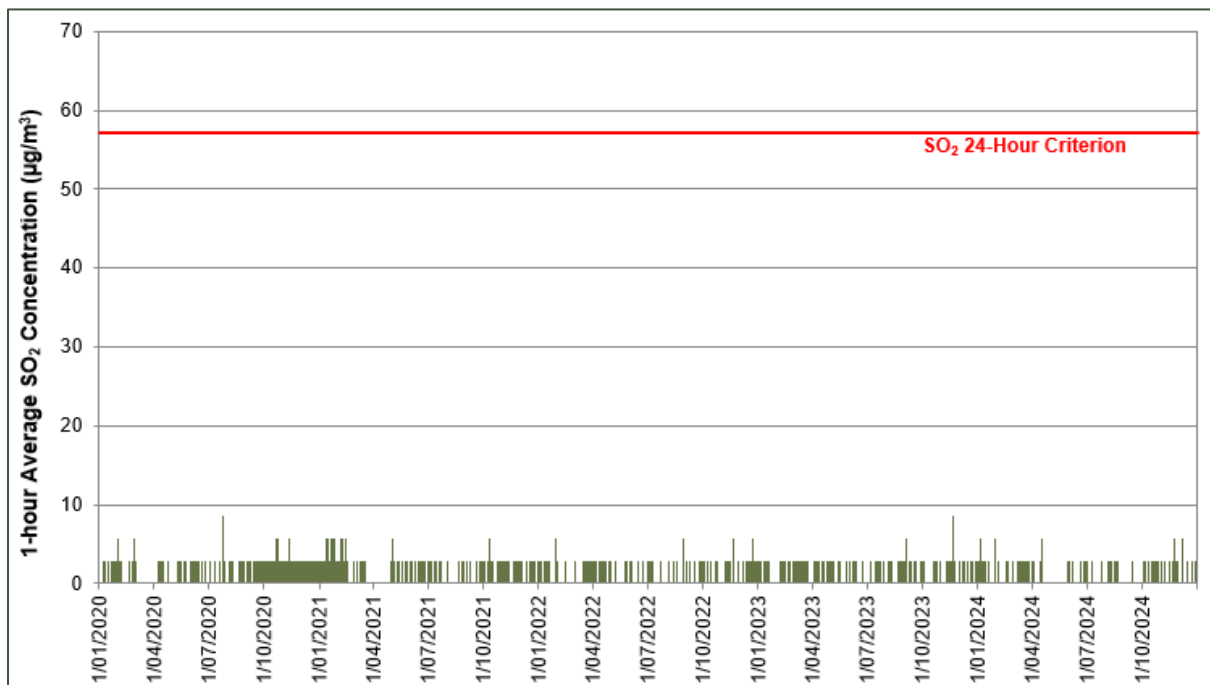


Figure 4-13 Measured 24-Hour Average SO₂ Concentrations at Bringelly AQMS (2020-2024)



5.0 Construction Assessment Methodology

The assessment of air emissions from the proposed construction 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. Topographical, 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.

5.1 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. Badgerys Creek 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 5-1**. Evaluation of the processed meteorological data is provided **Appendix B**.

5.1.1 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 5.2**.

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.

5.1.2 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 5-1 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	12.5 km x 12.5 km
Grid point resolutions	30 km, 10 km, 3 km, 1 km	Receptor grid	50 m resolution
Domain origin centre point	E: 295,164 N: 6,253,975 Zone: 56H	Domain origin southwest corner	E: 286,250 N: 6,241,750 Zone: 56H
Period	31/12/2020 to 01/01/2022	Period	31/12/2020 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

5.2 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 5-2**.

Table 5-2 CALPUFF Domain Details and Model Settings

Item	Details
Domain details	50 m resolution for 12.5 km by 12.5 km domain
Receptor details	50 m resolution gridded receptors and 106 discrete receptors
Emissions data	Varys by emission source. Refer to Appendix D for details.
Further details on model settings can be provided as required.	

5.2.1 Model Configuration

Emissions from the activities at the Site 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).



- The Rest (RE>10 µm).

These parameters were then grouped using CALPOST to predict PM_{2.5}, PM₁₀ 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**.

5.3 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.”

5.4 Emission Estimation

5.4.1 Construction (Bulk Earthworks) Activities

To effectively estimate the worst-case impacts due to the proposed bulk earthworks for the Site, a maximum annual operating scenario was assessed and assumed to occur every day. This ensures that the 24-hour impacts for the peak construction phase are captured.

The total duration of construction works is anticipated to be 48 months. All topsoil is anticipated to be removed during the first 24 months of bulk earthworks.

Construction is anticipated to occur 7am to 6pm Monday to Saturday, excluding prestart and breaks activities. This assessment assumes 11 hours of construction works per day for 365 days per year, although actual works are anticipated to be up to 313 days per year.

The emission generating activity intensities were derived by averaging the indicative bulk material volumes over the anticipated total duration (e.g. 48 months for cut/fill/crushing/screening, 24 months for topsoil removal). To ensure a conservative assessment, the model assumed all activities occur simultaneously for 11 hours a day, 7 days per week, 365 days per year, between the hours of 7:00 am and 6:00 pm. In reality, bulk earthwork activities will be restricted to a reduced schedule, typically occurring for up to 11 hours a day and up to 313 days per year. Wind erosion is modelled 24 hours a day for 365 days.

The equipment is anticipated to include the following:

- Scrapers
- Dozers
- Graders
- Dump trucks
- Material delivery trucks
- Crushing and screening plant
- Water trucks

In addition, as the precise location of the equipment will vary on a day-to-day basis, the emissions estimation conservatively assumes that multiple equipment will be operating concurrently across the Site. Thus, the predicted contributions are also considered to be conservative, particularly with respect to travel on unsealed roads.



A detailed breakdown of the emissions factors and assumptions used to estimate the Site emissions is provided in **Appendix C**. Control measures outlined in **Table C-5** of **Appendix C** are calculated to have the following reduction rates to emissions on uncontrolled emissions from the Site:

- 67% reduction in TSP emissions
- 64% reduction in PM₁₀ emissions
- 56% reduction in PM_{2.5} emissions

The estimated emissions for each activity are presented in **Table 5-4**. This also shows the ranked value for PM₁₀ impacts. The largest sources of PM₁₀ emissions are wind erosion of active areas and haulage on unpaved roads within the Site (for material transfer to and from stockpiles, import, export).

Table 5-3 Activity Intensity

Activity	Intensity	Unit
Scrapers stripping topsoil	185,086	tonnes/year
Scraper travel mode	7,119	VKT/year
Scraper unloading (batch drop)	185,086	tonnes/year
Scrapers stripping cut material from paddocks	435,625	tonnes/year
Scraper travel moving cut material from paddocks	33,510	VKT/year
Scraper unloading cut material (batch drop) to fill areas	435,625	tonnes/year
Loading material to trucks in cut area for transfer to stockpiles	1,862,316	tonnes/year
Excavated material haulage transfer to stockpiles	1,862,316	tonnes/year
Unloading at stockpiles	1,862,316	tonnes/year
Loading material to transfer to crusher	934,871	tonnes/year
Excavated material haulage to crusher	934,871	tonnes/year
Loading material into crusher	934,871	tonnes/year
Crushing (uncontrolled)	934,871	tonnes/year
Screening (uncontrolled)	934,871	tonnes/year
Unloading Material to stockpile from crush/screen	934,871	tonnes/year
Imported material haulage to stockpiles	679,632	tonnes/year
Unloading at stockpile area (from imported material)	679,632	tonnes/year
Loading material to trucks from stockpiles for transfer to fill	2,587,536	tonnes/year
Excavated material haulage transfer to fill area	2,587,536	tonnes/year
Unloading at fill area	2,587,536	tonnes/year
Loading unusable cut material for export	397,588	tonnes/year
Unusable cut material haulage	397,588	tonnes/year
Loading topsoil for export	185,086	tonnes/year
Export topsoil haulage	185,086	tonnes/year
Dozer	12,540	hours/year



Activity	Intensity	Unit
Grader	48024	VKT/year
Wind erosion pit (active disturbed area)	88	ha
Diesel combustion	7,500	m ³ /year



Table 5-4 Activity Emission Rates

Activity	TSP emission (kg/y)	PM ₁₀ emission (kg/y)	PM _{2.5} emission (kg/y)	Total (kg/y)	Rank
Scrapers stripping topsoil	2,684	676	135	3,494	18
Scrapers travel mode	3,702	925	185	4,812	16
Scrapers unloading (batch drop)	3,702	925	185	4,812	17
Scrapers stripping cut material from cut area	6,317	1,590	318	8,225	14
Scraper travel moving cut material from cut area	17,425	4,356	871	22,653	9
Scraper unloading cut material (batch drop) to fill areas	8,713	2,178	436	11,326	13
Loading material to trucks in cut area for transfer to stockpiles	945	447	68	1,460	21
Excavated material haulage transfer to stockpiles	66,789	19,128	1,913	87,830	4
Unloading at stockpiles	945	447	68	1,460	21
Loading material to transfer to crusher	475	224	34	733	23
Excavated material haulage to crusher	8,941	2,561	256	11,757	12
Loading material into crusher	475	224	34	733	23
Crushing (uncontrolled)	2,524	1,122	166	3,812	15
Screening (uncontrolled)	11,686	4,020	272	15,977	10
Unloading material to stockpile from crush/screen	475	224	34	733	23
Imported material haulage to stockpiles	73,705	21,108	2,111	96,924	3
Unloading at stockpile area (from imported material)	345	163	25	533	26
Loading material to trucks from stockpiles for transfer to fill	1,313	621	94	2,029	19
Excavated material haulage transfer to fill area	92,799	26,577	2,658	122,033	2



Activity	TSP emission (kg/y)	PM ₁₀ emission (kg/y)	PM _{2.5} emission (kg/y)	Total (kg/y)	Rank
Unloading at fill area	1,313	621	94	2,029	19
Loading unusable cut material for export	202	95	14	312	27
Unusable cut material haulage	43,118	12,349	1,235	56,701	5
Loading topsoil for export	94	44	7	145	28
Export topsoil haulage	20,072	5,749	575	26,396	8
Dozers	36,146	7,799	3,795	47,741	7
Graders	7,199	2,904	223	10,327	11
Wind erosion	153,934	76,967	11,545	242,446	1
Diesel combustion	8,775	8,775	8,400	25,950	6
Total emissions (kg/yr)	567,632	201,056	35,082	813,383	



5.4.2 Surrounding Sources

This assessment has considered potential cumulative impacts from construction on surrounding sensitive receptors from the Site and surrounding likely construction development. These developments are outlined in **Table 5-5**. Sources included in the assessment are shown in **Figure 5-1**.

A two-tiered approach to emission estimation was adopted for the surrounding sources included in the modelling:

1. Where a publicly available Environmental Impact Statement (EIS) containing a detailed construction air quality assessment existed, TSP, PM₁₀, and PM_{2.5} emission rates were adopted directly from those studies.
2. Where no detailed assessment was available, the TSP emission factor for heavy construction was sourced from 'US EPA AP42 Section 13.2.3 Heavy Construction Operation' (USEPA 1995). Emission rates for finer particulate fractions were then estimated using scaling factors published in the *NPI Emissions Estimation Technique Manual for Mining v3.1* (DSEWPC 2012) and Proposed Revisions to Fine Fraction Ratios (Cowherd, Donaldson and Hegarty 2010).

A summary of the adopted emission factors for Tier-2 sources is presented in **Table 5-6** and the resulting estimated emissions are detailed in **Table 5-7**. To ensure a conservative assessment, the modelling assumed that for all surrounding sources:

- All proposed developments would be under construction simultaneous (highly conservative).
- 75% of the developable land is actively under construction at any given time.
- Construction occurs 365 days a year, for 11 hours per day (7:00 am to 6:00 pm).
- Mitigation controls achieve a similar reduction efficiency to those applied at the Site (see **Section 5.4.1** and **Appendix C**).

It is noted that the modelling assumes that dust emissions from surrounding sources are limited to the construction hours of 7:00 am to 6:00 pm everyday (although in reality no construction occurs on Sunday or Public Holidays). This assumption is justified by the mechanics of wind erosion, which typically requires wind speeds to exceed a threshold of approximately 5 m/s (USEPA 2006) to initiate dust lift-off from exposed surfaces. As illustrated in **Figure 5-2**, wind speeds exceeding 5 m/s are uncommon outside of construction hours. Furthermore, **Figure 5-3** indicates that such wind speeds occur less than 4.5% of the time during the night (6:00 pm to 7:00 am). Therefore, potential dust generation from exposed surfaces outside of active work hours is considered insignificant for the purpose of this assessment.

All sources were modelled as area sources in CALPUFF. While the absence of detailed information for many of these surrounding sources leads to high uncertainty in emission estimation, this approach is considered conservative for the following reasons:

- Assumes all activities occur simultaneously across all modelled areas during the operational hours.
- Excludes benefits from some proposed mitigation measures such as low vehicle speeds, and reduced activities during adverse weather or air quality impacts from other outside sources.
- Potentially underestimates the quenching effect of rainfall on dust emissions.



Considering the conservatism of the above assumptions and methodology, the cumulative assessment is deemed to overestimate potential cumulative impacts. It is noted that potential impacts of likely future development/uses on the proposal has been excluded from this assessment.



Table 5-5 Surrounding Future Development

Development	Status	Consideration	Included in Cumulative Assessment?	Construction Details
SSD 97688711 (Internal Works)	Prepare EIS	It is anticipated that internal construction works would occur through stages as areas of the bulk earthworks assessment in this report are finalised. It is noted that all topsoil removal and material export during the bulk earthworks (peak bulk earthworks phase) will occur in the first two years, prior to the commencement of Internal Works. No overlap of bulk earthworks and operational activities under SSD 97688711 (Internal Works) is anticipated. It is noted that these activities cannot occur concurrently on the same areas, and the majority of earthworks required to prepare for Internal Works are to be completed under the SSD-97711727 activities and are considered in this assessment. If staged commencement of Internal Works commenced after bulk earthworks were completed for an area, any cumulative impacts on offsite receptors would likely be lower.	No	-
Part 5 Activity – External Works Lead in Roads and Services (Parts 2-4 - Martin Road / East West Collector Road / Lawson Road Upgrades, refer Section 1.1.1)	Prepare Part 5	It is anticipated that the highest intensity of bulk earthworks will occur prior to commencement of road upgrade works. However, there may be cumulative impacts at offsite receptors due to the location of these works. This is anticipated to occur during the delivery of the road upgrade works. .	Yes	The project area for the road upgrade works under the Part 5 Approvals is approximately 48,500 m ² ^a .



Development	Status	Consideration	Included in Cumulative Assessment?	Construction Details
Part 5 Activity – External Works Lead in Roads and Services (Part 1 - Martin Road / Elizabeth Drive intersection upgrades, refer Section 1.1.1)	It is expected that these works will be approved by way of amendment to the existing Part 5 approval by Transport for New South Wales ('TfNSW').	It is anticipated that the highest intensity of bulk earthworks will occur prior to commencement of intersection upgrade works. However, there may be cumulative impacts at offsite receptors due to the location of these works. This is anticipated to occur during the delivery of the intersection upgrade works.	Yes	The project area for the intersection upgrade works under the Part 5 Approvals is approximately 41,500 m ² ^a .
SSD-70316465 Burrah Park, (953-2109 Elizabeth Drive, Badgerys Creek)	Under Assessment.	This development is located over 1km from the Site, cumulative impacts are considered unlikely.	No	-
SSD-74191717 Badgerys Creek Industry Park (85 Martin Road, Badgerys Creek)	Response to Submissions.	This development is located within 1km from the Site, cumulative impacts are considered possible.	Yes	The total project area is approximately 170,000 m ² ^b . The air quality assessment report submitted with the EIS did not quantify potential dust emissions associated with the proposed construction works.
SSD-65529236 EMKC3 Industrial Development (230 Martin Road, Badgerys Creek NSW 2555)	Prepare EIS	This development is located within 1km from the Site, cumulative impacts are considered possible.	Yes	The site area is approximately 245,000 m ² , however the total project area is approximately 79,000 m ² ^c . An assessment of air quality impacts was not publicly available at the time of preparing this report.
SSD-81662708 Cross Link Industrial Estate (125; 145-175 Lawson Road, Badgerys Creek)	Prepare EIS.	This development is located within 1km from the Site, cumulative impacts are considered possible.	Yes	The total project area is approximately 80,500 m ² ^d .



Development	Status	Consideration	Included in Cumulative Assessment?	Construction Details
				An assessment of air quality impacts was not publicly available at the time of preparing this report.
SSD-19618251 Elizabeth Enterprise Precinct - Stage 1 (1669-1723 Elizabeth Drive, Badgerys Creek)	Approved.	This development is located within 1km from the Site, cumulative impacts are considered possible.	Yes	The total project area is approximately 272,000 m ² . A quantitative AQIA was completed by SLR in August 2025 ^e .
SSD-76913969 Aldi Automated Distribution Centre (475 Badgerys Creek Road, Bradfield)	Approved.	This development is located within 1km from the Site, cumulative impacts are considered possible. However, Aldi Automated Distribution Centre is contained within the IPG Badgerys Creek Road site. The IPG Badgerys Creek Road Master Plan was approved in July 2025 (the IPG Master Plan). The staging of the IPG Master Plan has been reviewed for timing and found that IPG Stage 6 is likely to overlap with peak Site construction activities, and due to that, Stage 6 of the IPG Master Plan has been included.	Yes – IPG Master Plan Stage 6.	The total project area of IPG Master Plan Stage 6 is approximately 382,000 m ² ^f . A quantitative assessment of construction stage air quality impacts was not publicly available at the time of preparing this report.
SSD-48438209 Barings Industrial Park (2289-2309, 2311 Elizabeth Drive, Luddenham)	Approved 15 April 2025.	This development is located over 1km from the Site, cumulative impacts are considered unlikely.	No	-
SSD-82437463 30-40 Martin Road, Badgerys Creek Waste Transfer Station, Badgerys Creek	Prepare EIS	This development is located within 1km from the Site, cumulative impacts are considered possible.	Yes	The site area is approximately 44,500 m ² however the total project area is approximately 25,000 m ² ^g .



Development	Status	Consideration	Included in Cumulative Assessment?	Construction Details
				An assessment of air quality impacts is not publicly available at this stage.
Notes: a – Client information b – Source: https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-74191717%2120250520T055155.401%20GMT, Accessed 3 December 2025. c – Source: https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-65529236%2120231206T221219.036%20GMT, Accessed 3 December 2025. d – Source: https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=PDA-81613458%2120250327T235757.337%20GMT, Accessed 3 December 2025. e – Source: https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=EXH-83152958%2120251013T041327.831%20GMT, Accessed 3 December 2025. f – Source: https://shared-drupal-s3fs.s3.ap-southeast-2.amazonaws.com/master-test/s3fs-public/dpe-public/documents/NSW%2BPlanning%2BPortal%2Bexhibitions%2B/Badgerys%2BCreek%2BRoad%2BMaster%2BPlan/Appendix+AA_Civil+Engineering+Drawings_for+Master+Plan+(1).pdf, Accessed 3 December 2025. g – Measured from plans included in request for SEARS, source: https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-82437463%2120250411T065901.441%20GMT, Accessed 3 December 2025.				



Table 5-6 Summary of Emission Factor/ Equations Used to Estimate Emissions

Activity	Emission Factor			Units	Source
	TSP	PM ₁₀	PM _{2.5}		
Construction operations	EFTSP = 2.69	EFPM ₁₀ = EFTSP x 0.47	EFPM _{2.5} = EFPM ₁₀ x 0.1	tonne/hectare/ month of activity	EFTSP: (USEPA 1995), PM ₁₀ /TSP particle size ratio: (DSEWPC 2012) PM _{2.5} /PM ₁₀ particle size ratio: (Cowherd, Donaldson and Hegarty 2010)

Table 5-7 Summary of Emission Rates used to Assess Cumulative Impacts

Address of Construction	Area Modelled (m ²)	TSP emissions (g/s)	PM ₁₀ emissions (g/s)	PM _{2.5} emissions (g/s)
Martin Road/Elizabeth Drive Intersection	41,469	1.41	0.54	0.07
85 Martin Road, Badgerys Creek	127,476	4.32	1.67	0.21
230 Martin Road, Badgerys Creek NSW 2555	59,137	2.00	0.77	0.10
125; 145-175 Lawson Road, Badgerys Creek	60,365	2.05	0.79	0.10
1669-1723 Elizabeth Drive, Badgerys Creek	203,871	5.27	1.60	0.16
475 Badgerys Creek Road, Bradfield	286,500	9.71	3.75	0.46
30-40 Martin Road, Badgerys Creek	18,719	0.63	0.25	0.03



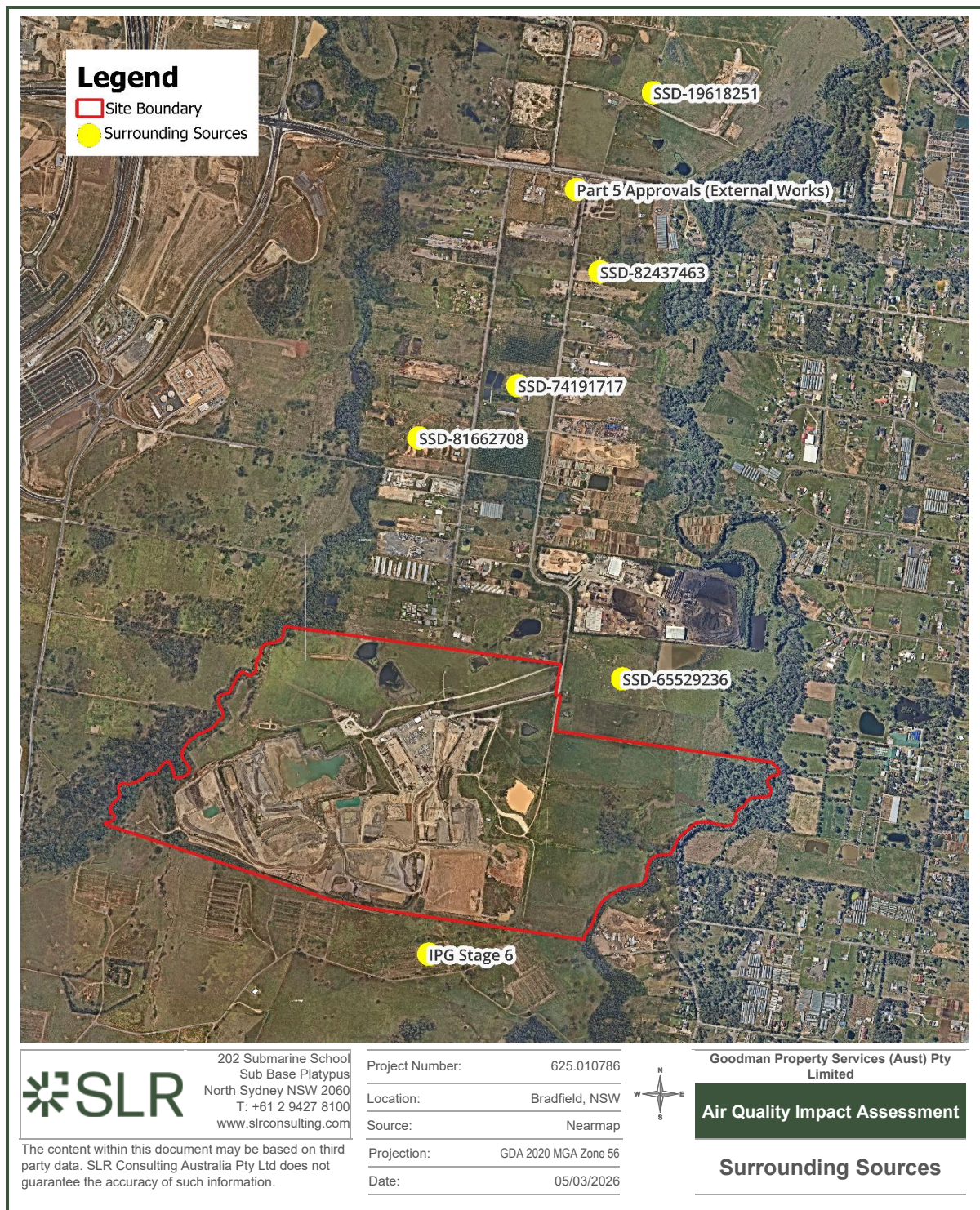


Figure 5-1 Location of Modelled Surrounding Sources



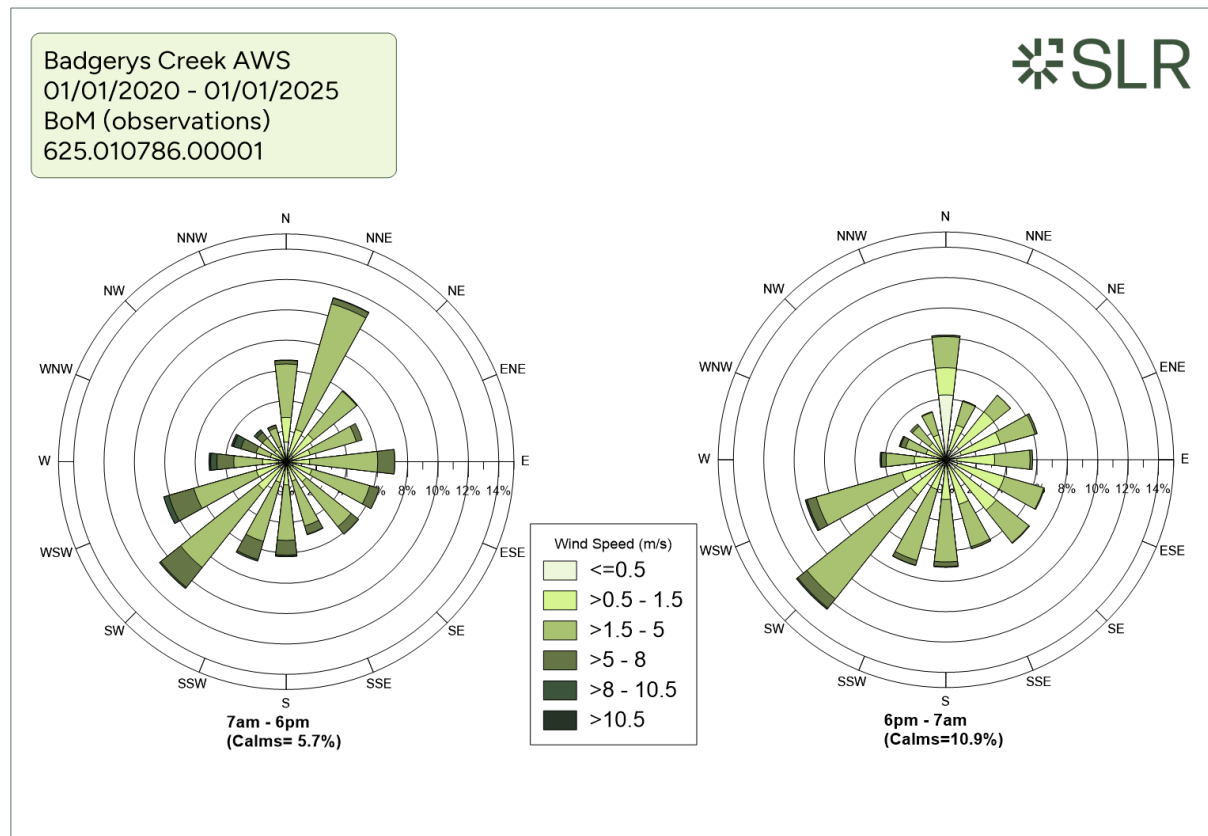


Figure 5-2 Average Construction (7am to 6pm) and Non-Construction (6pm to 7am) Wind Roses for Badgerys Creek AWS – 2020-2024



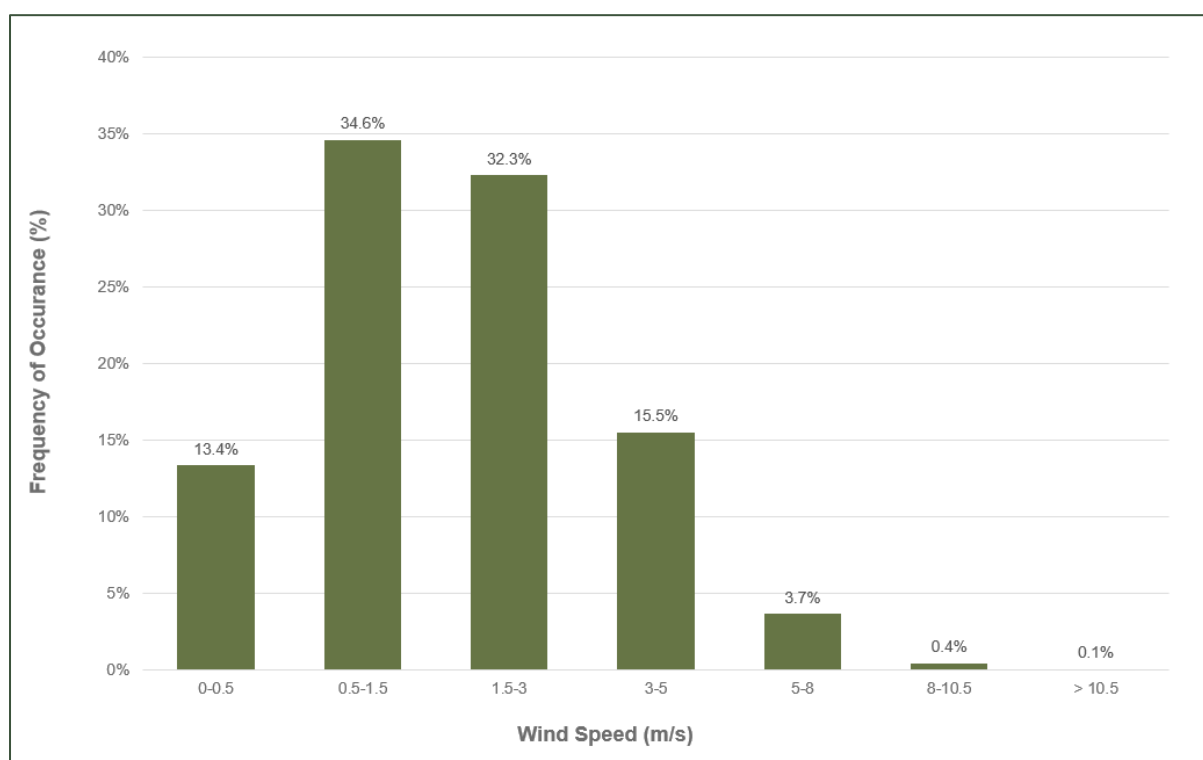


Figure 5-3 Average Night (6pm to 7am) Wind Frequency Badgerys Creek AWS – 2020-2024

5.5 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 Site and any other cumulative sources modelled 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 5-8**.

Table 5-8 Adopted Background Data

Pollutant	Averaging Period	Concentration	Notes
TSP	Annual	Daily varying	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	As monitored at Bringelly AQMS during 2021
	Annual	15.3 µg/ m ³	As monitored at Bringelly AQMS during 2021



Pollutant	Averaging Period	Concentration	Notes
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



6.0 Assessment of Construction Air Quality Impacts

The sections below present a summary of the air quality impacts predicted by the modelling at the worst impacted sensitive receptors modelled.

Isopleth plots showing the incremental impact predicted due to the Site 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 6-1 summarises the incremental and cumulative 24-hour average PM_{2.5} impacts for the 15 most affected discrete receptor locations modelled. These locations were selected based on the maximum 24-hour PM_{2.5} increments predicted by the modelling due to the proposed bulk earthworks.

A contemporaneous analysis was conducted to assess cumulative impacts against the relevant air quality criteria. This involved combining the incremental 24-hour PM_{2.5} impacts from Site activities with the developments identified in **Section 5.4.2** (Surrounding Sources) and the daily varying background concentrations recorded at the Bringelly AQMS on an hour by hour basis.

While cumulative 24-hour average PM_{2.5} concentrations are predicted to exceed the 25 µg/m³ criterion at all 106 modelled receptors, these results are heavily influenced by elevated background levels. It is noted that the background data for the 2021 meteorological year already included three exceedances of the criterion, independent of the Site's activities.

Receptor R8, identified as having the highest incremental impact, is predicted to experience three additional exceedances above the background levels. However, further analysis indicates that the number of additional exceedances at R8 would decrease if emissions from surrounding construction sites are adequately controlled or if all Surrounding Sources are not simultaneously under construction. Further, the recommended trigger action response plan (TARP) and monitoring outlined in **Section 6.5** could significantly reduce the likelihood of additional exceedances (but only if the Site is driving these exceedances).

A detailed daily contemporaneous analysis of Receptor R8 is presented in **Figure 6-1** and **Figure 6-2**, illustrating that incremental impacts from the Site are highest during the winter months. **Figure 6-2** illustrates that for the vast majority of days, throughout the year cumulative concentrations are well below the relevant criterion at the most impacted receptor.

Isopleths showing dispersion patterns across the modelling domain are provided in **Appendix E**.



Table 6-1 Top 15 Highest PM_{2.5} Incremental Impact Receptors - 24-Hour PM_{2.5} Impact

Receptor ID	Maximum 24-Hour Average PM _{2.5} Concentrations (µg/m ³)		Additional Exceedances ² due to Site Activities & Surrounding Sources	Additional Exceedances ² due to Site Activities only
	Incremental Impact	Cumulative Impact ¹		
R8	18.8	58.9	3	3
R10	16.3	58.8	2	2
R11	14.7	58.8	4	3
R113	13.8	58.5	1	1
R30	12.8	58.5	2	0
R99	11.9	58.6	1	0
R63	11.5	58.2	1	0
R101	11.4	58.6	1	0
R31	10.5	58.6	0	0
R98	9.7	58.7	0	0
R16	9.7	58.2	1	0
R53	9.2	58.7	0	0
R55	8.8	58.8	0	0
R18	8.6	57.5	0	0
R56	8.6	58.7	0	0
Criterion		25		
1 – Cumulative impact includes: Site activities, Surrounding Sources, background concentrations.				
2 – Additional exceedances above and over Bringelly AQMS				



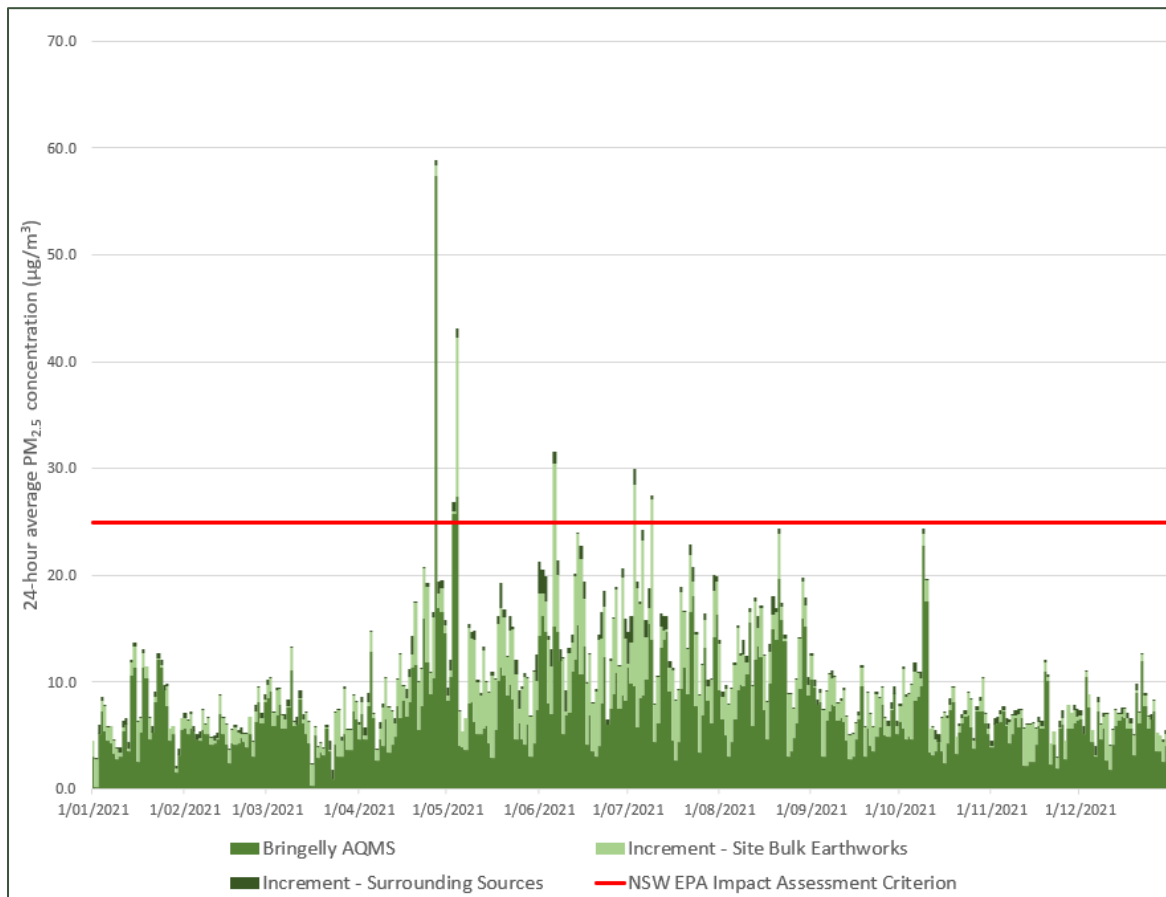


Figure 6-1 Daily Contemporaneous Analysis for Receptor R8

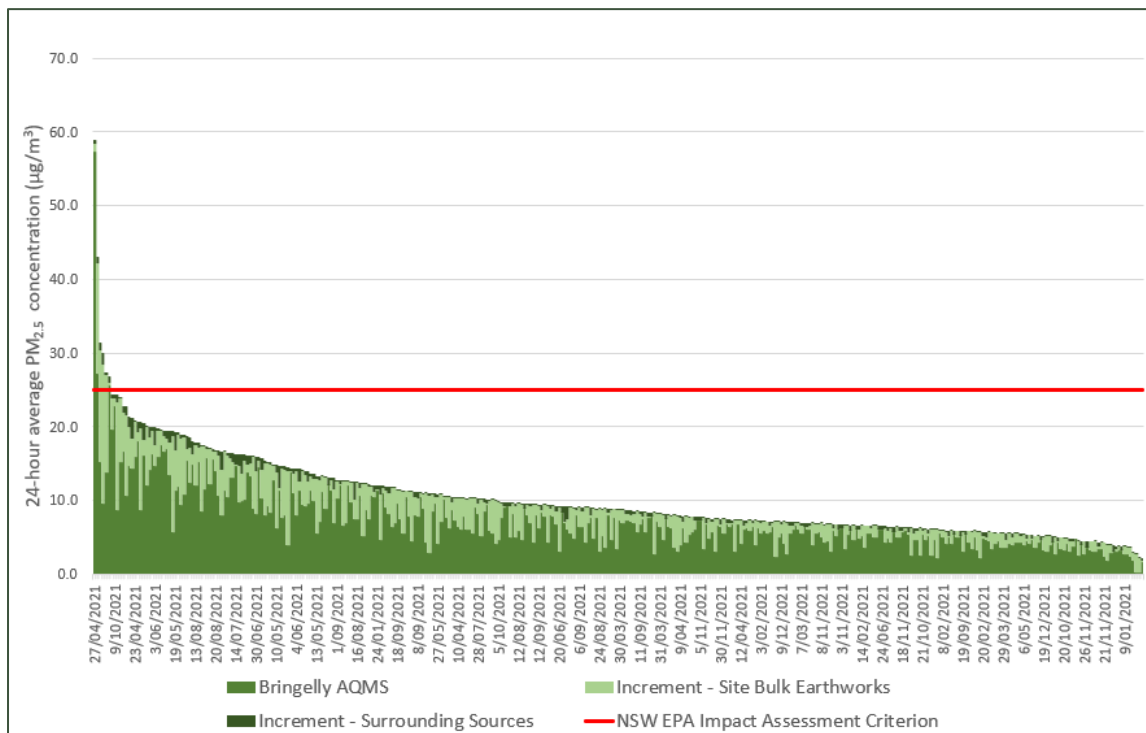


Figure 6-2 Ranked Daily Contemporaneous Analysis for Receptor R8



6.1.2 Annual Average PM_{2.5} Concentrations

Table 6-2 summarises the incremental and cumulative annual average PM_{2.5} impacts for the 15 most affected discrete receptor locations modelled. These locations were selected based on the annual average PM_{2.5} increments predicted by the modelling due to the proposed bulk earthworks at the Site.

Cumulative impacts against the criterion have been considered by including the annual average concentrations from Site activities, Surrounding Sources, and background concentrations adopted from the Bringelly AQMS.

The cumulative annual average PM_{2.5} concentrations are predicted to exceed the annual average PM_{2.5} criterion of 8 µg/m³ at 51 of the 106 receptors modelled. However, these predictions overestimate the impacts as the conservative assumptions used in the emission estimation, to ensure short-term impacts were not underestimated, lead to an overestimation of annual averages.

Receptor R8, identified as the most impacted location, is predicted to receive annual average PM_{2.5} concentrations that exceed the annual criterion by 2.3 µg/m³. As outlined in **Section 6.1.1**, cumulative impacts at R8 would decrease if emissions from surrounding construction sites are adequately controlled, if all Surrounding Sources are not simultaneously under construction or if the recommended TARP, mitigation activities and monitoring outlined in **Section 6.5** is implemented.

Isopleths showing dispersion patterns across the modelling domain are provided in **Appendix E**.

Table 6-2 Top 15 Highest PM_{2.5} Incremental Impact Receptors - 24-Hour PM_{2.5} Impact

Receptor ID	Annual Average PM _{2.5} Concentrations (µg/m ³)		Additional Exceedances ² due to Site Activities & Surrounding Sources
	Incremental Impact	Cumulative Impact ¹	
R8	2.6	10.3	Yes
R11	2.2	9.9	Yes
R10	2.1	9.7	Yes
R113	1.7	9.3	Yes
R30	1.6	9.3	Yes
R99	1.5	9.2	Yes
R101	1.3	9.2	Yes
R31	1.2	9.1	Yes
R63	1.1	8.7	Yes
R98	1.1	9.0	Yes
R16	1.0	8.7	Yes
R53	1.0	9.0	Yes
R56	0.9	8.9	Yes
R55	0.9	8.9	Yes
R54	0.9	9.0	Yes
R61	0.8	8.7	Yes



Receptor ID	Annual Average PM _{2.5} Concentrations (µg/m ³)		Additional Exceedances ² due to Site Activities & Surrounding Sources
	Incremental Impact	Cumulative Impact ¹	
Criterion		8	
1 – Cumulative impact includes: Site activities, Surrounding Sources, background concentrations.			
2 – Additional exceedances above and over Bringelly AQMS			

6.2 Particles as PM₁₀

6.2.1 Maximum 24-Hour Average PM₁₀ Concentrations

Table 6-3 summarises the incremental and cumulative 24-hour average PM₁₀ impacts for the 15 most affected discrete receptor locations modelled. These locations were selected based on the maximum 24-hour PM₁₀ increments predicted by the modelling due to the proposed bulk earthworks.

A contemporaneous analysis was conducted to assess cumulative impacts against the relevant air quality criteria. This involved combining the incremental 24-hour PM₁₀ impacts from Site activities with those from Surrounding Sources and the daily varying background concentrations recorded at the Bringelly AQMS.

While cumulative 24-hour average PM₁₀ concentrations are predicted to exceed the 50 µg/m³ criterion at all the 106 receptors modelled, these results are influenced by elevated background levels. It is noted that the background PM₁₀ concentrations for the contemporaneous 2021 meteorological year already included one exceedance of the criterion recorded during that year, independent of the Site's activities.

Receptors R8, identified as having the highest incremental impact, is predicted to experience 42 additional exceedances above the background levels. However, further analysis indicates that the number of additional exceedances at R8 would decrease if emissions from surrounding construction sites are adequately controlled or if all Surrounding Sources are not simultaneously under construction. Further, the recommended trigger action response plan (TARP), mitigation activities and monitoring outlined in **Section 6.5** could significantly reduce the likelihood of additional exceedances.

A detailed daily contemporaneous analysis of Receptor R8 is presented in **Figure 6-3** to **Figure 6-4**, illustrating that incremental impacts associated with the Site are higher in the winter months. **Figure 6-4** illustrates that for the vast majority of days, throughout the year cumulative concentrations are well below the relevant criterion at the most impacted receptor.

Isopleths showing dispersion patterns across the modelling domain are provided in **Appendix E**.



Table 6-3 Top 15 Highest PM₁₀ Incremental Impact Receptors - 24-Hour PM₁₀ Impact

Receptor ID	Maximum 24-Hour Average PM ₁₀ Concentrations (µg/m³)		Additional Exceedances ² due to Site Activities & Surrounding Sources	Additional Exceedances ² due to Site Activities only
	Incremental Impact	Cumulative Impact ¹		
R8	97.4	122.3	42	27
R10	83.3	107.3	23	14
R11	71.1	98.0	14	10
R113	69.3	93.7	14	7
R30	61.0	88.1	9	5
R99	57.6	84.8	7	5
R63	56.6	81.1	6	5
R101	55.0	82.0	8	4
R31	50.5	77.7	6	3
R16	48.0	78.2	5	3
R98	46.6	77.7	6	3
R53	44.1	78.1	7	3
R18	41.2	69.7	4	1
R55	41.1	78.6	8	2
R22	40.3	69.6	3	1
Criterion		50		
1 – Cumulative impact includes: Site activities, Surrounding Sources, background concentrations.				
2 – Additional exceedances above and over Bringelly AQMS				



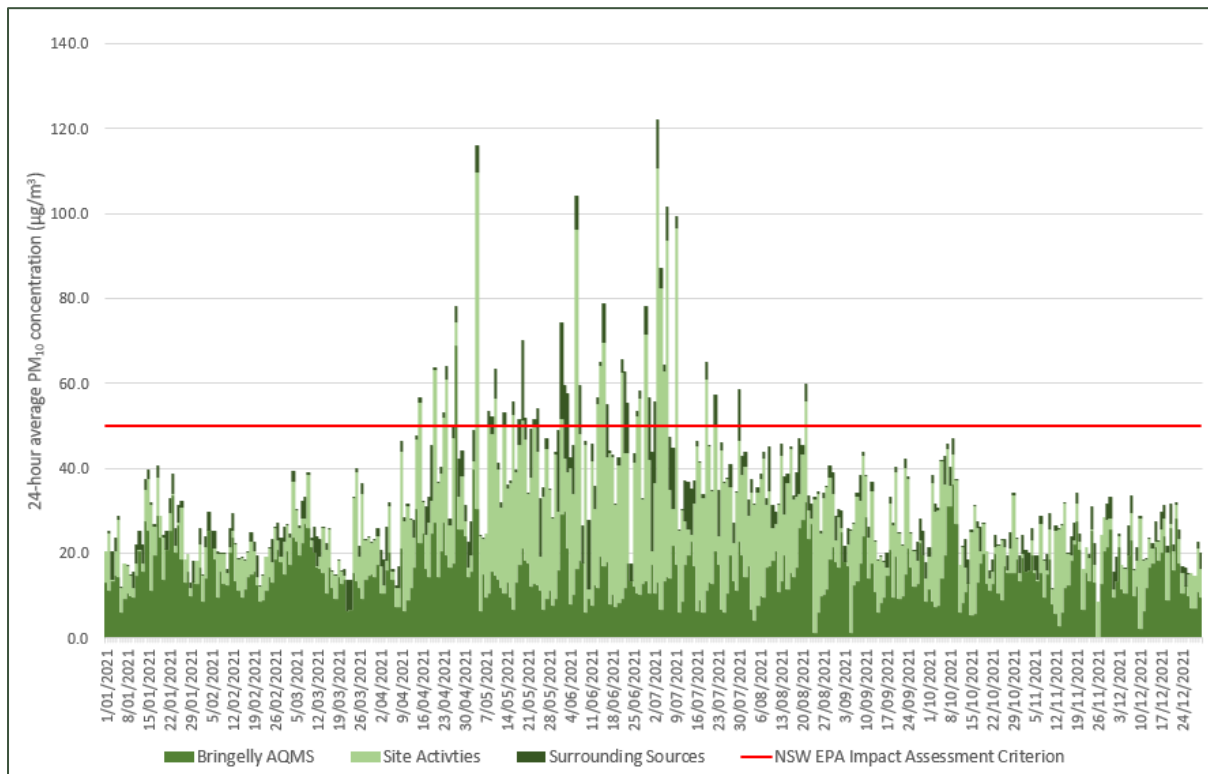


Figure 6-3 Daily Contemporaneous Analysis for Receptor R8

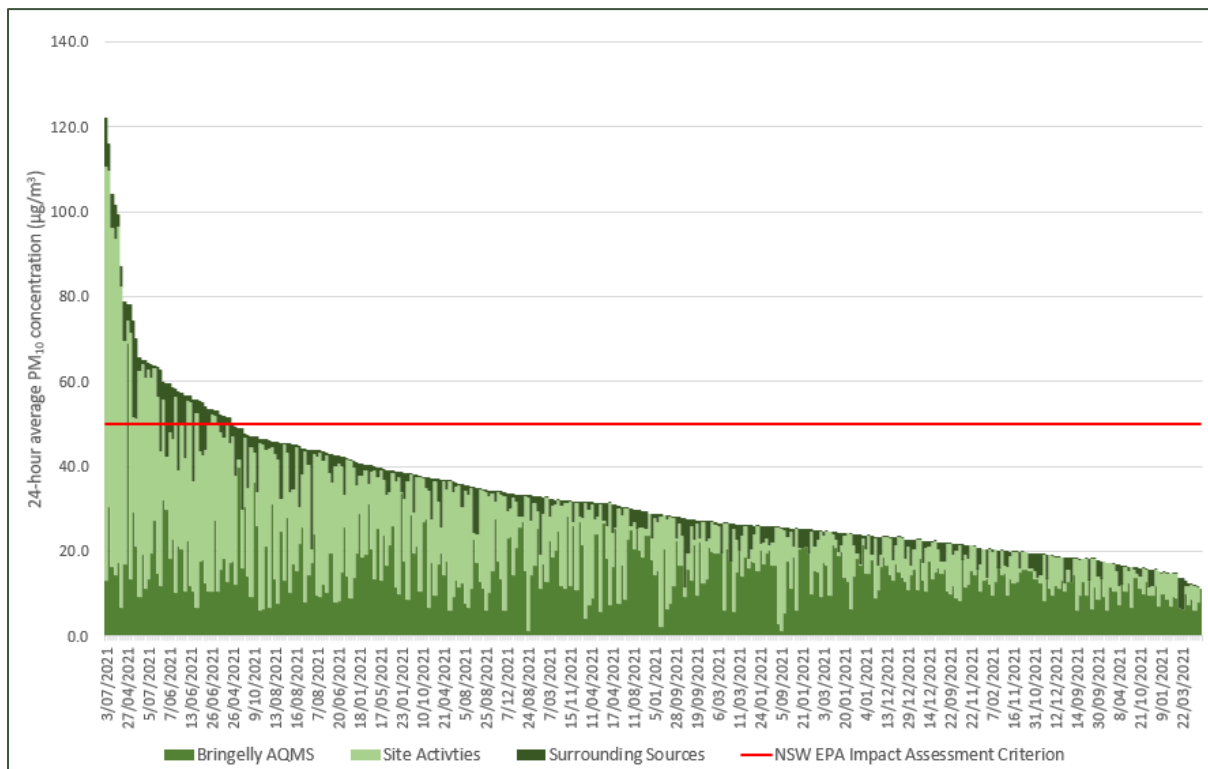


Figure 6-4 Ranked Daily Contemporaneous Analysis for Receptor R8



6.2.2 Meteorological Conditions Contributing to Exceedances

In order to determine the meteorological conditions that result in the highest contribution at the worst impacted receptors, timeseries of predicted 1-hour average PM₁₀ contributions were extracted at the 6 most affected discrete receptor locations modelled, and combined with the contemporaneous windspeed and wind direction data to create the polar plots presented in **Figure 6-5**.

Polar plots show how the predicted contribution at each receptor varies with both wind speed and direction. All figures are plotted on the same arbitrary scale to allow for direct comparison between them.

Figure 6-5 presents the 95th percentile data to remove outliers. A review of the polar plots indicates that the PM₁₀ contribution at receptors R10, R11, R113, R30, R8, R99 is greater at wind speeds <2 m/s. This suggests that lower winds are inhibiting effective dispersion of dust emissions from the Site at these locations. There is no single predominant wind direction that causes impacts across all receptors. This is because the sensitive receptors are located in various directions around the Site, so different wind directions affect different receptors.

Figure 6-6 presents annual and seasonal wind roses at the Site based on the meteorological data used in the dispersion modelling for the proposed operating hours (7am to 6pm). A review of these wind roses show that high windspeeds occur most frequently in winter and spring, and most frequently from the southwest.

Figure 6-7 presents box and whisker plots showing the spread of concentrations per hour of the day for the PM₁₀ contribution at receptors R10, R11, R113, R30, R8, R99. It can be seen that most of the outliers (highest hourly concentrations) occur between 7:00 am - 8:00 am and 5:00 am - 6:00 pm. Particular attention should be made to mitigation during these hours and where possible activities with the highest potential for dust generation should be done outside of these hours.



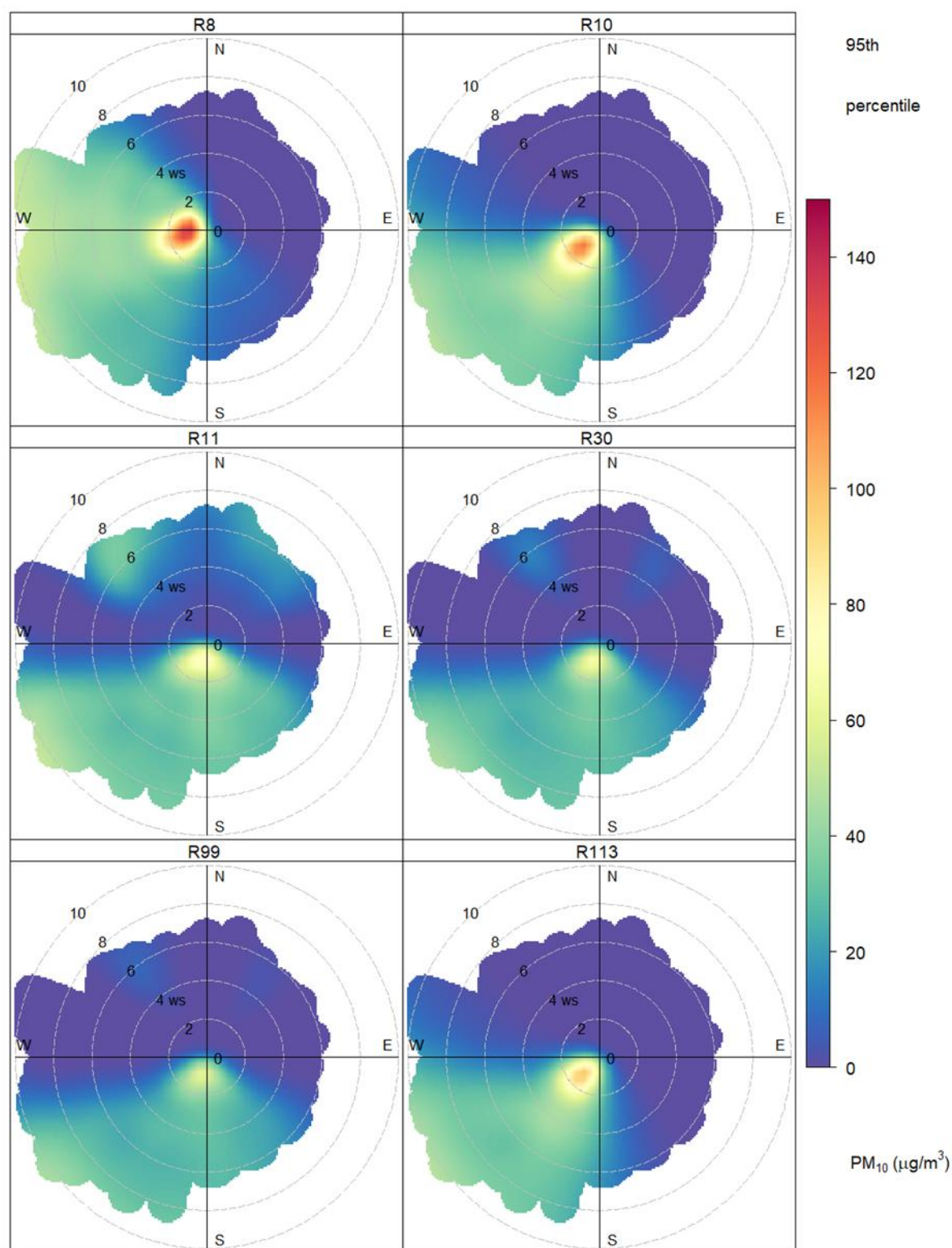


Figure 6-5 Polar Plots of Predicted 1-hour Average PM_{10} Contribution at Selected Worst Impacted Receptors



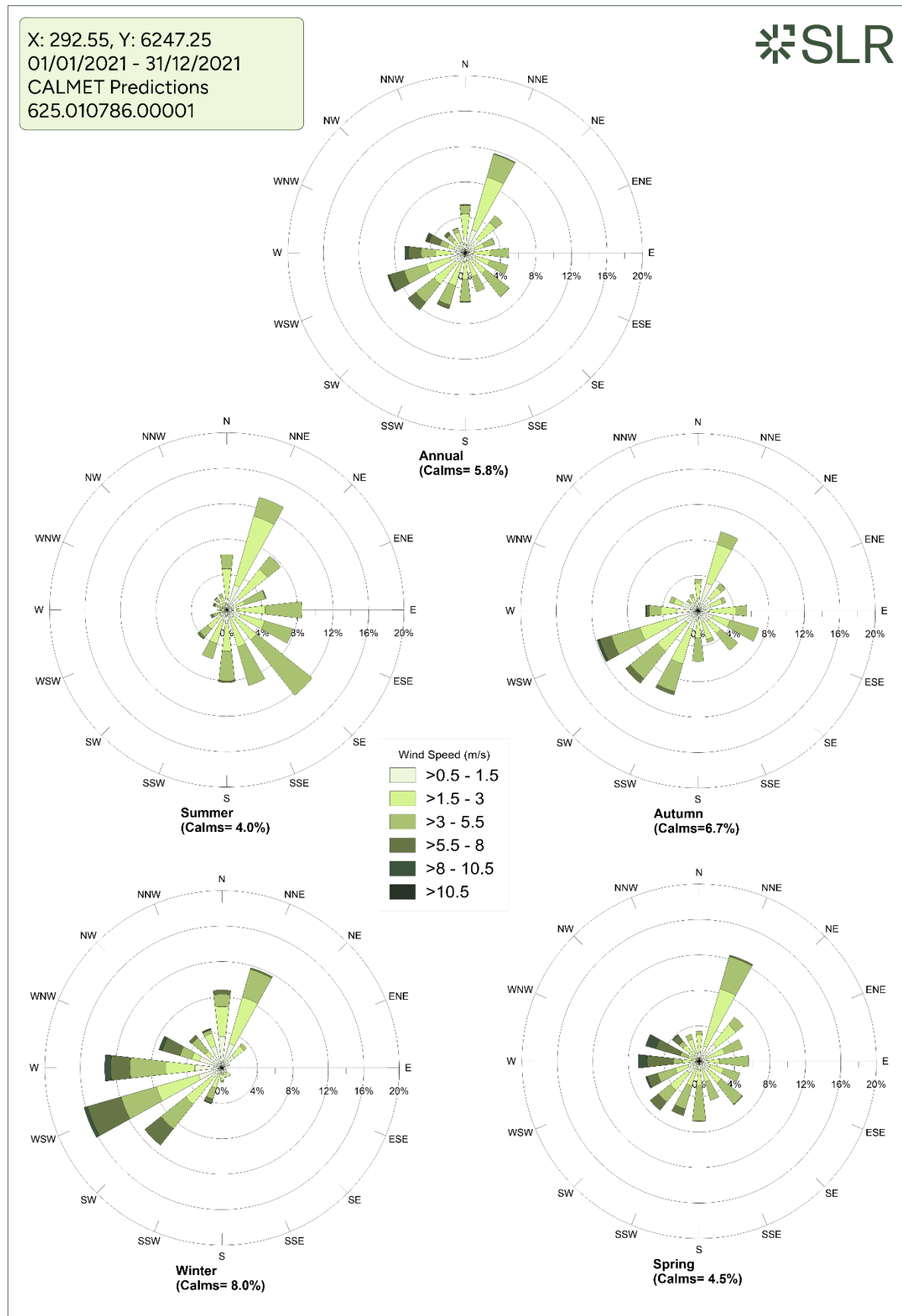


Figure 6-6 Annual and Seasonal Wind Roses at the Site: 7am – 6pm



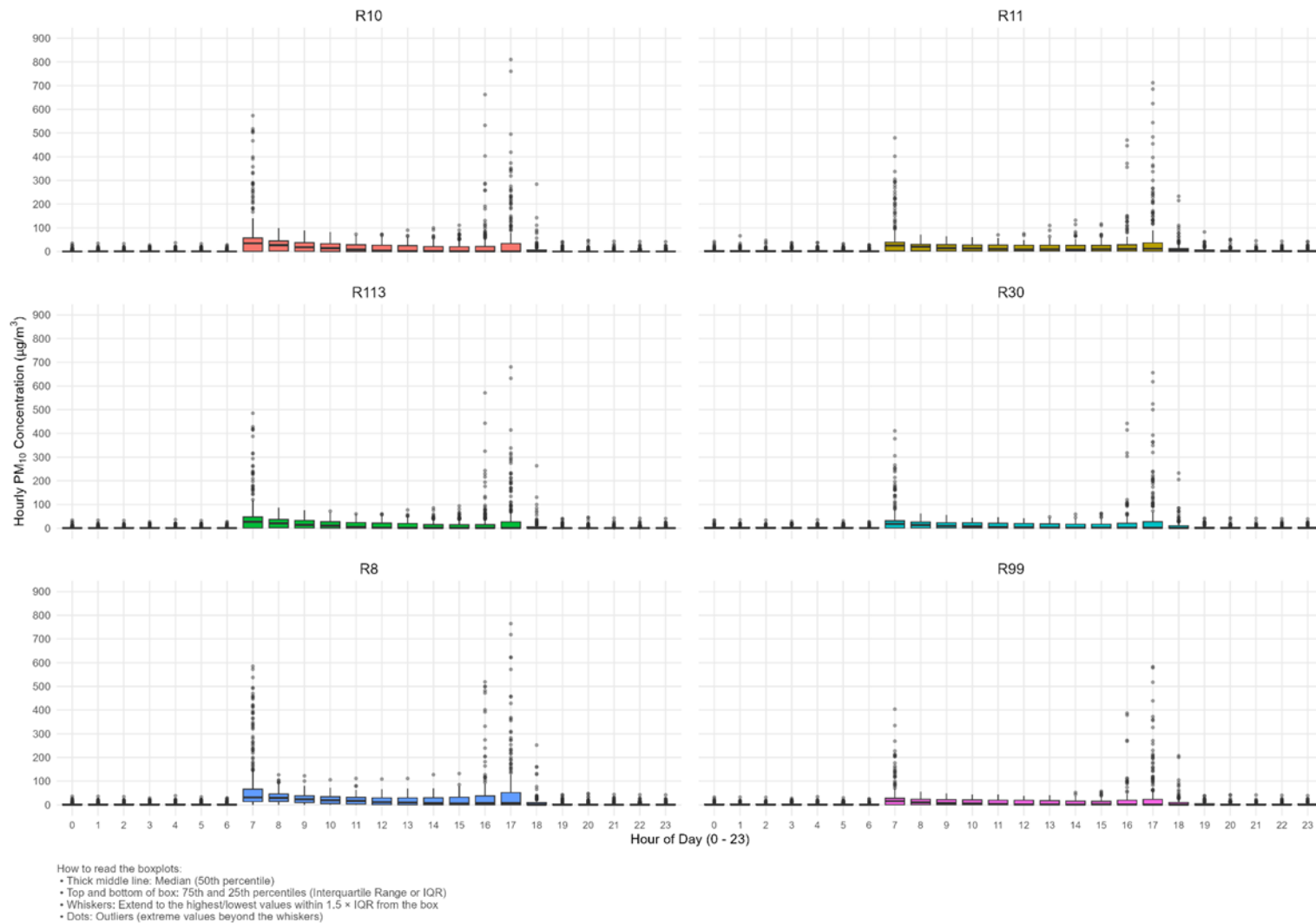


Figure 6-7 Hourly Concentration Distribution by Receptor



6.2.3 Annual Average PM₁₀ Concentrations

Table 6-4 summarises the incremental and cumulative annual average PM₁₀ impacts for the 15 most affected discrete receptor locations modelled. These locations were selected based on the annual average PM₁₀ increments predicted by the modelling due to the proposed bulk earthworks at the Site.

Cumulative impacts against the criterion have been considered by including the annual average concentrations from Site activities, Surrounding Sources, and background concentrations adopted from the Bringelly AQMS.

The cumulative annual average PM₁₀ concentrations are predicted to exceed the annual average PM₁₀ criterion of 25 µg/m³ at 35 of the 106 receptors modelled. However, these predictions overestimate the impacts as the conservative assumptions used in the emission estimation, to ensure short-term impacts were not underestimated, lead to an overestimation of annual averages.

Receptor R8, identified as the most impacted location, is predicted to exceed the annual criterion by 8.1 µg/m³. As outlined in **Section 6.1.1**, cumulative impacts at R8 would decrease if emissions from surrounding construction sites are adequately controlled, if all Surrounding Sources are not simultaneously under construction or if the recommended TARP and monitoring outlined in **Section 6.5** is implemented.

Isopleths showing dispersion patterns across the modelling domain are provided in **Appendix E**.

Table 6-4 Top 15 Highest PM₁₀ Incremental Impact Receptors - Annual PM₁₀ Impact

Receptor ID	Annual Average PM ₁₀ Concentrations (µg/m ³)		Additional Exceedances ² due to Site Activities
	Incremental Impact	Cumulative Impact ¹	
R8	14.5	33.1	Yes
R11	11.9	30.3	Yes
R10	11.5	29.5	Yes
R113	9.5	27.5	Yes
R30	8.6	27.8	Yes
R99	7.9	27.3	Yes
R101	7.2	27.0	Yes
R31	6.4	26.7	Yes
R63	6.1	24.1	No
R98	5.7	26.5	Yes
R16	5.5	24.0	No
R53	5.3	26.5	Yes
R56	4.8	26.3	Yes
R55	4.8	25.9	Yes
R54	4.6	26.7	Yes
Criterion		25	



Receptor ID	Annual Average PM ₁₀ Concentrations (µg/m³)		Additional Exceedances ² due to Site Activities
	Incremental Impact	Cumulative Impact ¹	
1 – Cumulative impact includes: Site activities, Surrounding Sources, background concentrations.			
2 – Additional exceedances above and over Bringelly AQMS			

6.3 Particles as TSP

Table 6-5 summarises the incremental and cumulative annual average TSP impacts for the 15 most affected discrete receptor locations modelled. These locations were selected based on the annual average TSP increments predicted by the modelling due to the proposed bulk earthworks at the Site.

Cumulative impacts against the criterion have been considered by including the annual average concentrations from Site activities, surrounding sources, and estimated background concentrations. Background TSP concentrations have been calculated from PM₁₀ concentrations at Bringelly AQMS during 2021 assuming a PM₁₀/TSP ratio of 0.4

The cumulative annual average TSP concentrations are predicted to exceed the annual average TSP criterion of 90 µg/m³ at 1 of the 106 receptors modelled. As outlined in **Section 6.1.2**, annual average predictions overestimate the impacts as the conservative assumptions used in the emission estimation, to ensure short-term impacts were not underestimated, lead to an overestimation of annual averages.

As outlined in **Section 6.1.1**, cumulative impacts would decrease if emissions from surrounding construction sites are adequately controlled, if all surrounding sources are not simultaneously under construction or if the recommended TARP and monitoring outlined in **Section 6.5** is implemented.

Isopleths showing dispersion patterns across the modelling domain are provided in **Appendix E**.

Table 6-5 Predicted Incremental and Cumulative Annual Average TSP Concentrations

Receptor ID	Annual Average TSP Concentrations (µg/m ³)	
	Incremental Impact	Cumulative Impact 1
R8	37.2	82.5
R10	28.9	72.9
R11	28.1	72.8
R113	23.4	67.3
R30	20.1	66.5
R99	18.3	65.2
R101	16.6	64.4
R31	14.6	63.5
R63	14.1	58.0
R98	12.9	63.1
R16	12.7	58.0



Receptor ID	Annual Average TSP Concentrations (µg/m ³)	
	Incremental Impact	Cumulative Impact 1
R53	11.9	63.0
R56	10.6	62.6
R55	10.6	61.6
R54	10.2	63.4
Criterion	-	90
1 – Cumulative impact includes: Site activities, Surrounding Sources, background concentrations.		

6.4 Dust Deposition

Table 6-6 summarises the incremental and cumulative dust deposition rates for the 15 most affected discrete receptor locations modelled. These locations were selected based on the annual average dust deposition increments predicted by the modelling due to the proposed bulk earthworks at the Site.

Cumulative impacts against the criterion have been considered by including the annual average concentrations from Site activities, surrounding sources, and an assumed background dust deposition rate of 2 g/m²/month.

The worst incremental impacted receptor is identified as R8. **Table 6-6** indicates that the predicted incremental annual average dust deposition rates are below the criterion of 2 g/m²/month. Cumulative annual average dust deposition rates are below the 4 g/m²/month criterion at all receptors with the exception of R8 (4.2 g/m²/month).

As outlined in **Section 6.1.2**, annual average predictions are expected to overestimate the impacts as the conservative assumptions used in the emission estimation, to ensure short-term impacts were not underestimated, lead to an overestimation of annual averages.

Further, as outlined in **Section 6.1.1**, cumulative impacts would decrease if emissions from surrounding construction sites are adequately controlled, if all surrounding sources are not simultaneously under construction or if the recommended TARP and monitoring outlined in **Section 6.5** is implemented.



Table 6-6 Predicted Annual Average Dust Deposition Rates

Receptor ID	Annual Average Dust Deposition Rate (g/m ² /month)	
	Incremental Impact	Cumulative Impact ¹
R8	1.9	4.2
R11	1.6	3.9
R10	1.5	3.7
R113	1.2	3.4
R30	1.1	3.3
R99	1.0	3.2
R101	0.9	3.2
R31	0.8	3.1
R63	0.7	2.9
R98	0.7	3.1
R16	0.6	2.9
R53	0.6	3.1
R56	0.5	3.0
R55	0.5	3.0
R54	0.5	3.0
Criterion	2 g/m ² /month	4 g/m ² /month
1 – Cumulative impact includes: Site activities, Surrounding Sources, background concentrations.		

6.5 Mitigation Measures

The results of the dispersion modelling indicate potential exceedances of both short-term (24-hour) and long term (annual average) particulate criteria for PM₁₀ and 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 Site are listed in **Appendix C**.

Additional dust mitigation and management measures recommended are listed in **Table 6-7** to



Table 6-9. It is noted that the benefits gained from all mitigation measures outlined in these tables could not be quantified.

These mitigation measures may be adopted in a site-specific Construction Air Quality Management Plan (CAQMP). CAQMPs cover all sources of emissions, such as those identified in **Section 5.4.1** of this AQIA, including wind erosion, wheel generated dust, extraction, material handling and processing of extracted material. The CAQMP should also recognise the increased risk of impacts during winter.

In addition, it is recommended that the Site utilises a TARP supported by PM₁₀ real-time air quality monitors to manage impacts at receptors.

Table 6-7 Recommended Dust Mitigation Measures for the Site

	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 CAQMP which includes a TARP, details of the proposed monitoring program as well as measures to control dust and if required other emissions (such as odour and combustion gases).
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 real-time monitoring and daily on-site and off-site inspections, where receptors 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	Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
12	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period
13	Avoid site runoff of water or mud.



	Activity
14	Keep site fencing, barriers and scaffolding clean using wet methods.
15	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.
16	Cover, seed, or fence stockpiles to prevent wind whipping where possible and when stored for extended periods.
Operating Vehicle/Machinery and Sustainable Travel	
17	Ensure all vehicles switch off engines when stationary - no idling vehicles.
18	Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where practicable.
19	Impose and signpost a maximum-speed-limit of 20 km/h on surfaced and 10 km/h 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).
Operations	
20	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.
21	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
22	Use enclosed chutes and conveyors, and covered skips.
23	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and using fine water sprays on such equipment wherever appropriate.
24	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	
25	Avoid bonfires and burning of waste materials.

Table 6-8 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.
During windy weather, large, unprotected areas will be kept moist (not wet) by sprinkling with water to keep dust under control. In the event water is not available in sufficient quantities, soil binders and/or dust retardants will be used or the surface will be left in a cloddy state that resists removal by wind.
Limiting the area of lands exposed to erosive forces through phasing works, provision of a protective ground cover including (mulches, vegetation, organic binders or dust retardants) keeping the ground surface damp (not wet), leaving the surface in a rough cloddy condition to increase roughness and slow surface wind speed.



Activity
If unexpected odorous materials are uncovered, works in the affected area will cease immediately. The exposed material will be covered to minimise emissions, and removed offsite immediately. If there is another occurrence, the same procedure should be followed in addition to engaging and a qualified environmental specialist to will assess the source and extent of the odorous material. Appropriate controls—such as temporary capping, rapid removal, or modification of the excavation sequence—will be implemented before excavation resumes.



Table 6-9 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 bowzers 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.

6.5.1 Recommended Ambient Air Quality Monitoring

Ambient air quality monitoring is proposed to assist in mitigating potential impacts at sensitive receptors. An example monitoring program is provided in **Table 6-10**.

Goodman maintains real time monitoring using SiteHive monitors as well as dust deposition monitoring as per the approved Air Quality and Greenhouse Gas Management Plan (AQGHGMP) under MP10_0014.

As discussed in **Section 6.2.2**, as there are receptors in all directions from Site, there is not a predominate wind direction causing impacts at receptors, therefore it is recommended that monitors are located in each direction near the most impacted receptors. The locations monitored currently at the Site are shown in **Figure 6-8**. It is considered suitable to continue monitoring at these locations to assist with effective project management and assist in minimising the potential for adverse air quality impacts at the sensitive receptors.

However, it is recommended that these locations are reviewed periodically to ensure representative of current construction activities and the seasonal variation in wind directions presented in **Figure 6-6**.

Table 6-10 Air Quality and Meteorological Monitoring Program

Actions	Frequency
Conduct real-time continuous PM10 monitoring and monthly DDG sampling at locations representative of nearest sensitive receptors & prevailing wind directions.	Continuously one month prior to commencement and monthly continuously during construction.
Continuous meteorological data will be recorded from an on-site station including wind speed and wind direction as a minimum.	Continuously during construction.



Actions	Frequency
Undertake regular on-site inspections to check compliance with dust controls and maintain a log of results.	Daily during construction.



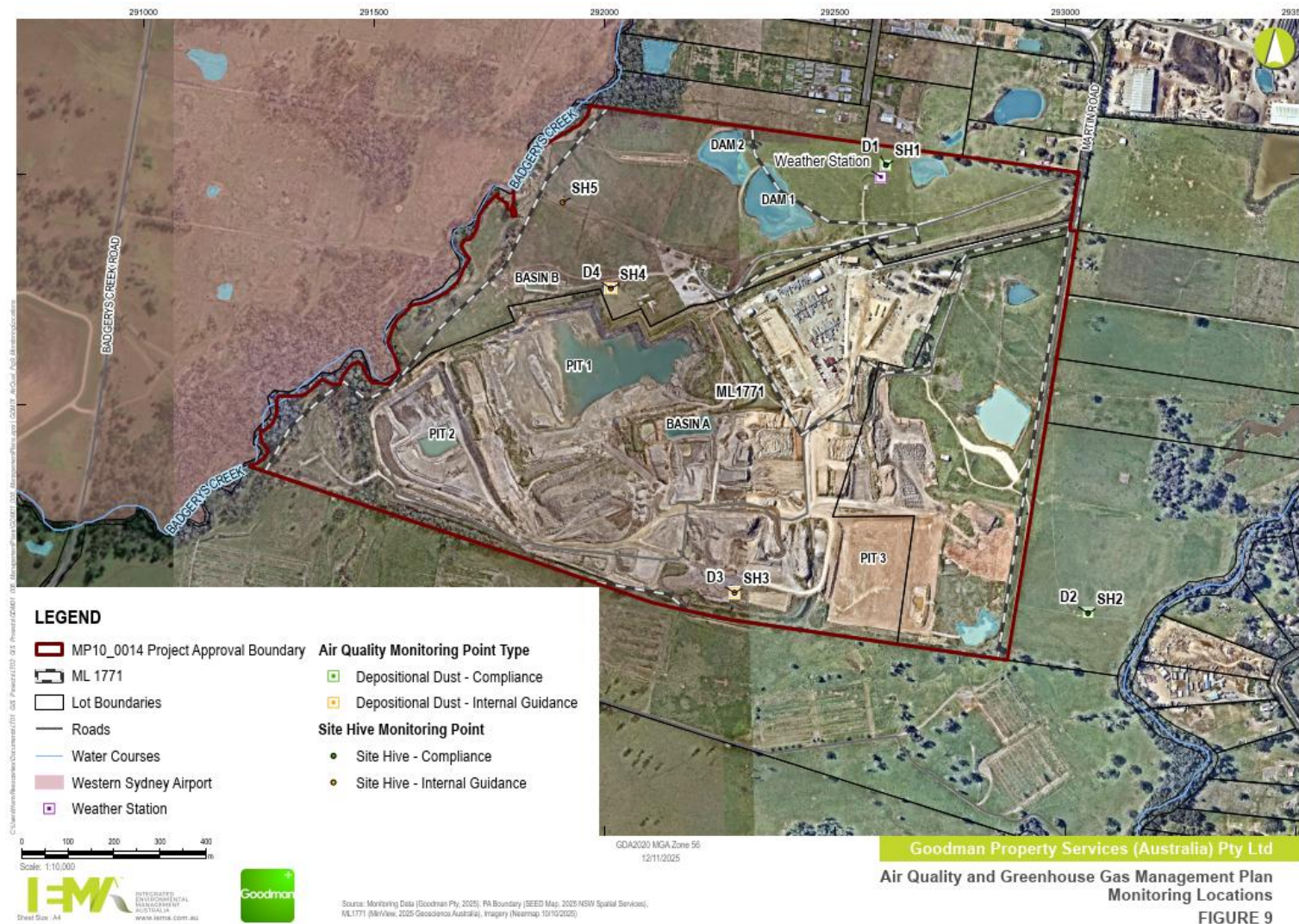


Figure 6-8 Existing Monitoring Locations



6.5.2 Recommended Trigger Action Response Plan

TARPs define the minimum set of actions required by workers in response to a deviation from normal working conditions.

A 1-hour average time period has been selected as a practical time-step for identifying sustained elevated dust concentrations that could potentially result in an exceedance of the NSW EPA 24-hour average PM₁₀ criterion, while providing sufficient time for additional mitigation measures to be implemented at the Site to reduce dust emissions before such an exceedance occurs. Monitoring of PM₁₀ will be outlined in the AQGHGMP.

Table 6-11 presents recommended 1-hour average PM₁₀ concentrations and actions. In the absence of local guidance, these values are adapted from the recommendation in the UK Institute of Air Quality Management (IAQM) Guidance on Monitoring in the Vicinity of Demolition and Construction Sites (IAQM 2018) that was developed based on extensive monitoring in the vicinity of construction sites and recommended a 1-hour average PM₁₀ concentration of 190 mg/m³ as the trigger upon which action must immediately be taken to minimise dust emissions. The upper trigger has been conservatively lowered to 150 mg/ m³.

Table 6-11 TARP PM₁₀ Trigger Levels and Responses

Level	1-hour Average PM10 Trigger Level	Action
Alert	$\geq 100 \mu\text{g/ m}^3$ but $< 125 \mu\text{g/ m}^3$ Or Wind speed $< 2\text{m/s}$ Or Visible dust leaving the Site	- Review operations via a visual inspection of dust emissions from current activities to ensure all standard dust mitigation measures are being appropriately implemented. Where appropriate, implement additional remedial measures, such as: - Deployment of additional water sprays, water trucks etc - Determine if background concentrations may be the key contributor to high concentrations being recorded (e.g., based on wind direction, information on regional events such as bush fires or dust storms, etc). - Continue to closely monitor PM₁₀ concentrations being recorded.
Action I	$\geq 125 \mu\text{g/ m}^3$ but $< 150 \mu\text{g/ m}^3$ AND Wind speed $< 2\text{m/s}$ Or Visible dust leaving the Site	- Increase watering rates on haul roads where appropriate. - Reduce speed of equipment / vehicles. - Continue to closely monitor PM₁₀ concentrations being recorded. - Undertake an investigation of the dust generating activities, and if necessary, temporarily halt the dust generating activities
Action II	$\geq 150 \mu\text{g/ m}^3$ AND Wind speed $< 2\text{m/s}$ AND Or Visible dust leaving the Site	- Review planned operations considering exposed areas. - Cease any non-critical dust-producing activities or relocate relevant activities where possible away from sensitive receptors, or to less exposed locations. - Continue to closely monitor PM₁₀ concentrations being recorded.



6.6 Urban Heat Considerations

Rising temperatures and increasing urban heat have the potential to worsen air quality as outlined in **Section 4.4.1**.

The assessment of construction impacts within this report indicate potential exceedances of both short-term and long term particulate criteria for PM₁₀ and long term particulate averages for PM_{2.5}. 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.

Adherence to the recommended mitigation measures will assist in ensuring compliance and minimising air quality impacts at surrounding receptors. The ongoing monitoring and TARP will assist in reactively adjusting Site activities as per the environmental conditions at the time. This is considered sufficient to mitigate potential impacts due to urban heat.

It is noted that western Sydney experiences an average of 15.4 days over 35°C annually and registers temperatures 6 to 10°C higher than eastern Sydney during extreme heat events². Due to the relationship with increased temperatures and worsened air quality, this may impact the ambient air quality at the Site in the future.

It is beyond the scope of this assessment to predict meteorological changes and impacts on air quality, however, cumulative impacts to air quality from the Site will be dependent on the future used of the warehouse developments. Further consideration at the Development Application stage may be warranted.

In addition, there are a number of actions proposed by Goodman to reduce impacts on urban heat, including but not limited to ensuring roof materials meet standards that mitigate urban heat island effects and the integration of blue-green infrastructure to enhance passive cooling that can mitigate urban heat island effect.

It is also worth noting that this project is likely to be completed well within the timescales of change for the urban heat island effects.

² <https://www.planning.nsw.gov.au/policy-and-legislation/resilience-and-natural-hazard-risk/urban-heat>



7.0 Greenhouse Gas Assessment

7.1 Overview of Approach

This assessment was performed as a desktop study. The calculation of GHG emissions from the construction has been performed in a five-stage process:

- 1 Definition of the GHG assessment boundary.
- 2 Identification of GHG emission sources within the assessment boundary (direct emissions) and outside the assessment boundary (indirect emissions).
- 3 Identification of GHG emission calculation methods and GHG emission factors for each source.
- 4 Identification of the activity data for each GHG emission source required for the calculations.
- 5 Calculation of estimated GHG emissions.

A number of assumptions have been relied upon in compiling the GHG emission inventory. GHG emissions from the key sources identified have been estimated based on the most current available emission factors published for use in reporting GHG emissions, which rely on estimates of the level of intensity of each activity (referred to as activity data). The activity data used in the calculations has been compiled based on the current available provided by the Applicant. The basis of the emission estimates and activity data are detailed in

Section 7.3.

7.2 Boundary Definition

This section defines the boundaries adopted for the GHG emission inventory compiled for the construction activities as part of this GHG assessment.

The assessment has considered scope 1, scope 2 and scope 3 emissions associated with construction activities (see **Table 7-1**). The geographical boundary set for the emissions considered in the GHG assessment covers the project footprint shown in **Figure 1-1**.

7.3 Identification of GHG Emission Sources

Construction GHG emission sources are limited to the use of diesel fuel. At time of reporting there was no breakdown of diesel use by equipment available. Whilst it is probable that a high percentage would be used in road-registered vehicles e.g. dump trucks within the site and semi-trailers for import and export of material, it has conservatively been assumed that all diesel fuel will be used in non-road registered vehicles.

Estimates of electricity consumption were unavailable at the time of reporting, However in SLR's experience and familiarity with these types of developments, the electricity consumptions is likely to be well below 5% of the total inventory and therefore is considered to be below materiality threshold and is not considered further.

Based on the above, GHG emissions associated with project that were considered in preparing this assessment are summarised in **Table 7-1**.



Table 7-1 GHG Emission Sources Included in the Inventory for the Project

Project Activity	Scope 1	Scope 2	Scope 3 a
Construction of project infrastructure	Emissions from diesel combustion in construction equipment, including cranes, dozers, excavators, haul trucks, portable power generators (gensets) etc	-	- Emissions associated with extraction and production of fuels consumed - Emissions associated with the extraction and production of purchased materials - Emissions associated with the operation of businesses at the Site - Emissions associated with the decommissioning of business at the Site
a Without understanding the exact mix of business that will be utilising this site the assessment of Scope 3 emissions for the production and delivery of purchased materials including steel and concrete cannot be undertaken at this time and will need to be assessed at a later date noting that these will be captured by ASRS reporting. Nor can the emissions associated with operations and decommissioning be undertaken.			

7.4 Calculation Methods and Emission Factors Used

7.4.1 Scope 1 Emissions

7.4.1.1 Diesel Combustion

Estimates of GHG emissions from the combustion of diesel were calculated by multiplying the estimated quantities of diesel to be combusted by a fuel-specific energy content factor and fuel-specific CO₂-e scope 1 emission factors. The emission factors used in the calculations are summarised in **Table 7-2**.

The emission factors used for the combustion of diesel fuel in the construction equipment are those given for stationary energy use, as the NGA Factors Workbook (DCCEEW 2025b) states “*No transport factors are provided for vehicles not registered for road use. Stationary energy factors for individual fuel types should be used in these cases*”.

Table 7-2 Scope 1 Emission Factors Used

Emission Source	Energy Content Factor	Scope 1 Emission Factors				
		CO ₂	CH ₄	N ₂ O	Total	Units
Fuel Use – Stationary (including off-road equipment) ¹						
Diesel	38.6 GJ/kL	69.9	0.1	0.2	70.2	kg CO ₂ -e/GJ
Note:						
¹ NGA Factors Workbook 2025, Table 8 (DCCEEW 2025b)						



7.4.2 Scope 3 Emissions

7.4.2.1 Production and Supply of Diesel

Estimates of scope 3 GHG emissions from the production and supply of diesel consumed were calculated by multiplying the estimated quantities of diesel to be combusted by a fuel-specific energy content factor and fuel-specific CO₂-e scope 3 emission factors. The emission factors used in the calculations are summarised in **Table 7-3**.

Table 7-3 Scope 3 Emission Factors Used – Production and Supply of Fuels Used

Production and Supply of Diesel ¹			
Fuel / Substance	Energy Content Factor (GJ/kL)	Scope 3 Emission Factor	Unit
Diesel oil	38.6	17.3	kg CO ₂ -e/GJ
¹ NGA Factors Workbook 2025, Table 8 (DCCEE 2025b)			

7.5 Activity Data

The activity data used in the GHG emission calculations have been provided by the Applicant:

- Diesel oil consumption per year = 7,500,000 L/y
- Construction duration = 4 years

7.6 Estimated GHG Emissions

The estimated annual scope 1 and scope 3 GHG emissions over the life of the construction are presented in **Table 7-4**.

Table 7-4 Estimated Scope 1 and Scope 3 GHG Emissions

GHG Emissions Source	Emissions by Source (t CO ₂ -e)	
	Per Year	Total Life of Construction*
Scope 1		
Diesel consumption - Construction equipment	20,323	81,292
Scope 3		
Production & supply of diesel	5,008	20,033
* Totals may differ due to rounding		

7.7 Comparison to State, National and Global GHG Emissions

For the 2023 reporting year, which is the most recent available data available at time of writing this report, Australia's total GHG emissions were reported to be 453.45 Mt CO₂-e, with 114.45 Mt CO₂-e contributed by NSW (DCCEE 2025a).

The total annual scope 1 GHG emissions due to diesel fuel usage during construction are estimated be 20,323 t CO₂-e per annum. This would represent approximately 0.004% of Australia's 2023 emissions, and 0.018% of NSW's 2023 emissions. On this basis, the



construction would be expected to be a minor contributor to Australia and NSW's GHG emission inventories.

When the estimated scope 3 emissions are considered, the annual emissions of 25,331 t CO₂-e per annum (scope 1 and scope 3 combined) represent 0.0005% of the global emissions estimated for 2024 of 53.2 Gt CO₂-e (EC 2025).

7.8 Opportunities for GHG Reduction

Goodman emissions strategy prioritises avoiding and reducing emissions by better design selections and an efficient building design. This includes reducing upfront emissions by optimising the design and selecting low emission options in construction where possible, as well as installing efficient systems to reduce operational emissions.

The following measures are typically considered to improve energy efficiency and in turn reduce green house gas emissions:

- LED lighting and daylight harvesting.
- Provision of metering and monitoring systems to reduce operational energy use.
- Efficient HVAC system for conditioned spaces.

In addition, the project proposes installation of PV system for the building's operation. Current design allows for approximately 250 kW per 10,000 m² (~30% coverage), providing significant scope for additional installations.

Strategic planning further includes identifying potential EV charging locations within truck parking and loading bays, with spare conduits from MDB to facilitate future implementation.'



8.0 Conclusions

SLR Consulting Australia Pty Ltd was commissioned by Goodman Property Services (Aust) Pty Ltd (Applicant), on behalf of Goodman Western Sydney Pty Limited as trustee for the Goodman Western Sydney Trust (Owner), to prepare an air quality impact assessment report for the bulk earthworks for the development located at 225 – 245 Martin Road, Bradfield, 2556.

The main potential sources of air emissions were identified as fugitive particulate matter during the bulk earthworks. The potential for off-site dust impacts during the bulk earthworks was assessed using modelling methods in general accordance with the Approved Methods. The results of this assessment which was based on a conservative scenario assuming all activities occur concurrently indicate that exceedances of short term and long term PM_{2.5} and PM₁₀ criteria could potentially occur if sufficient mitigation measures are not adopted by the Site. It is noted, considering the following factors, overestimation of predicted concentrations by the model is likely due to the following:

- 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.)
- Assessment of all activities operating simultaneously at all times at all times:
 - Modelling peak intensity of concurrent bulk earthworks activities.
- Conservative assessment of surrounding construction sources operating concurrently.
- Limitation of the CALPUFF model in predicting nearfield pollutant concentrations.
- Conservative approach to dispersion modelling that does not representatively predict reduced pollutant dispersion due to rainfall.

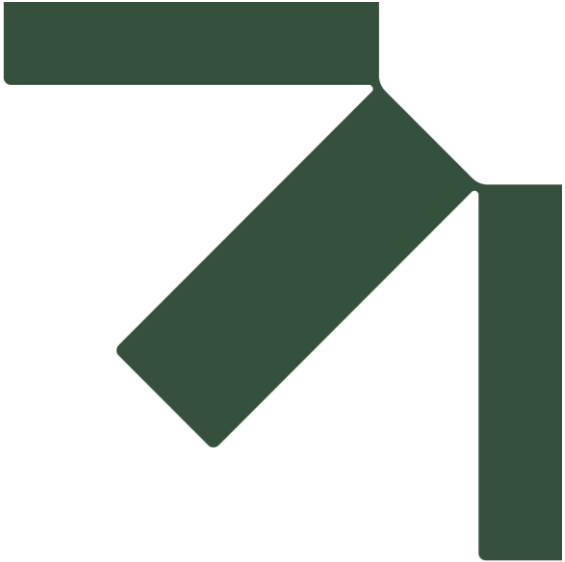
Regardless, it is recommended that:

- Real-time monitoring of ambient air quality be performed throughout the construction period to allow for effective site management and assist in minimising the potential for adverse air quality impacts at the sensitive receptors.
- A TARP based on 1-hour average PM₁₀ concentrations and wind directions with a range of actions to minimise the potential for adverse effects at the sensitive receptors be adopted.

Greenhouse gas emissions have been estimated for Scope 1 and Scope 3. Estimates of electricity consumption were unavailable at the time of reporting, however, in SLR's experience and familiarity with these types of developments, the electricity consumptions is likely to be well below 5% of the total inventory and therefore is considered to be below materiality threshold and is not considered. No scope 3 emissions have been estimated for purchased materials, operational activities nor decommissioning as the businesses that will be established at Site are not yet known. The identified annual emissions of 25,331 t CO₂-e per annum (scope 1 and scope 3 combined) represent 0.0005% of the global emissions estimated for 2024 of 53.2 Gt CO₂-e (EC 2025).

It is concluded that with an appropriate ambient air quality monitoring plan and TARP in place, as well as greenhouse gas reduction strategies, the proposed construction activities can be completed without any significant impact on the surrounding receptors.





Appendix A Selection of Representative Meteorological Data

**225-245 Martin Road, Bradfield Bulk Earthworks,
Rehabilitation & Quarrying - SSD-97711727**

Air Quality Impact Assessment

Goodman Property Services (Aust) Pty Ltd

SLR Project No.: 610.010786.00004

11 March 2026

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 (2020 to 2024 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.

Data collected from 2020 to 2024 is summarised in **Figures A-1 to A-2**. Examination of the data indicates the following:

Figure A-1 indicates relatively similar wind roses for all years analysed, with a higher frequency of winds from the west-southwest in 2024 .

Figure A-2 indicates that 2020 and 2021 exhibit wind speeds that are lower than the 5-year average which will result in a conservative assessment due to reduced dispersion.

Figure A-3 indicates that 2020, 2021 and 2022 are most similar to the 5-year average of calms conditions, however 2020 has a much higher frequency of calms than the 5-year average, which may be overly conservative if selected.

Figure A-4 indicates relatively similar monthly temperatures for all years analysed, with some above average temperatures in 2024, 2023 and 2024.

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



Figure A-1 Frequency of Winds at Badgerys Creek AWS for 2020 – 2024

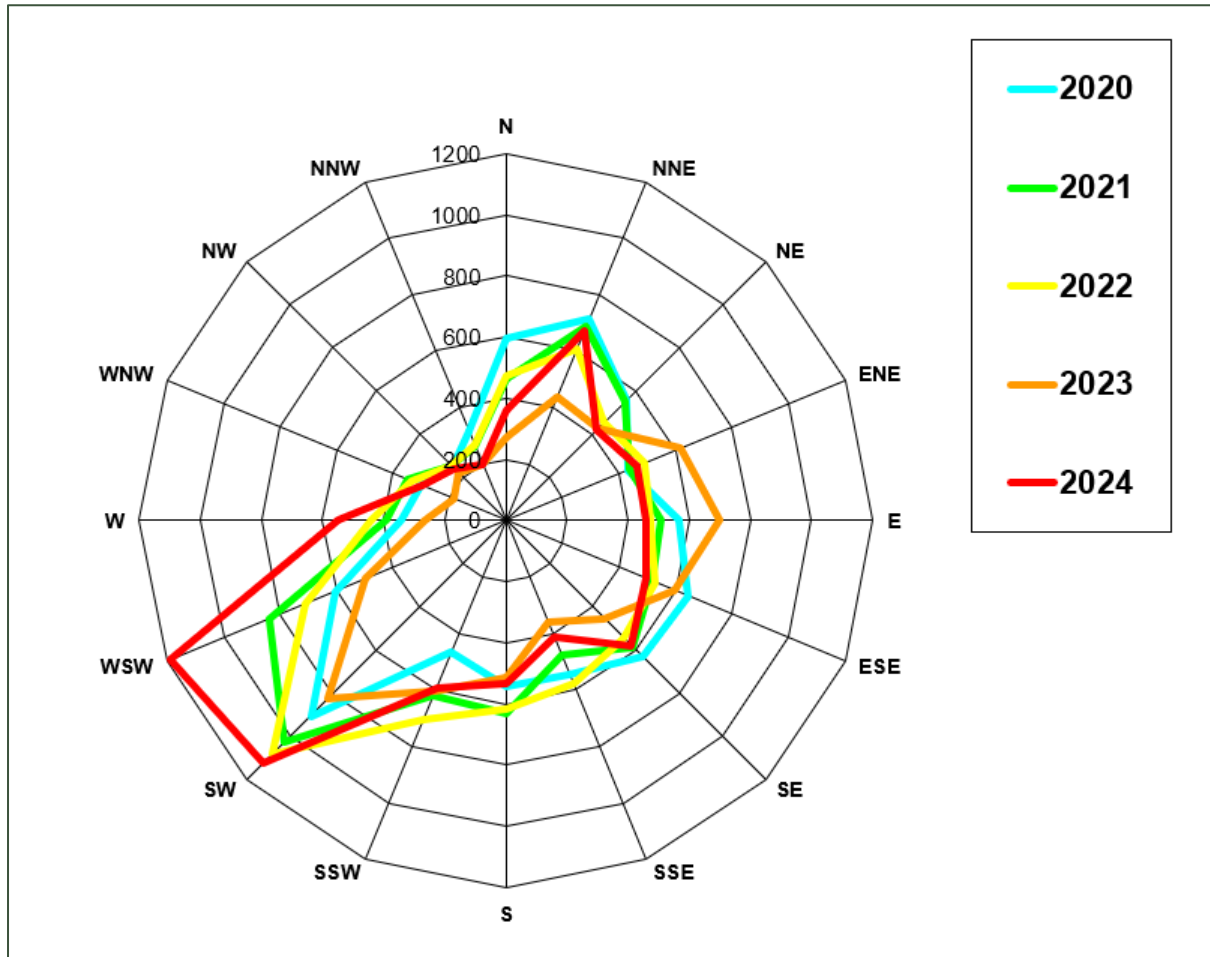


Figure A-2 Monthly Average Wind Speed at Badgerys Creek AWS for 2020 – 2024

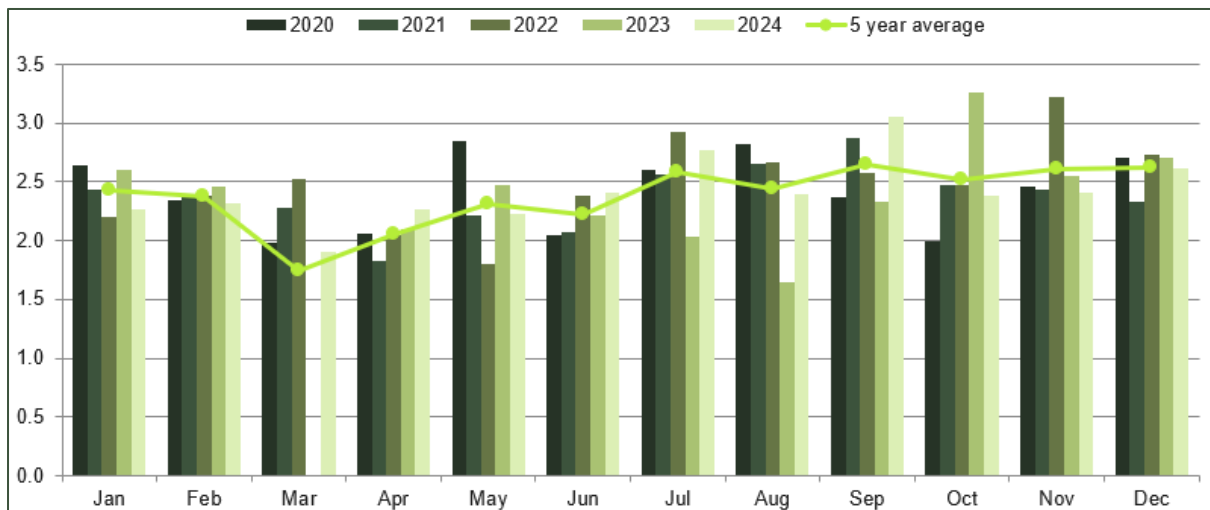


Figure A-3 Monthly Average Occurrence of Calms at Badgerys Creek AWS for 2020 – 2024

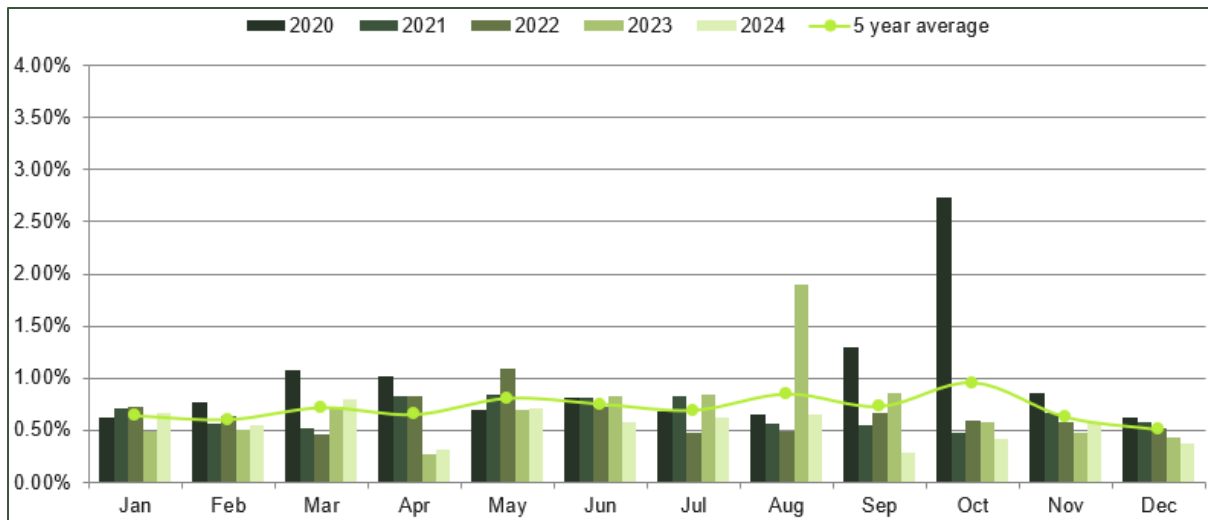
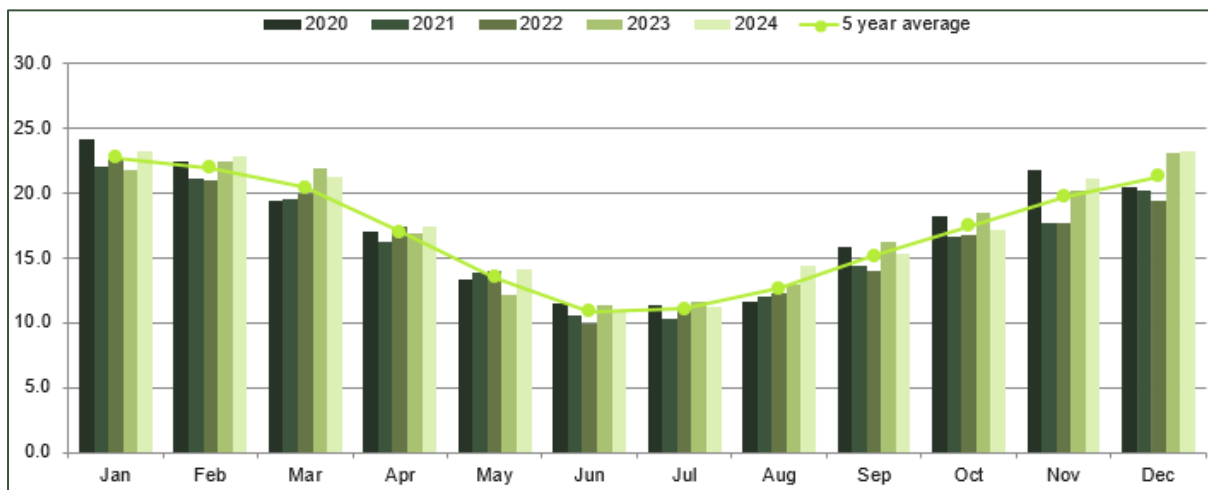
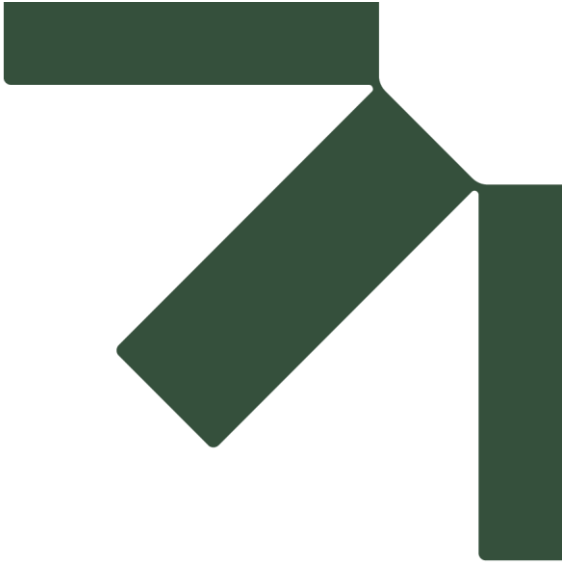


Figure A-4 Monthly Average Temperature at Badgerys Creek AWS for 2020 – 2024





Appendix B Evaluation of Meteorological Data

**225-245 Martin Road, Bradfield Bulk Earthworks,
Rehabilitation & Quarrying - SSD-97711727**

Air Quality Impact Assessment

Goodman Property Services (Aust) Pty Ltd

SLR Project No.: 610.010786.00004

11 March 2026

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 light to moderate during 2021. Calm wind conditions were predicted to occur 6.8% of the time throughout the modelling period.

The seasonal wind roses indicate that typically:

- In summer, winds blow from all directions except the northwestern quadrant, where winds occur infrequently. Calms were predicted 5.8% 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 predicted 6.8% of the time during the autumn months.
- In winter, winds predominantly blow from the southwestern and northwestern quadrants, with the least frequent winds originating from the southeastern quadrant. Calms were predicted 9.5% of the time.
- In spring, winds blow almost evenly from all directions, with fewer withs from the northwestern quadrant. Calms were predicted 5.5% of the time.

A comparison of the wind roses presented in **Figure B-1** with the Badgerys Creek AWS wind roses presented in **Figure 4-6** shows that the frequency distribution of wind speed and direction for both is very similar throughout the year, with the CALMET predictions having slightly lower calm frequency.



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

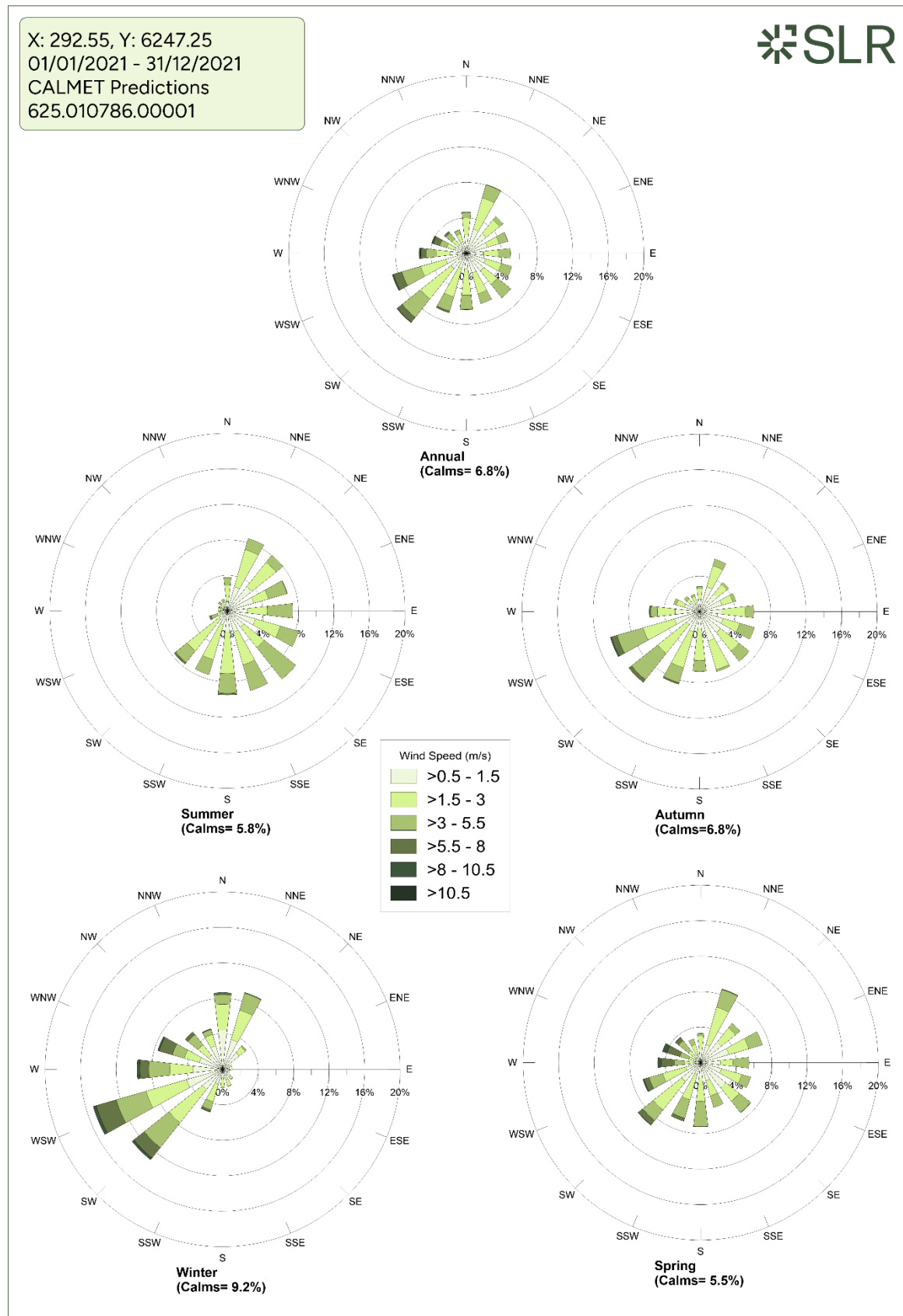
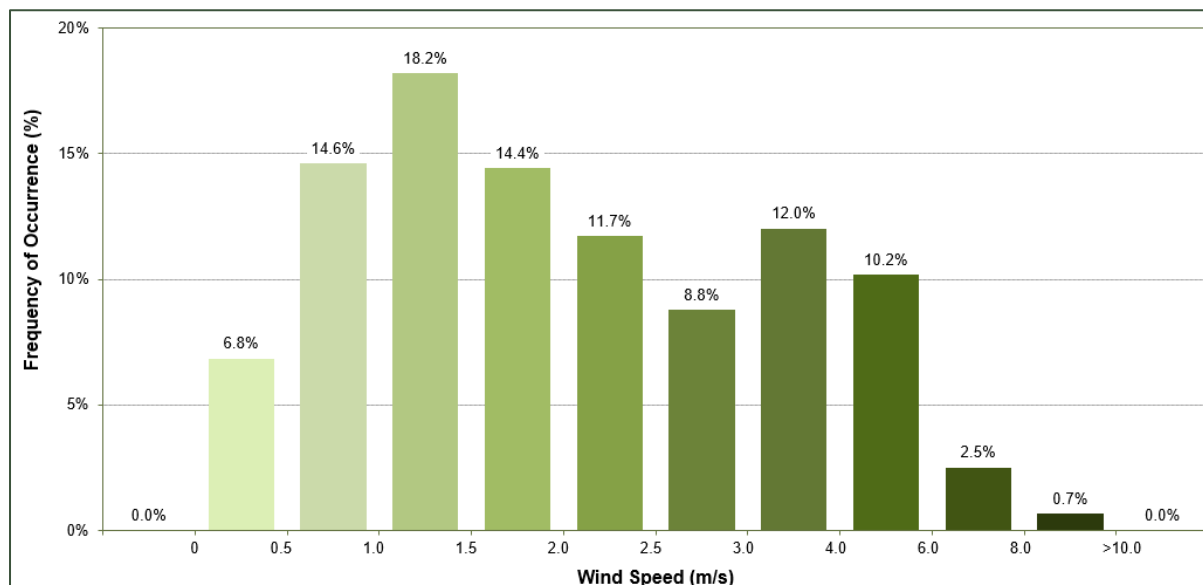


Figure B-2 Annual Wind Speed Frequencies at the Site (CALMET Predictions, 2021)



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 **Table B-1**.

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

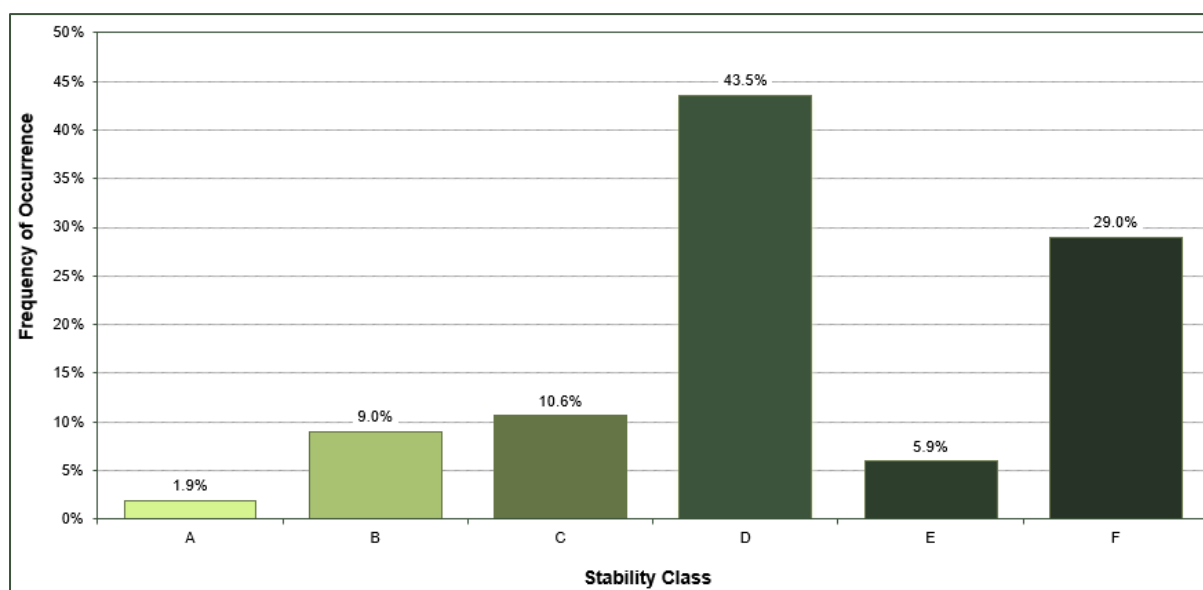
Source: (NOAA 2018)

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, which typically indicates poorer dispersion of pollutants.

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



Mixing Heights

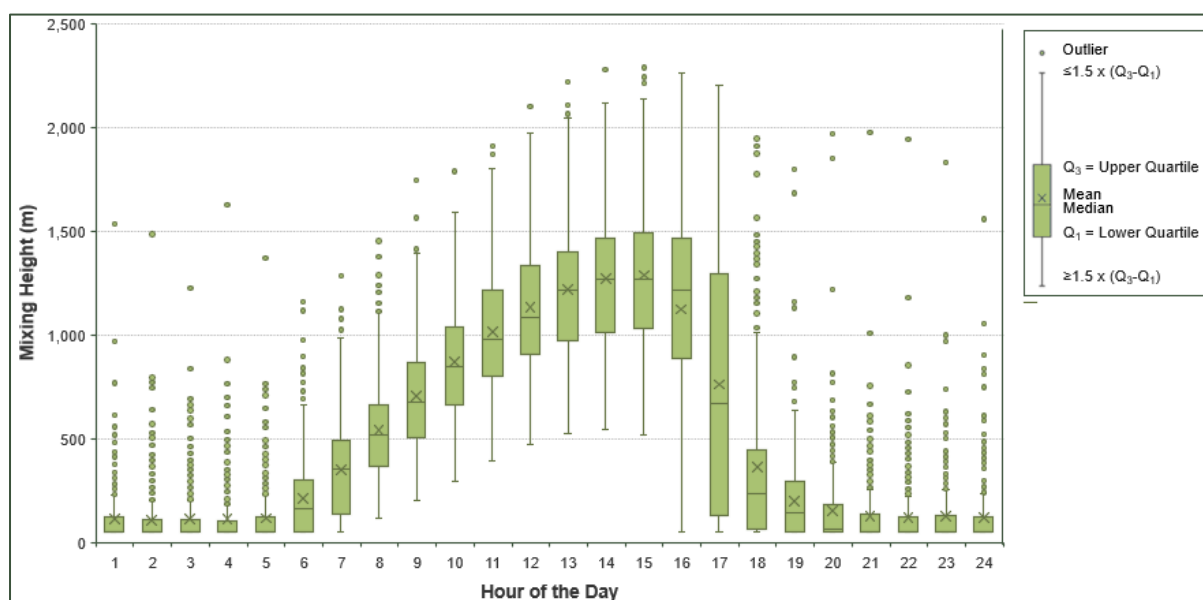
The mixing height is the depth of the atmospheric mixing layer between ground level and an elevated temperature inversion. Depending on conditions, vertical dispersion is typically limited by the mixing height. This is an important parameter in dispersion modelling since the mixing height largely sets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

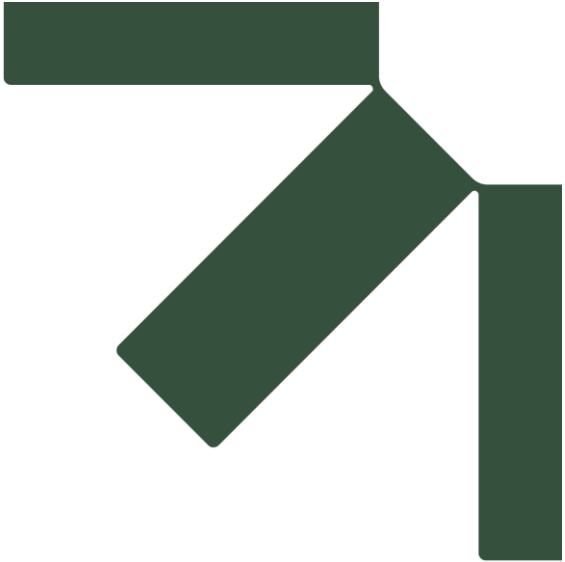
Mixing heights have a diurnal variation in response to mixing from convection due to insolation and grow from sunrise to around midday. Followed by a decline until sunset when there typically is a rapid decline. If a plume penetrates through, or is released above, the mixing height the pollutants will 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 Emission Estimation

**225-245 Martin Road, Bradfield Bulk Earthworks,
Rehabilitation & Quarrying - SSD-97711727**

Air Quality Impact Assessment

Goodman Property Services (Aust) Pty Ltd

SLR Project No.: 610.010786.00004

11 March 2026

Particulate matter emissions from the Site 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 factors are presented in **Table C-6**.



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

Activity	Emission Factor			Units	Sources & Notes
	TSP	PM ₁₀	PM _{2.5}		
Scraper stripping topsoil and cut material	$EF_{TSP} = 0.029$	$EFPM_{10} = 0.0073$	$EFPM_{2.5} = 0.2 \times EFPM_{10}$	kg/t	EFTSP: (US EPA 1998) EFPM ₁₀ : (DSEWPC 2012) EFPM _{2.5} : Derived from the application of a PM _{2.5} /PM ₁₀ size ratio (Cowherd, Donaldson and Hegarty 2010).
Scraper Travel	$EF_{TSP} = 2.08$	$EFPM_{10} = 0.52$	$EFPM_{2.5} = 0.2 \times EFPM_{10}$	Kg/VKT	EFTSP & EFPM ₁₀ : (DSEWPC 2012) EFPM _{2.5} : Derived from the application of a PM _{2.5} /PM ₁₀ size ratio (Cowherd, Donaldson and Hegarty 2010)
Scraper unloading	$EF_{TSP} = 0.02$	$EFPM_{10} = 0.25 \times EFTSP$	$EFPM_{2.5} = 0.2 \times EFPM_{10}$	kg/t	EFTSP: (US EPA 1998) EFPM ₁₀ : Derived from the application of PM ₁₀ /TSP size ratio for the scraper in travel mode (i.e. 25%) (DSEWPC 2012). EFPM _{2.5} : Derived from the application of a PM _{2.5} /PM ₁₀ size ratio (Cowherd, Donaldson and Hegarty 2010)
Unloading and unloading (material transfer)	$EF_{TSP} = \frac{0.74 \times 0.0016 \times \frac{U^{1.3}}{2.2}}{\frac{M^{1.4}}{2}}$	$EF_{PM10} = \frac{0.35 \times 0.0016 \times \frac{U^{1.3}}{2.2}}{\frac{M^{1.4}}{2}}$	$EF_{PM2.5} = \frac{0.053 \times 0.0016 \times \frac{U^{1.3}}{2.2}}{\frac{M^{1.4}}{2}}$	kg/t	EFTSP, EFPM ₁₀ , & EFPM _{2.5} : (US EPA 2006b) Average of $U^{1.3}/2.2$ = wind speed factor = 1.11m/s Refer to Table C-2 for moisture (M) assumptions



Activity	Emission Factor			Units	Sources & Notes
	TSP	PM ₁₀	PM _{2.5}		
Crushing	EFTSP = 0.0027	EFPM ₁₀ = 0.0012	EFPM _{2.5} = 0.148 × EFPM ₁₀	kg/t	EFTSP & EFPM ₁₀ (US EPA 2004) EFPM _{2.5} : Derived from the application of PM _{2.5} /PM ₁₀ size ratio of tertiary crushing (controlled) emission factors
Screening	EFTSP = 0.0125	EFPM ₁₀ = 0.0043	EFPM _{2.5} = 0.068 × EFPM ₁₀	kg/t	EFTSP & EFPM ₁₀ (US EPA 2004) EFPM _{2.5} : Derived from the application of PM _{2.5} /PM ₁₀ size ratio of screening (controlled) emission factors
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 × EFTSP	kg/h	EFTSP & EFPM ₁₀ : (DSEWPC 2012) EFPM _{2.5} : (US EPA 1998) Refer to Table C-2 for silt (s) and moisture (M) assumptions
Grader	$EF_{TSP} = 0.0034 \times (S^{2.5})$	$EF_{PM10} = (0.0056 \times (S^2)) \times 0.6$	EFPM _{2.5} = 0.031 × EFTSP	kg/VKT	EFTSP & EFPM ₁₀ : (US EPA 1998) EFPM _{2.5} : Derived from the application of PM _{2.5} /TSP scaling factor Refer to Table C-2 for mean vehicle speed (S) assumptions
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	EFTSP, EFPM ₁₀ , & EFPM _{2.5} : (US EPA 2006a) Refer to Table C-2 for surface silt (s) and vehicle weight (W) assumptions



Activity	Emission Factor			Units	Sources & Notes
	TSP	PM ₁₀	PM _{2.5}		
Diesel Combustion	EFTSP = 1.17	EFPM ₁₀ = 1.17	EFPM _{2.5} = 1.12	kg/ m ³	EFTSP, EFPM ₁₀ , &EFPM _{2.5} : (DEWHA 2008). All TSP is assumed to be PM ₁₀
Wind Erosion of Exposed Areas	EFTSP = 0.4	EFPM ₁₀ = 0.5 × EFTSP	EFPM _{2.5} = 0.075 × EFTSP	kg/ha/hr	EFTSP & EFPM ₁₀ : (DSEWPC 2012) EFPM _{2.5} : Derived from the application of PM _{2.5} /TSP particle size multiplier (US EPA 2006) Refer to Table C-4 for assumptions.
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-2 Emission Factor Assumptions - Material Properties

Parameter	Value	Units	Sources & Notes
Silt content	8.6	%	Double the average silt content value in AP42 Section 11.9 Table 11.9-3 (haul truck mean) (US EPA 1998)
Moisture content	4	%	Conservatively half of the average moisture content value in AP42 Section 11.9 Table 11.9-3 (Overburden mean) (US EPA 1998)
Topsoil density	1.8	t/m ³	Confirmed by client; Source: https://theconstructor.org/building/density-construction-materials/13531/ , Accessed 21/11/2025
Clay density	1.6	t/m ³	Confirmed by client; Source: https://civilplanets.com/unit-weight-of-construction-materials/ Accessed 21/11/2025



Parameter	Value	Units	Sources & Notes
Shale density	2.5	t/m ³	Confirmed by client; Source: https://theconstructor.org/building/density-construction-materials/13531/ , Accessed 21/11/2025
Hard rock density	3.0	t/m ³	Confirmed by client; Source: https://civilplanets.com/unit-weight-of-construction-materials/ Accessed 21/11/2025

Table C-3 Emission Factor Assumptions – Vehicles

Variable	Value	Units	Source
Scrapers – Topsoil and Cut			
Empty weight	41	tonnes	Client information
Capacity	26	tonnes per load	
Gross weight	67	tonnes	
Average empty/gross weight	54	tonnes	
Dozers			
Number of units	4	-	Client information
Utilisation	95	%	
Operating hours	12,540	Hours per year	Client information
Grader			
Number of units	3	-	Client information. Noting conservatively assumed 3 operating the whole time, although the first year will be only 1 grader in the first year, 3 in the second year and then 2 grader in the remainder of years.
Operating hours	2,668 hr/year		
Haul Trucks – Import/Export			
Empty weight	28	tonnes	Client information



Variable	Value	Units	Source
Capacity	36	tonnes per load	
Gross weight	644	tonnes	
Average empty/gross weight	46	tonnes	
Haul Trucks – Onsite transfer			
Empty weight	28	tonnes	Client information
Capacity	42	tonnes per load	
Gross weight	70	tonnes	
Average empty/gross weight	49	tonnes	

Table C-4 Material Movements and Travel Distances

Parameter	Annual/Max Unit	Unit
Existing Stockpiles		
Clay Stockpiles	1,107,941	m³ total
	1,772,706	tonnes total
	443,176	tonnes / year
	276,985	m³ / year
Cut quantities		
Topsoil	205,651	m³ total
	370,172	tonnes total
	185,086	tonnes / year
	205,651	m³ / year



Parameter	Annual/Max Unit	Unit
Cut – Remaining In-situ Clay	850,000	m ³ total
	1,360,000	tonnes total
	340,000	tonnes / year
	212,500	m ³ / year
Cut – Brown shale	1,957,941	m ³ total
	4,894,853	tonnes total
	1,223,713	tonnes / year
	489,485	m ³ / year
Cut – Hardrock	978,971	m ³ total
	2,936,912	tonnes total
	734,228	tonnes / year
	244,743	m ³ / year
Import		
Import - Brown shale	1,087,411	m ³ total
	2,718,528	tonnes total
	679,632	tonnes / year
	271852.75	m ³ / year
Fill		
Fill– Clay (from cut & stockpiles)	1,783,177	m ³ total
	2,853,084	tonnes total
	713,271	tonnes / year
	445,794	m ³ / year



Parameter	Annual/Max Unit	Unit
Fill – Brown shale (from cut and import)	2,521,060	m ³ total
	6,302,651	tonnes total
	1,575,663	tonnes / year
	630,265	m ³ / year
Fill – Hardrock (from cut)	978,971	m ³ total
	2,936,912	tonnes total
	734,228	tonnes / year
	244,743	m ³ / year
Export		
Export – Topsoil (from cut)	205,651	m ³ total
	370,172	tonnes total
	185,086	tonnes / year
	205,651	m ³ / year
Export – Clay (from cut)	174,764.00	m ³ total
	279,622.40	tonnes total
	69,905.60	tonnes / year
	43,691.00	m ³ / year
Export – Brown shale (from cut)	524,292.00	m ³ total
	1,310,730.00	tonnes total
	327,682.50	tonnes / year
	131,073.00	m ³ / year



Parameter	Annual/Max Unit	Unit
Wind Erosion		
Site area	116	ha
Actively disturbed area (including stockpiles)	88	ha
Scrapers (Total)		
Scrapers removal % topsoil	100.0%	% of topsoil material moved using scraper
Scrapers removal % in-situ clay	50.0%	% of in-situ clay material moved using scraper
Scrapers removal % shale	21.7%	% of all shale material moved using scraper
Scrapers removal % hard rock	0%	% of hard rock moved using scraper
Topsoil		
Scrapers removal - topsoil	185,086	tonnes / year
Scraper travel distance	1	km/trip
Scraper trips	7,118.7	trips/year
Scraper - travel	7,118.7	VKT/year
Cut material		
Scrapers removal - clay	170,000	tonnes / year
Scrapers removal – shale	265,625	
Scrapers removal - hard rock	-	tonnes / year
Scrapers removal - total	435,625	tonnes / year
Scraper travel distance	1	km/trip
Scraper trips	16,754.8	trips/year
Scraper – travel	16,754.8	VKT/year



Parameter	Annual/Max Unit	Unit
Grader		
Speed of Grader	6.0	km/hr
Grader Vehicle km travelled	40,320.0	km/annum
Onsite material transfer (from excavation)		
Quantity of material moved - clay	170,000	tonnes / year
Quantity of material moved – brown shale	958,088	tonnes / year
Quantity of material moved - hard rock	734,228	tonnes / year
Onsite material transfer (from stockpiles, including import)		
Quantity of material moved - clay	543,271	tonnes / year
Quantity of material moved – brown shale (including import)	1,310,038	tonnes / year
Quantity of material moved - hard rock	734,228	tonnes / year
Crushing and screening		
Crushing	934,871.3	tonnes / year
Screening	934,871.3	tonnes / year
Onsite material transfer		
Haul road silt content	8.6	%
Haul road length	1.5	km/ return trip
Number of return trips	1.5	trips / annum
Truck unloading	1,862,316	tonnes / annum
Import		
Haul road silt content	8.6	%
Haul road length	4	km/ return trip



Parameter	Annual/Max Unit	Unit
Number of return trips	18,879	trips / annum
Truck unloading	679,632	tonnes / annum
Export		
Haul road silt content	8.6	%
Haul road length	4	km/ return trip
Number of return trips	11,044	trips / annum
Truck unloading	397,588	tonnes / annum
Fuel usage		
Diesel combustion	7,500,000.0	L/year



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 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 Suppress Wheel Generated Dust

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

- Level 1 watering (2 L/m²/h): 50% control
- Level 2 watering (>2 L/m²/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).

BoM³ 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 Site 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 suppress 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/m²/h. This control rate would increase with more frequent water application, likely lower traffic rates, and the anticipated watering rate of less than 2 L/m²/h. However, for modelling purposes, a 75% control factor was conservatively applied to the unpaved haul road wheel generated dust estimates.

³ 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



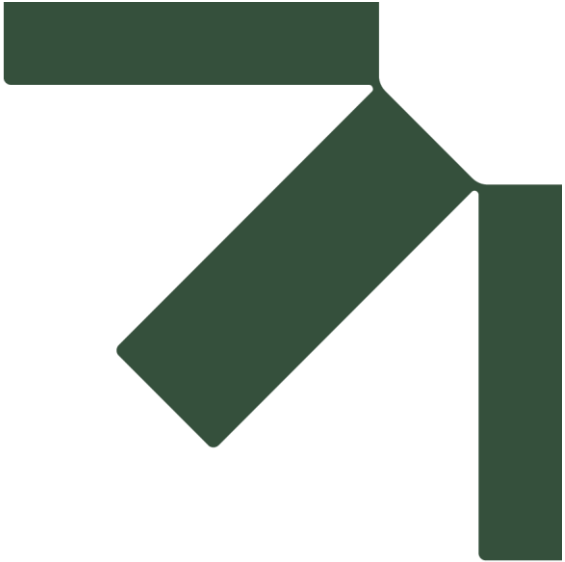
Table C-6 Emission Factors

Activity	TSP Emission Factor	PM ₁₀ Emission Factor	PM _{2.5} Emission Factor	Units
Scrapers stripping topsoil	0.029	0.0073	0.0015	kg/t
Scraper travel mode	2.1	0.52	0.10	kg/VKT
Scraper unloading (batch drop)	0.020	0.0050	0.0010	kg/t
Scrapers stripping cut material from paddocks	0.029	0.0073	0.0015	kg/VKT
Scraper travel moving cut material from paddocks	2.08	0.52	0.10	kg/t
Scraper unloading cut material (batch drop) to fill areas	0.020	0.0050	0.0010	kg/t
Loading material to trucks in cut area for transfer to stockpiles	0.00051	0.00024	0.000036	kg/t
Excavated material haulage transfer to stockpiles	0.14	0.041	0.0041	kg/t
Unloading at stockpiles	0.00051	0.00024	0.000036	kg/t
Loading material to transfer to crusher	0.00051	0.00024	0.000036	kg/t
Excavated material haulage to crusher	0.038	0.011	0.0011	kg/t
Loading material into crusher	0.00051	0.00024	0.000036	kg/t
Crushing (uncontrolled)	0.0027	0.0012	0.00018	kg/t
Screening (uncontrolled)	0.013	0.0043	0.00029	kg/t
Unloading Material to stockpile from crush/screen	0.00051	0.00024	0.000036	kg/t
Imported material haulage to stockpiles	0.43	0.12	0.012	kg/t
Unloading at stockpile area (from imported material)	0.00051	0.00024	0.000036	kg/t
Loading material to trucks from stockpiles for transfer to fill	0.00051	0.00024	0.000036	kg/t
Excavated material haulage transfer to fill area	0.14	0.041	0.0041	kg/t
Unloading at fill area	0.00051	0.00024	0.000036	kg/t



Activity	TSP Emission Factor	PM ₁₀ Emission Factor	PM2.5 Emission Factor	Units
Loading unusable cut material for export	0.00051	0.00024	0.000036	kg/t
Unusable cut material haulage	0.43	0.12	0.012	kg/t
Loading topsoil for export	0.00051	0.00024	0.000036	kg/t
Export topsoil haulage	0.43	0.12	0.012	kg/t
Dozer	5.8	1.2	0.61	kg/h
Grader	0.30	0.12	0.0093	kg/VKT
Wind erosion pit	0.40	0.20	0.030	kg/ha/hour
Diesel combustion	1.2	1.2	1.1	kg/m ³





Appendix D Variable Emission File

**225-245 Martin Road, Bradfield Bulk Earthworks,
Rehabilitation & Quarrying - SSD-97711727**

Air Quality Impact Assessment

Goodman Property Services (Aust) Pty Ltd

SLR Project No.: 610.010786.00004

11 March 2026

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 - PM ₁₀ , 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



$FP_{AC,i,h} = \frac{FP_{annual,i} \times 1000}{N_{days} \times OH_i \times 3600 \times N_{s,i} \times WSFactor_{i,h}}$ $CM_{AC,i,h} = \frac{CM_{annual,i} \times 1000}{N_{days} \times OH_i \times 3600 \times N_{s,i} \times WSFactor_{i,h}}$ $RE_{AC,i,h} = \frac{RE_{annual,i} \times 1000}{N_{days} \times OH_i \times 3600 \times N_{s,i}} \times WSFactor_{i,h}$ 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 $WSFactor_{i,h} = \frac{(WS_h)^3}{\frac{\sum_{j=1}^n (WS_j)^3}{n}}$	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
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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.

Step 6: Calculate hourly average emission rate for each source

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.

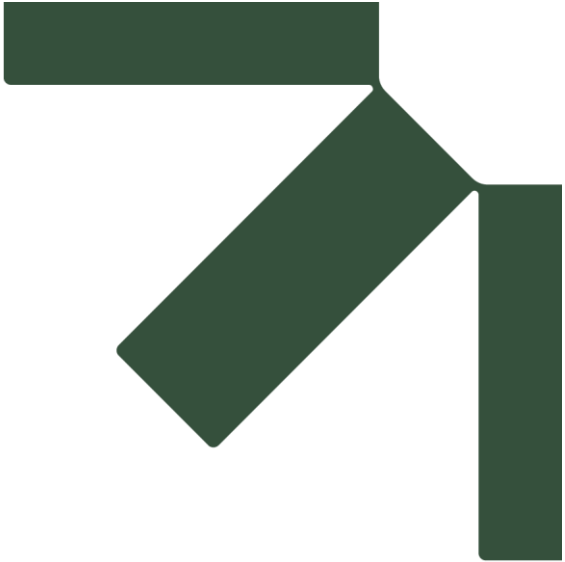
For example, if Source 1 is associated with Activity 1, Activity 2 and Activity 3, then:

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

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

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





Appendix E Isopleths

**225-245 Martin Road, Bradfield Bulk Earthworks,
Rehabilitation & Quarrying - SSD-97711727**

Air Quality Impact Assessment

Goodman Property Services (Aust) Pty Ltd

SLR Project No.: 610.010786.00004

11 March 2026

Figure E-1 24-hour Average Incremental Impacts of PM_{2.5}

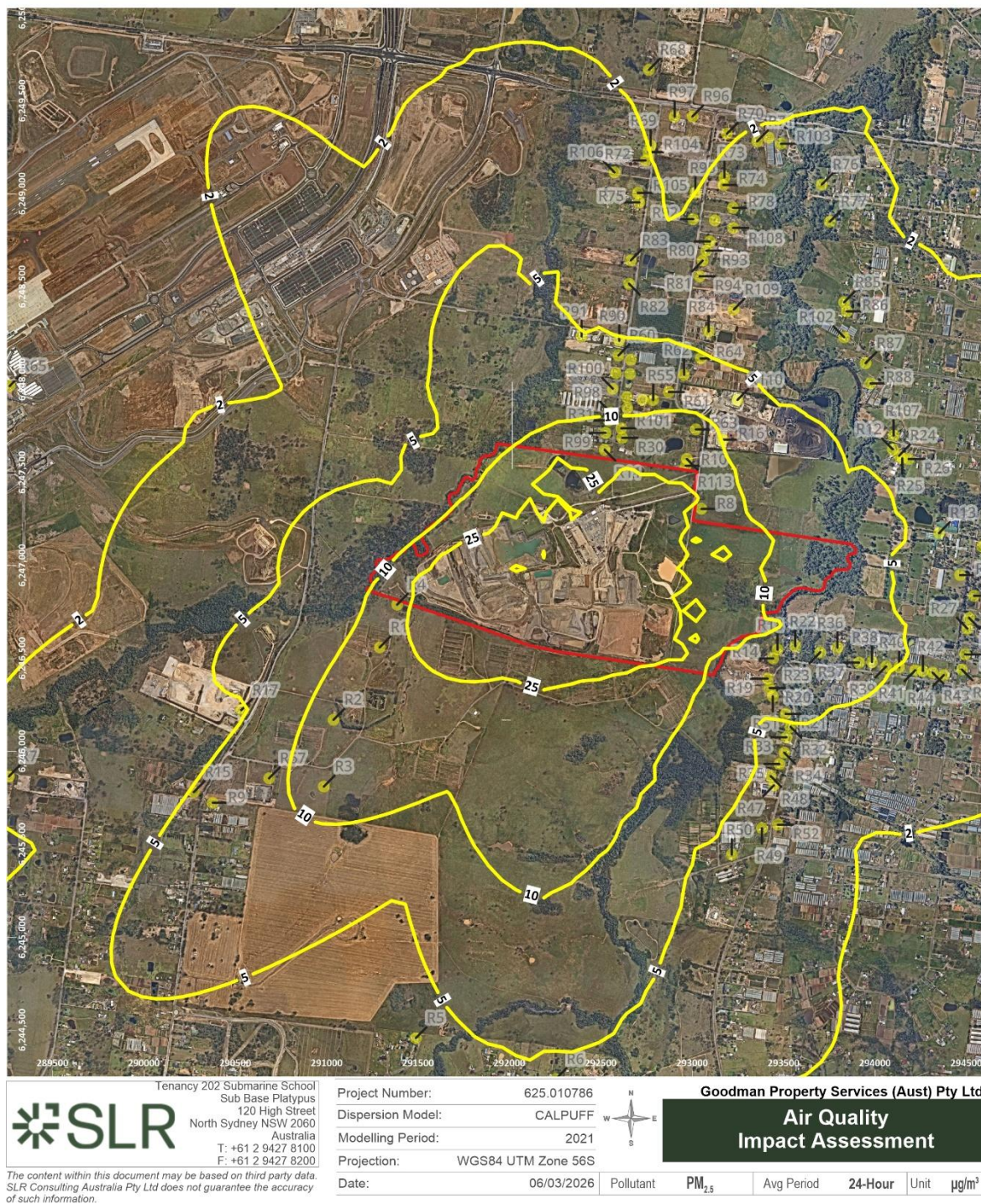


Figure E-2 Annual Average Incremental Impacts of PM_{2.5}

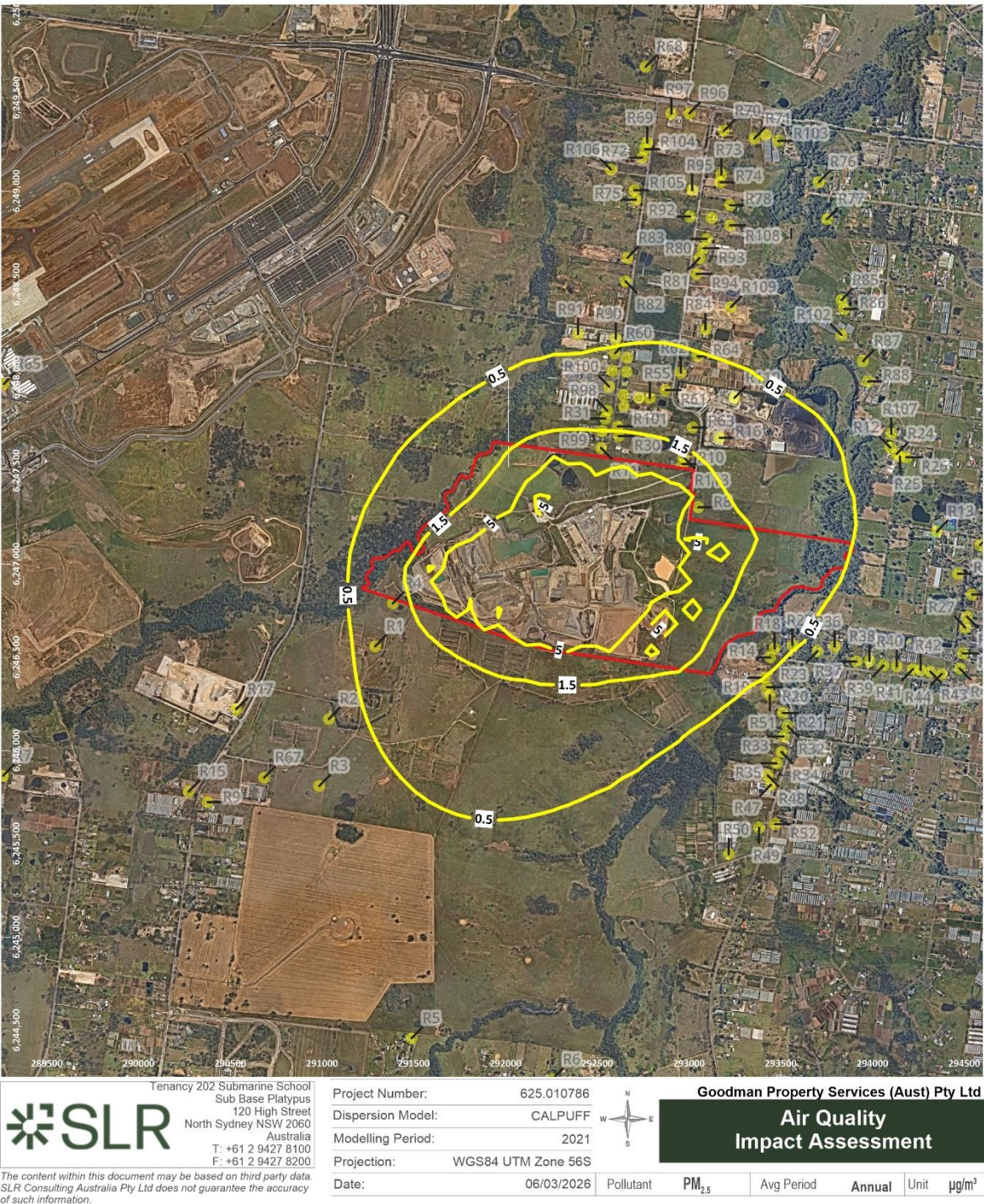


Figure E-3 24-hour Average Incremental Impacts of PM₁₀

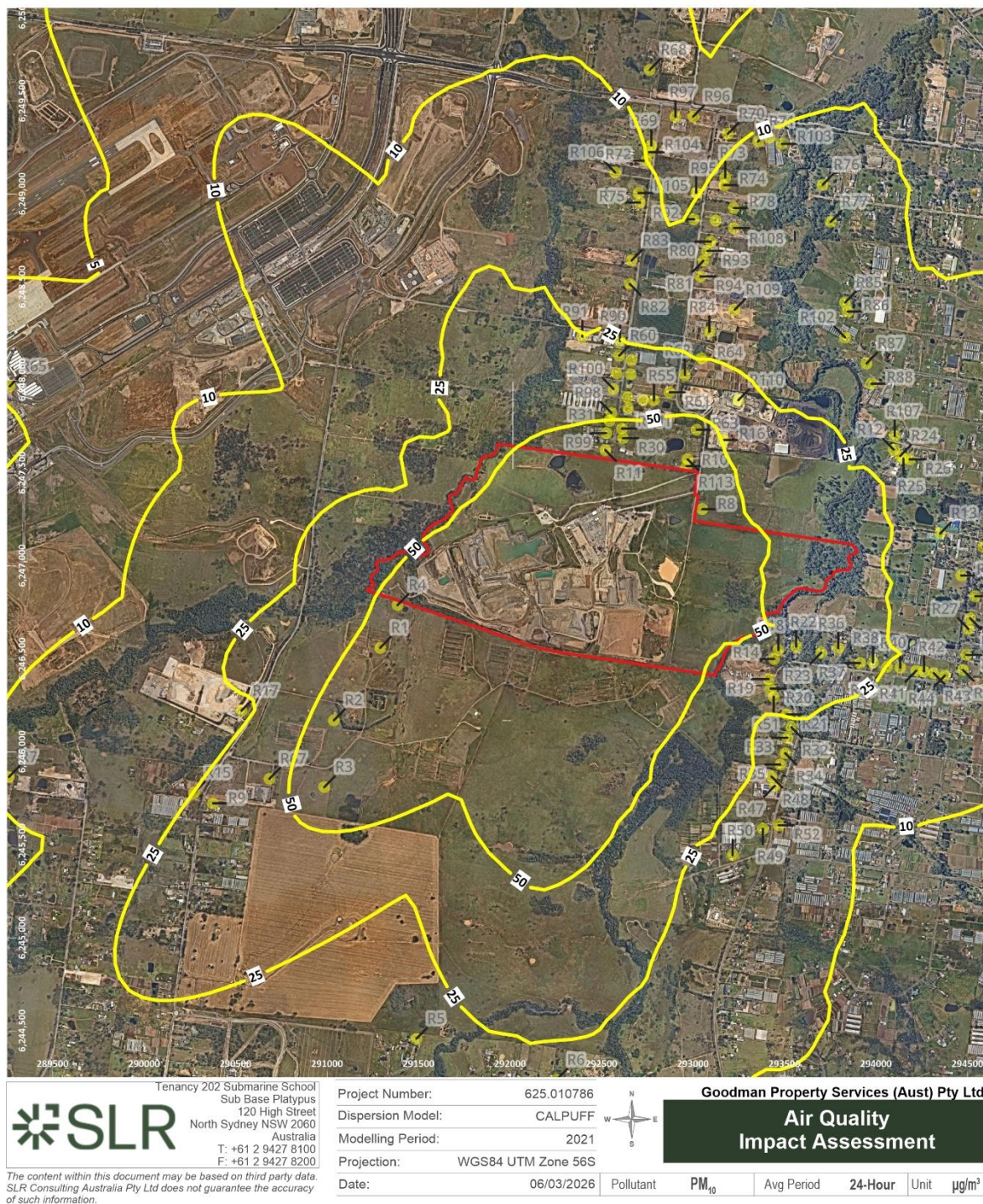


Figure E-4 Annual Average Incremental Impacts of PM₁₀

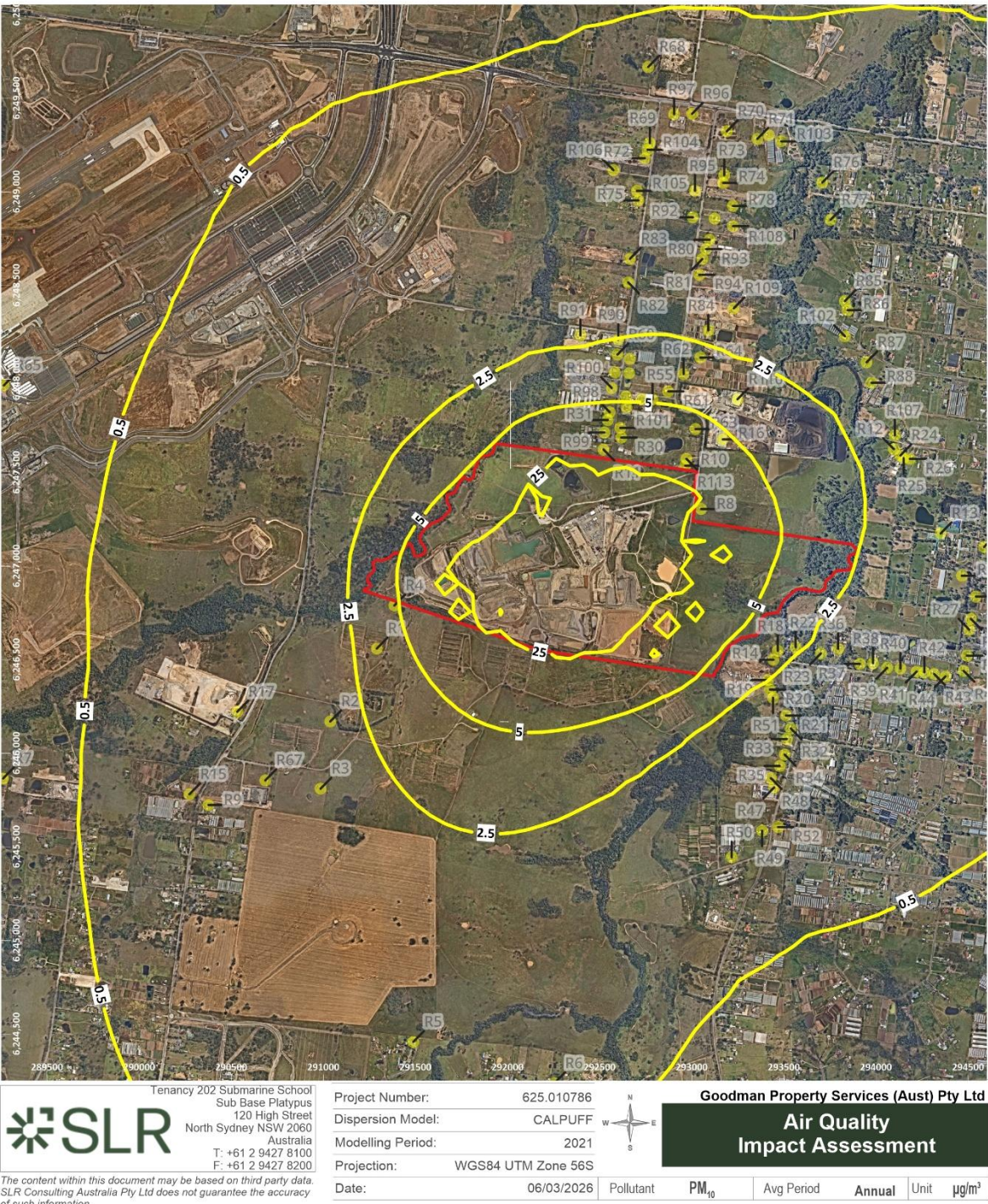
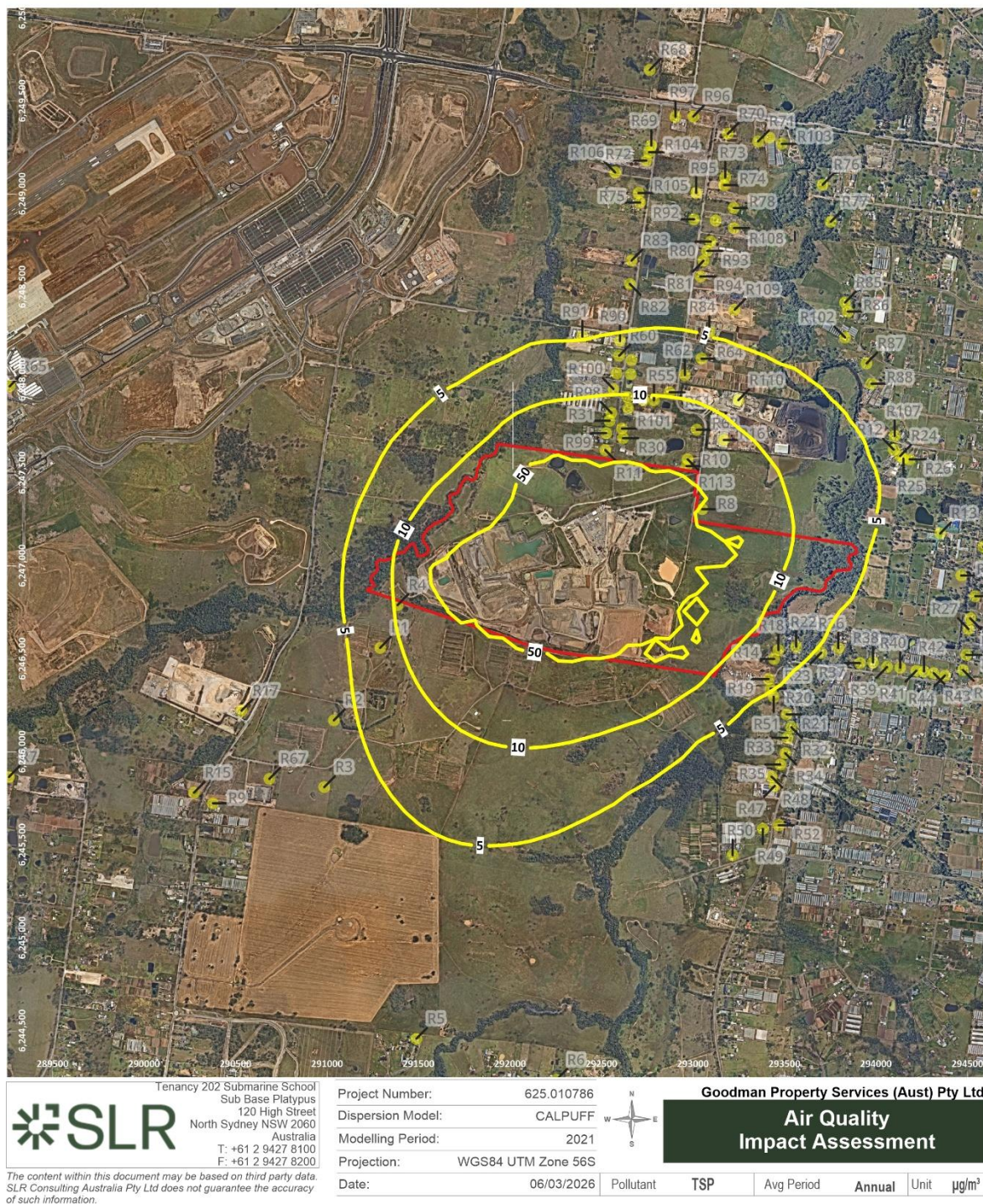
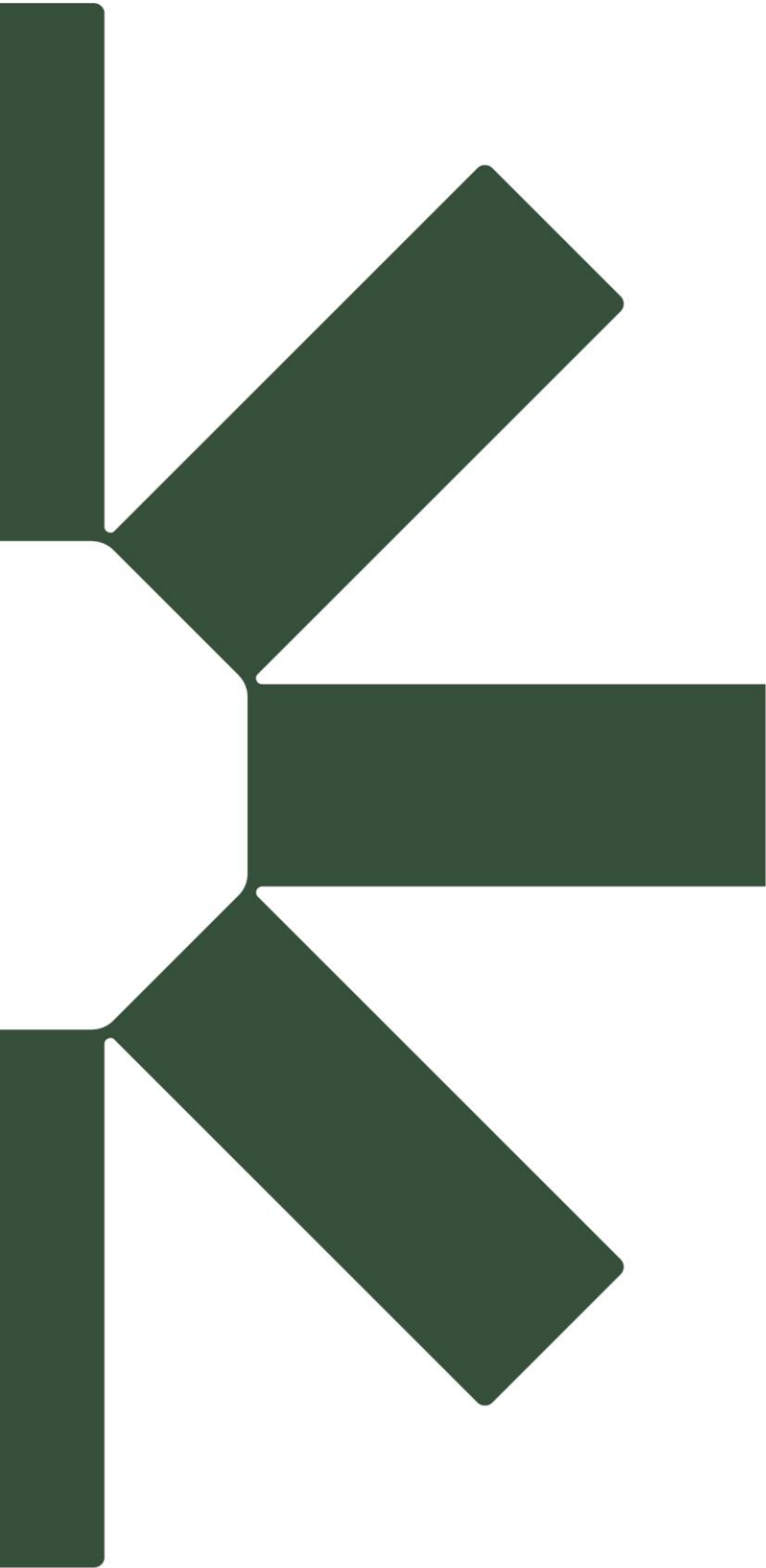


Figure E-5 Annual Average Incremental Impacts of TSP





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