BORAL BERRIMA CEMENT WORKS

Air Quality Impact Assessment
SWDF Increase, Delivery Variation and Site Access

Prepared for:

Boral Cement Limited
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APPENDICES

1 Introduction

SLR Consulting Australia Pty Ltd (SLR) was commissioned by Boral to perform the air quality impact assessment (AQIA) for the proposed changes in operations at the Berrima Cement Works (henceforth the Cement Works) aimed at reducing the sites coal consumption by compensating with an increase in the sites solid waste derived fuel (SWDF) consumption.

Due to the lower calorific vale of SWDF, compared to coal, additional fuel material will be required to be delivered to site. Boral recognises that the proposed changes will increase the truck material deliveries to site and propose that coal and SWDF deliveries are rerouted to enter and exit the site via a new entry off Old Hume Highway from the current entry and exit via Taylor Avenue.

The new entryway will reduce the site truck traffic and divert it further from the residential area north of the cement works. While the distance from the receptors is increased, the road and truck travel distance are also increased which means that the diversion comes with a trade-off of somewhat increased wheel generated dust emissions. Details on the proposed changes are summarised in the project description in **Section 2**.

This report presents the AQIA resulting from the proposed changes to the operations and considers dust emissions from the operation and odour emissions from the storage of the SWDF.

1.1 Background

The Cement Works have undergone a number of modifications in recent years relating to reduction and replacement of coal as kiln fuel with SWDF. The AQIAs for these modifications have primarily focused on stack emissions and have included other fugitive dust sources to a varying degree.

From what is understood, this assessment is the first dispersion modelling study for the Cement Works to also include wheel generated dust for onsite paved road truck traffic. For previous studies this has not been included.

1.2 Purpose of Report

The purpose of this report is to address the Environmental Assessment Requirements (EARs) pertaining to potential air quality impacts as shown in **Table 1**.

Table 1 Environmental Assessment Requirements (DPIE, 2021)

Key Issue	Assessment Requirement	Addressed in Section
Air Quality	*A quantitative assessment of the potential air quality, dust and odour impacts of all stages of the development, including cumulative impacts, in accordance with relevant Environment Protection Authority guidelines, including:*	**This report**
	• a description of the receiving environment and all existing and proposed emission sources	**Sections 3, 5 and Appendix A**
	• an assessment of opportunities to minimise vehicle kilometres travelled and measures to minimise the potential for air quality impacts associated with truck movements	**Sections 7 and 8**
	• details of emission control techniques, and management and monitoring measures.	**Section 8**

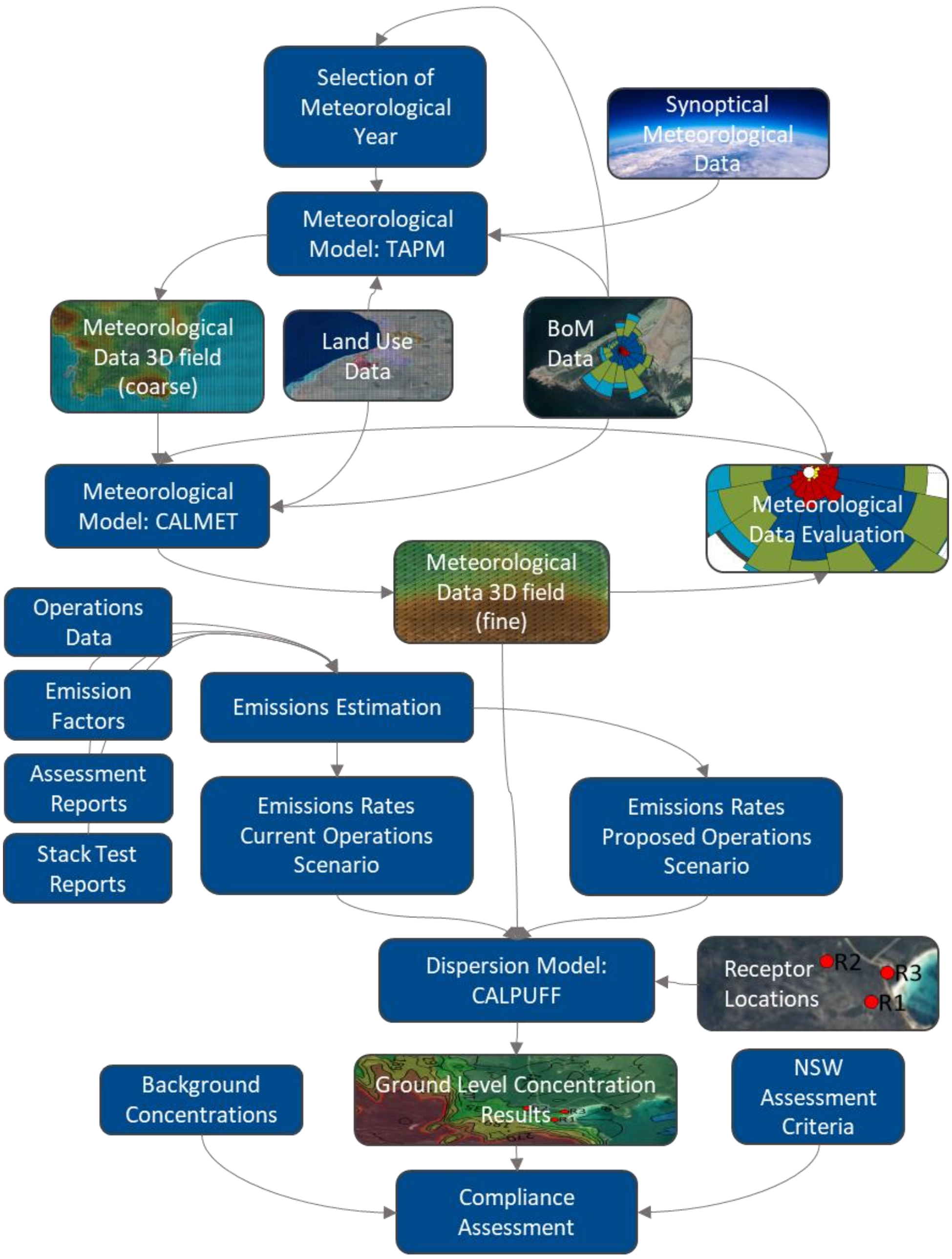
1.3 Approach to Assessment

1.3.1 Assessment of Impacts from Operations

An overview of the AQIA methodology is presented in **Figure 1**.

The air quality assessment and dispersion modelling was performed in line with the NSW Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales.

Figure 1 AQIA Methodology Overview



1.3.2 Assessment of Impacts from Construction

For review of potential impacts from the construction works of the new entryway, the IAQM *"Guidance on the Assessment of Dust from Demolition and Construction",* developed in the United Kingdom by the Institute of Air Quality Management (IAQM, 2014) was used for screening of assessment requirements (See **Appendix C**).

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

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

With no sensitive receptor within 350 m from the alignment of the new entry road, or within 500 m from the new site entrance (by distance of road) there is no further assessment is required by the IAQM method.

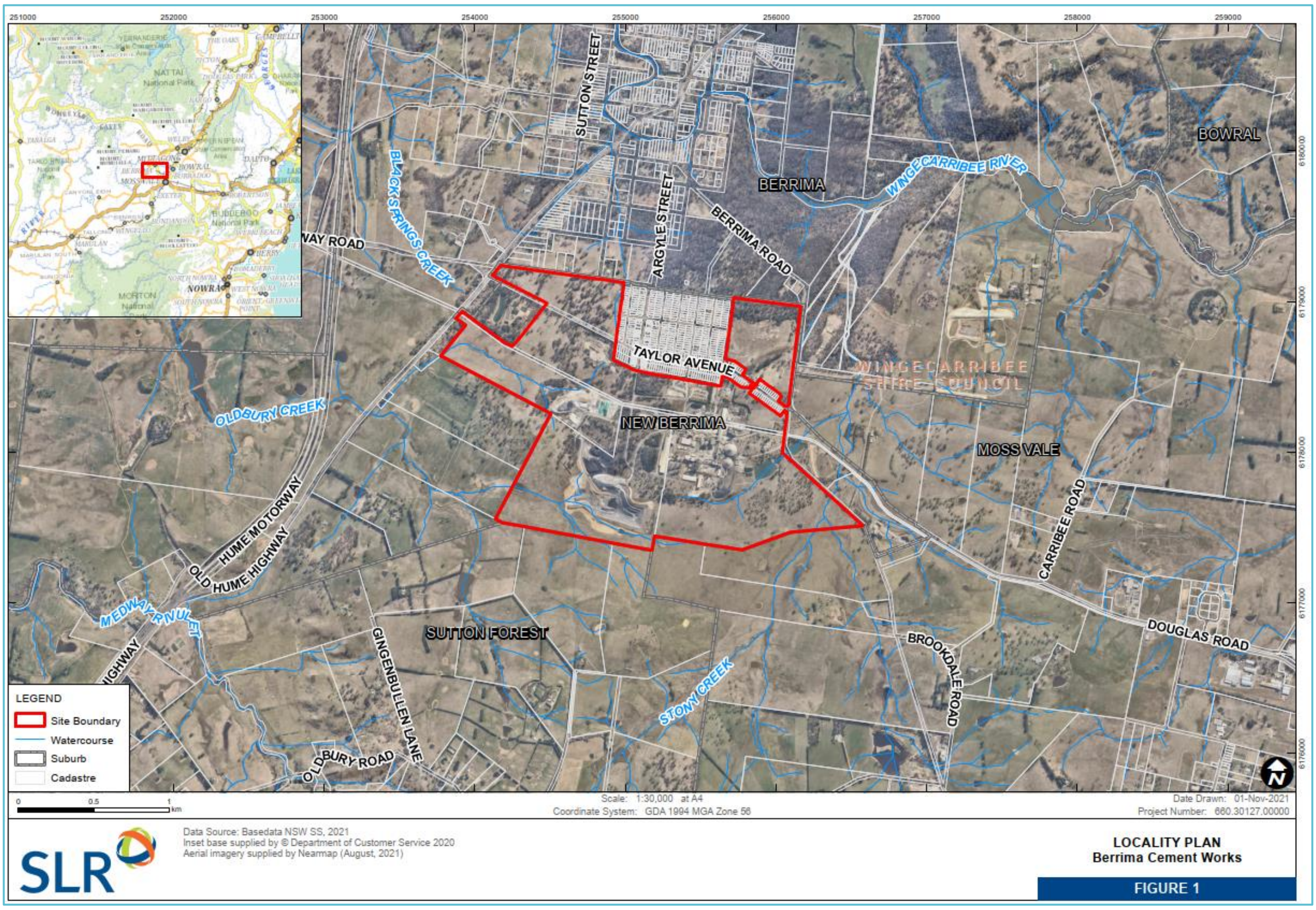
The risks in relation to air quality impacts on sensitive receptors from the new entry road construction are considered negligible. However, common good practices for construction dust management should be applied.

2 Project Description

2.1 Site Location

The Cement Works is located south of New Berrima in the Southern Highlands of NSW in the Wingecarribee LGA. The existing main site access is via Taylor Avenue, which connects the facility with the Hume Motorway, approximately 2.5 km to the west.

Figure 2 Site Location Berrima Cement Works



2.2 Existing Current Operations

The Cement Works has operated since 1929, producing cement products comprising cement and clinker for sale in NSW and the ACT, as well as for export. It is approved to produce up to 1.56 million tonnes per annum (Mtpa) of cement products, which includes cement and clinker. These products are transported to market via road, rail and sea via Port Kembla.

The facility operates one kiln and two cement mills, along with ancillary storage and stockpile facilities. Cement manufacture is an energy intensive process due to the high temperatures required to produce clinker. To fuel this process, the site has previous approval to use a range of fuel sources including coal, gas, diesel and solid waste derived fuels (SWDFs), with SWDF approved for use by Modification 9 in 2016.

The expanded range of fuel sources has been progressed by Boral to reduce reliance on coal, with approximately 170,000 tonnes per annum of coal currently used to heat the kiln. Coal was historically sourced from Medway Colliery less than 10 km to the west of the site up to its closure in 2013, with the majority of coal now transported by road from the Illawarra coal mines.

Boral has been exploring the use of SWDF for heat energy in Kiln 6 for approximately 17 years and has consistently used the material in the kiln for the past 3 years. Using waste derived fuels has been common practice in cement plants in Europe for around 25 years, and all other cement kilns in Australia have been using these fuels for several years.

2.3 Proposed Operations

The Cement Works remains reliant on coal as the primary fuel source for the kiln, with associated environmental and cost implications. The proposed Project would increase the use of SWDF, diverting waste products from landfill to become a valuable component of the cement manufacturing process.

The use of SWDF help to improve the plant's energy costs, reduces greenhouse gas emissions and allows the Cement Works to remain competitive relative to imported products. The successful use of SWDF at the site coupled with the recently approved Modification 13 for a Chloride Bypass System at the kiln allowing improved management of naturally occurring volatile components from the SWDF, has led to Boral seeking to increase the consumption of SWDF at the kiln.

To efficiently fuel the kiln with SWDF an ongoing regular supply is required. The current site operations and approvals currently limit this. To facilitate the use of SWDF in the kiln modifications to the current approval is required to:

- Increase the permissible delivery times.
- Increase the maximum permitted deliveries to site.
- Increase on-site storage capacity.

In the interests of reducing noise impacts to sensitive receivers along Taylor Avenue, and to remove the inherent constraint these receivers present on 24 hour operations, it is proposed that a new site access be established, primarily for the purposes of allowing deliveries of fuel (as outlined in **Table 2**) for the Kiln to the site.

The internal haul road will be constructed to predominantly align with an existing internal haul road, which is approximately 340 m south of Taylor Avenue, within Boral owned land, and will require a new intersection with the Old Hume Highway. This and the current main access are shown in **Figure 3**.

To facilitate the increased consumption of SWDF and the introduction of AKF-5 (tyre) non-standard fuels, construction of two additional storage sheds on the site, to appropriately shelter and manage SWDF and AKF-5 deliveries on the site are also proposed. Currently, the there is one SWDF shed in use. The locations of the SWDF storage sheds are shown in **Figure 3**.

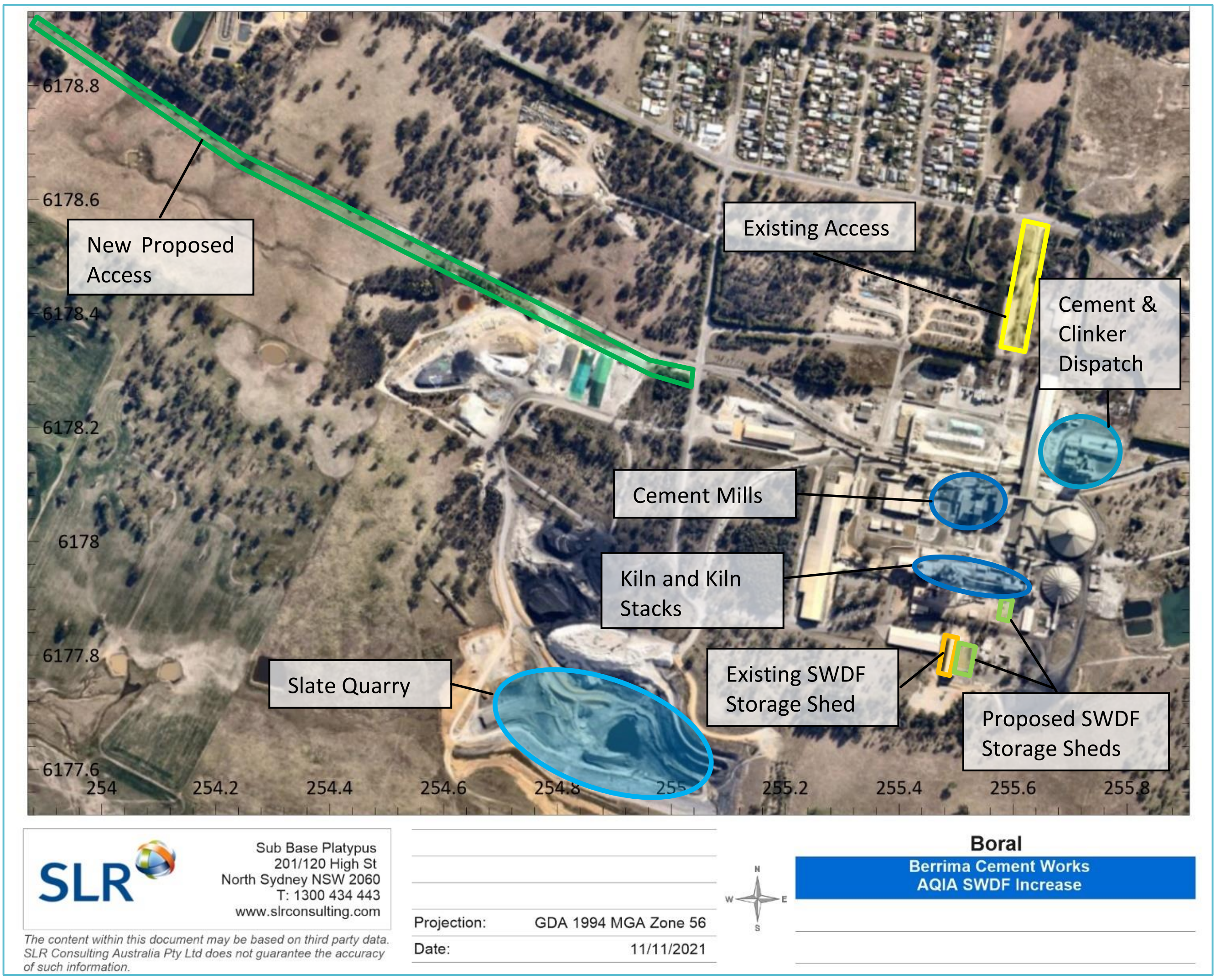
Table 2 Approved and Proposed Truck Movements

Material Type	Current Volume (approximate)	Trucks per year	Change Proposed	Proposed Volume	Proposed Trucks per Year	Route
Raw Materials	357,000	17,850	No	No Change	No Change	Existing Access
Fuels for Kiln (Coal)	170,000	6,285	Yes	56,700	2,100	New Access
Fuels for Kiln (SWDF)	100,000	4,166	Yes	250,000	10,415	New Access
Fuels for Kiln (AKF-5)	0	0	Yes	30,000	1,250	New Access
Dispatch of Clinker	300,000	10,000	No	No Change	No Change	Existing Access
Dispatch of Cement	500,000	16,700	No	No Change	No Change	Existing Access

2.4 Site Layout

The site layout presented in **Figure 3** shows the existing and proposed new site access entry ways, the existing and proposed SWDF storage sheds and other operations at site.

Figure 3 Site Layout Berrima Cement Works



2.5 Project Air Emissions

Air emissions from the Cement Works include:

- Particulate matter emissions from stack sources (kiln stack, kiln cooler stack and cement mills).
- Fugitive dust emissions from materials handling.
- Fugitive dust from wind erosion from stockpiles and other exposed dusty surface areas.
- Fugitive wheel generated dust from paved and unpaved truck road traffic at site.
- Odour emissions from the SWDF storage sheds[1].

The site emissions, as they relate to the proposed changes with diversion of the fuel delivery transports from the current site main access via Taylor Avenue to the new access via Old Hume Highway, primarily concern wheel generated dust from sealed roads on site. The dust impact assessment component is focused on these changes.

[1] At the time the assessment was being prepared there were two sheds proposed.

Odour emissions from the additional SWDF storage sheds are also assessed as a single odour assessment scenario.

Kiln stack combustion emissions were not modelled as part of this assessment. There are no changes in the current proposal to what has previously been assessed for the stack emissions. The increase in SWDF has previously been modelled and the proposed changes are within the combustion rates previously assessed[2].

The dispersion modelling of particulate matter included modelling of:

- PM_{10} – refers to all particles with equivalent aerodynamic diameters of less than 10 µm.
- $PM_{2.5}$ – refers to all particles with equivalent aerodynamic diameters of less than 2.5 µm diameter. These are often referred to as 'fine' particles and are a sub-component of PM_{10}.
- TSP – refers to all (total) suspended particles in the air. In practice, the upper size range is typically 30 micrometres (µm) to 50 µm.
- Deposited dust – refers to particulate matter and is measured as a dust deposition rate which is dust settled out over a given area and time under the influence of gravity. Deposited dust can include particles of any size, but it generally comprises particles larger than 20 µm in diameter that rapidly settle out of the air near the point of emission. It is measured to assess if an emission source is causing a nuisance, such as soiling of property and materials.

Particulate matter emissions are modelled for two scenarios:

- Current operations – All current site activities for production and all truck movements through the Taylor Avenue entry.
- Proposed operations – All current site activities for production (as for the current operations) and truck movements through the Taylor Avenue entry for dispatch of cement and clinker sales and for all materials deliveries and coal and SWDF deliveries through the new entry from the Old Hume Highway.

[2] Two latest reports include (AQP , 2015) and (EMM, 2021)

3 Project Setting

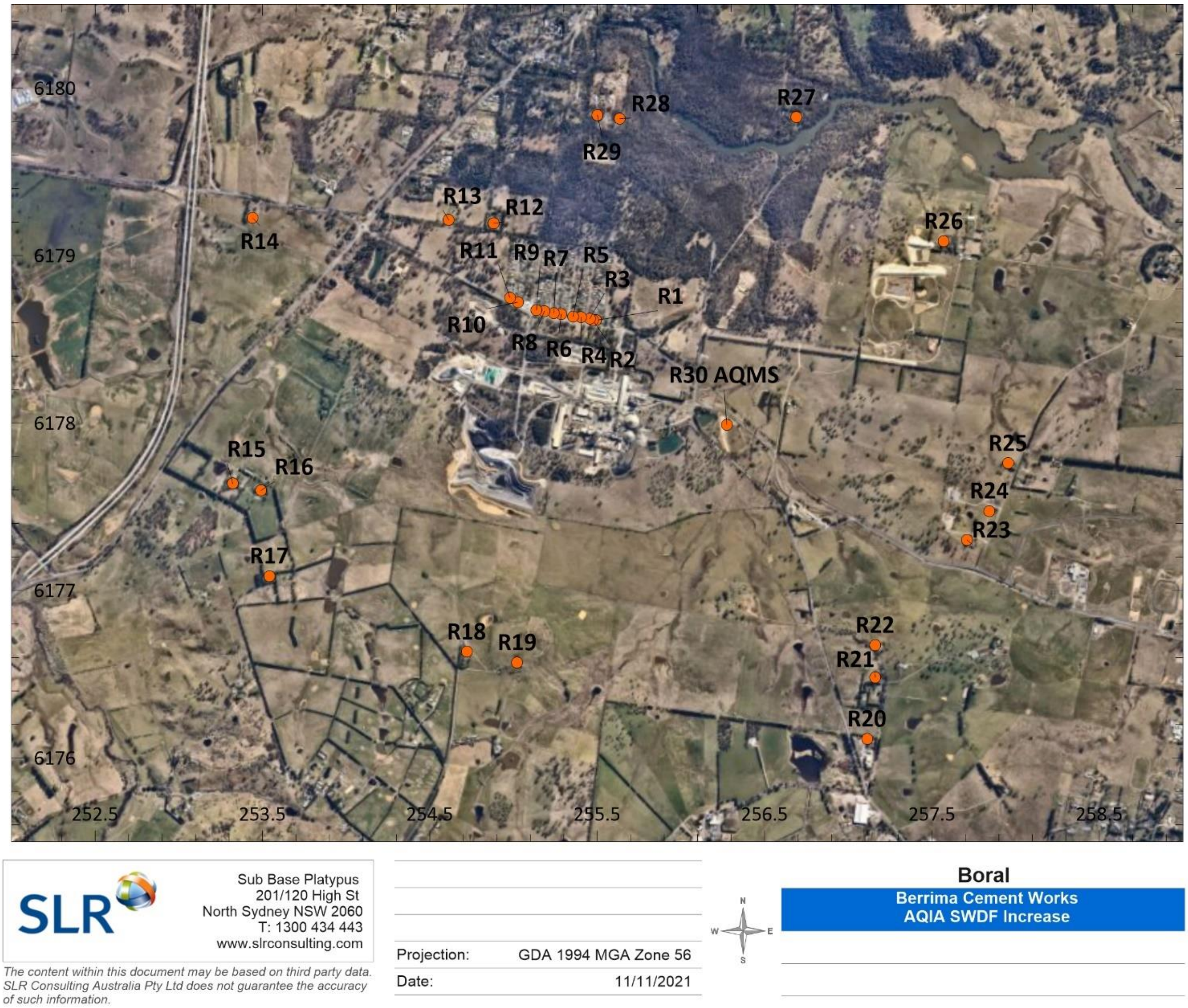
The facility is located wholly on Boral owned land, which comprises approximately 135 ha (see **Figure 2**).

3.1 Surrounding Land Use, Sensitive Receptors and Zoning

The closest residential area and zone to the Cement Works is the New Berrima Township, which has the closest sensitive residential receptors at a distance of approximately 650 m north of the No 6 kiln stack and approximately 450 m from the closest materials handling operations and cement dispatch loading operations. There are also sensitive receptors, separate rural residences surrounding the plant to the west south and east at distances between 1 to 2 km. The nearest sensitive receptor locations are shown in **Figure 4**.

The area to the southeast of the Cement Works between New Berrima and Moss Vale is part of the Moss Vale Enterprise Corridor (MVEC) set aside for employment generating development under the Wingecarribee Local Environmental Plan 2010. The Cement Works is situated within a Heavy Industrial (IN3) zone and the land to the immediate east and south is zoned General Industrial (IN1).

Figure 4 Nearest Sensitive Receptor Locations



3.2 Local Topography

Berrima is located in the Southern Highlands which is characterised by hilly terrain. The locality around the cement works can be described as undulating terrain rising towards both the north and south of the site.

3.3 Local Meteorology

The nearest active Bureau of Meteorology (BoM) Automatic Weather Station (AWS) is located at Moss Vale, approximately 7.5 km west southwest of the Cement Works. Temperature, rainfall and relative humidity data from the Moss Vale BoM AWS are presented below. Wind data are presented for the Cement Works air quality monitoring station (AQMS) weather stations, which being located at the site is more representative than the Moss Vale data.

3.3.1 Temperature

Long-term temperature statistics for Moss Vale AWS are summarised in **Figure 5**. Mean maximum temperatures range from 11.9°C in winter to 26.3°C in summer, while mean minimum temperatures range from 2.4°C in winter to around 14.1°C in summer. Maximum temperatures of 40°C and minimum temperatures less than -6°C have been recorded.

3.3.2 Rainfall

Long-term rainfall statistics for Moss Vale AWS are summarised in **Figure 6.** The average monthly rainfall is relatively high between early summer and early winter, reducing from mid-winter to late spring with the lowest average of 37.1 mm/month recorded during September. No months recorded an average of less than ten days of rain days per month. The highest average monthly rainfall of 99.4 mm/month occurs in February, with an average of 14 rain days recorded in this month. The highest monthly rainfall recorded over the time period examined was 318 mm recorded in June 2016.

3.3.3 Relative Humidity

Long-term humidity statistics (9 am and 3 pm monthly averages) for Moss Vale AWS are summarised in **Figure 7**. Morning humidity levels range from an average of around 63% in mid spring to around 83% in early autumn to mid-summer. Afternoon humidity levels are lower, at around 63% in late summer and dropping to a low of 51% in spring.

Figure 5 Long Term Temperature Data for Moss Vale AWS

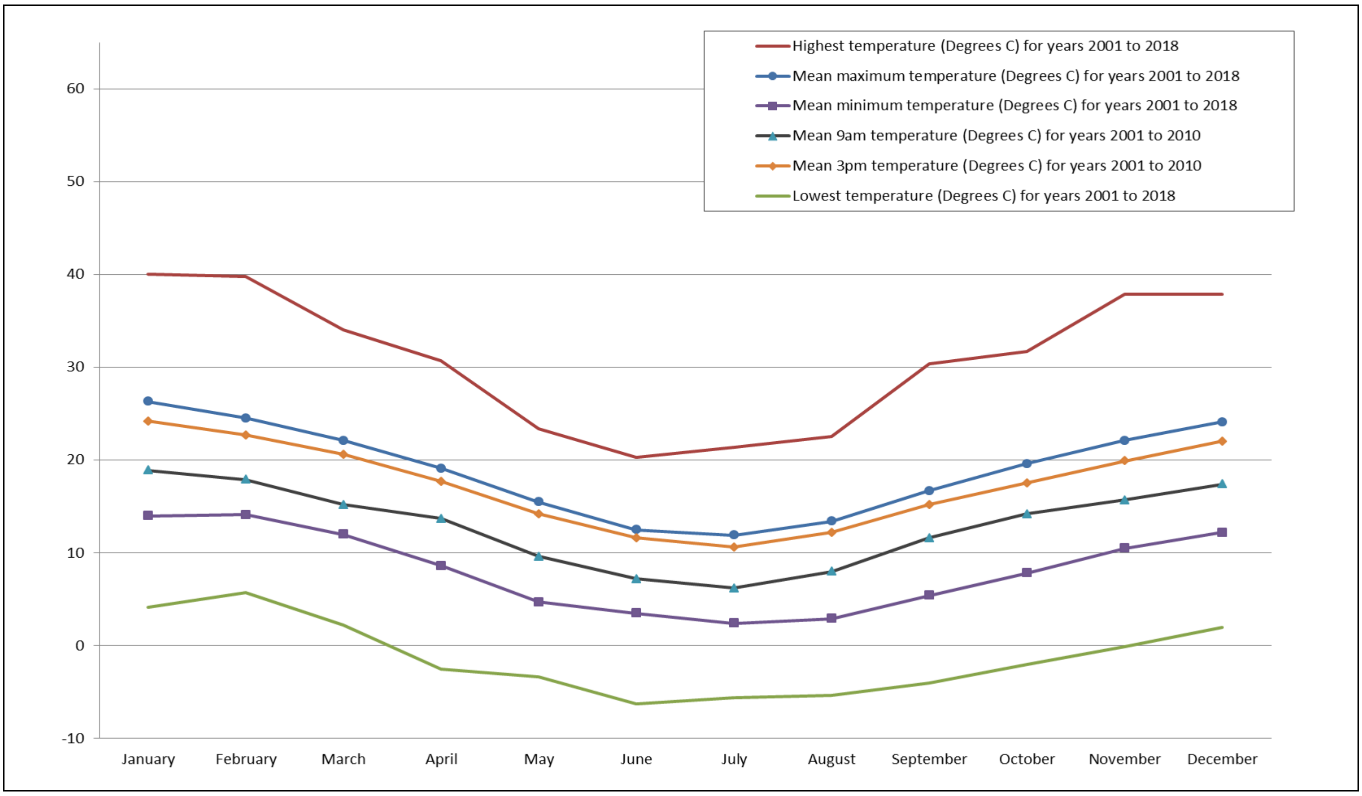


Figure 6 Long Term Monthly Rainfall Data for Moss Vale AWS

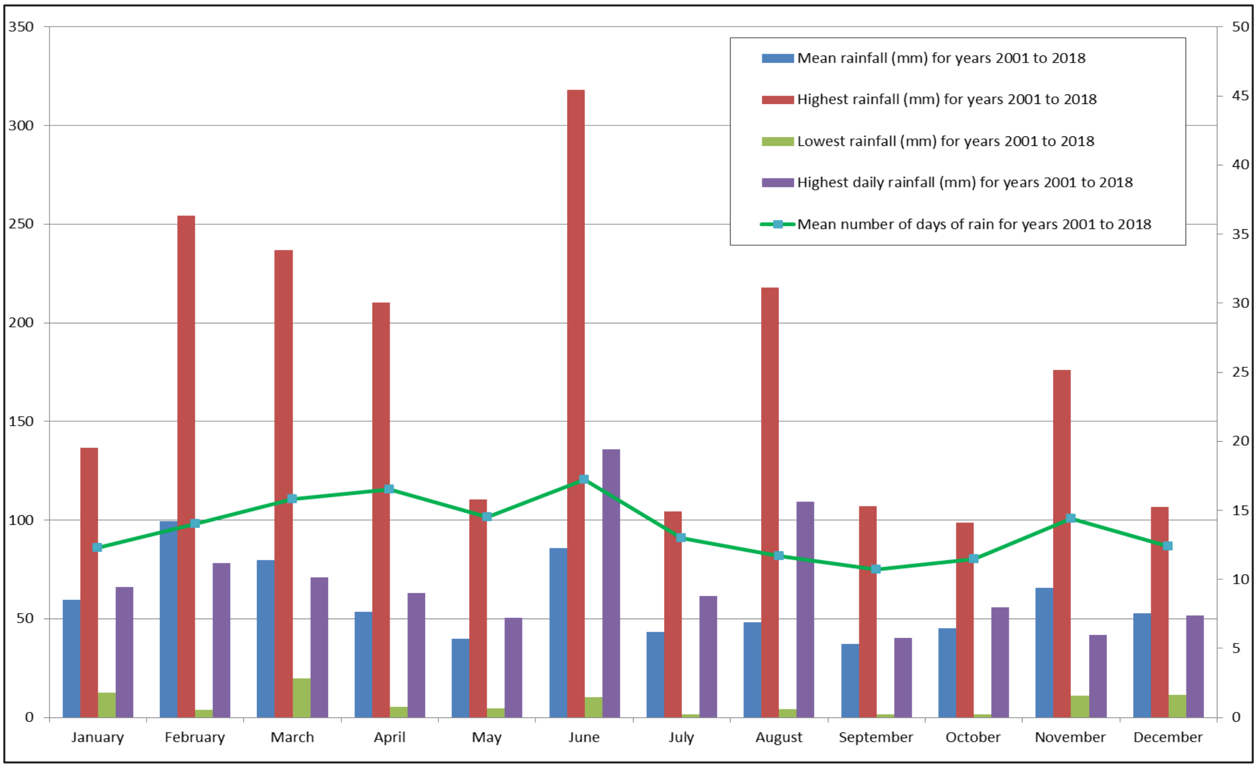
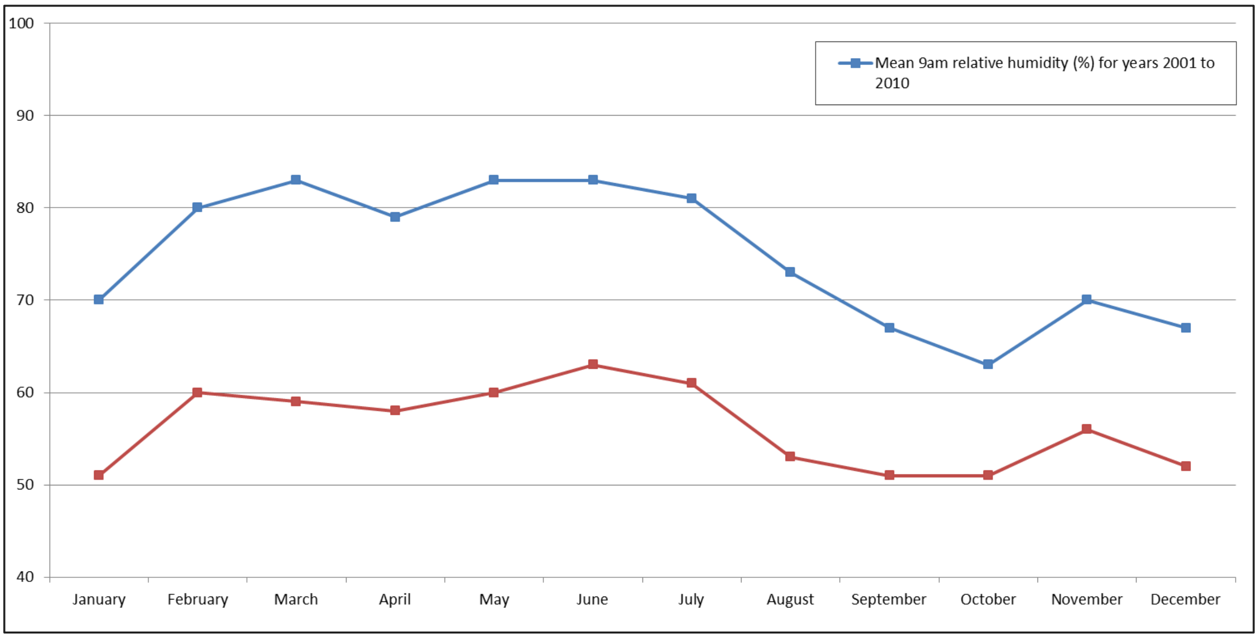


Figure 7 Long Term Humidity Data for Moss Vale AWS

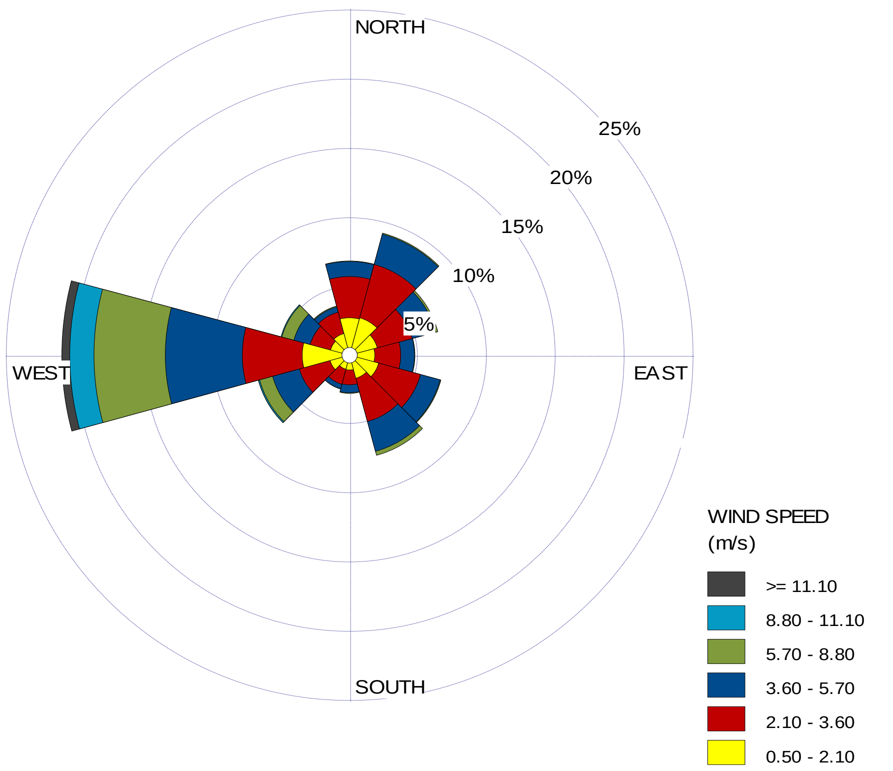


3.3.4 Wind Speed and Wind Direction

Wind data from the air quality monitoring station (AQMS) weather station located just east of the site (approximately 500 m east of the operations at the location shown in **Figure 4**) are presented in **Figure 8** and shows that the prevailing wind direction at the site locations is very much westerly with a lower frequency of southerly winds towards the nearest sensitive receptors in the New Berrima township.

Additional details on the wind and meteorological data used in the dispersion modelling are provided in **Section 6.2**.

Figure 8 Wind Roses for 2017 to 2019



Location: AQMS (east of site)	**Data period:** 2017 to 2019	**Time period:** All hours	**Data type:** AQMS weather station
Average wind speed: 2.9 m/s		**Calm wind frequency:** 12.6%	

3.4 Other Local Emission Sources

A review of National Pollutant Inventory (NPI) reporting operations in the vicinity surrounding the Cement Works showed that there are no operations nearby of any scale that would have the potential to contribute particulate matter (dust) emissions at a scale of any significance.

Regarding odour it is noted that there is an Ingham's feed mill approximately 1 km to the west southwest from the Cement Works. There is typically a bit of odour associated with feed mill operations. However, it is not expected any odour levels from the feed mill would have an impact on odour levels at surrounding receptors in a cumulative capacity with the lower level of odour emissions from the SWDF storage sheds as estimated in the assessment.

3.5 Existing and Local Ambient Air Quality

Local air quality data are available from the Cement Works AQMS which consists of two High Volume Air Samplers (HVASs) vol samplers to record TSP and PM_{10} levels on the standard 1 in 6 days rotational program as is common for HVASs.

Since the Cement Works AQMS is located in the prevailing downwind wind direction of the Cement Works, and since the reported dust levels include contribution from the Cement Works, these monitoring data, while providing information on the TSP and PM_{10} concentrations near the Cement Works, are not suitable to use as background data[3] in the dispersion modelling for cumulative assessment.

For reference to regional PM_{10} and $PM_{2.5}$ background concentration data from Bargo located approximately 32 km to the northeast were considered.

3.5.1 Boral Berrima AQMS

Statistics of the site AQMS monitoring data for PM_{10} and TSP are presented in **Table 3** and **Table 4**. Plots for the data since 2016 are provided in **Figure 9** and **Figure 10**.

Overall, the data shows downwards trends for both PM_{10} and TSP for recent years of operation.

[3] Using this data as background data includes double counting of the site contribution.

Table 3 Site AQMS PM_{10} Air Quality Statistics 2012 to June 2021

Year	Annual Maximum ($\mu g/m^3$)	99th Percentile ($\mu g/m^3$)	90th Percentile ($\mu g/m^3$)	70th Percentile ($\mu g/m^3$)	Annual Average ($\mu g/m^3$)	Days >50 $\mu g/m^3$
2012	51.7	47.9	25.6	14.4	13.7	1
2013	56.2	53.8	30.8	19.2	15.2	2
2014	45.5	37.8	23.0	13.3	11.5	0
2015	59.0	50.4	34.0	18.0	15.4	1
2016	76.3	71.4	47.2	22.1	19.6	5
2017	79.2	65.9	49.8	25.0	21.8	7
2018	70.9	66.2	41.8	24.0	19.4	4
2019	45.7	41.1	23.3	14.5	11.7	4
2020	240.0	120.8	44.7	20.0	19.6	3
2021 [a]	36.4	35.7	22.48	9.98	9.8	0
Average: 2012 - 2021	76.1	59.1	34.3	18.0	15.8	2.7

[a] Data to June 2021
Data provided by Boral

Figure 9 Plot Site AQMS PM_{10} 2016 to June 2021 (HVAS Monitoring 1 Day in 6)

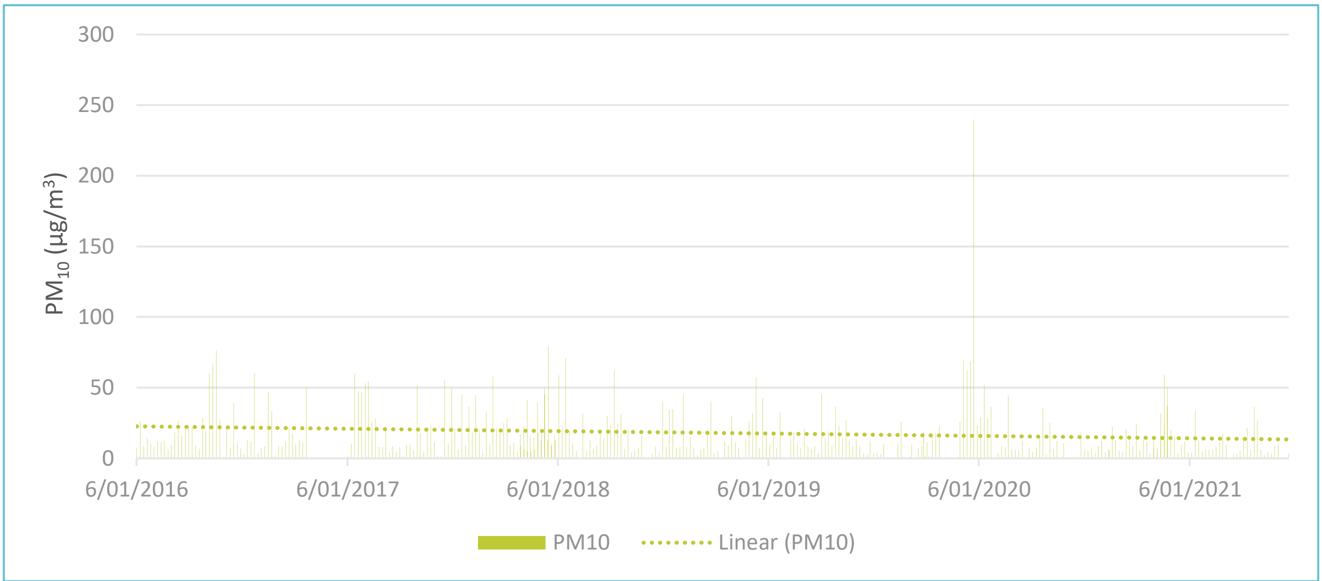
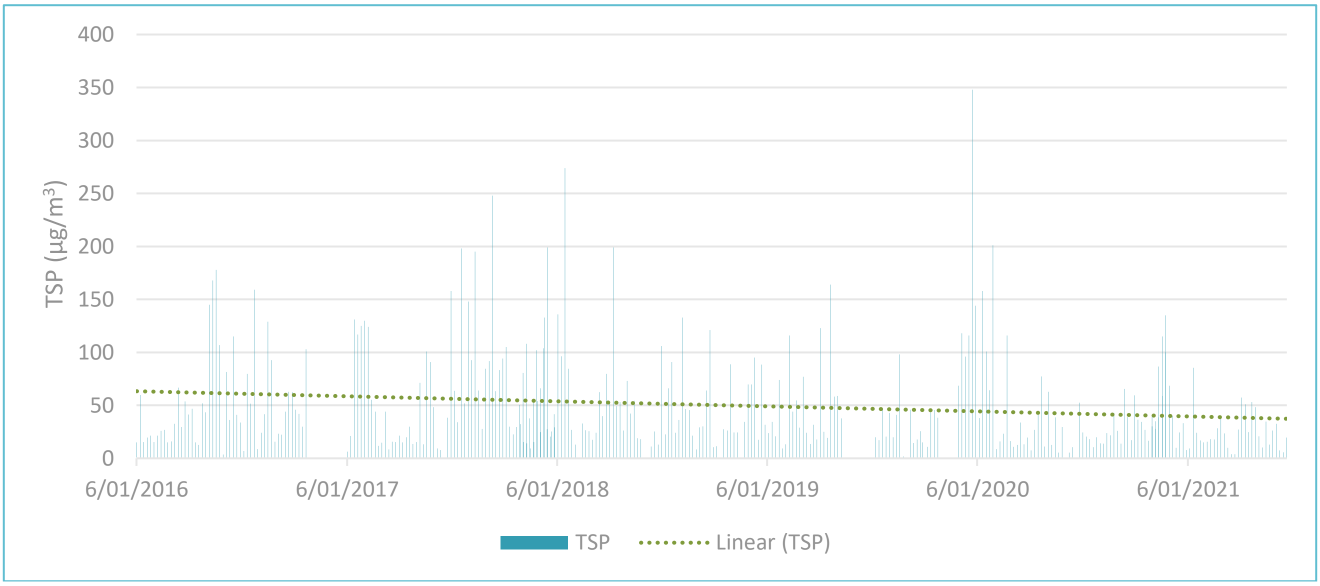


Table 4 Site AQMS TSP Air Quality Statistics 2012 to June 2021

Year	Annual Maximum ($\mu g/m^3$)	99th Percentile ($\mu g/m^3$)	90th Percentile ($\mu g/m^3$)	70th Percentile ($\mu g/m^3$)	Annual Average ($\mu g/m^3$)
2012	173	153	85	47	42
2013	142	133	94	58	45
2014	138	133	69	43	36
2015	183	157	105	53	44
2016	178	173	116	56	52
2017	248	214	131	85	63
2018	274	233	101	65	54
2019	164	148	77	44	41
2020	348	247	116	55	50
2021 [a]	86	78	51	28	25
Average: 2012 - 2021	193	167	95	53	45

[a] Data to June 2021
Data provided by Boral

Figure 10 Plot Site AQMS TSP 2012 to June 2021 (HVAS Monitoring 1 Day in 6)



3.5.2 Bargo

The PM_{10} and $PM_{2.5}$ data for Bargo are presented in **Table 5** and **Table 6** and as plotted in **Figure 11** and **Figure 12** show elevated concentrations for 2019/2020 due to the extensive bushfires over that summer.

In line with the NSW preference for using contemporaneous ambient concentration data cumulative assessment the daily PM_{10} and $PM_{2.5}$ Bargo monitoring data for 2017 (same year as the meteorological data) were used in the results evaluation of the sensitive receptor results.

Table 5 Bargo PM_{10} Air Quality Statistics 2016 to October 2021

Year	Annual Maximum (µg/m³)	99th Percentile (µg/m³)	90th Percentile (µg/m³)	70th Percentile (µg/m³)	Annual Average (µg/m³)	Days >50 µg/m³
2016	58.4	33.7	23.4	16.9	14.2	3
2017	53.5	30.8	21.7	15.7	13.9	1
2018	60.8	50.9	28.0	19.8	16.9	4
2019	188.9	125.0	36.1	21.2	21.2	21
2020	265.7	112.1	25.2	16.1	15.9	6
2021 [a]	63.9	28.7	19.5	13.7	11.8	1
Average: 2012 - 2021	115	63.5	25.6	17.2	15.7	6.0

[a] Data to October 2021
Source: https://www.environment.nsw.gov.au/topics/air/monitoring-air-quality/sydney/monitoring-stations/bargo

Figure 11 Plot Bargo PM_{10} 2016 to October 2021

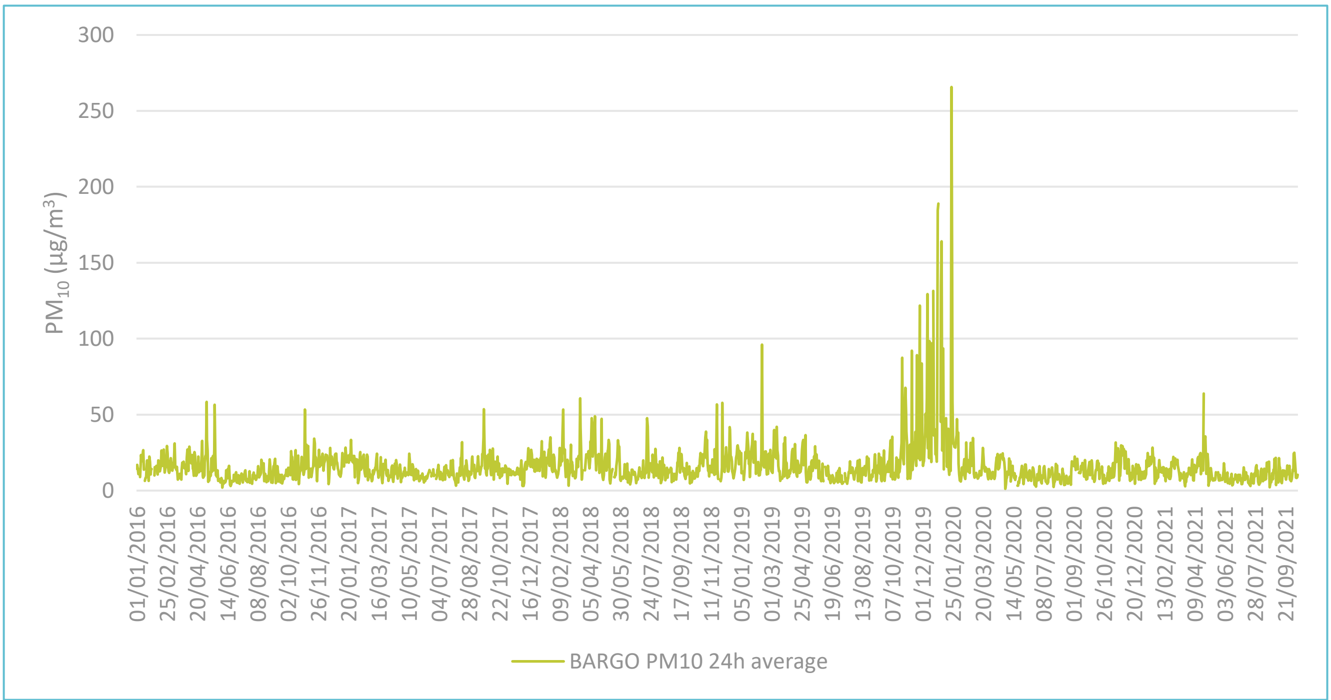
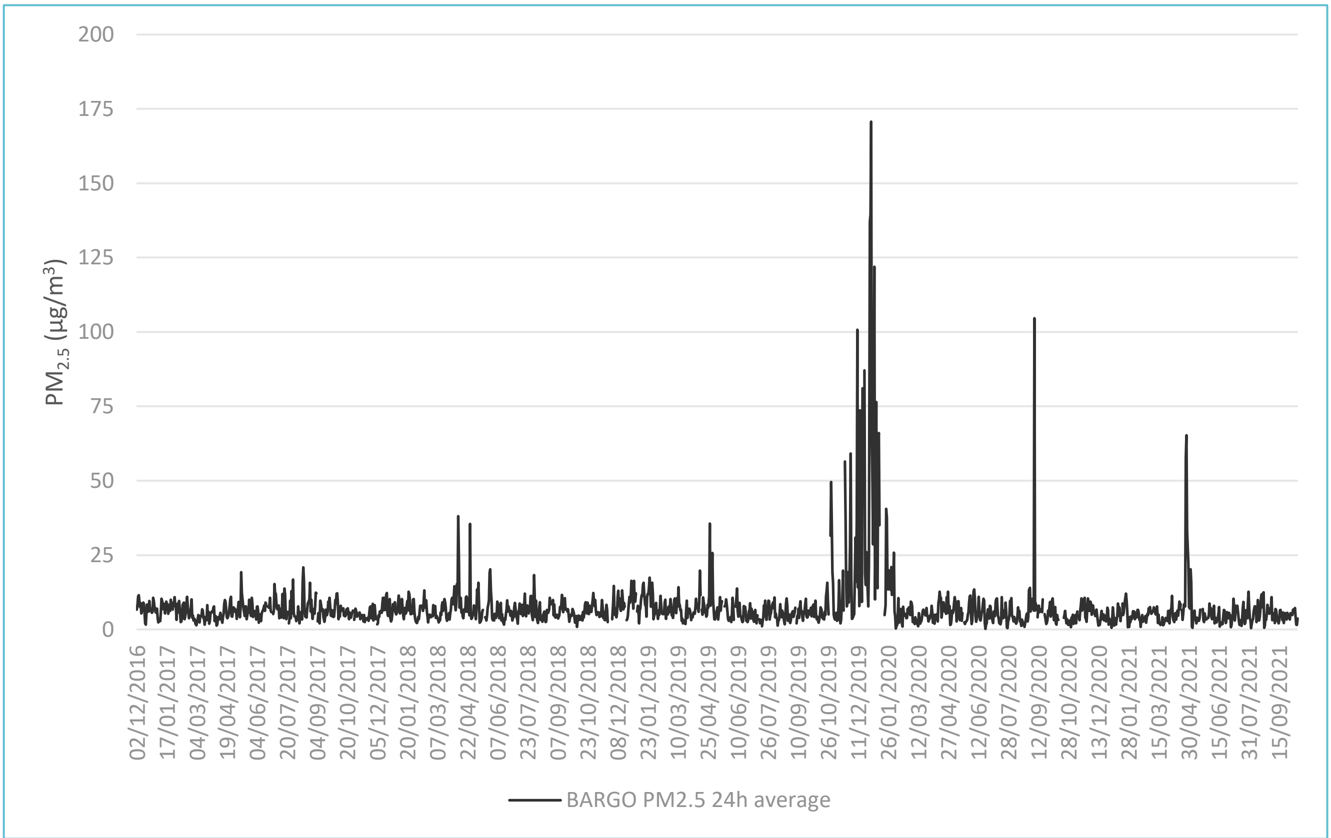


Table 6 Bargo $PM_{2.5}$ Air Quality Statistics 2017 to Oct 2021

Year	Annual Maximum ($\mu g/m^3$)	99th Percentile ($\mu g/m^3$)	90th Percentile ($\mu g/m^3$)	70th Percentile ($\mu g/m^3$)	Annual Average ($\mu g/m^3$)	Days >50 $\mu g/m^3$
2017	20.9	16.1	10.0	7.3	6.2	0
2018	38.1	19.6	10.6	8.0	6.8	2
2019	170.7	94.3	16.0	8.7	10.4	21
2020	121.9	65.3	11.1	7.0	7.8	14
2021 [a]	65.3	28.6	8.3	6.2	5.6	4
Average: 2012 - 2021	71.4	39.2	10.9	7.6	7.3	6.8

[a] Data to October 2021
Source: https://www.environment.nsw.gov.au/topics/air/monitoring-air-quality/sydney/monitoring-stations/bargo

Figure 12 Plot Bargo $PM_{2.5}$ 2017 to October 2021



3.6 Dust Complaints

A review of the dust complaints made to the Cement Works since June 2019, and the follow up complaints investigations was included as part of the assessment.

The review showed a total of 90 complaints between June 2019 and May 2021 from the New Berrima township. Almost all of the complaints are nuisance related in relation to cement dust (dust fallout/deposition) on cars.

4 Regulatory Framework

4.1 Environmental Assessment Requirements

The Environmental Assessment Requirements (EARs) for the air quality impact assessment for the proposed changes to the operations include (DPIE, 2021):

A quantitative assessment of the potential air quality, dust and odour impacts of all stages of the development, including cumulative impacts, in accordance with relevant Environment Protection Authority guidelines, including:

- a description of the receiving environment and all existing and proposed emission sources

- an assessment of opportunities to minimise vehicle kilometres travelled and measures to minimise the potential for air quality impacts associated with truck movements

- details of emission control techniques, and management and monitoring measures.

4.2 Relevant Legislation, Policy and Guidance

The following air quality policy and guidance documents have been referenced within this assessment and have been used to identify the relevant air quality criteria.

4.2.1 Protection of the Environment Operations Act 1997 & Amendment Act 2011

The *Protection of the Environment Operations Act 1997* (and *Amendment Act 2011*) (hereafter the POEO Act) is a key piece of environment protection legislation administered by the NSW EPA which enables the Government to establish instruments for setting environmental standards, goals, protocols and guidelines.

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

- Section 124 and 125 of the POEO Act states that any plant located at a premise should be maintained in an efficient condition and operated in a proper and efficient manner to reduce the potential for air pollution.
- Section 126 of the POEO Act requires that materials (e.g. building and maintenance materials at the development 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 a 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.

4.2.2 Protection of the Environment Operations (Clean Air) Regulation 2010

The "*POEO (Clean Air) Regulation 2010*" (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 plant for a number of substances.

4.2.3 Approved Methods for Modelling and Assessment

The EPA is the NSW regulatory authority responsible for air quality regulation and associated activities.

The EPA'S published "*Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales"* (NSW EPA, 2017) (The Approved Methods) lists the statutory methods for modelling and assessing air pollutants from stationary sources and specifies criteria which reflect the environmental outcomes adopted by the EPA. The Approved Methods are referred to in the POEO (Clean Air) Regulation 2002 for assessment of impacts of air pollutants.

The air quality criteria set out in the Approved Methods have been reproduced and discussed in **Section 4.3**.

4.3 Relevant Air Quality Criteria

Ambient air quality criteria relevant to the key pollutants associated with the Project (as identified in **Section 2.5**) are discussed in the following sections.

The Approved Methods lists the statutory methods that are to be used to model and assess emissions of air pollutants from stationary sources in NSW. The criteria specified in the Approved Methods are the defining ambient air quality criteria for NSW and are considered to be appropriate for this Project.

4.3.1 Particulate Matter

Airborne contaminants that can be inhaled directly into the lungs can be classified on the basis of their physical properties as gases, vapours or particulate matter. In common usage, the terms "dust" and "particulates" are often used interchangeably. The 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). The annual goal for TSP recommended by the NSW EPA is 90 micrograms per cubic metre of air (µg/m^3).

The TSP goal was developed before the more recent results of epidemiological studies which suggested a relationship between health impacts and exposure to concentrations of finer particulate matter.

Emissions of particulate matter less than 10 µm and 2.5 µm in diameter (referred to as PM_{10} and $PM_{2.5}$ respectively) are considered important pollutants due to their ability to penetrate into the respiratory system. In the case of the $PM_{2.5}$ category, recent health research has shown that this penetration can occur deep into the lungs. Potential adverse health impacts associated with exposure to PM_{10} and $PM_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

The PM_{10} and $PM_{2.5}$ impact assessment criteria set out in the Approved Methods are as follows:

- PM_{10} - 24-hour maximum of 50 µg/m^3
- PM_{10} - annual average of 25 µg/m^3
- $PM_{2.5}$ - 24-hour maximum of 25 µg/m^3
- $PM_{2.5}$ - annual average of 8 µg/m^3.

The assessment criteria discussed above are concerned in large part with the health impacts of airborne particulate matter. Nuisance impacts need also to be considered, mainly in relation to deposited dust. In NSW, accepted practice regarding the nuisance impact of dust is that dust-related nuisance can be expected to impact on residential areas when annual average dust deposition levels exceed 4 grams per square metre per month ($g/m^2/month$).

4.3.2 Odour

The EPA's *Assessment and Management of Odour from Stationary Sources in NSW (Technical Framework and Technical Notes)* publications provide a policy framework for assessing and managing activities that emit odour and offer guidance on dealing with odour issues. These documents are required to be referenced when assessing any odour issue in NSW.

4.3.2.1 Odour Concentration and Emission Rate Definitions

Odour concentration is measured in terms of odour units (ou). 1 ou is the concentration of odour-containing air that can just be detected by 50% of members of an odour panel (persons chosen as representative of the average population sensitivity to odour). This process is defined within Australian Standard AS4323.3: *Stationary Source Emissions – Part 3: Determination of Odour Concentration by Dynamic Olfactometry (Standards Australia 2001).*

The Specific Odour Emission Rate (SOER) is a measure of odour released from an area source and is expressed in odour units emitted per surface and time unit (ou. m^3/ m^2/s or ou. m^3/ m^2/min).

An Odour Emission Rate (OER) is the product of the odour concentration (ou) and the volumetric flow rate (e.g. m^3/s or m^3/min), and is often annotated as ou.m^3/s, or ou.m^3/min. For area sources, the SOER is multiplied by the area of the source to obtain the OER.

4.3.2.2 Odour Impact Assessment Criteria

Impacts from odorous air contaminants are often nuisance-related rather than health-related. Odour performance goals guide decisions on odour management, but are generally not intended to achieve "no odour".

The detectability of an odour is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation. This point is called the *odour threshold* and defines 1 ou. An odour goal of less than 1 ou would theoretically result in no odour impact being experienced.

In practice, the character of a particular odour can only be judged by the receiver's reaction to it, and preferably only compared to another odour under similar social and regional conditions. Based on the literature available, the level at which an odour is perceived to be a nuisance can range significantly depending on a combination of the following factors:

- *Odour Quality*: whether an odour results from a pure compound or from a mixture of compounds. Pure compounds tend to have a higher threshold (lower offensiveness) than a mixture of compounds.
- *Population sensitivity:* any given population contains individuals with a range of sensitivities to odour. The larger a population, the greater the number of sensitive individuals it may contain.
- *Background level:* whether a given odour source, because of its location, is likely to contribute to a cumulative odour impact. In areas with more closely-located sources it may be necessary to apply a lower threshold to prevent offensive odour.

- *Public expectation:* whether a given community is tolerant of a particular type of odour and does not find it offensive, even at relatively high concentrations. For example, background agricultural odours may not be considered offensive, particularly in a rural or semi-rural environment, until a higher threshold is reached than for odours from a landfill facility.
- *Source characteristics:* whether the odour is emitted from a stack (point source) or from an area (diffuse source). Generally, the components of point source emissions can be identified and treated more easily than diffuse sources. Emissions from point sources can be more easily controlled using control equipment.
- *Health Effects:* whether a particular odour is likely to be associated with adverse health effects. In general, odours from agricultural activities are less likely to present a health risk than emissions from industrial facilities.

Experience gained through odour assessments from proposed and existing facilities in NSW indicates that an odour performance goal of 7 ou is likely to represent the level below which “offensive” odours should not occur (for an individual with a ‘standard sensitivity’ to odours). The OEH recommends within the Odour Framework that, as a design goal, no individual be exposed to ambient odour levels of greater than 7 ou. This is expressed as the 99th percentile value, as a nose response time average (approximately one second).

Odour performance goals need to be designed to take into account the range in sensitivities to odours within the community, and provide additional protection for individuals with a heightened response to odours. In NSW this is done using a statistical approach which depends on the size of the affected population. As the affected population size increases, the number of sensitive individuals is also likely to increase, which suggests that more stringent goals are necessary in these situations. In addition, the potential for cumulative odour impacts in relatively sparsely populated areas can be more easily defined and assessed than in highly populated urban areas. It is often not possible or practical to determine and assess the cumulative odour impacts of all odour sources that may impact on a receptor in an urban environment. Therefore, the proposed odour performance goals allow for population density, cumulative impacts, anticipated odour levels during adverse meteorological conditions and community expectations of amenity.

The equation used by the OEH to determine the appropriate impact assessment criteria for complex mixtures of odorous air pollutants, as specified in the Approved Methods, is expressed as follows:

$$\text{Impact assessment criterion (ou)} = (\log_{10}(\text{population})-4.5)/-0.6$$

A summary of the impact assessment criteria given for various population densities, as drawn from the Approved Methods, is given in **Table 7**. This factor has been used to derive a project specific odour criterion.

Table 7 OEH Impact Assessment Criteria for Complex Mixtures of Odorous Air Pollutants

Population of Affected Community	Impact Assessment Criteria for Complex Mixtures of Odours (ou) (nose-response-time average, 99th percentile)
Urban area (≥ 2000)	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single residence (≤ 2)	7.0

Source: The Approved Methods (NSW EPA, 2017)

The Approved Methods states that the impact assessment criteria for complex mixtures of odorous air pollutants must be applied at the nearest existing or likely future off-site sensitive receptor(s).

The incremental impact (predicted impact due to the pollutant source alone) must be reported in units consistent with the impact assessment criteria (ou), as peak concentrations (i.e. approximately 1 second average) and as the:

- 100th percentile of dispersion model predictions for Level 1 impact assessments; or
- 99th percentile of dispersion model predictions for Level 2 impact assessments.

It is noted that a Level 2 odour impact assessment as defined by the Approved Methods is equivalent to a Level 3 odour impact assessment as defined by the Technical Framework.

4.3.2.3 Adopted Odour Impact Assessment Criterion

As determined in (AQP , 2015) the assessment criterion for:

- the New Berrima township is likely to be 3 ou
- the surrounding rural residences is likely to be 6 ou considering that there is some co-location.

4.3.2.4 Peak to Mean Ratio

Since the dispersion modelling timestep is 1 hour a peak to mean conversion is required for the dispersion model odour concentration results for assessment against the nose response time (1 second) assessment criteria. There are a range of peak to mean ratios that are best suited for different circumstances. However, a P/M60 factor of 2.3 is commonly used and recommended for volume sources and wake-affected point sources for all stability classes.

5 Estimation of Air Emissions

5.1 Dust Emissions Estimation

For the emissions estimation previous air quality and dust impact assessment studies and NPI data for the Cement Works were referenced. Where relevant updated parameters or additional information were provided.

Full details on the emissions estimation are provided in **Appendix A**.

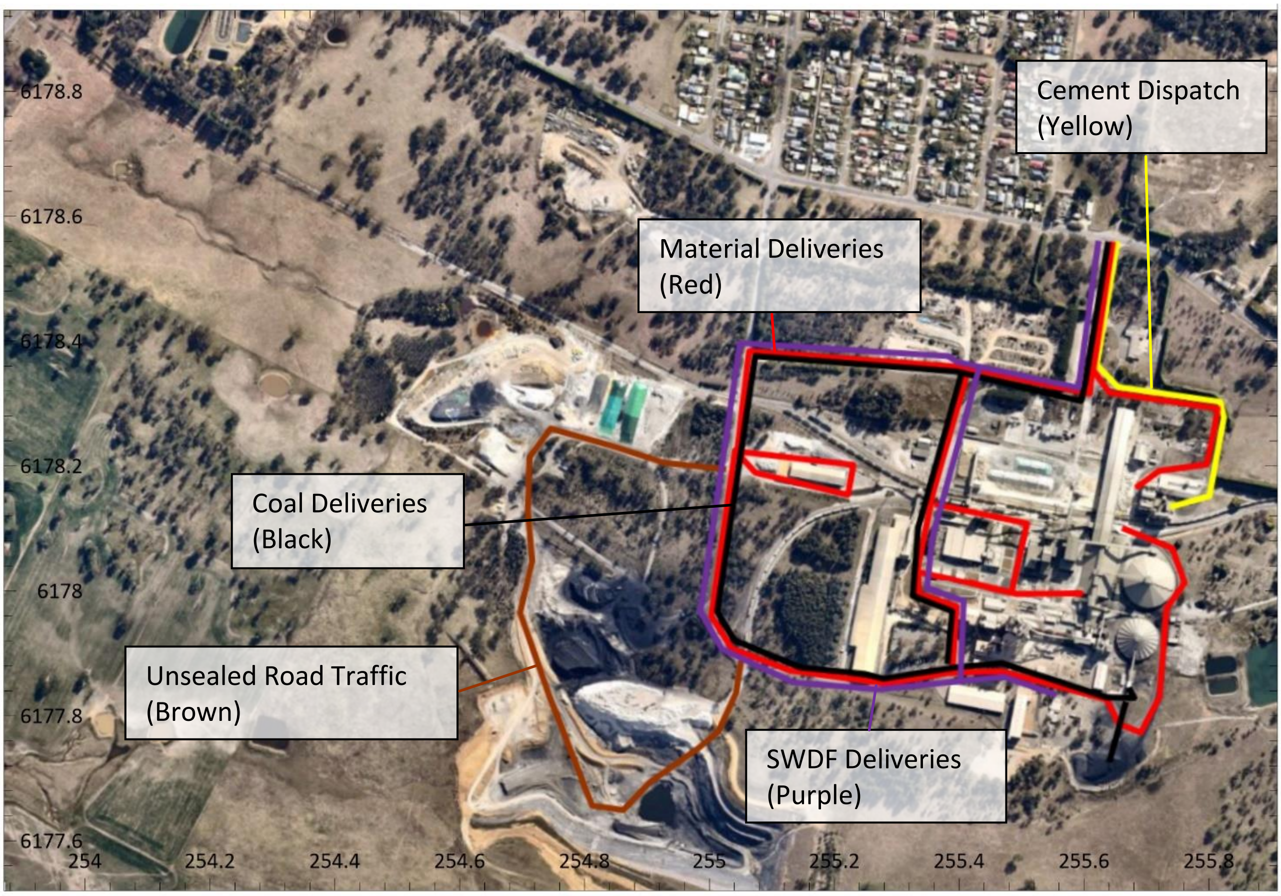
Of significant note is that previous dispersion modelling studies have not included emissions from the truck vehicle movements on the sealed roads at site. This inclusion adds to the overall site emissions.

Since the focus of the assessment was on the changes in the onsite truck movements with diversion of the fuel transports (going to the southern side of the site) from the current access via Taylors Avenue to the new access via Old Hume Highway the emissions characterisation was performed with as much details as was available.

The material transports presented in **Table 2** for both the current and proposed activities were modelled for the different routes as shown in **Figure 13** and **Figure 14**. Instead of modelling annual daily averages of truck movements, site access truck data for a two month period of representative operations were analysed to determine the frequency of truck movements according to time of day for each day of the week. By including this and scaling the frequencies for each material transport reasonable conservatism was included in the assessment by making sure that periods of peak activity were included.

The annual emissions estimated for each scenario of the current and proposed operations are presented in **Table 8** and **Table 9**.

Figure 13 Truck Routes Across Site Current Operations (As Modelled)



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Projection:	GDA 1994 MGA Zone 56
Date:	11/11/2021

Boral
Berrima Cement Works
AQIA SWDF Increase
Current Operations

Figure 14 Truck Routes Across Site Proposed Operations (As Modelled)

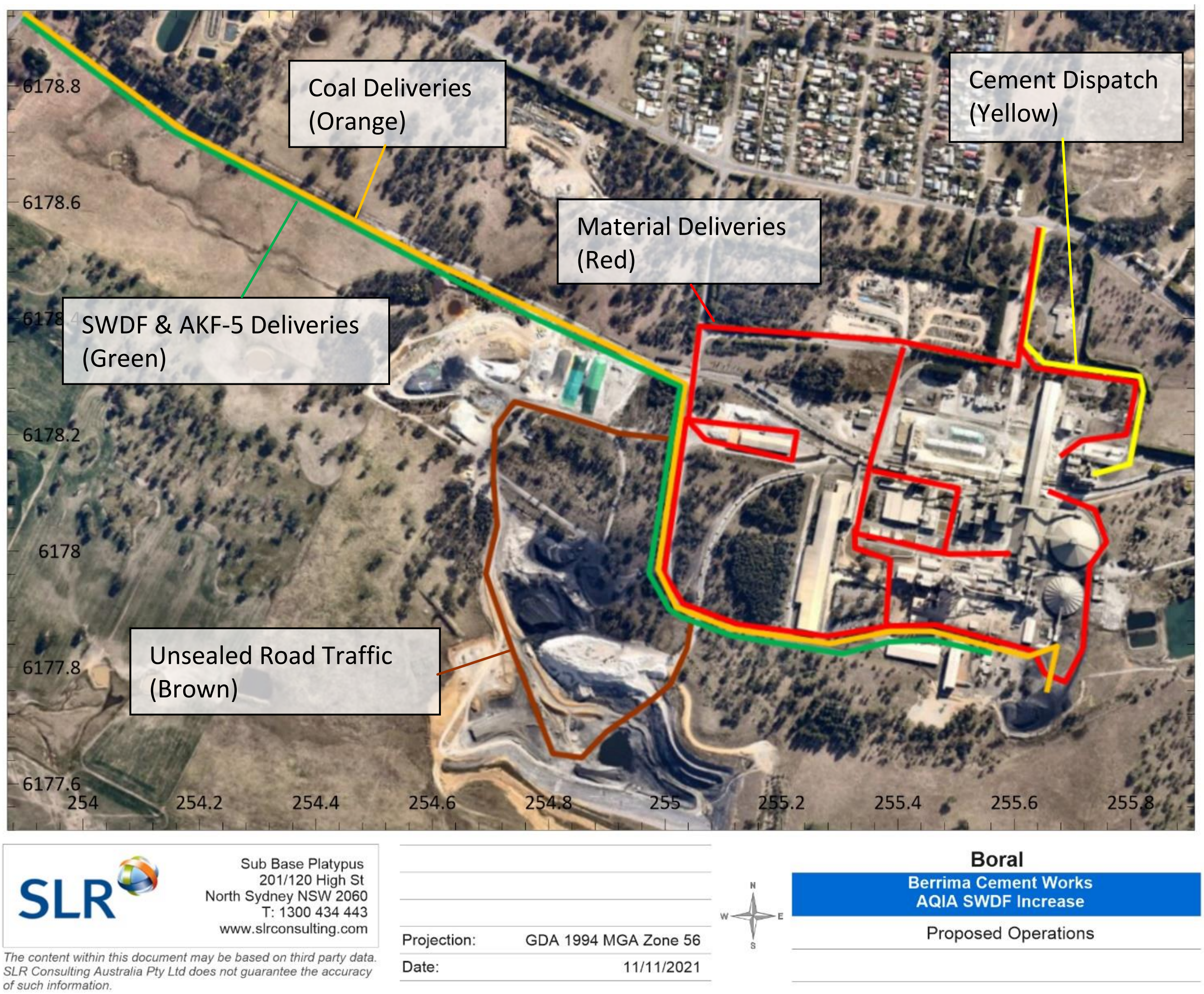


Table 8 Estimated Annual Emissions Applied in the Dispersion Modelling for the Current Operations

Source	Annual Emissions (kg/yr)			Annual Emissions (%)		
	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Truck Transports						
Raw materials	36,171	6,943	1,680	7.3%	2.5%	1.5%
Fuels for Kiln (Coal)	17,860	3,428	829	3.6%	1.2%	0.7%
Fuels for Kiln (SWDF)	10,383	1,993	482	2.1%	0.7%	0.4%
Fuels for Kiln (AKF-5)	-	-	-	-	-	-
Dispatch Clinker	8,462	1,624	393	1.7%	0.6%	0.4%
Dispatch Cement	14,132	2,713	656	2.8%	1.0%	0.6%
Diesel Loaders & Tractor	2,831	837	84	0.6%	0.3%	0.1%
Off-road Trucks	25,380	7,500	750	5.1%	2.7%	0.7%
Sub Total	*115,219*	*25,038*	*4,874*	*23.1%*	*9.0%*	*4.4%*
Materials Handling						
Transfer Points	1,894	888	89	0.4%	0.3%	0.1%
Excavators/FELs	29,765	14,369	1437	6.0%	5.2%	1.3%
Unloading (Dumping)	3,695	1,324	132	0.7%	0.5%	0.1%
Loading of Trains	3.2	1.3	0.1	0.001%	0.0005%	0.0001%
Loading of Trucks	3.6	1.5	0.2	0.001%	0.001%	0.0001%
Sub Total	*35,361*	*16,584*	*1,658*	*7.1%*	*6.0%*	*1.5%*
Materials Processing						
Crushing	287	29	3	0.06%	0.01%	0.003%
Wind Erosion						
Stockpiles and exposed areas	68,328	34,164	5,125	13.7%	12.3%	4.6%
Stacks						
No 6 Kiln Stack	189,216	132,451	62,441	37.9%	47.6%	56.4%
No 6 Kiln Cooler	52,517	40,997	21,444	10.5%	14.7%	19.4%
No 6 Cement Mill	29,007	22,187	11,668	5.8%	8.0%	10.5%
No 7 Cement Mill	8,567	6,511	3,469	1.7%	2.3%	3.1%
Sub Total	*279,307*	*202,14*	*99,023*	*56.0%*	*72.7%*	*89.5%*
Total	***498,501***	***277,960***	***110,683***	***100%***	***100%***	***100%***

Table 9 Estimated Annual Emissions Applied in the Dispersion Modelling for the Proposed Operations

Source	Annual Emissions (kg/yr)			Annual Emissions (%)		
	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Truck Transports						
Raw materials	36,171	6,943	1,680	7.0%	2.5%	1.5%
Fuels for Kiln (Coal)	7,182	1,379	334	1.4%	0.5%	0.3%
Fuels for Kiln (SWDF)	33,193	6,371	1,541	6.4%	2.3%	1.4%
Fuels for Kiln (AKF-5)	3,984	765	185	0.8%	0.3%	0.2%
Dispatch Clinker	8,462	1,624	393	1.6%	0.6%	0.4%
Dispatch Cement	14,132	2,713	656	2.7%	1.0%	0.6%
Diesel Loaders & Tractor	2,831	837	84	0.5%	0.3%	0.1%
Off-road Trucks	25,380	7,500	750	4.9%	2.7%	0.7%
Sub Total	*131,334*	*28,131*	*5,623*	*25.5%*	*10.0%*	*5.0%*
Materials Handling						
Transfer Points	1,894	888	89	0.4%	0.3%	0.1%
Excavators/FELs	29,765	14,369	1437	5.8%	5.1%	1.3%
Unloading (Dumping)	3,695	1,324	132	0.7%	0.5%	0.1%
Loading of Trains	3.2	1.3	0.1	0.001%	0.0005%	0.0001%
Loading of Trucks	3.6	1.5	0.2	0.001%	0.001%	0.0001%
Sub Total	*35,361*	*16,584*	*1,658*	*6.9%*	*5.9%*	*1.5%*
Materials Processing						
Crushing	287	29	3	0.06%	0.01%	0.003%
Wind Erosion						
Stockpiles and exposed areas	68,328	34,164	5,125	13.3%	12.2%	4.6%
Stacks						
No 6 Kiln Stack	189,216	132,451	62,441	36.8%	47.1%	56.0%
No 6 Kiln Cooler	52,517	40,997	21,444	10.2%	14.6%	19.2%
No 6 Cement Mill	29,007	22,187	11,668	5.6%	7.9%	10.5%
No 7 Cement Mill	8,567	6,511	3,469	1.7%	2.3%	3.1%
Sub Total	*279,307*	*202,14*	*99,023*	54.3%	71.9%	88.9%
Total	***514,617***	***281,054***	***111,432***	***100%***	***100%***	***100%***

5.2 Odour Emissions Estimation

Odour emissions from the SWDF storage sheds were estimated based on the same methodology as applied for a previous assessment (AQP , 2015).

The estimated odour emission rate for the existing shed was 3,200 ou/s based on:

- an approximate building volume of 21,630 m^3
- a building air exchange rate per hour of approximately 0.5
- an odour concentration of 1,000 ou.

The same emission rate was assumed for each of the additional two storage sheds[4]. The total odour emission rate from the three storage sheds included in the modelling was 9,600 ou/s.

[4] As noted in Section 2.5 at the time the assessment was being prepared two additional storage sheds were being proposed. At the time of finalizing the report this plan had changed and the shed to the northeast of the existing SWDF shed was no longer proposed.
Since the assessment showed no compliance issues or concerns regarding potential odour impacts from the SWDF fuel storage sheds it was decided not to revise the modelling to provide an update. As presented the assessment is conservative.

6 Meteorological Modelling Methodology

6.1 Meteorological Modelling

6.1.1 Selection of Representative Year for Meteorological Modelling

Data from the five most recent years from 2016 to 2020 were considered for selection of a meteorologically representative year for assessment purposes for the dispersion modelling.

Data from the nearest Bureau of Meteorology weather station at Moss Vale, approximately 7.5 km to the west southwest of the Cement Works and the Cement Work AQMS data for the period 2017 to 2019 were considered.

Wind roses and wind data statistics tables are provided in **Appendix B**.

From the data reviewed 2017 were selected. The basis for the selection included:

- 2017 was the year with the most conservative (lowest) annual average wind for both Moss Vale and the Boral AQMS.
- 2017 had a high percentage of calms for both Moss Vale and the Boral AQMS.
- The critical wind direction frequency from the Cement Works towards the New Berrima township is highest for both Moss Vale and the Boral AQMS in 2017.

6.1.2 TAPM

The TAPM prognostic model, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), was used to generate the meteorological data required for the CALMET modelling.

TAPM predicts wind speed and direction, temperature, pressure, water vapour, cloud, rain water 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 one full year of hourly meteorological observations at user-defined levels within the atmosphere.

Additionally, the TAPM model may assimilate actual local wind observations so that they can optionally be included in a model solution. The wind speed and direction observations are used to realign the predicted solution towards the observation values. In this study, data from the BoM's Moss Vale AWS were used to nudge (i.e. optimise) the TAPM predictions. **Table 10** details the parameters used in the TAPM meteorological modelling for this assessment.

Table 10 Meteorological Parameters Used for this Study - TAPM

TAPM (v 4.0)	
Number of Grids (spacing)	4 (30 km, 10 km, 3 km and 1 km)
Number of Grid Points (x,y,z)	25 x 25 x 35
Year of Analysis	2017
Centre of Analysis	255,184 m E 6,178,250 m S
Data Assimilation	Moss vale AWS

6.1.3 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.

The CALMET domain covered an area of 12 km by 12 km centred on the Project Site, and was modelled with a resolution of 0.1 km (i.e. 100 m).

The CALMET run was performed in 'hybrid' mode with inclusion of surface observation data for the BoM Moss Vale AWS and the Cement Works AQMS weather station. The TAPM-generated 3-dimensional meteorological data (1 km resolution) was used as the 'initial guess' wind field and the local topography and land use for the modelling domain were used to refine the wind field predetermined by TAPM. **Table 11** details the parameters used in the meteorological modelling to drive the CALMET model.

Table 11 Meteorological Parameters Used for this Study

CALMET Domain	
Meteorological Grid	12.0 km × 12.0 km
Meteorological Grid Resolution	0.1 km
Initial Guess Filed	3D output from TAPM modelling
Topography	SRTM-derived 1 Second data sourced from Geosciences Australia

6.2 Meteorological Data Used in Modelling

To provide a summary of the meteorological conditions predicted at the Cement Works using the methodology described in **Section 6.1**, a single-point, ground-level meteorological dataset was 'extracted' from the 3-dimensional dataset for the Cement Works location.

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

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

Evaluation of the meteorological data for the above parameters for the Cement Works locations is provided below.

6.2.1 Wind Speed and Direction

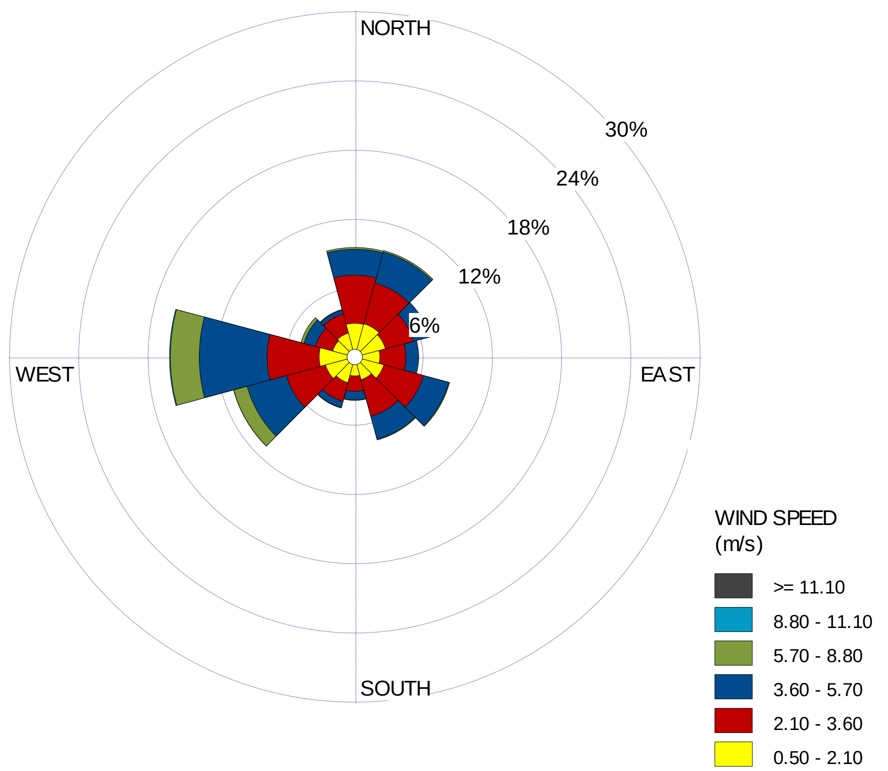
Wind roses show the frequency of occurrence of winds by direction and strength. The bars show the direction the wind is blowing from and the lengths show the frequency of winds from that direction. The bars also show the wind speed categories for each direction with the frequency represented by the size of each bar with the lightest wind speed category closest to the centre of the wind rose.

Wind roses are presented in **Figure 15** to **Figure 17** for the annual period of 2017 as well as for each season and time of day.

Compared to the site AQMS weather station observation data the prevailing wind data for the modelled year of 2017 is a little bit less pronounced. However, as observed in **Section 3.3.4** The prevailing wind direction at site is westerly with a relatively low frequency of southerly winds towards the New Berrima township.

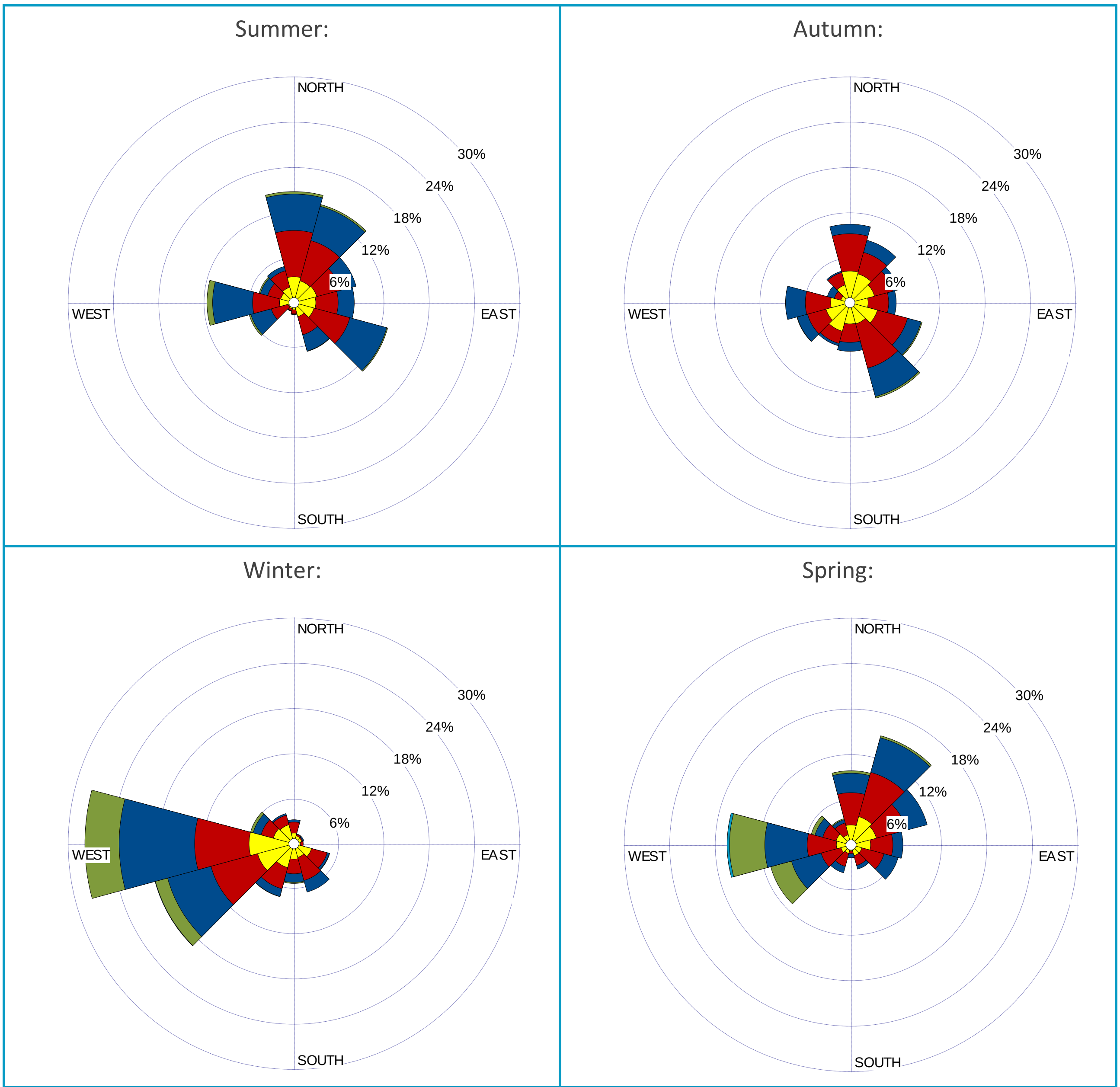
The seasonal and time of day wind roses show that the wind direction frequency with southerly winds towards the New Berrima township is the highest for autumn and throughout the year in afternoon and evenings.

Figure 15 Annual Wind Rose Cement Works Location



Location: Boral Cement Works	**Data period:** 2017	**Time period:** All hours	**Data type:** CALMET Extract
Average wind speed: 2.7 m/s		**Calm wind frequency:** 7.6%	

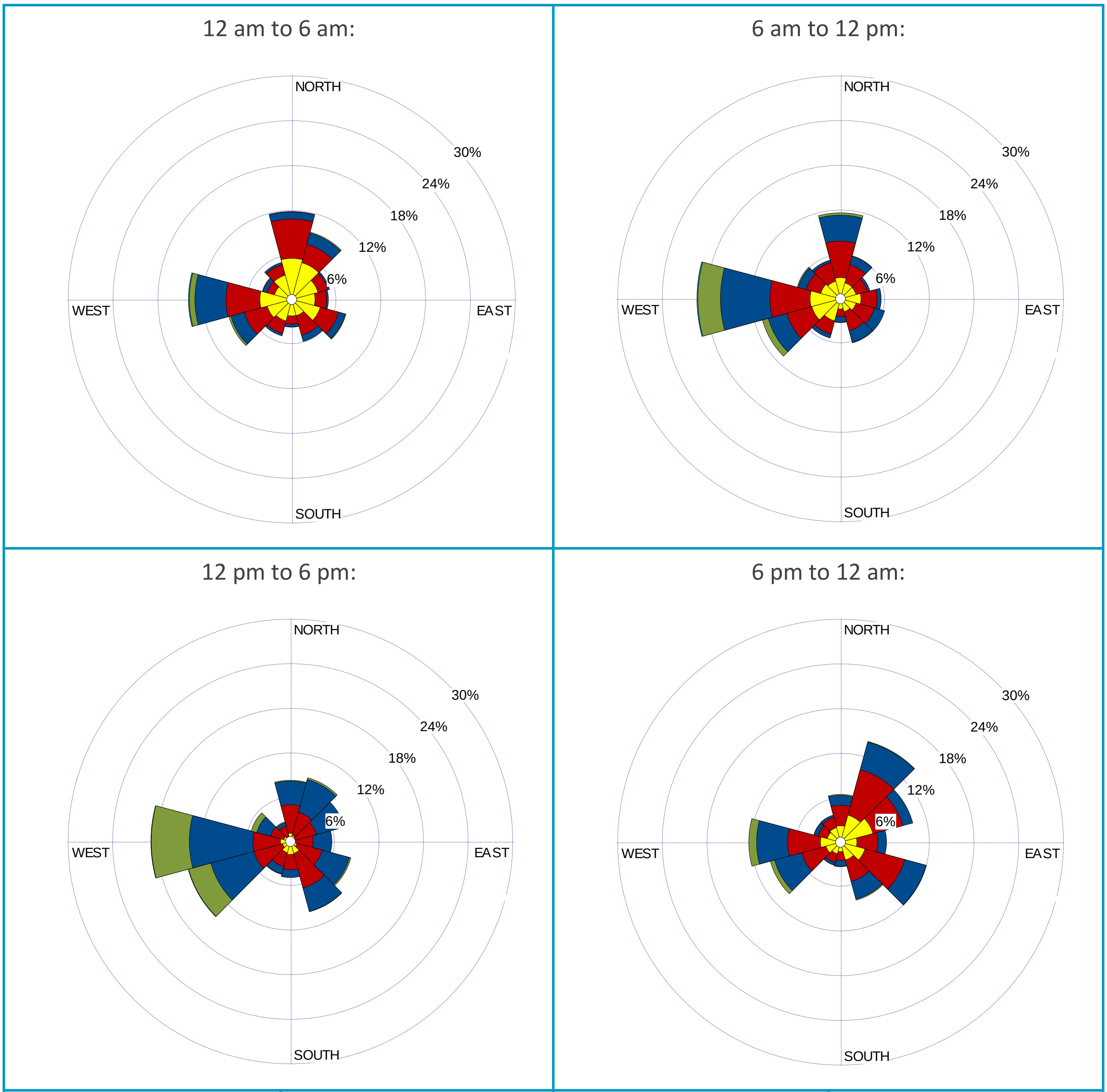
Figure 16 Seasonal Wind Roses Cement Works Location



Location:	Data period:	Time period:	Data type:
Boral Cement Works	2017	Seasonal	CALMET Extract

Average wind speed:	Calm wind frequency:	WIND SPEED (m/s)
Summer: 2.8 m/s Autumn: 2.3 m/s Winter: 2.6 m/s Spring: 3.1 m/s	Summer: 4.7% Autumn: 8.8% Winter: 11.1% Spring: 5.7%	>= 11.10 8.80 - 11.10 5.70 - 8.80 3.60 - 5.70 2.10 - 3.60 0.50 - 2.10

Figure 17 Time of Day Wind Roses Cement Works Location



Location: Boral Cement Works	**Data period:** 2017	**Time period:** Time of day	**Data type:** CALMET Extract
Average wind speed: 12 am to 6 am: 2.0 m/s 6 am to 12 pm: 2.5 m/s 12 pm to 6 pm: 3.7 m/s 6 pm to 12 am: 2.6 m/s		**Calm wind frequency:** 12 am to 6 am: 14.0% 6 am to 12 pm: 9.7% 12 pm to 6 pm: 0.1% 6 pm to 12 am: 6.5%	WIND SPEED (m/s) >= 11.10 8.80 - 11.10 5.70 - 8.80 3.60 - 5.70 2.10 - 3.60 0.50 - 2.10

6.2.2 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:

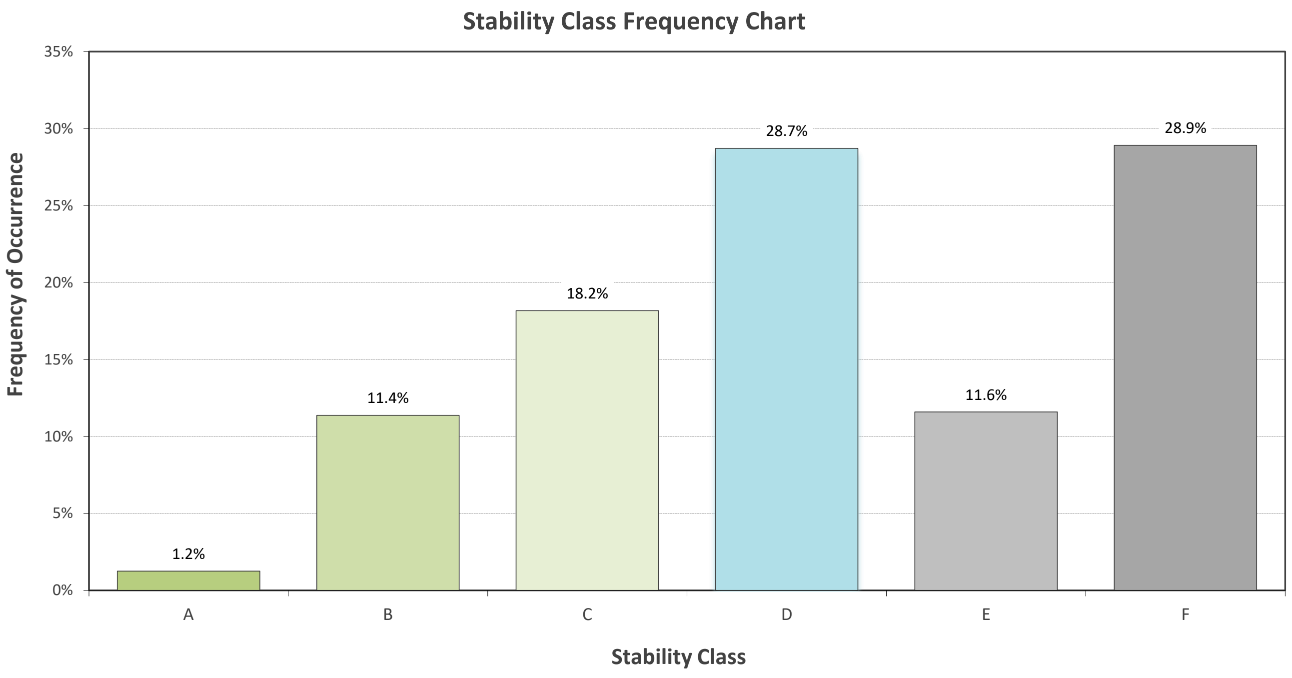
- A = Extremely unstable conditions
- B = Moderately unstable conditions
- C = Slightly unstable conditions
- D = Neutral conditions
- E = Slightly stable conditions
- F = Moderately stable conditions

Unstable conditions are favourable for dispersion and 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.

Stability class data as extracted for the Cement Works are presented in **Figure 18** and shows a typical distribution for inland locations.

Figure 18 Stability Class Data Cement Works Location



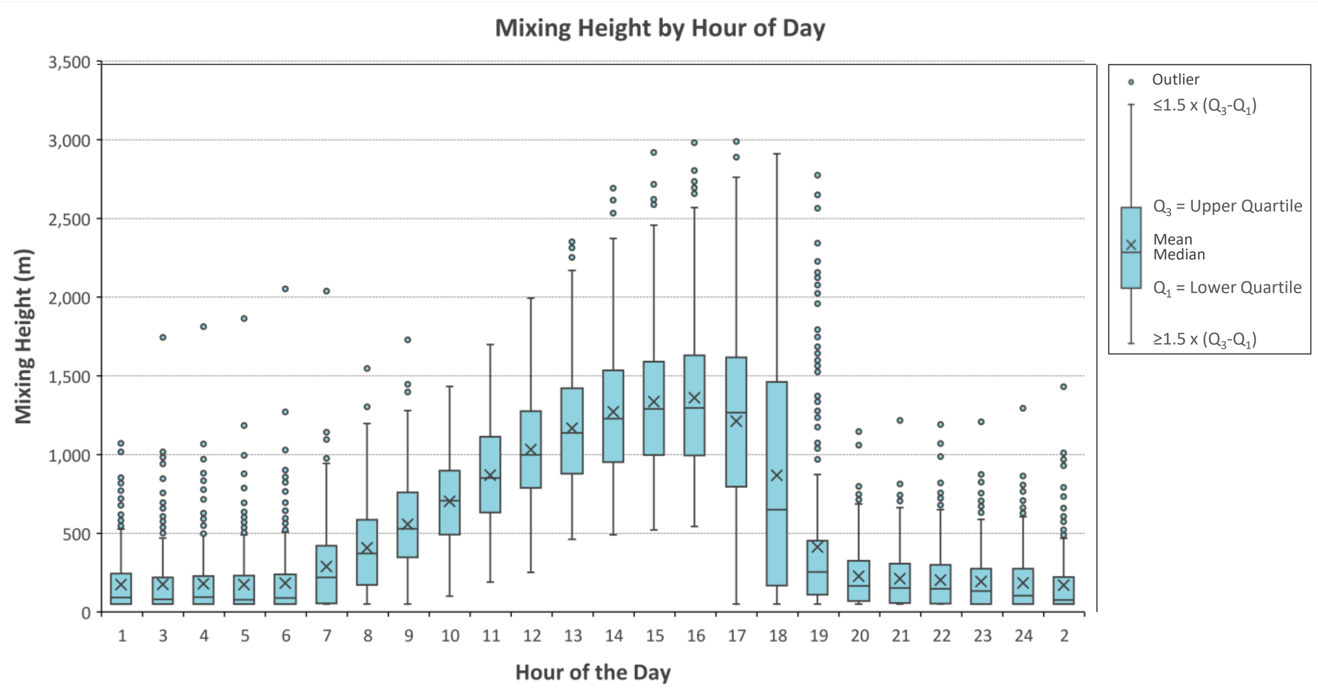
6.2.3 Mixing Heights

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.

The profile of the diurnal mixing heights predicted at the Cement Works are presented in **Figure 19** and shows a typical profile for inland conditions.

Figure 19 Mixing Height Data Cement Works Location



7 Dispersion Modelling

CALPUFF is widely used in Australia and is a capable model for a range of applications and conditions such as larger scale modelling assessments and complex meteorological/terrain settings.

As discussed, and shown in **Section 5** the dispersion modelling was performed for two scenarios to assess the changes in the dust emissions and resulting impacts from the proposed operations with the diversion of the fuel additional truck deliveries to the new entry via Old Hume Highway compared to the current operations with all truck traffic coming through the Taylor Avenue site entry.

7.1 Results

The results for the dispersion modelling are presented below for particulate matter for the current operations and for particulate matter and odour for the proposed operations.

All contour plots are for incremental result (no background included).

Cumulative assessment (with inclusion of background concentrations) results are provided in the results tables for sensitive receptor location R1 which is located closest to the Cement Works and showing the highest concentration impacts in the contour plots.

7.1.1 Comments on the Results

The results from the dispersion modelling show that dust impacts from the Cement Works at the corner of the New Berrima township closest to the Cement Works Taylor Avenue entry access are elevated and that with the introduction of the new Old Hume Highway access and diversion of some of the truck traffic from this area that there is a small improvement.

The cumulative assessment shows that contribution of background concentrations are overall low. The year of background data used in the assessment (2017) shows lower values compared to other recent years. If higher background concentrations were to be considered the predicted maximum ground level concentrations would be closer to the assessment criteria.

A large portion of the site particulate matter emissions are from stack sources and are better dispersed than fugitive emissions from ground level such as materials handling and vehicle movements. As such the contribution to ground level concentrations at surrounding sensitive receptors is higher from fugitive sources than the stack sources at site.

There is some uncertainty about the surface silt loading assumed in the emissions estimation. For improved emissions estimation of wheel generated dust at site it would be recommended that samples are taken of surface silt loadings across the plant sealed roads. From site observations in comparison to the descriptions of the reference surface silt loading values the emissions estimation may have been conservative.

The site air quality monitoring for compliance purposes is performed with HiVol samplers for PM_{10} and TSP at the AQMS location approximately 550 m east of the operations (in the prevailing downwind direction). The dispersion modelling results show that exposure at this location is lower than at the nearest sensitive receptor locations for the New Berrima township, which also is located closer to the operations than the AQMS.

It is understood that a real-time dust monitor is in place at the northern boundary for dust management purposes to inform the operations in combined use with a Trigger and Response Plan (TARP) to avoid operations contributing to nuisance dust complaints.

Review of the predicted dust deposition results do not show higher levels in relation to potential nuisance issues. However, from review of the complaints data it is understood that complaints are most often in relation to individual events of deposition of cement dust on cars rather than higher rates on an ongoing basis over time.

The odour concentration results show that there is no issue with potential odour from the SWDF storage sheds[5].

[5] As noted at the time of the finalisation of this report the plan had been changed to one additional shed only. The proposed shed is the shed next to the current SWDF storage shed. The second shed, shown to be located to the northeast of the existing SWDF storage in Figure 3 is no longer proposed. Since the results showed no concerns regarding potential odour from the SWDF storage sheds the assessment was not updated. With the proposal being for one and not two sheds it is noted that the presented results are conservative.

7.1.2 Current Operations PM_{10}

Figure 20 Maximum Predicted 24-hour Average PM_{10} Concentrations (Incremental) - Current Operations

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Assessment Criterion:	50
Background Concentration:	Not Included
Statistic:	Maximum
Projection:	GDA 1994 MGA Zone 56
Date:	11/11/2021

N S W E

Boral
Berrima Cement Works
AQIA SWDF Increase
Current Operations

Pollutant: PM_{10} Avg. Period: 24-Hr Unit: µg/m³

Table 12 Cumulative Results Current Operations PM_{10} 24 Hour Average Concentrations at Receptor 1

Date	PM_{10} 24 hr Concentrations (µg/m³)			Date	PM_{10} 24 hr Concentrations (µg/m³)		
	Background	Predicted Increment	Cumulative Impact		Background	Predicted Increment	Cumulative Impact
Ten Highest Maximum Background Days				**Ten Highest Maximum Incremental Impact Days**			
24/09/2017	53.5	0.0	53.5	13/04/2017	10.4	32.1	42.5
23/09/2017	34.8	2.8	37.6	15/06/2017	11.4	31.1	42.5
25/01/2017	33.4	0.5	33.9	12/07/2017	8.8	30.6	39.4
15/08/2017	31.9	5.1	37.0	20/06/2017	9.3	30.6	39.9
25/09/2017	30	0.6	30.6	31/05/2017	7.7	30.6	38.3
15/01/2017	28.2	0.5	28.7	01/06/2017	9.8	27.4	37.2
14/12/2017	27.8	3.1	30.9	29/06/2017	7.6	26.6	34.2
10/10/2017	27.6	0.0	27.6	22/06/2017	11.2	25.8	37.0
05/10/2017	26.9	4.4	31.3	09/03/2017	13.6	25.7	39.3
19/12/2017	26.8	0.8	27.6	31/08/2017	10.3	24.0	34.3
Criterion			50	Criterion			50

Background data: Bargo 2017

Figure 21 Maximum Predicted Annual Average PM_{10} Concentrations (Incremental) - Current Operations

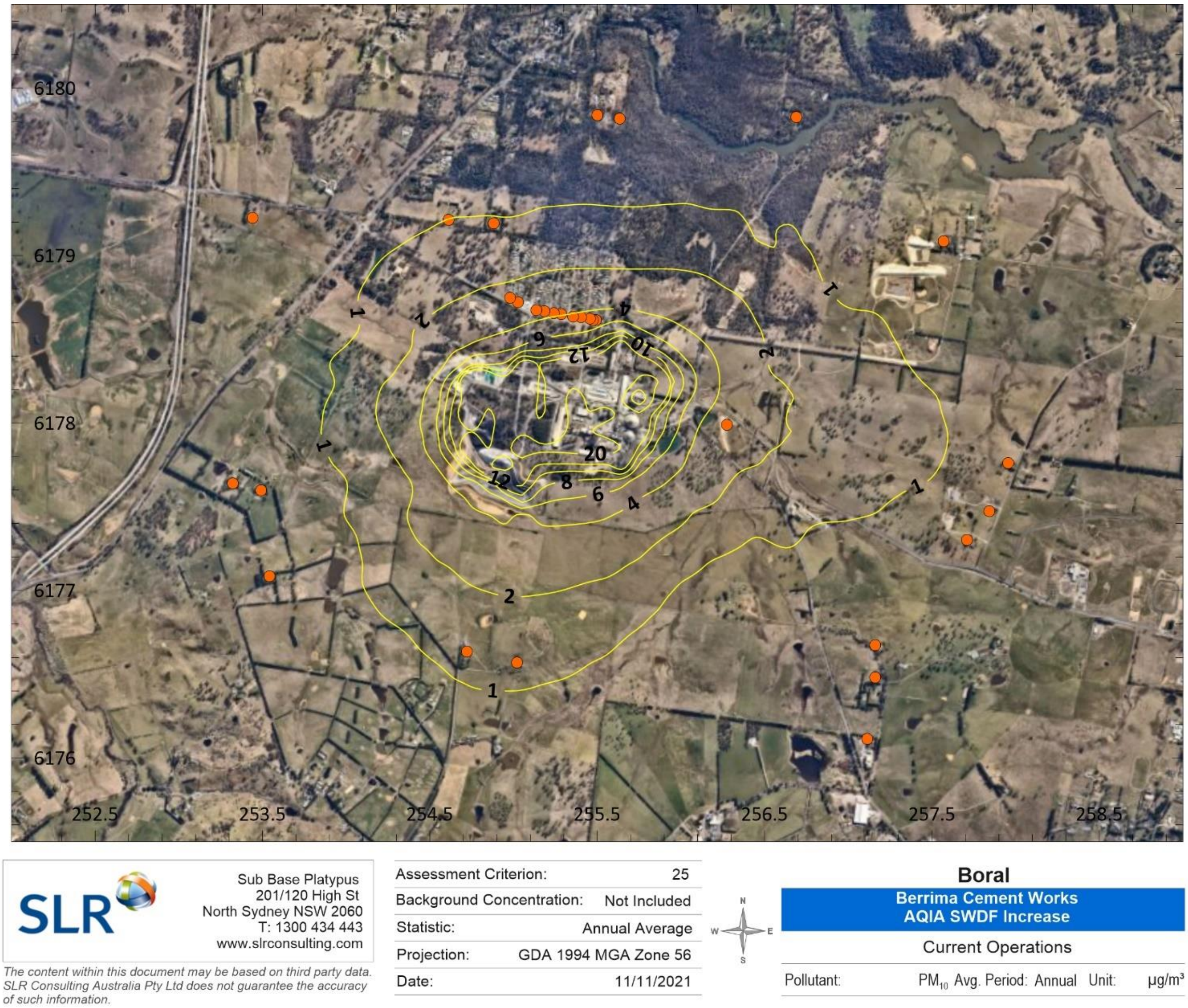

Table 13 Cumulative Results Current Operations PM_{10} Annual Average Concentrations at Receptor 1

Background (µg/m³)	Predicted Increment (µg/m³)	Cumulative Impact (µg/m³)
13.8	4.9	18.6
Criterion		25

Background data: Bargo 2017

7.1.3 Current Operations $PM_{2.5}$

Figure 22 Maximum Predicted 24-hour Average $PM_{2.5}$ Concentrations (Incremental) - Current Operations

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Assessment Criterion:	25
Background Concentration:	Not Included
Statistic:	Maximum
Projection:	GDA 1994 MGA Zone 56
Date:	11/11/2021

Boral
Berrima Cement Works
AQIA SWDF Increase
Current Operations

Pollutant: $PM_{2.5}$ Avg. Period: 24-Hr Unit: µg/m³

Table 14 Cumulative Results Current Operations $PM_{2.5}$ 24 Hour Average Concentrations at Receptor 1

Date	$PM_{2.5}$ 24 hr Concentrations (µg/m³)			Date	$PM_{2.5}$ 24 hr Concentrations (µg/m³)		
	Background	Predicted Increment	Cumulative Impact		Background	Predicted Increment	Cumulative Impact
Ten Highest Maximum Background Days				**Ten Highest Maximum Incremental Impact Days**			
14/08/2017	20.9	1.1	22.0	13/04/2017	4.2	7.7	11.9
11/05/2017	19.2	5.0	24.2	12/07/2017	5.9	7.5	13.4
29/07/2017	16.8	0.0	16.8	31/05/2017	6.2	7.2	13.4
15/08/2017	16.3	1.1	17.4	20/06/2017	7.8	7.2	15.0
13/08/2017	16	0.6	16.6	15/06/2017	8.1	7.1	15.2
24/08/2017	15.7	3.9	19.6	01/06/2017	5.9	6.6	12.5
01/07/2017	15.3	2.8	18.1	09/03/2017	4.5	6.5	11.0
16/07/2017	13.8	1.2	15.0	22/06/2017	7.3	6.4	13.7
27/07/2017	12.9	5.4	18.3	29/06/2017	5.2	6.1	11.3
02/09/2017	12.4	0.9	13.3	02/03/2017	1.9	5.9	7.8
Criterion			25	Criterion			25

Background data: Bargo 2017

Figure 23 Precited Annual Average $PM_{2.5}$ Concentrations (Incremental) - Current Operations

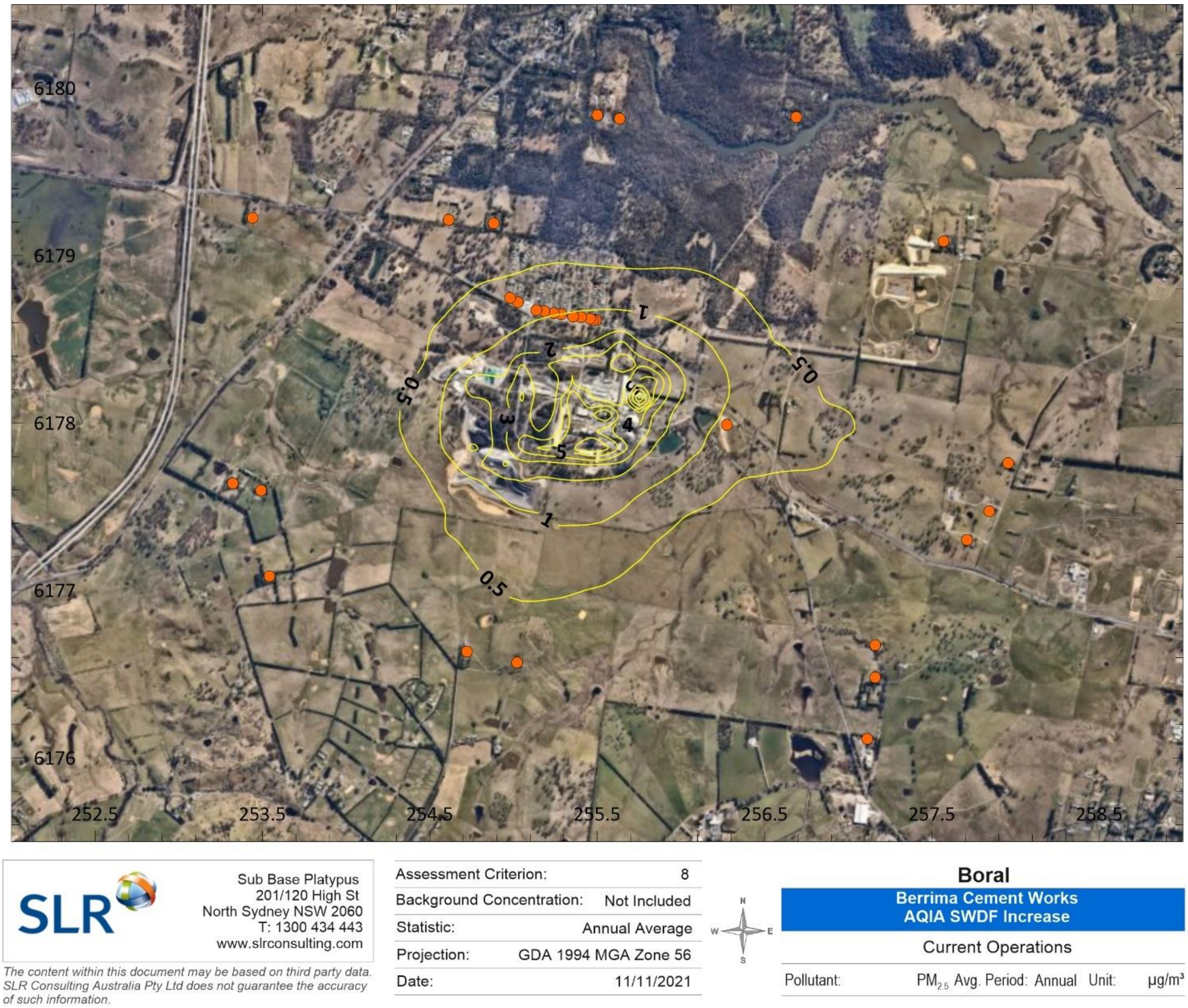


Table 15 Cumulative Results Current Operations $PM_{2.5}$ Annual Average Concentrations at Receptor 1

Background ($\mu g/m^3$)	Predicted Increment ($\mu g/m^3$)	Cumulative Impact ($\mu g/m^3$)
6.3	1.2	7.3
Criterion		8

Background data: Bargo 2017

7.1.4 Current Operations TSP

Figure 24 Predicted Annual Average TSP Concentrations (Incremental) - Current Operations

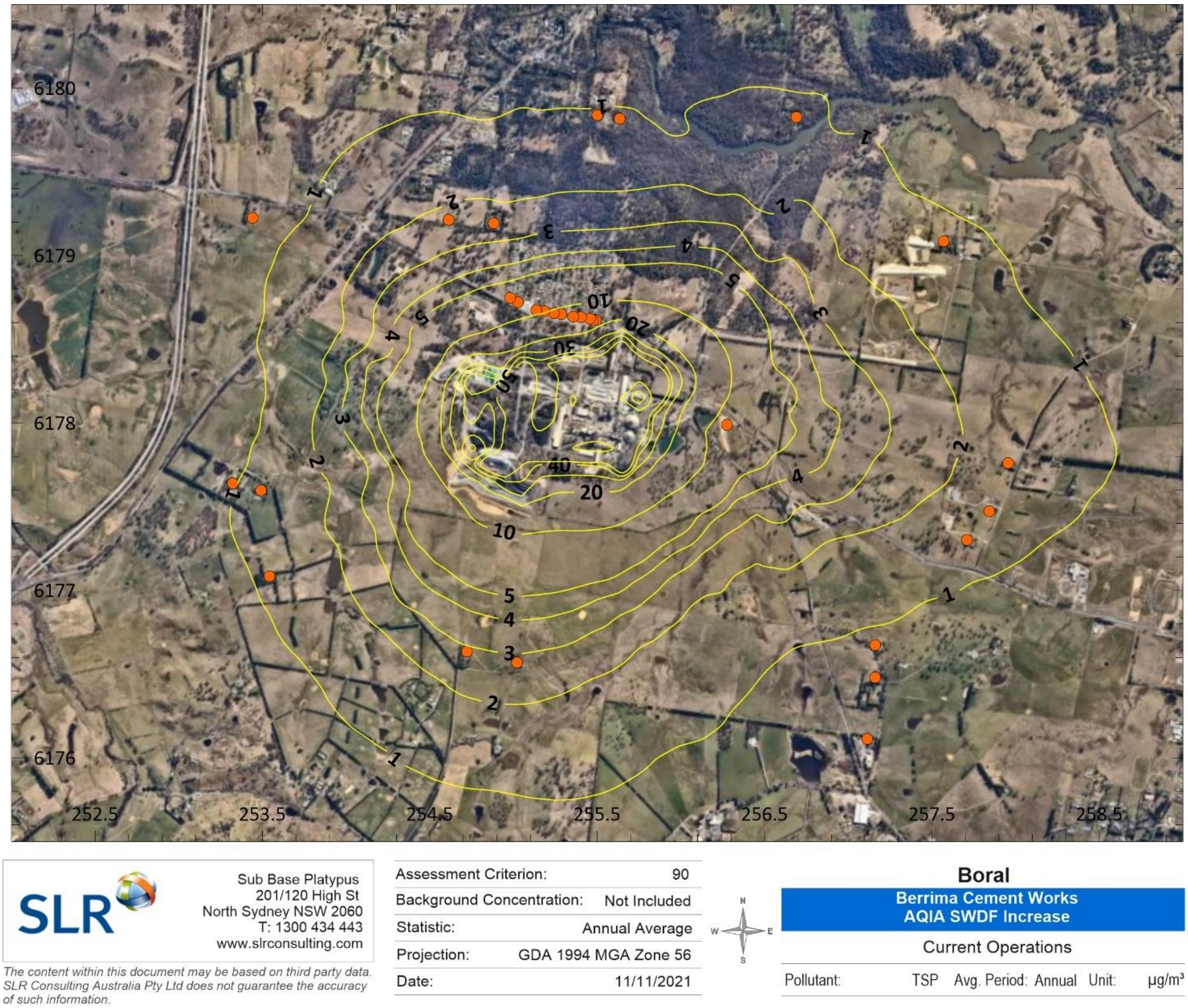


Table 16 Cumulative Results Current Operations TSP Annual Average Concentrations at Receptor 1

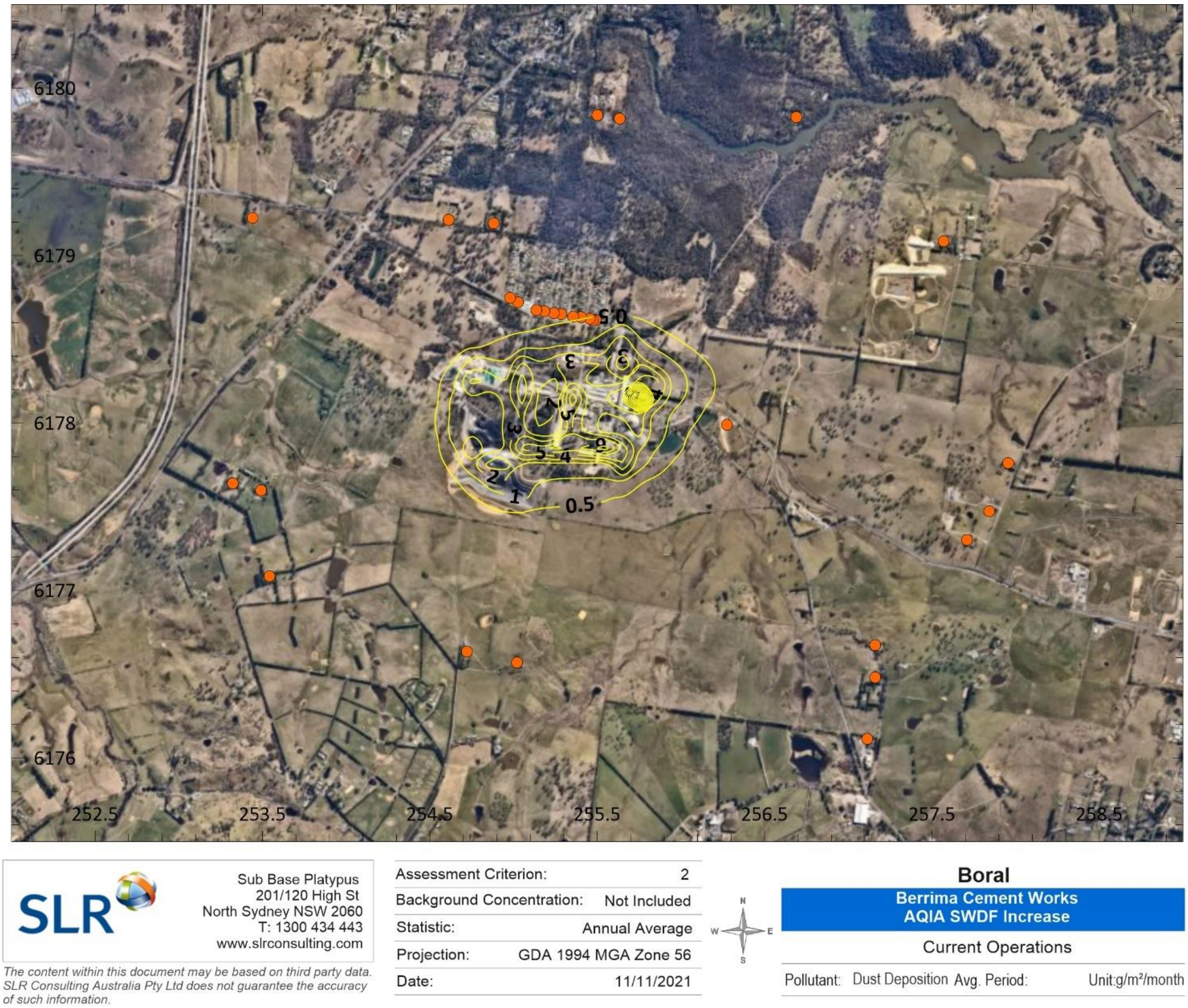
Background at site (AQMS) (µg/m³)	Predicted Increment (µg/m³)	Cumulative Impact (µg/m³)
62.8	15.7	78.5 [a]
Criterion		90

Background data: Boral AQMS HiVol data 2017

[a] Cumulative impact evaluated with site TSP concentration data – site contribution accounted for twice

7.1.5 Current Operations Dust Deposition

Figure 25 Predicted Annual Average Dust Deposition Levels (g/m²/month) (incremental) - Current Operations



7.1.6 Proposed Operations PM_{10}

Figure 26 Maximum Predicted 24-hour Average PM_{10} Concentrations (Incremental) - Proposed Operations

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Assessment Criterion:	50
Background Concentration:	Not Included
Statistic:	Maximum
Projection:	GDA 1994 MGA Zone 56
Date:	11/11/2021

Boral
Berrima Cement Works
AQIA SWDF Increase
Proposed Operations

Pollutant: PM_{10} Avg. Period: 24-Hr Unit: µg/m³

Table 17 Cumulative Results Proposed Operations PM_{10} 24 Hour Average Concentrations at Receptor 1

Date	PM_{10} 24 hr Concentrations (µg/m³)			Date	PM_{10} 24 hr Concentrations (µg/m³)		
	Background	Predicted Increment	Cumulative Impact		Background	Predicted Increment	Cumulative Impact
Ten Highest Maximum Background Days				**Ten Highest Maximum Incremental Impact Days**			
24/09/2017	53.5	0.0	53.5	15/06/2017	11.4	30.1	41.5
23/09/2017	34.8	2.6	37.4	13/04/2017	10.4	29.9	40.3
25/01/2017	33.4	0.4	33.8	20/06/2017	9.3	27.9	37.2
15/08/2017	31.9	5.1	37.0	31/05/2017	7.7	27.2	34.9
25/09/2017	30	0.8	30.8	12/07/2017	8.8	26.8	35.6
15/01/2017	28.2	0.5	28.7	01/06/2017	9.8	26.3	36.1
14/12/2017	27.8	3.1	30.9	29/06/2017	7.6	25.1	32.7
10/10/2017	27.6	0.0	27.6	22/06/2017	11.2	24.5	35.7
05/10/2017	26.9	3.9	30.8	09/03/2017	13.6	23.9	37.5
19/12/2017	26.8	0.8	27.6	16/06/2017	12.5	22.2	34.7
Criterion			50	Criterion			50

Background data: Bargo 2017

Figure 27 Maximum Predicted Annual Average PM_{10} Concentrations (Incremental) - Proposed Operations

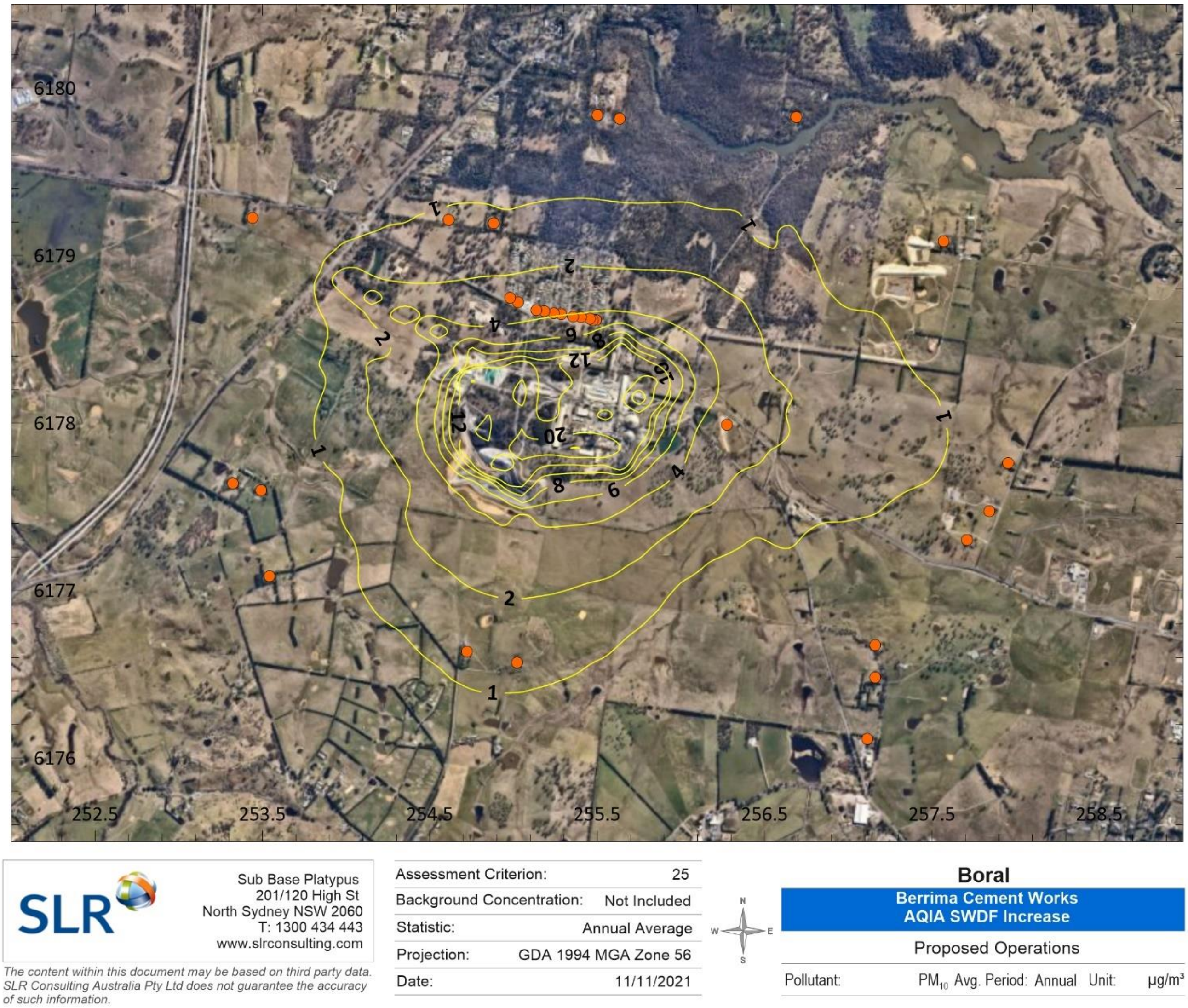

Table 18 Cumulative Results Proposed Operations PM_{10} Annual Average Concentrations at Receptor 1

Background (µg/m³)	Predicted Increment (µg/m³)	Cumulative Impact (µg/m³)
13.8	4.7	18.4
Criterion		25

Background data: Bargo 2017

7.1.7 Proposed Operations $PM_{2.5}$

Figure 28 Maximum Predicted 24-hour Average $PM_{2.5}$ Concentrations (Incremental) - Proposed Operations

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Assessment Criterion:	25
Background Concentration:	Not Included
Statistic:	Maximum
Projection:	GDA 1994 MGA Zone 56
Date:	11/11/2021

N
W E
S

Boral
Berrima Cement Works
AQIA SWDF Increase
Proposed Operations

Pollutant: $PM_{2.5}$ Avg. Period: 24-Hr Unit: µg/m³

Table 19 Cumulative Results Proposed Operations $PM_{2.5}$ 24 Hour Average Concentrations at Receptor 1

Date	$PM_{2.5}$ 24 hr Concentrations (µg/m³)			Date	$PM_{2.5}$ 24 hr Concentrations (µg/m³)		
	Background	Predicted Increment	Cumulative Impact		Background	Predicted Increment	Cumulative Impact
Ten Highest Maximum Background Days				**Ten Highest Maximum Incremental Impact Days**			
14/08/2017	20.9	1.1	22.0	13/04/2017	4.2	7.2	11.4
11/05/2017	19.2	4.8	24.0	15/06/2017	8.1	6.9	15.0
29/07/2017	16.8	0.1	16.9	20/06/2017	7.8	6.5	14.3
15/08/2017	16.3	1.1	17.4	12/07/2017	5.9	6.5	12.4
13/08/2017	16	0.6	16.6	31/05/2017	6.2	6.4	12.6
24/08/2017	15.7	3.9	19.6	01/06/2017	5.9	6.3	12.2
01/07/2017	15.3	2.8	18.1	22/06/2017	7.3	6.1	13.4
16/07/2017	13.8	1.1	14.9	09/03/2017	4.5	6.0	10.5
27/07/2017	12.9	5.1	18.0	29/06/2017	5.2	5.7	10.9
02/09/2017	12.4	0.8	13.2	08/06/2017	4.8	5.4	10.2
Criterion			25	Criterion			25

Background data: Bargo 2017

Figure 29 Precited Annual Average $PM_{2.5}$ Concentrations (Incremental) - Proposed Operations

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Assessment Criterion:	8
Background Concentration:	Not Included
Statistic:	Annual Average
Projection:	GDA 1994 MGA Zone 56
Date:	11/11/2021

Boral
Berrima Cement Works
AQIA SWDF Increase
Proposed Operations

Pollutant: $PM_{2.5}$ Avg. Period: Annual Unit: $\mu g/m^3$

Table 20 Cumulative Results Proposed Operations $PM_{2.5}$ Annual Average Concentrations at Receptor 1

Background ($\mu g/m^3$)	Predicted Increment ($\mu g/m^3$)	Cumulative Impact ($\mu g/m^3$)
6.3	1.2	7.3
Criterion		8

Background data: Bargo 2017

7.1.8 Proposed Operations TSP

Figure 30 Predicted Annual Average TSP Concentrations (Incremental) - Proposed Operations

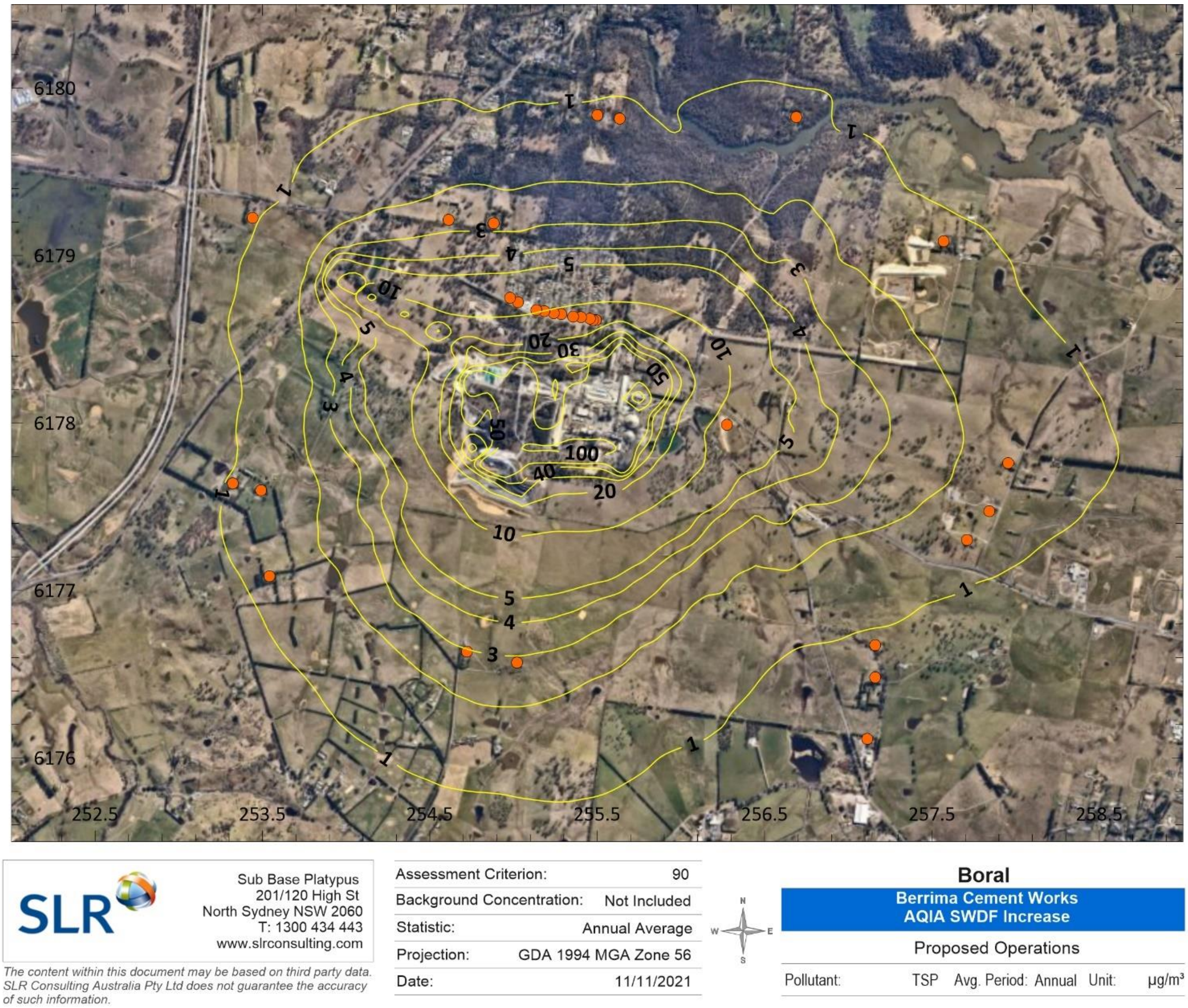

Table 21 Cumulative Results Proposed Operations TSP Annual Average Concentrations at Receptor 1

Background at site (AQMS) (µg/m³)	Predicted Increment (µg/m³)	Cumulative Impact (µg/m³)
62.8	14.9	77.7 [a]
Criterion		90

Background data: Boral AQMS HiVol data 2017

[a] Cumulative impact evaluated with site TSP concentration data – site contribution accounted for twice

7.1.9 Proposed Operations Dust Deposition

Figure 31 Predicted Annual Average Dust Deposition Levels (g/m2/month) (incremental) - Proposed Operations

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Assessment Criterion:	2
Background Concentration:	Not Included
Statistic:	Annual Average
Projection:	GDA 1994 MGA Zone 56
Date:	11/11/2021

N S W E

Boral

Berrima Cement Works
AQIA SWDF Increase

Proposed Operations

Pollutant: Dust Deposition Avg. Period: Unit:g/m²/month

7.1.10 Proposed Operations Odour

Figure 32 Results Proposed Operations Odour Concentrations Peak to Mean

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Assessment Criterion:	3, 6
Background Concentration:	Not Included
Statistic:	99%ile
Projection:	GDA 1994 MGA Zone 56
Date:	11/11/2021

N
W E
S

Boral

Berrima Cement Works
AQIA SWDF Increase

Proposed Operations

Pollutant: Odour Avg. Period: Nose Response Unit: OU

8 Mitigation Measures

The modelling shows that diversion of trucks from the Taylor Avenue access to the proposed Old Hume Highway access improves the air quality in the New Berrima township.

To reduce wheel generated dust emissions from sealed roads road cleanliness is important and surface silt levels need to be kept low from carry out from less clean areas and spills. The dust management plan mentions a street sweeper be regularly used for maintenance of the sealed internal haul roads. This should be reviewed and optimised and consideration should be given to updating the TARP to list street sweeping as part of the Level 1 trigger dust mitigation strategy actions.

Overall, the site dust monitoring data for recent years show declining trends which is interpreted as that ongoing improvements at site have shown results.

9 Conclusions

The comparison of the results from the dispersion modelling of the current and proposed operations with a new access via the Old Hume Highway shows improvements in the air quality for the New Berrima township with diversion of the fuel related truck deliveries.

The EAR's requested assessment of opportunities to minimise vehicle kilometres travelled and measures to minimise the potential for air quality impacts associated with truck movements be assessed. As shown in the emissions estimation and the dispersion modelling results the new site access will not achieve a reduction in vehicle kilometres travelled at site, but improvement in air quality for the New Berrima township are demonstrated.

It is a recommendation from the assessment that the TARP and dust management plan be reviewed to consider additional details around the street sweeping dust mitigation measures for maintenance of the sealed internal haul roads.

10 References

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APPENDIX A

Emissions Estimation and Source Details

Truck Transports

The truck transports at site were divided into seven routes at site relating to the material transports and the potential routes at site (6 on sealed roads, 1 on unsealed road). The details for the emissions estimation of the annual emissions are presented in **Table A.1** to **Table A.4**.

Table A.1 Truck Route Scenario Details and Dust Emissions

Source	Scenario	Trucks per year	Dust Emissions (kg/yr)
Raw material deliveries	No changes proposed for the raw material deliveries. Proposed operations to continue via Taylor Ave.	17,850	TSP: 36,171 PM_{10}: 6,943 $PM_{2.5}$: 1,680
Cement products dispatch	No changes proposed for the raw material deliveries. Proposed operations to continue via Taylor Ave.	26,700	TSP: 22,594 PM_{10}: 4,337 $PM_{2.5}$: 1,049
Coal deliveries	Current operations via Taylor Ave	6,285	TSP: 17,860 PM_{10}: 3,428 $PM_{2.5}$: 829
SWDF deliveries	Current operations via Taylor Ave	4,166	TSP: 10,383 PM_{10}: 1,993 $PM_{2.5}$: 482
Coal deliveries	Proposed operations via Old Hume Highway	2,100	TSP: 7,182 PM_{10}: 1,379 $PM_{2.5}$: 334
SWDF and (AK-5) deliveries	Proposed operations via Old Hume Highway	11,655	TSP: 37,176 PM_{10}: 7,136 $PM_{2.5}$: 1,726

In recognition that the access entry ways typically are in better condition than roads further in at site the paved road emissions were estimated for two different silt loadings as presented in **Table A.2**. The distances of the 3 g/m^2 silt loading is the return distance that was applied from the site entries and covered the entry ways and the access road across the site at the northern end (running east/west).

Table A.2 Truck Route Details

Source	Distance [a] (km/ return trip)	Distance Silt Loading 3 g/m^2 (km)	Distance Silt Loading 12 g/m^2 (km)	Road Segments Modelled
Raw material deliveries	2.6	1.2	1.4	69
Cement products dispatch	1.3	0.8	0.5	11
Coal deliveries	3.3	1.2	2.1	45
SWDF deliveries	3	1.2	1.8	44
Coal deliveries	4.8	2.6	2.2	45
SWDF and (AK-5) deliveries	4.6	2.6	2.0	44

[a] Distance calculated as an average trip distance across site considering potential multiple destinations

Details on the silt loading references are provided in the notes to **Table A.3**.

The AP-42 reference for concrete batching plants of 12 g/m^2 was assumed around the plant centrally. However, it was considered that this silt loading was assumed to be too conservative to apply for the entry road conditions and the roads at the northern end of the operations which are in better conditions.

Table A.3 Sealed Road Dust Emissions Estimation Factors and Parameters

Pollutant	Variables for Emission Factor Equation: E=k (SL)^a (W)^b (US EPA, 2011)					Emission Factor Uncontrolled (kg/VKT)
	k (lb/VMT)	a	b	SL	W (t)	
Entry sections with lower silt loading						
TSP	3.23	0.91	1.02	3 [a]	35 [c]	0.330
PM_{10}	0.62					0.063
$PM_{2.5}$	0.15					0.015
Higher silt loading across site						
TSP	3.23	0.91	1.02	12 [b]	35 [c]	1.165
PM_{10}	0.62					0.224
$PM_{2.5}$	0.15					0.054

[a] 3 g/m^2: Dirty roads with visible carry out or sand on them for fewer vehicle than 5,000 vehicles per day, paved road dust section (Air & Waste Management Association, 2000)

[b] 12 g/m^2: Average for concrete batching plants Table 13.2.1-3 (US EPA, 2011)

[c] (Boral, 2021c)

The dust emissions from unsealed roads at site were sourced from Borals NPI emissions estimation as summarised in **Table A.4**.

Table A.4 Unsealed Road Dust Emissions Estimation Factors and Emissions

Source	Emission Factor (kg/VKT)	VKT [c] (km)	Annual Emissions [c] (kg)
TSP	4.23 [a]	6,669	28,211
PM_{10}	1.25 [a]		8,337
$PM_{2.5}$	0.125 [b]		833.7

[a] (NPI, 2012)

[b] (Cowherd C Donaldson J.Jr & Hegarty R., 2006)

[c] (Boral, 2021b)

Table A.5 to **Table A.10** contains the details of the hour and day variability in the trucking activity at site as determined from onsite data (Boral, 2021c).

Table A.5 Raw Materials Delivery Truck Trips Distribution per Hour & Day - Current & Future Operations

Hour of day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Trips per day
Monday	0.5	0.4	0.5	1.0	2.0	4.3	4.3	2.6	3.1	4.2	3.7	3.2	3.9	3.2	2.5	2.6	1.9	1.8	1.0	0.7	0.6	0.7	0.7	0.6	50.1
Tuesday	0.6	0.5	0.6	1.3	2.5	5.5	5.4	3.3	3.9	5.3	4.7	4.0	5.0	4.1	3.1	3.3	2.5	2.2	1.2	0.8	0.8	0.9	0.9	0.7	63.3
Wednesday	0.6	0.5	0.6	1.3	2.6	5.6	5.5	3.4	4.0	5.4	4.8	4.1	5.1	4.2	3.2	3.4	2.5	2.3	1.3	0.9	0.8	0.9	0.9	0.7	64.7
Thursday	0.8	0.6	0.8	1.6	3.1	6.7	6.6	4.0	4.8	6.4	5.7	4.9	6.1	4.9	3.8	4.0	3.0	2.7	1.5	1.0	1.0	1.1	1.1	0.9	77.0
Friday	0.6	0.5	0.6	1.2	2.4	5.2	5.1	3.1	3.7	5.0	4.4	3.8	4.7	3.8	2.9	3.1	2.3	2.1	1.2	0.8	0.8	0.8	0.8	0.7	59.9
Saturday	0.2	0.2	0.2	0.4	0.8	1.8	1.8	1.1	1.3	1.8	1.6	1.4	1.7	1.4	1.0	1.1	0.8	0.8	0.4	0.3	0.3	0.3	0.3	0.2	21.3
Sunday	0.1	0.1	0.1	0.1	0.3	0.6	0.6	0.4	0.4	0.6	0.5	0.4	0.6	0.4	0.3	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	7.0

Table A.6 Fuels for Kiln (Coal) Delivery Truck Trips Distribution per Hour & Day - Current Operations

Hour of day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Trips per day
Monday	0.2	0.1	0.2	0.4	0.7	1.5	1.5	0.9	1.1	1.5	1.3	1.1	1.4	1.1	0.9	0.9	0.7	0.6	0.3	0.2	0.2	0.2	0.2	0.2	17.6
Tuesday	0.2	0.2	0.2	0.5	0.9	1.9	1.9	1.2	1.4	1.9	1.6	1.4	1.8	1.4	1.1	1.2	0.9	0.8	0.4	0.3	0.3	0.3	0.3	0.3	22.3
Wednesday	0.2	0.2	0.2	0.5	0.9	2.0	2.0	1.2	1.4	1.9	1.7	1.4	1.8	1.5	1.1	1.2	0.9	0.8	0.4	0.3	0.3	0.3	0.3	0.3	22.8
Thursday	0.3	0.2	0.3	0.6	1.1	2.4	2.3	1.4	1.7	2.3	2.0	1.7	2.1	1.7	1.3	1.4	1.1	1.0	0.5	0.4	0.4	0.4	0.4	0.3	27.1
Friday	0.2	0.2	0.2	0.4	0.8	1.8	1.8	1.1	1.3	1.8	1.6	1.3	1.7	1.4	1.0	1.1	0.8	0.7	0.4	0.3	0.3	0.3	0.3	0.2	21.1
Saturday	0.1	0.1	0.1	0.2	0.3	0.7	0.6	0.4	0.5	0.6	0.6	0.5	0.6	0.5	0.4	0.4	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.1	7.5
Sunday	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	2.5

Table A.7 Fuels for Kiln (Coal) Delivery Truck Trips Distribution per Hour & Day - Future Operations

Hour of day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Trips per day
Monday	0.1	0.0	0.1	0.1	0.2	0.5	0.5	0.3	0.4	0.5	0.4	0.4	0.5	0.4	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	5.9
Tuesday	0.1	0.1	0.1	0.2	0.3	0.6	0.6	0.4	0.5	0.6	0.6	0.5	0.6	0.5	0.4	0.4	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.1	7.4
Wednesday	0.1	0.1	0.1	0.2	0.3	0.7	0.7	0.4	0.5	0.6	0.6	0.5	0.6	0.5	0.4	0.4	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.1	7.6
Thursday	0.1	0.1	0.1	0.2	0.4	0.8	0.8	0.5	0.6	0.8	0.7	0.6	0.7	0.6	0.4	0.5	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1	9.1
Friday	0.1	0.1	0.1	0.1	0.3	0.6	0.6	0.4	0.4	0.6	0.5	0.4	0.6	0.5	0.3	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	7.0
Saturday	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	2.5
Sunday	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8

Table A.8 Fuels for Kiln (SWDF) Delivery Truck Trips Distribution per Hour & Day - Current Operations

Hour of day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Trips per day
Monday	0.1	0.1	0.1	0.2	0.5	1.0	1.0	0.6	0.7	1.0	0.9	0.7	0.9	0.8	0.6	0.6	0.5	0.4	0.2	0.2	0.2	0.2	0.2	0.1	11.7
Tuesday	0.1	0.1	0.1	0.3	0.6	1.3	1.3	0.8	0.9	1.2	1.1	0.9	1.2	0.9	0.7	0.8	0.6	0.5	0.3	0.2	0.2	0.2	0.2	0.2	14.8
Wednesday	0.1	0.1	0.1	0.3	0.6	1.3	1.3	0.8	0.9	1.3	1.1	1.0	1.2	1.0	0.7	0.8	0.6	0.5	0.3	0.2	0.2	0.2	0.2	0.2	15.1
Thursday	0.2	0.1	0.2	0.4	0.7	1.6	1.5	0.9	1.1	1.5	1.3	1.1	1.4	1.2	0.9	0.9	0.7	0.6	0.4	0.2	0.2	0.2	0.3	0.2	18.0
Friday	0.1	0.1	0.1	0.3	0.6	1.2	1.2	0.7	0.9	1.2	1.0	0.9	1.1	0.9	0.7	0.7	0.5	0.5	0.3	0.2	0.2	0.2	0.2	0.2	14.0
Saturday	0.0	0.0	0.0	0.1	0.2	0.4	0.4	0.3	0.3	0.4	0.4	0.3	0.4	0.3	0.2	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	5.0
Sunday	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.6

Table A.9 Fuels for Kiln (SWDF & AKF-5) Delivery Truck Trips Distribution per Hour & Day - Future Operations

Hour of day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Trips per day
Monday	0.3	0.3	0.3	0.7	1.3	2.8	2.8	1.7	2.0	2.7	2.4	2.1	2.6	2.1	1.6	1.7	1.3	1.2	0.6	0.4	0.4	0.5	0.5	0.4	32.7
Tuesday	0.4	0.3	0.4	0.9	1.6	3.6	3.5	2.2	2.6	3.4	3.1	2.6	3.3	2.7	2.0	2.2	1.6	1.5	0.8	0.5	0.5	0.6	0.6	0.5	41.4
Wednesday	0.4	0.3	0.4	0.9	1.7	3.7	3.6	2.2	2.6	3.5	3.1	2.7	3.3	2.7	2.1	2.2	1.6	1.5	0.8	0.6	0.5	0.6	0.6	0.5	42.3
Thursday	0.5	0.4	0.5	1.0	2.0	4.4	4.3	2.6	3.1	4.2	3.7	3.2	4.0	3.2	2.5	2.6	2.0	1.8	1.0	0.7	0.7	0.7	0.7	0.6	50.3
Friday	0.4	0.3	0.4	0.8	1.6	3.4	3.4	2.0	2.4	3.3	2.9	2.5	3.1	2.5	1.9	2.1	1.5	1.4	0.8	0.5	0.5	0.5	0.6	0.4	39.1
Saturday	0.1	0.1	0.1	0.3	0.6	1.2	1.2	0.7	0.9	1.2	1.0	0.9	1.1	0.9	0.7	0.7	0.5	0.5	0.3	0.2	0.2	0.2	0.2	0.2	13.9
Sunday	0.0	0.0	0.0	0.1	0.2	0.4	0.4	0.2	0.3	0.4	0.3	0.3	0.4	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	4.6

Table A.10 Dispatch of Clinker & Cement Truck Trips Distribution per Hour & Day - Current & Future Operations

Hour of day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Trips per day
Monday	0.7	0.6	0.7	1.5	3.0	6.5	6.4	3.9	4.7	6.2	5.5	4.8	5.9	4.8	3.7	3.9	2.9	2.6	1.5	1.0	1.0	1.0	1.1	0.9	74.9
Tuesday	0.9	0.7	0.9	1.9	3.8	8.2	8.1	5.0	5.9	7.9	7.0	6.0	7.5	6.1	4.6	5.0	3.7	3.3	1.9	1.2	1.2	1.3	1.3	1.1	94.7
Wednesday	1.0	0.8	1.0	2.0	3.9	8.4	8.3	5.1	6.0	8.1	7.2	6.2	7.6	6.2	4.7	5.1	3.8	3.4	1.9	1.3	1.3	1.3	1.4	1.1	96.8
Thursday	1.1	0.9	1.1	2.4	4.6	10.0	9.9	6.0	7.2	9.6	8.5	7.3	9.1	7.4	5.6	6.1	4.5	4.1	2.3	1.5	1.5	1.6	1.6	1.3	115.2
Friday	0.9	0.7	0.9	1.8	3.6	7.8	7.7	4.7	5.6	7.5	6.6	5.7	7.1	5.8	4.4	4.7	3.5	3.2	1.8	1.2	1.2	1.2	1.3	1.0	89.6
Saturday	0.3	0.2	0.3	0.7	1.3	2.8	2.7	1.7	2.0	2.6	2.4	2.0	2.5	2.0	1.6	1.7	1.2	1.1	0.6	0.4	0.4	0.4	0.4	0.4	31.8
Sunday	0.1	0.1	0.1	0.2	0.4	0.9	0.9	0.5	0.7	0.9	0.8	0.7	0.8	0.7	0.5	0.5	0.4	0.4	0.2	0.1	0.1	0.1	0.1	0.1	10.5

Material Handling and Processing

Emissions data for the materials handling was sourced from Borals NPI reporting (Boral, 2021b). Estimated emissions and details are provided in **Table A.11**. The details included give an overview of the emissions estimation for each activity. Full details on repeat handling and control factors for all steps have not been included. The materials handling emissions were modelled for 10 sources across site where materials handling takes place for the locations as shown in **Table A.12**.

Table A.11 Materials Handling Boral NPI Emissions Data

Activity	Material Used (t)	Emission Factors TSP [a] PM_{10} [a] $PM_{2.5}$ [b] (kg/t)	Estimated Emissions			Comments
			TSP	PM_{10}	$PM_{2.5}$	
Transfer Points	2,157,557	0.00032 0.00015 0.000015	1,893.7	887.7	88.77	Material handled in multiple steps. 70% reduction for enclosure included.
Excavators/Front end loaders	363,264	0.029 0.014 0.0014	29,765.1	14,369.3	1,436.93	Some materials handled in multiple steps.
Unloading/Dumping	2,158,989	0.010 0.0042 0.0042	3,695.0	1,324.0	132.4	70% reduction for enclosure included for coal and limestone unloading.
Loading of trains (cement products)	792,729	0.0004 0.00017 0.000017	3.2	1.3	0.13	99% reduction for enclosure and extraction control.
Loading of trucks (cement products)	634,782	0.0004 0.00017 0.000017	3.6	1.5	0.15	99% reduction for enclosure and extraction control.
Crushing	143,581	0.2 0.02 0.002	287.2	28.7	2.87	99% reduction for enclosure and extraction control.
Total			*35,648*	*16,613*	*1,661*	

[a] Emission factors from (NPI, 2012)

[b] $PM_{2.5}$ estimated based on (Cowherd C Donaldson J.Jr & Hegarty R., 2006) $PM_{2.5}/PM_{10}$ fractions

Table A.12 Materials Handling Source Locations

Source	Easting (m)	Northing (m)
Materials Handling/Processing 1	254,869	6,177,706
Materials Handling/Processing 2	254,783	6,178,324
Materials Handling/Processing 3	255,108	6,178,218
Materials Handling/Processing 4	255,655	6,177,742
Materials Handling/Processing 5	255,438	6,178,202
Materials Handling/Processing 6	255,662	6,178,170
Materials Handling/Processing 7	255,582	6,178,176
Materials Handling/Processing 8	255,522	6,178,128
Materials Handling/Processing 9	255,625	6,178,119
Materials Handling/Processing 10	255,694	6,178,124

Wind Erosion

Wind erosion emissions were estimated as for the air quality impact assessment for the use of solid waste derived fuels (AQP , 2015). Emissions were estimated for a total surface area of 19.5 ha of stockpiles and other exposed areas subject to wind erosion as shown in **Figure A.1** and summarised in **Table A.13**. The wind erosion emissions were included for six sources as presented with annual emission rates and source corner locations as presented in **Table A.14** and **Table A.15**.

Hourly emission rates were assigned according to the cubic relationship to allow for increased emission rates with increasing wind speed.

Wind erosion emission rates were estimated with the following emission factors:

- TSP 0.4 kg/ha/hr (NPI, 2012)
- PM_{10} 0.2 kg/ha/hr (NPI, 2012)
- $PM_{2.5}$ 0.03 kg/ha/hr based the PM_{10} emissions factor and a $PM_{2.5}/PM_{10}$ fraction of 0.15 (Cowherd C Donaldson J.Jr & Hegarty R., 2006)

Figure A.1 Wind Erosion Source Details (AQP , 2015)

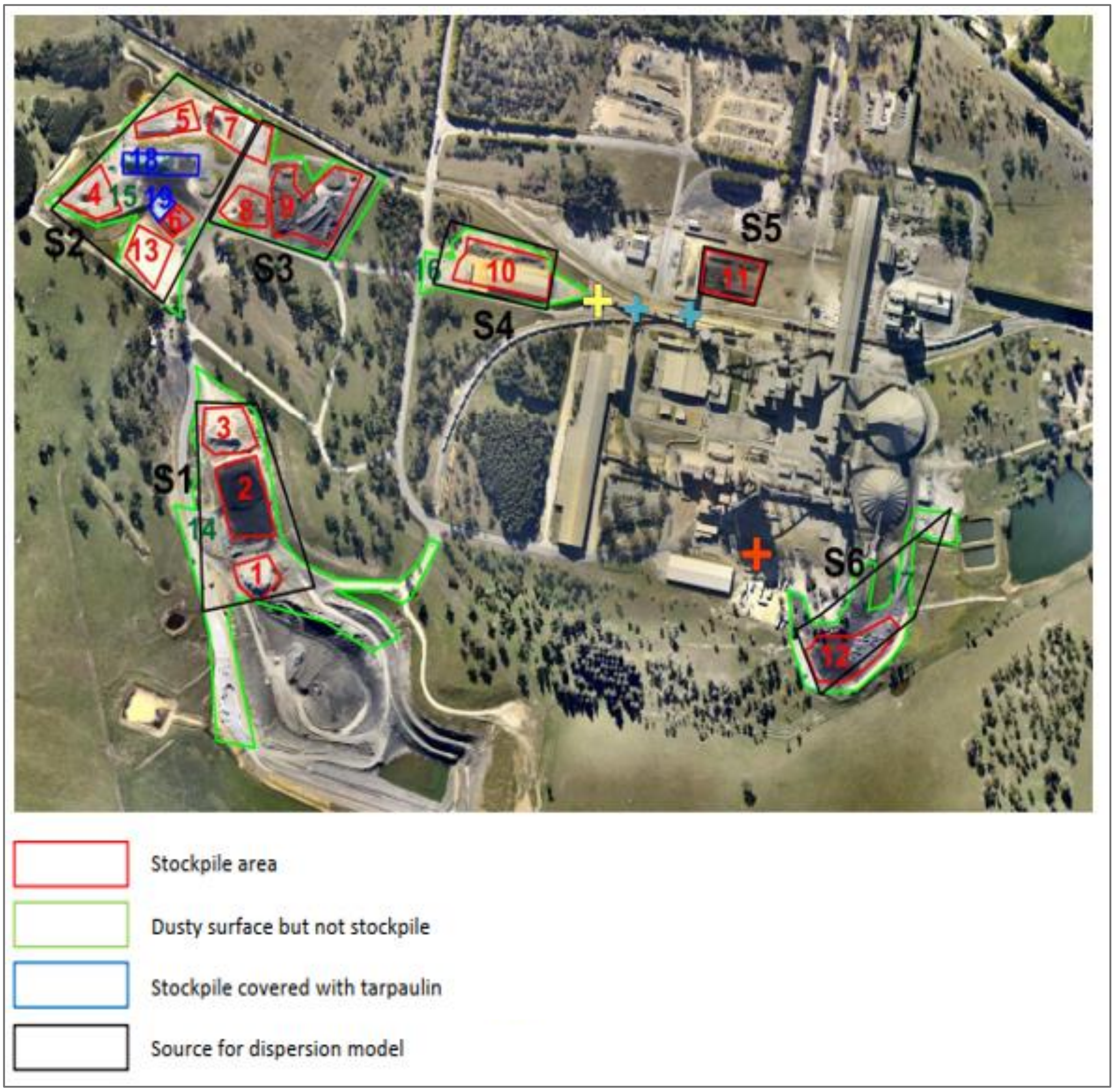

Table A.13 Stockpiles and Exposed Surface Areas

Are	Description	Area (m^2)
1	Stockpile	2,372
2	Stockpile	5,712
3	Stockpile	3,875
4	Stockpile	3,045
5	Stockpile	2,298
6	Stockpile	952
7	Stockpile	3,652
8	Stockpile	2,488
9	Stockpile	7,976
10	Stockpile	6,842
11	Stockpile	3,944
12	Stockpile	5,686
13	Stockpile	2,862
14	Exposed surface area	48,401
15	Exposed surface area	59,923
16	Exposed surface area	13,369
17	Exposed surface area	18,695
18	Stockpile	2,665
19	Stockpile	646
Total		195,403 19.5 ha

Table A.14 Annual Emissions per Source for Dispersion Modelling

Model Sources	Area (m^2)	Area (%)	Annual Emissions (kg/year)		
			TSP	PM_{10}	$PM_{2.5}$
Source 1	28,800	22.4%	15,290	7,64	1,147
Source 2	39,000	30.3%	20,705	10,353	1,553
Source 3	21,600	16.8%	11,468	5,734	860
Source 4	11,500	8.9%	6,105	3,053	458
Source 5	11,200	8.7%	5,946	2,973	446
Source 6	16,600	12.9%	8,813	4,407	661
Total	128,700	100%	68,328	34,164	5,125

Table A.15 Wind Erosion Source Corner Coordinates

Source	Easting 1 (m)	Northing 1 (m)	Easting 2 (m)	Northing 2 (m)	Easting 3 (m)	Northing 3 (m)	Easting 4 (m)	Northing 4 (m)
Source 1	254,735	6,177,783	254,722	6,178,041	254,804	6,178,037	254,888	6,177,812
Source 2	254,520	6,178,277	254,693	6,178,441	254,807	6,178,384	254,676	6,178,164
Source 3	254,742	6,178,261	254,814	6,178,389	254,968	6,178,317	254,902	6,178,218
Source 4	255,053	6,178,190	255,075	6,178,263	255,224	6,178,229	255,210	6,178,157
Source 5	255,422	6,178,180	255,427	6,178,234	255,612	6,178,203	255,609	6,178,141
Source 6	255,561	6,177,761	255,771	6,177,909	255,719	6,177,776	255,591	6,177,681

Stack Sources

The stack sources were included in the modelling with the following source and parameter details as presented in **Table A.16** and **Table A.17**. The source and emission parameters were collated from a number of sources as referenced in the tables to best reflect current conditions.

Stack emissions were modelled with continuous emissions and building wakes.

Table A.16 Stack Source Parameters

Source	Easting (m)	Northing (m)	Stack Height (m)	Stack Diameter (m)	Exit Velocity (m/s)	Exit Temp (°C)
No 6 Kiln Stack	255,480	6,177,958	84 [a]	3 [b]	32.7 [a]	121 [a]
No 6 Kiln Cooler	255,634	6,177,934	37 [b]	2.4 [b]	14 [b]	87 [b]
No 6 Cement Mill	255,568	6,178,077	17 [b]	1.75 [b]	13 [b c]	84 [b]
No 7 Cement Mill	255,521	6,178,053	8 [b]	1.91 [b]	7.7 [b c]	102 [b]

[a] (EMM, 2021)

[b] (AQP , 2015)

[c] No vertical momentum

Building wakes were included for all stacks with building heights from the plant area includes as from (Beca, 2012)

Table A.17 Stack Source Emission Rates

Source	TSP Concentration (mg/Nm³)	PM_{10}/TSP Fraction	$PM_{2.5}$/TSP Fraction	Flow Rate (Nm³/s)	Emission Rates (g/s)		
					TSP	PM_{10}	$PM_{2.5}$
No 6 Kiln Stack	50 [a]	70% [b]	33%	120 [c]	6.0	4.2	1.98
No 6 Kiln Cooler	39 [b]	76% [d]	40%	42.7 [b]	1.7	1.3	0.68
No 6 Cement Mill	42 [b]	76% [d]	40%	21.9 [b]	0.92	0.70	0.37
No 7 Cement Mill	20 [b]	76% [d]	41%	13.6 [b]	0.27	0.21	0.11

[a] EPL limit

[b] (AQP , 2015)

[c] (Ektimo, 2020) (Ektimo, 2021)

d Data from Warun Ponds Boral

Building wakes were included for all stacks with building heights from the plant area includes as from Beca 2012

APPENDIX B

Selection of Representative Year

Figure B.1 Wind Roses Moss Vale BoM

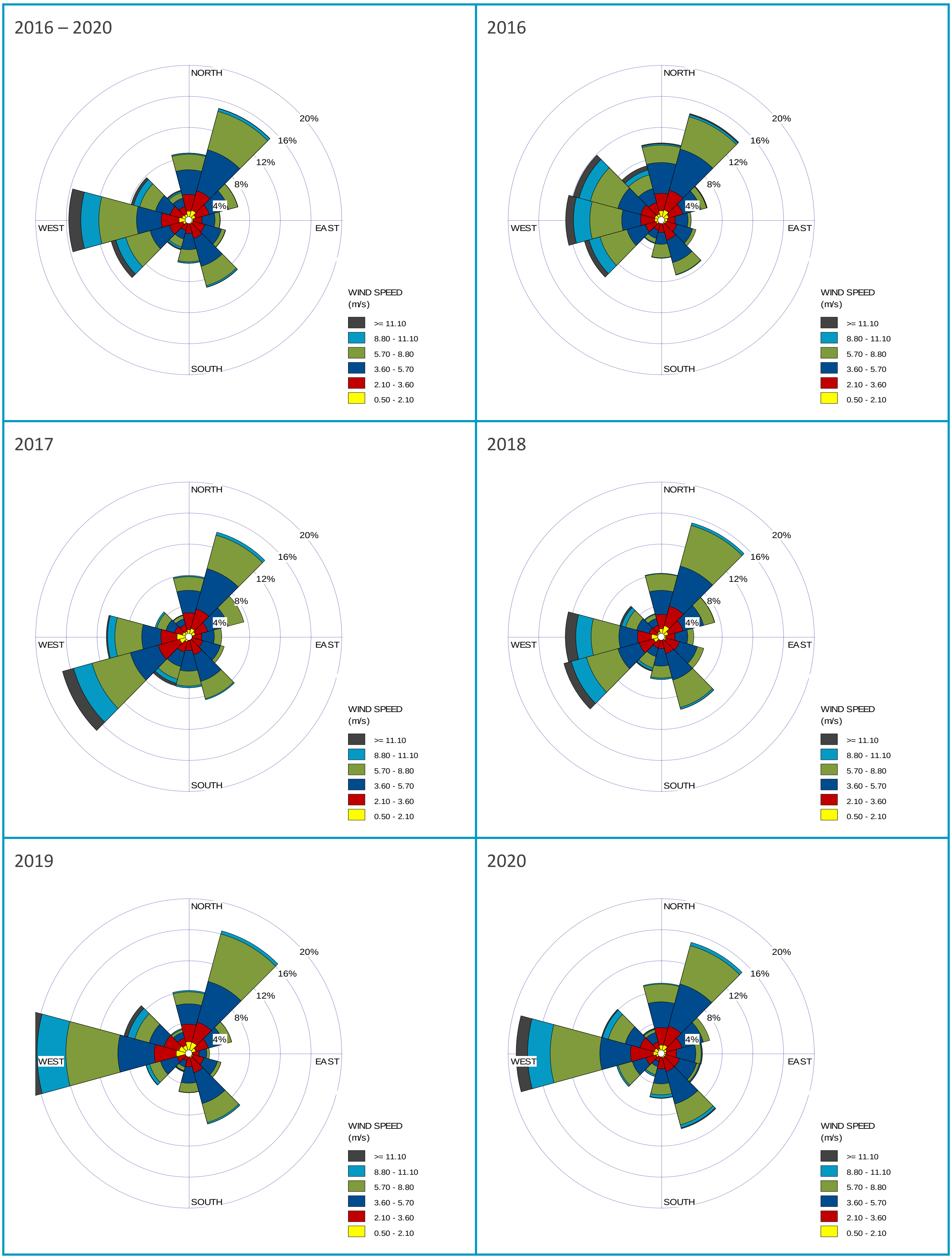

Figure B.2 Wind Roses Boral AQMS

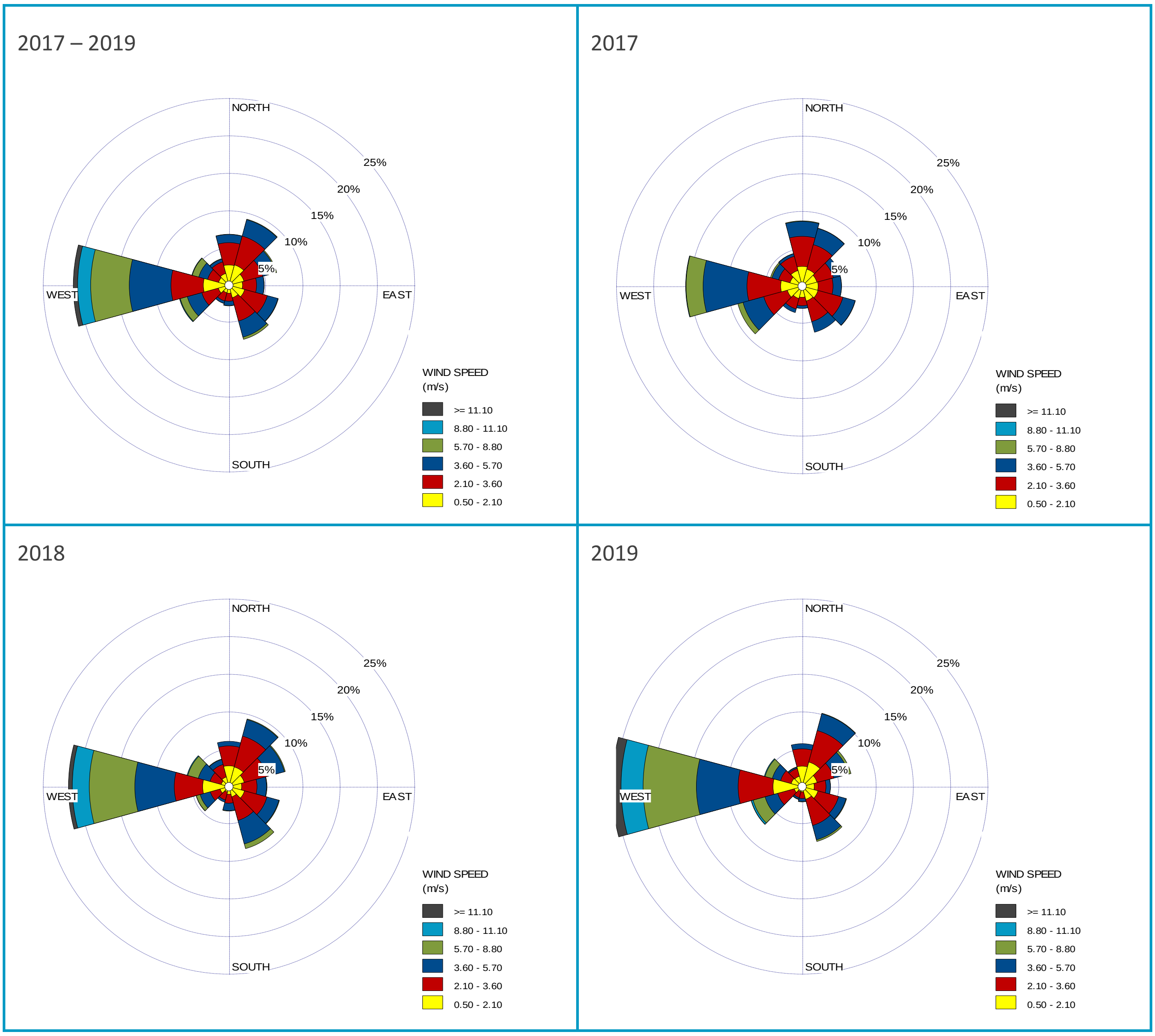

Table B.1 Summary Wind Statistics Moss Vale BoM

Period	Annual Average Wind Speed (m/s)	Annual Frequency of Calms	Data Availability	Critical Wind Direction Frequency (ESE, SSE, S, SSW, WSW)
2016-2020	4.9	3.8%	99.9%	34.2%
2016	4.9	3.2%	99.9%	30.7%
2017	**4.7**	**4.4%**	100.0%	**43.6%**
2018	4.9	4.5%	99.7%	38.9%
2019	5.0	3.8%	99.9%	27.3%
2020	4.8	3.1%	99.98%	30.5%

Table B.2 Summary Wind Statistics Boral AQMS

Period	Annual Average Wind Speed (m/s)	Annual Frequency of Calms	Data Availability	Critical Wind Direction Frequency (ESE, SSE, S, SSW, WSW)
2017-2019	2.9	12.6%	96.7%	26.8%
2017	**2.5**	**13.8%**	95.5%	**29.6%**
2018	3.1	11.2%	96.8%	25.8%
2019	3.2	12.6%	97.6%	25.0%

APPENDIX C

Construction Dust Impact Assessment Methodology

APPENDIX C - Construction Assessment Methodology

Step 1 – Screening Based on Separation Distance

The Step 1 screening criteria provided by the IAQM guidance suggests screening out any assessment of impacts from construction activities where sensitive receptors are located more than 350 m from the boundary of the Site, more than 50 m from the route used by construction vehicles on public roads, and more than 500 m from the Site entrance. This step is noted as having deliberately been chosen to be conservative and will require assessments for most projects.

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

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

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

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

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

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

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

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

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

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

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

Step 2b – Risk Assessment

Assessment of the Sensitivity of the Area

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

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

Individual receptors are classified as having *high*, *medium* or *low* sensitivity to dust deposition and human health impacts (ecological receptors are not addressed using this approach). The IAQM method provides guidance on the sensitivity of different receptor types to dust soiling and health effects as summarised in **Table C.1**. It is noted that user expectations of amenity levels (dust soiling) is dependent on existing deposition levels.

Table C.1 IAQM Guidance for Categorising Receptor Sensitivity

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

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

- Any history of dust generating activities in the area;
- The likelihood of concurrent dust generating activity on nearby sites;

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

The IAQM guidance for assessing the sensitivity of an area to dust soiling is shown in **Table C.2**. The sensitivity of the area should be derived for each of activity relevant to the project (i.e. construction and earthworks).

Table C.2 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Soiling Effects

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

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

A modified version of the IAQM guidance for assessing the *sensitivity of an area* to health impacts is shown in **Table C.3**. For high sensitivity receptors, the IAQM methods takes the existing background concentrations of PM_{10} (as an annual average) experienced in the area of interest into account and is based on the air quality objectives for PM_{10} in the UK. As these objectives differ from the ambient air quality criteria adopted for use in this assessment (i.e. an annual average of 25 $\mu g/m^3$ for PM_{10}) the IAQM method has been modified slightly.

- This approach is consistent with the IAQM guidance, which notes that in using the tables to define the *sensitivity of an area*, professional judgement may be used to determine alternative sensitivity categories, taking into account the following factors:
- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local meteorological data which accurately represent the area, and if relevant the season during which the works will take place;
- any conclusions drawn from local topography;
- duration of the potential impact; and
- any known specific receptor sensitivities which go beyond the classifications given in this document.

Table C.3 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Health Effects

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

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

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

Risk Assessment

The dust emission magnitude from Step 2a and the receptor sensitivity from Step 2b are then used in the matrices shown in **Table C.4** (demolition), **Table C.5** (earthworks and construction) and **Table C.6** (trackout) to determine the risk category with no mitigation applied.

Table C.4 Risk Category from Demolition Activities

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

Table C.5 Risk Category from Earthworks and Construction Activities

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

Table C.6 Risk Category from Trackout Activities

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

Step 3 - Site-Specific Mitigation

Once the risk categories are determined for each of the relevant activities, site-specific management measures can be identified based on whether the site is a low-, medium- or high-risk site.

Step 4 – Residual Impacts

Following Step 3, the residual impact is then determined after management measures have been considered.

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