AIR QUALITY IMPACT ASSESSMENT
PREPARED FOR
GOW STREET RECYCLING CENTRE
81 GOW STREET, PADSTOW NSW 2211

Prepared for: Gow Street Recycling Centre

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Engineering a Sustainable Future for Our Environment

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EXECUTIVE SUMMARY

Benbow Environmental has been engaged by Gow Street Recycling Centre (GSRC) to undertake an Air Quality Impact Assessment (AQIA) for the existing recycling centre located at 81 Gow Street, Padstow NSW 2211. The AQIA has been prepared to quantify dust and particulate emissions to air from the construction and demolition (C&D) resource recovery facility that currently operates on site.

The AQIA is also in support of a proposed drilling mud dewatering facility on site which would be established within an existing building on site. Dewatering processes were not included in dispersion modelling as they are completely enclosed in a wet environment and do not generate dust. However, stockpiled recovered aggregates from processed water has been included as this has the potential to generate airborne dust (via wind erosion) where not managed correctly. It is noted that the dust from these stockpiles represent negligible emissions (DMAG source in emission inventory Table 7-6 and Table 7-7) as the total dust emissions are several orders of magnitude less that more significant sources.

The assessment determines the predicted dust and particulate matter contribution from the existing and proposed site operations. It also determines the impacts associated with greenhouse gas (GHG) emissions from the site.

The assessment does not include an assessment of odour impacts, as no odour is expected to be generated from the proposed development. The drilling mud received by the facility is non-destructive digging waste, which is a water-based drilling mud containing clay (usually bentonite) and various non-odorous chemicals. Odorous drilling mud types (including oil-based muds and synthetic based muds) would not be received by the facility.

This AQIA has been prepared in accordance with the NSW EPA guidelines *"Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales"* (2016) (AMMAAP), which shall henceforth be referred to as the *Approved Methods*. Additionally, the GHG assessment has been prepared in accordance with the Australian Government *Department of the Environment and Energy, August 2019 Australian National Greenhouse Accounts – National Greenhouse Accounts Factors*.

DUST IMPACT ASSESSMENT

The air dispersion model AERMOD was used for the prediction of off-site dust impacts associated with the air emissions from the proposed operations. Two scenarios were included in the air dispersion modelling:

> Scenario 1 – modelled emission sources <u>with general mitigation measures recommended</u> and
> Scenario 2 – modelled emission sources with an additional custom flexible hood and vacuum ducting applied to the crusher/screen.

The assessment aimed to demonstrate the predicted dust impacts from site activities on neighbouring receptors with and without the use of the flexible hood and vacuum ducting applied to the crusher/screener. Preliminary dust monitoring undertaken on- and off-site demonstrate that current dust emissions from site activities exceed NSW EPA criteria.

Results of air impact modelling for both scenario 1 and scenario 2 demonstrate that incremental dust levels were reduced with the inclusion of a custom hood covering applied to the crusher/screener by ~12-46% at the most heavily impacted receptor (R11; 89 Gow Street, Padstow). It is recommended that all controls listed for Scenario 2 be applied onsite on site to ensure continued compliance and further reduce dust impacts from the proposed development on all nearest receptors, both industrial and sensitive.

In cases of elevated background concentrations, the NSW EPA requires a demonstration that no additional exceedances of the impact assessment criteria will occur as a result of the proposed site activities. Contemporaneous additions assessment was conducted for the most impacted receptor (R11; 89 Gow Street, Padstow). The 24 hour averaging period for PM_{10} showed 2 additional days of exceedance, however this is attributed to the elevated background concentration levels of 48.23 µg/m^{3}and 46.21 µg/m^3. The 24 hour averaging period for $PM_{2.5}$ demonstrated no additional days of exceedance.

With the proposed site activities and additional dust controls in place, it is considered that emissions to air from the site's operation are unlikely to cause harm to resident's health or the environment.

Greenhouse Gas (GHG) Assessment

Scope 1 GHG emissions from the proposed development are limited to diesel fuel consumption from plant and equipment operation on site. Scope 2 GHG emissions are limited to electricity consumption during site operations. Scope 3 emissions encompass a wide range of potential sources which are expected to be negligible for the proposed development. Therefore, Scope 3 GHG emissions were not assessed any further.

Annual GHG emissions for Scope 1 and Scope 2 GHG emissions for the operation of the C&D and drilling mud dewatering facilities are estimated to be 955 t CO_2-e.

Australia's total GHG emissions as at December 2019 (the most recent inventory update) was estimated to be 532.5 Mt CO_2-e (Australian Government, Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2019). In comparison, the estimated annual GHG emission for proposed development is 0.00096 Mt CO_2-e. Therefore, the annual contribution of GHG emissions from the proposed development in comparison to the Australian greenhouse emissions in 2019 is approximately 0.0000018%.

Conclusion

To mitigate potential current and future dust emissions off-site, GSRC propose to construct a custom built hood and vacuum enclosure to be applied to the crusher and screener, in additional to other dust mitigation measures around the site, to ensure continued compliance with NSW EPA criteria and further reducing dust impacts from the proposed development on all nearest receptors, industrial and sensitive.

GHG contributions from the proposed development are considered negligible.

With the proposed site activities and additional dust controls in place, it is considered that dust and GHG emissions to air from site operations are unlikely to cause harm to health or the environment.

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1. INTRODUCTION

Benbow Environmental has been engaged by Gow Street Recycling Centre (GSRC) to undertake an Air Quality Impact Assessment (AQIA) for the proposed liquid waste processing facility at their existing recycling centre located at 81 Gow Street, Padstow NSW 2211. The proposal also includes emissions to air from the construction and demolition (C&D) resource recovery facility that currently operates on site.

The assessment determines the predicted dust and particulate matter contribution from the proposed and existing site operations. It also determines the impacts associated with greenhouse gas (GHG) emissions from the site. The assessment does not include an assessment of odour impacts, as no odour is expected to be generated from the proposed development.

This AQIA has been prepared in accordance with the NSW EPA guidelines *"Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales"* (2016) (AMMAAP), which shall henceforth be referred to as the *Approved Methods*. Additionally, the GHG assessment has been prepared in accordance with the Australian Government *Department of the Environment and Energy, August 2019 Australian National Greenhouse Accounts – National Greenhouse Accounts Factors*.

This AQIA uses existing air quality data to establish the background levels of dust and particulates. This background data is then combined with the predicted levels resulting from the current and proposed operations of the C&D and drilling mud dewatering facilities to assess the cumulative air quality impacts.

Additionally, the AQIA assesses the suitability of a custom built dust controls on the site to adequately reduce existing dust impacts at neighbouring facilities.

2. PROPOSED DEVELOPMENT

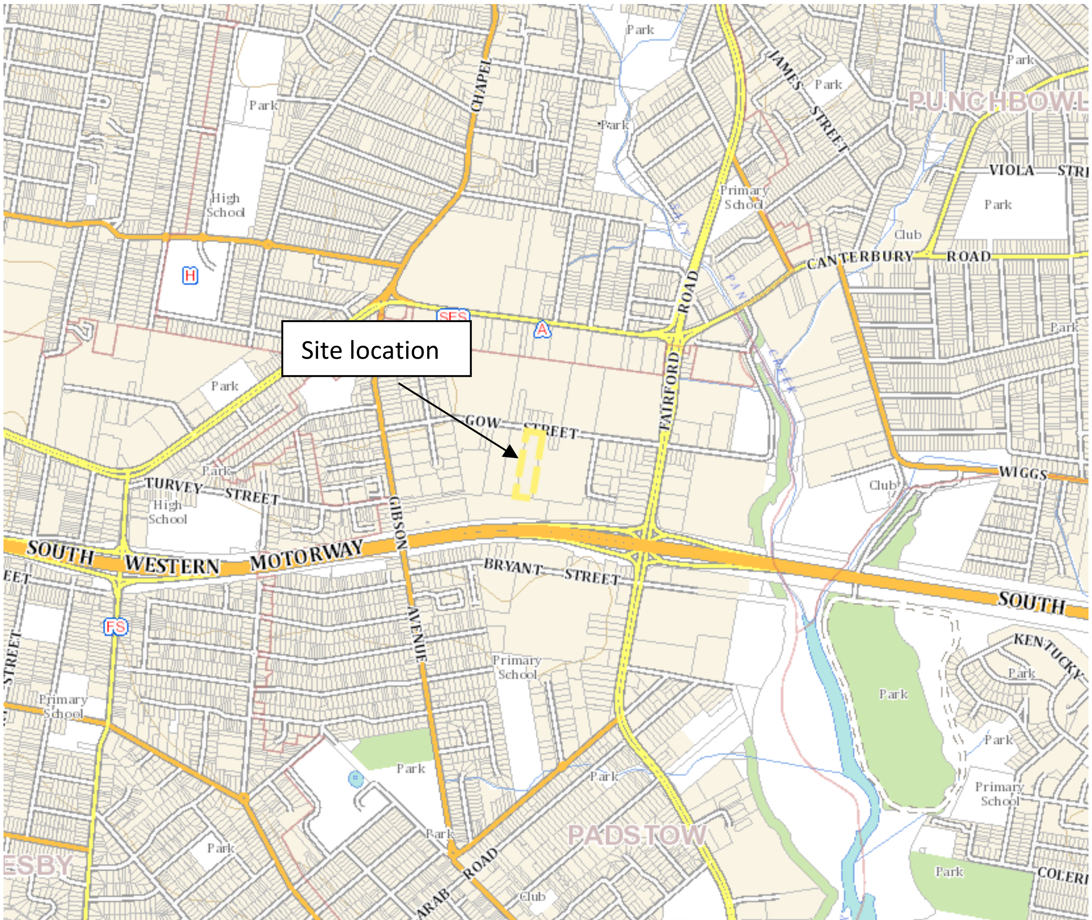
2.1 SITE LOCATION

The proposed development is to be located at 81 Gow Street, Padstow NSW 2211 ("the subject site"), legally described as Lot A DP 103140. The location of the subject site as an aerial view is shown in Figure 2-1 and its location in a local context is shown in Figure 2-2.

Figure 2-1: Location of subject sites

↑N	**Source:** SIX Maps 2020 **Legend:** Site boundary	Benbow Environmental 25-27 Sherwood Road Northmead NSW 2152

Figure 2-2: The Site Location in a Local Context



↑N

Source: SIX Maps 2020

Legend: Site boundary

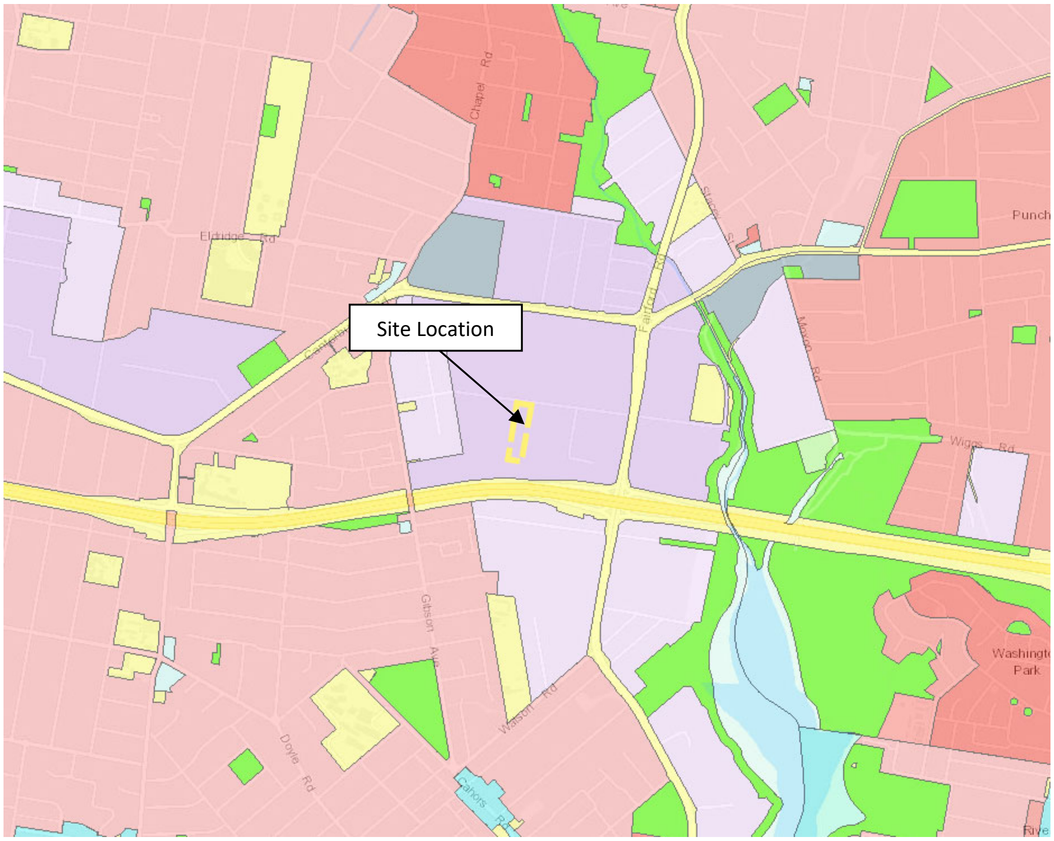
Benbow Environmental
25-27 Sherwood Road
Northmead NSW 2152

2.2 LAND USE

The site is situated in IN1 – General Industrial land use zoning under the Bankstown Local Environmental Plan (LEP) 2015 as shown in Figure 2-3. The site is surrounded on all sides by IN1 – General Industrial zoned land, with SP2 – Special Infrastructure zoned land (South Western Motorway) further south and IN2 – Light Industrial zoned land to the far west.

Beyond the immediate surrounds are also areas of R2 – Low Density Residential and RE1 — Public Recreation zoning to the south-west, west, north and east. Approximately 765 m east is Salt Pan Creek, W1 - Natural Waterways zoning. The T8 – Airport & South Line is located 1.6 km to the south. The closest residential areas are to the south (200 m) and west (375 m) of the site.

Figure 2-3: Surrounding land use zoning



Source: https://www.planningportal.nsw.gov.au

Legend: Site boundary

- B1 - Neighbourhood Centre
- B2 - Local Centre
- B3 - Commercial Core
- B4 - Mixed Use
- B5 - Business Development
- B6 - Enterprise Corridor
- B7 - Business Park
- B8 - Metropolitan Centre
- E1 - National Parks and Nature Reserves
- E2 - Environmental Conservation
- E3 - Environmental Management
- E4 - Environmental Living
- IN1 - General Industrial
- IN2 - Light Industrial
- IN3 - Heavy Industrial
- IN4 - Working Waterfront
- R1 - General Residential
- R2 - Low Density Residential
- R3 - Medium Density Residential
- R4 - High Density Residential
- R5 - Large Lot Residential
- RE1 - Public Recreation
- RE2 - Private Recreation
- RU1 - Primary Production
- RU2 - Rural Landscape
- RU3 - Forestry
- RU4 - Primary Production Small Lots
- RU5 - Village
- RU6 - Transition
- SP1 - Special Activities
- SP2 - Infrastructure
- SP3 - Tourist
- W1 - Natural Waterways
- W2 - Recreational Waterways
- W3 - Working Waterways

2.3 Hours of Operations

The proposed facility is requesting approval to operate 24 hours per day, 7 day per week.

2.4 Proposed Development Description

The development is aiming to establish a drilling mud dewatering facility on site. The facility will be located within an existing structure on site, located towards the centre of the property. The development will continue its existing C&D waste recycling processes and utilise equipment from this to support the proposed liquid waste facility.

Existing equipment on site includes:

- 1 x Crusher,
- 1 x Screen,
- 2 x Front End Loaders (FEL),
- 2 x Excavators,
- 3 x Trucks.

Additionally, the facility proposes to establish a custom built dust control system to capture emissions from the crusher and screener.

Minor construction works will be required to establish the new infrastructure for the proposed dewatering plant. It is expected that construction of the plant will take approximately 4 months.

The proposed dewatering plant will include the following equipment:

- Screen spray bar pump;
- Vibrating screen;
- Conveyors;
- Screw separator;
- Submersible pump;
- Flocculant station and dosing system;
- Stainless steel tank/silo;
- Slurry homogeniser tank;
- Filter feeding centrifugal pump;
- Filter press;
- Pipework valves etc.

The processes occurring on the site have the potential to impact the air quality where not managed effectively. Mitigation measures for all dust generating processes will be discussed throughout Section 7 of this report.

2.4.1 Drilling Mud Dewatering Facility

The proposed drilling mud dewatering facility will accept up to 250,000 TPA (tonnes per annum) of liquid waste consisting of drilling mud and concrete washout water, which will be processed and output clean water that can be reused on site, as well as other recyclable and non-recyclable waste. The facility would involve the following activities:

- Unloading of drilling mud/concrete washout water into dirty water containment pits;
- This liquid is transferred into the dirty water pit and then into the flocculent station.
- The flocculants assist in settling sediments at the bottom of the tank.
- The sand/rock/sediment slurry is pumped from the bottom of the tank and into a screw separator.
- The screw separator removes the solids from the water.
- The solids are then transferred to a vibrating screen where the aggregates and sands are conveyed to internal and external storage bays.
- The water from the flocculent station and the screw separator is pumped to the two 60kl silos, the slurry homogeniser tank and then into the filter press.
- The filter press removes the remaining silts and the cleaned water is pumped to the clean water pit.
- The sediments/silt from the filter press becomes a fine biscuit which is removed offsite as for application to land under the Treated Drilling Mud Exemption 2014 or to landfill.
- The filter press requires intermittent backwashing where backwash water is pumped to the dirty water pit to be reprocessed through the system.
- The clean water pit would be pH adjusted and then used for cleaning aggregates and sand during the screening process, dust suppression and washdown onsite. Excess water would be sent to tradewaste under a Trade Waste Agreement.

Site washdown water and stormwater will be collected in a 200kl underground tank and through the above dewatering system.

The maximum quantity of liquid waste that can be processed through the dewatering plant in a 24-hour period is approximately 1,500 tonnes. This can easily accommodate stormwater runoff and the proposed 250,000 tonnes per annum.

Activities associated with the liquid waste processing plant are performed in a closed environment and do not generate dust. The liquid waste facility and processes has not been considered a contributing factor to dust emissions on site. However, aggregate storage bays for recovered materials from drilling mud/concrete washout water has the potential to generate dust during windblown erosion.

2.5 EXISTING DEVELOPMENT DESCRIPTION

2.5.1 C&D Recycling Facility

The site will continue to accept up to 80,000 TPA of C&D waste. Existing processes and screening methodology will continue to be used for sorting the waste. The recycling facility and its processes have the potential to impact surrounding air quality if proper mitigation measures are not undertaken. The processes involved in the C&D recycling facility are:

- Unloading of C&D waste streams into bays to await screening. This will be achieved using the FELs to move waste through;
- Sorting/screening of waste through an aggregate screen;
- Crushing of C&D waste into varying aggregate sizes; and
- Storage of products in storage bins/bays pending sale.

2.6 Nearest Sensitive Receptors

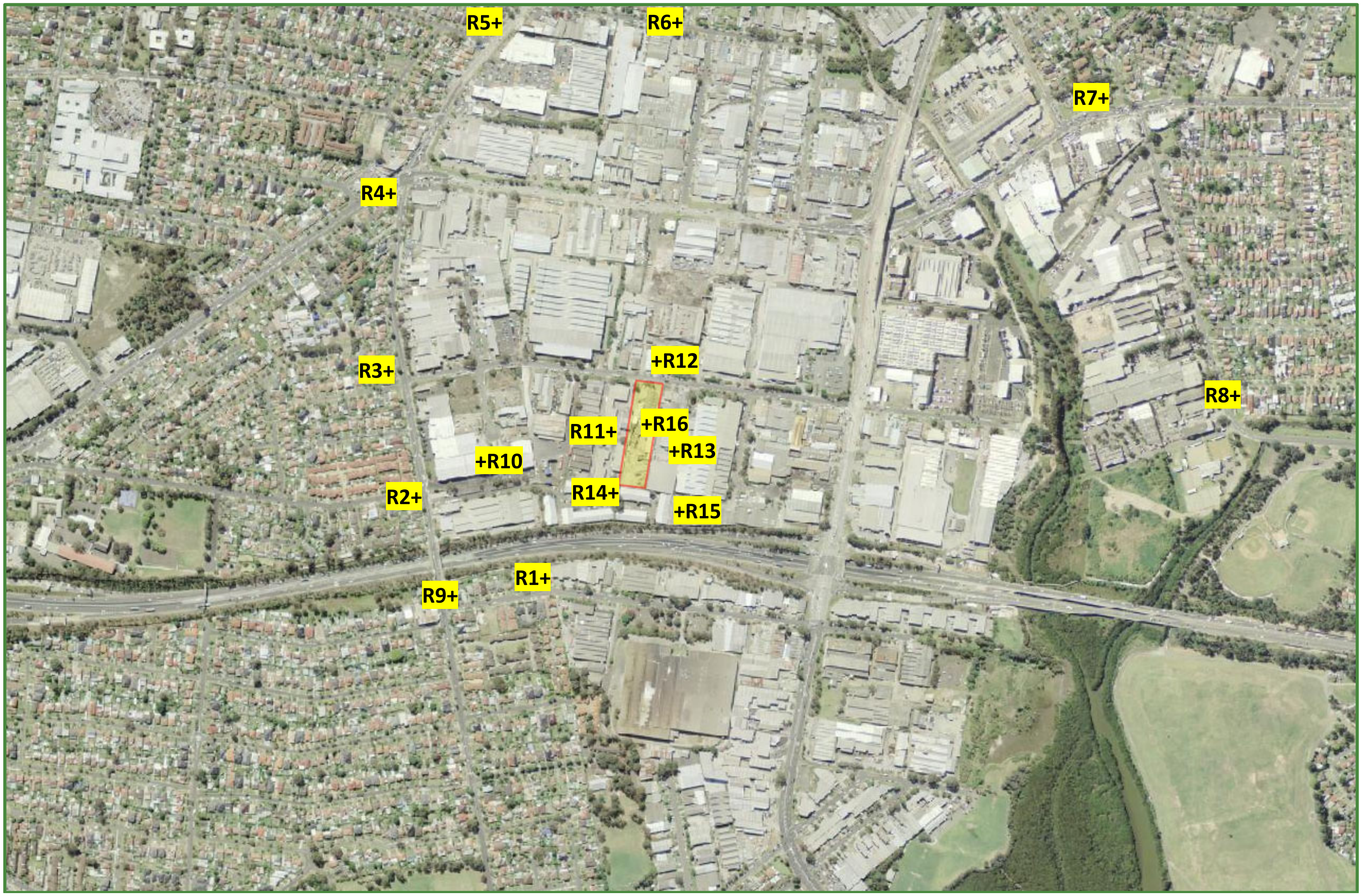
Table 2-1 lists the location of representative potentially affected receptors that are considered in this assessment. The locations are shown in Table 2-1 and Figure 2-4.

Table 2-1: Table of Nearest Receptors

Receptor ID	Address	Direction from Site	Lot & DP	Approx. Distance from Proposed Development	Type of Receptor
R1	24 Bryant Street, Padstow	SW	17 DP 18539	240 m	Residential
R2	59 Gibson Avenue, Padstow	W	1 DP 18270	430 m	Residential
R3	39 Gibson Avenue, Padstow	W	2 DP 26399	500 m	Residential
R4	168 Canterbury Road, Bankstown	NW	3 DP 10428	610 m	Residential
R5	76 Chapel Road, Bankstown	NW	6 DP 132453	780 m	Residential
R6	61 Marshall Street, Bankstown	N	4 DP 13275	700 m	Residential
R7	26 John Street, Punchbowl	NE	1 DP 36047	900 m	Residential
R8	62 Moxon Road, Punchbowl	E	1 DP 1129073	1030 m	Residential
R9	98-100 Gibson Avenue, Padstow	SW	11 DP 1208760	390 m	School Classroom
R10	9 Gatwood Close, Padstow	W	71 DP 1163243	290 m	Place of Worship
R11	89 Gow Street, Padstow	W	A SP 103140	Adjacent	Industrial
R12	82 Gow Street, Padstow	N	2 DP 392634	Adjacent	Industrial
R13	79 Gow Street, Padstow	E	3 DP 371357	Adjacent	Industrial
R14	78 Gibson Avenue, Padstow	S	SP 22907	Adjacent	Industrial
R15	9 Wordie Place, Padstow	SW	12 DP 242730	Adjacent	Industrial
R16	81 Gow Street, Padstow (on-site)	-	-	On-site	Dust monitor location

Note: distances measured from the boundaries of the site

Figure 2-4: Receptor Map



3. PREVIOUS AIR QUALITY ASSESSMENTS

3.1 AIR QUALITY MANAGEMENT PLAN (NORTHSTAR AIR)

Northstar Air, a specialist air quality practice, was engaged by GSRC to undertake on-site air monitoring for dust and make recommendations for dust management protocols.

After correspondence with the NSW EPA regarding conditions of the sites EPL (EPL No.: 10943) in relation to dust emissions, on-site dust monitoring and an Air Quality Management Plan (AQMP) was implemented by Northstar Air (Attachment 2). The purpose of the dust monitoring was to demonstrate that the implemented control measures outlined in the AQMP were sufficient to appropriately manage the risks of the activities being performed at the premises. Additionally, the AQMP was undertaken referencing the Dust Management Plan (DMP) also undertaken by Northstar Air for the site in 2018.

On-site monitoring was conducted over the course of approximately 3.5 months using active sampling for airborne particles of the PM_{10} size range. A summary of the findings of the AQMP are detailed below:

> *Air quality monitoring was performed to support dust management actions at the premises. The risk assessment outlined in report 20.1046.FR2V1 identified that without any mitigation measures applied, all activities performed at the premises would represent an unacceptable risk. The identified hazards were:*
>
> - *Movement of vehicles on hardstand areas*
> - *Unloading of material in the main yard*
> - *Loading of the crusher/screen*
> - *Crushing and screening of material*
> - *Unloading of materials from the crusher/screen to temp. stockpiles*
> - *Movement of materials about site by wheeled loader*
> - *Loading of trucks with product material*
> - *Wind erosion of hardstand areas*
> - *Wind erosion of stockpiles*
>
> *Correspondingly, control measures were required to reduce the associated risks as low as practicable. The controls outlined in Table 3-1 were recommended. These controls were selected based on the risk assessment outlined in report 20.1046.FR2V1, but also on detailed review of the previous Dust Management Plan as outlined in Appendix A of report 20.1046.FR2V1.*

Table 3-1: Recommended air quality management

Hazard	Recommended Control	Implementation	Contingency
Movement of vehicles on hardstand areas	Adherence to speed limits (5 km/hr), and installation of additional speed limit signs and speed humps	Always	Monitor the effectiveness of speed hump location and relocate as required
	Operation of contract street sweeper daily, Monday to Friday and GSRC sweeper on Saturdays	Always	GSRC street sweeper to be used in event of 'no show' by contractor
	Broom sweeping of required areas at least twice per day	Always	None required if street sweeper and contingency adopted
	Hosing and flushing of trafficked area	Always	None required if street sweeper and contingency adopted
	Use of reconfigured wheel bath	Always	Hosing of vehicles (especially wheels) if wheel bath not operational
	Minimisation of drop heights	Always	None available
Materials handling (loading and unloading)	Water sprays on all transfer points	Always	Modification of activities (i.e. reduction in activity rate)
	Modification of activities in windy condition	Always	Cessation of activities
	Use of wind shielding	Always	None required – engineered measure
Materials processing	Water sprays on crusher and screen when possible.	Always	Modification of activities (i.e. reduction in activity rate)
Wind erosion	Water sprays	Always	Modification of activities (i.e. reduction in activity rate)
	Storage of product in 3-sided bins	Always	None required – engineered measure
	Use of wind shielding	Always	None required – engineered measure
	Removal of fine particulates from premises	Always	None required

Results and recommendations from the AQMP indicate that with effective control measures on site, dust may be properly and appropriately managed.

It is expected that with the air dispersion modelling undertaken in this AQIA, coupled with continued additional and existing control measures, airborne dust emissions from the site can be managed appropriately and maintained below the criteria in the *Approved Methods.*
The AQMP dust monitoring data was utilised to establish real-time dust emissions on site and was adopted into calibrating the air dispersion model (Section 7.5) to accurately predict dust emissions off the site with current operations.

To accurately reflect current dust emissions from the site, source emissions in the air dispersion model were scaled up the NPI dust emission factors (with controls) by 450% for Scenario 1, as discussed in Section 7.3.2.

4. AIR QUALITY CRITERIA AND GUIDELINES

4.1 PROTECTION OF THE ENVIRONMENT OPERATIONS ACT 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) applies the following definitions relating to air pollution:

> *'**"Air pollution"** means the emission into the air of any air impurity.*
>
> *While "air impurity" includes smoke, dust (including fly ash), cinders, solid particles of any kind, gases, fumes, mists odours, and radioactive substances'*

The following sections of this Act have most relevance to the site:

- Section 124 Operation of Plant - other than domestic plant

  The occupier of any premises who operates any plant in or on those premises in such a manner as to cause air pollution from those premises is guilty of an offence if the air pollution so caused, or any part of the air pollution so caused, is caused by the occupier's failure:

  (a) to maintain the plant in an efficient condition, or

  (b) to operate the plant in a proper and efficient manner.

- Section 126 Dealing with Materials

  (1) The occupier of any premises who deals with materials in or on those premises in such a manner as to cause air pollution from those premises is guilty of an offence if the air pollution so caused, or any part of the air pollution so caused, is caused by the occupiers failure to deal with those materials in a proper and efficient manner.

  (2) In this section:

  ***deal** with materials means process, handle, move, store or dispose of the materials.*

  ***Materials** includes raw materials, materials in the process of manufacture, manufactured materials, by-products or waste materials.*

- Section 128 Standards of air impurities not to be exceeded

  (1) The occupier of any premises must not carry on any activity, or operate any plant, in or on the premises in such a manner as to cause or permit the emission at any point specified in or determined in accordance with the regulations of air impurities in excess of:

  (a) The standard of concentration and the rate, or

  (b) The standard of concentration or the rate.

Prescribed by the regulations in respect of any such activity or any such plant.

(2) Where neither such a standard nor rate has been so prescribed, the occupier of any premises must carry on any activity, or operate any plant, in or on the premises by such practicable means as may be necessary to prevent or minimise air pollution.

- Section 129 Standards of air impurities not to be exceeded

(1) The occupier of any premises at which scheduled activities are carried on under the authority conferred by a licence must not cause or permit the emission of any offensive odour form the premises to which the licence applies.

(2) It is a defence in proceedings against a person for an offence against this section if the person establishes that:

(a) The emission is identified in the relevant environment protection licence as a potentially offensive odour and the odour was emitted in accordance with the conditions of the licence directed at minimising the odour, or

(b) The only persons affected by the odour were persons engaged in the management or operation of the premises.

(3) A person who contravenes this section is guilty of an offence.

The proposed development is required to comply with this Act.

4.2 PROTECTION OF ENVIRONMENT OPERATIONS (CLEAN AIR) REGULATION 2010

In accordance with Part 5 of the *Protection of the Environment Operations (Clean Air) Regulation 2010* (herein referred to as the Clean Air Regulation), the proposed waste recycling facility would belong to Group 6 (Standards for scheduled premises) as the activity is to be "*commenced to be carried on, or to operate, on or after 1 September 2005 as a result of an environment protection licence granted under the* Protection of the Environment Operations Act 1997 *pursuant to an application made on or after 1 September 2005".*

Schedule 4 of the Clean Air Regulation provides standards of concentration for scheduled premises general activities and plant, any crushing, grinding, separating or materials handling activity:

Solid Particles (total) = 20 mg/m^3

The facility would be required to meet the above standard of concentration.

4.3 ADOPTED CRITERIA & NSW ENVIRONMENT PROTECTION AUTHORITY GUIDELINES

The *Approved Methods* (EPA 2016) provides guidance on methodology and thresholds that are to be used for the air impact assessment of a proposed development. This air impact assessment has been conducted in accordance with this guideline. Assessable pollutants (along with their corresponding limits) are summarised in Table 4-1. These criteria are applied at the nearest existing or likely future off-site sensitive receptor.

Table 4-1: Applicable Particulate Criteria at Sensitive Receptors from the NSW EPA Modelling Guidelines (*Approved Methods* 2016)

Pollutant	Averaging Period	Percentile	Concentration µg/m³
Total Suspended Particulates (TSP)	Annual	100th	90
PM_{10}	24 Hours	100th	50
	Annual	100th	25
$PM_{2.5}$	24 Hours	100th	25
	Annual	100th	8

5. METEOROLOGY AND LOCAL AIR QUALITY

The meteorological data used in the modelling of this assessment was no-observation prognostic meteorological data. A prognostic meteorological data file was created by Lakes Environmental with WRF and AERMET using a representative year. The representative year is selected based on the evaluation of weather monitoring stations for their proximity to the site, completeness of data, and similarity of topography to the subject site.

5.1.1 Representative Meteorological Year

The nearest weather monitoring station to the subject site with a full data set for both temperature and daily wind run is the Canterbury Racecourse AWS operated by the Bureau of Meteorology. This monitoring station is located approximately 8.55 km north-east of the subject site and was considered to be the most appropriate source of data for determining the representative year due to its proximity to the site, completeness of data, and similar topography to the subject site.

The representative meteorological year of 2015 was selected based on long term averages from Canterbury Racecourse AWS. Meteorological data for 2015 was compared with long term averages for minimum temperature, maximum temperature, and wind run and found to be consistent. (Attachment 1).

A 2015 prognostic meteorological data file was created by Lakes Environmental using the WRF model. This data file was used as input into AERMET pre-processor to create onsite Surface and profile met data.

5.1.2 WRF and AERMET

The Weather Research and Forecasting (WRF) Model is a next-generation mesoscale numerical weather prediction system designed as a collaborative effort between the American National Center for Atmospheric Research and other meteorological specialist organisations. It was created for both atmospheric research and operational forecasting applications and serves a wide range of meteorological applications across scales from tens of meters to thousands of kilometres.

AERMET is a meteorological pre-processor that organises data and estimates the necessary boundary layer parameters for dispersion calculations in AERMOD.

A meteorological data file was produced for inclusion in the air dispersion model using AERMET ver. 16216. The WRF prognostic data was entered into AERMET as onsite and upper air data. The surrounding land use was set to urban.

5.2 Wind Rose Plots

Wind rose plots show the direction from which the wind is coming with triangles known as "petals". The petals of the plots in summarise wind direction data into 8 compass directions ie. north, north-east, east, south-east, etc.

The length of the triangles, or "petals", indicates the frequency that the wind blows from the direction presented. Longer petals for a given direction indicate a higher frequency of wind from that direction. Each petal is divided into segments, with each segment representing one of the six wind speed classes. Thus, the segments of a petal show what proportion of wind for a given direction falls into each class.

The proportion of time for which wind speed is equal to or less than 0.5 m/s, when speed is negligible, is referred to as calm hours or "calms". Calms are not shown on a wind rose as they have no direction, but they are noted under each wind rose as a temporal percentage.

The concentric circles in each wind rose are the axes that denote wind frequencies. In comparing the plots it should be noted that the axis varies between wind roses, although all wind roses are the same size. The frequencies shown in the first quadrant (top-left quarter) of each wind rose are stated beneath the wind rose.

5.2.1 Local Wind Trends

Seasonal wind rose plots for this site using Canterbury Racecourse AWS data from 2015 have been included in Figure 5-1. Annual average wind speeds of 2.84 m/s and a calms frequency of 17.58% were estimated. Annual winds from the north-west were found to be dominant and were present at a frequency of approximately 15%.

The average summer wind speed was estimated to be the highest of the seasons at 3.31 m/s, with the lowest calms frequency of 14.10%. North-easterly winds were found to be strongly dominant followed by those from the south-east at a frequency of 21% and 18% respectively.

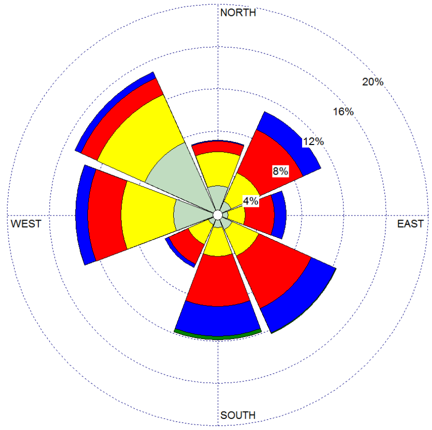
In autumn, dominant winds blew from the west (~18%). The average autumn wind speed was 2.76 m/s with a calms frequency of 18.26%.

The winter season data showed the prevalence of winds from the north-western and western directions. The dominant winds blew from the north-west at a frequency of ~26% and 22% from the west. The average winter wind speed was the lowest of all the seasons at 2.15 m/s with the highest calms frequency of 22.49%.

In the spring time, average wind speeds of 3.17 m/s were recorded. Dominant winds were from the north-east (15%), south-east (14%) and south (14%). The spring calms frequency was 14.89%.

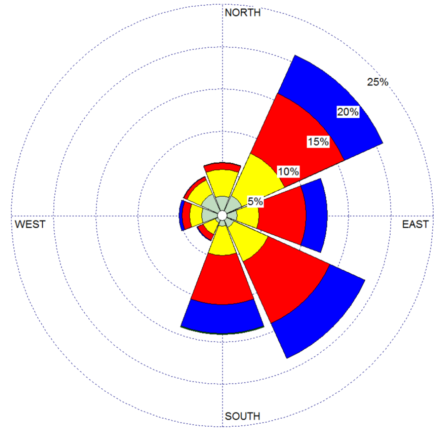
Figure 5-1: Wind Rose Plots for the Referenced Meteorological Station – Canterbury Racecourse, Bureau of Meteorology (2015)

All Seasons



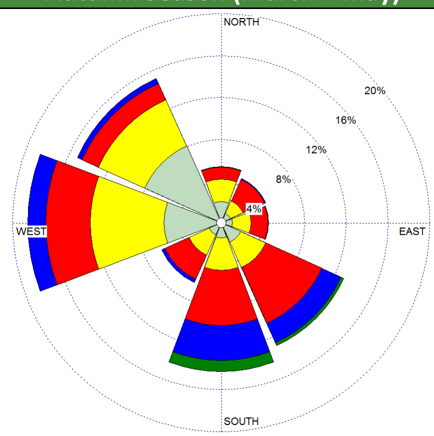
Average Wind Speed: 2.84 m/s
Calms Frequency: 17.58%
Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Summer Season (December – February)



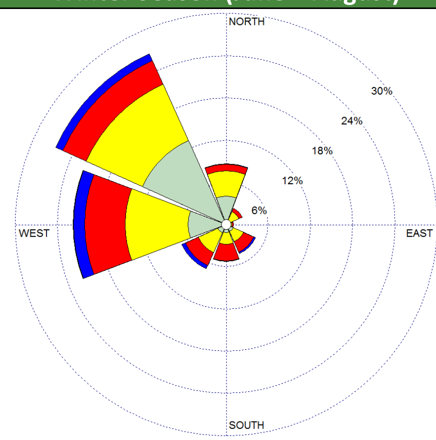
Average Wind Speed: 3.31 m/s
Calms Frequency: 14.10%
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Autumn Season (March – May)



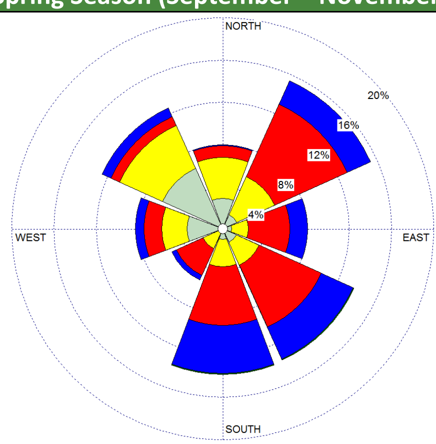
Average Wind Speed: 2.76 m/s
Calms Frequency: 18.26%
Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Winter Season (June – August)



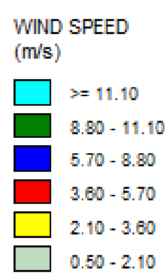
Average Wind Speed: 2.15 m/s
Calms Frequency: 22.49%
Axis Frequencies: 6%, 12%, 18%, 24%, 30%

Spring Season (September – November)



Average Wind Speed: 3.17m/s
Calms Frequency: 14.89%
Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Legend



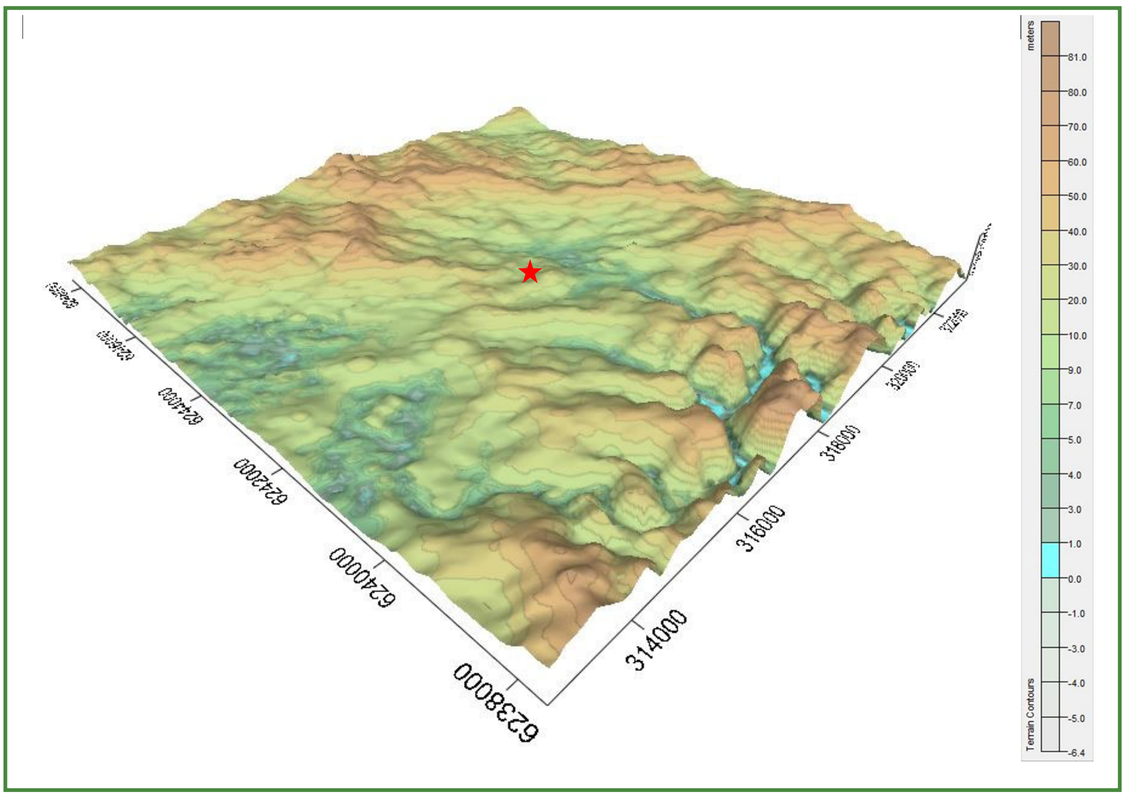
5.3 TERRAIN AND STRUCTURAL EFFECTS ON DISPERSION

The meteorological condition known as katabatic flow (or katabatic drift) is often identified as the condition under which maximum environmental impacts from primarily ground-based sources are likely to occur. Katabatic flow is simply the movement of cold air down a slope, generally under stable atmospheric conditions. Under such circumstances, dispersion of airborne pollutants is generally slow and the associated impacts can reach their peak.

Katabatic flow is unlikely to affect emissions from the site's activities as the site is at a low elevation and is relatively flat in an industrial area. The closest residential areas to the west and south-west are at higher elevations.

Figure 5-2 shows the terrain with the z-axis (i.e. vertical axis) exaggerated by a factor of 10 (i.e. a given distance on the x-axis or y-axis appears three times as great on the z-axis) in order to provide a clearer description of the topography. A coloured scale bar shows elevations corresponding to the colours used in the figures. It should be noted that these figures are an approximation of the actual terrain, based on terrain information from NASA SRTM 1-arc second digital elevation models.

Figure 5-2: Local topography of site with factor of 10 vertical exaggeration



★ = site location

5.4 LOCAL AIR QUALITY

No air quality measurements have been undertaken specifically for this project. Instead, the nearest available air quality monitoring data was used to gain an understanding of what current pollutant levels may be around the site and to provide background air quality parameters for the assessment.

Ambient air quality data for $PM_{2.5}$ and PM_{10} was obtained from the NSW EPA Chullora air quality monitoring station located approximately 5.35 km north-north-east of the subject site, adjacent to the Cooks River, Chullora. This station is considered to be site-representative. The relevant data is summarised in Table 5-1.

Table 5-1: Summary of 2015 Data for $PM_{2.5}$ and PM_{10} from Chullora Air Quality Monitoring Station.

Pollutant	Averaging period	Concentration (µg/m³)
$PM_{2.5}$	Maximum 24 hr average for 2015	**37.21**
	2nd highest 24 hr average for 2015	19.25
	3rd highest 24 hr average for 2015	18.37
	Annual average for 2015	**8.62**
PM_{10}	Maximum 24 hr average for 2015	**64.56**
	2nd highest 24 hr average for 2015	48.23
	3rd highest 24 hr average for 2015	46.21
	Annual average for 2015	17.59

Note: Bold values exceed the *Approved Methods* criteria.

No ambient air quality data for Total Suspended Particulates (TSP) is available from the referenced monitoring station. Therefore, the worst-case particle size distribution data from the AP-42 Emissions Database provided by the U.S. Environmental Protection Agency (US EPA, 1995), a PM_{10}-to-TSP ratio of 0.51 was used to estimate the TSP background concentration level of 34.31 µg/m³ for an annual averaging period.

The data collected from Chullora air quality monitoring station shows elevated background levels of both $PM_{2.5}$ and PM_{10} that are above the *Approved Methods* 24 hour average criterion of 25 µg/m³ for $PM_{2.5}$ and 50 µg/m³ for PM_{10}. Although, the annual average of PM_{10} was within the criteria of 25 µg/m³, the annual average of $PM_{2.5}$ exceeded the criteria of 8 µg/m³.

In cases of elevated background concentrations, the *Approved Methods* states:

> *In some locations, existing ambient air pollutant concentrations may exceed the impact assessment criteria from time to time. In such circumstances, a licensee must demonstrate that no additional exceedances of the impact assessment criteria will occur as a result of the proposed activity and that best management practices will be implemented to minimise emissions of air pollutants as far as is practical.*

This has been addressed in the modelling results and discussion in Section 7.6.

6. AIR QUALITY IMPACTS

6.1 Construction

Construction of the drilling mud dewatering facility and infrastructure will be undertaken on site within an existing building and expected to be completed within 4 months. These construction activities, while minor, have the potential to generate dust where not managed appropriately.

A Construction Environmental Management Plan (CEMP) is recommended to be prepared that documents the environmental aspects of the construction phase and establishes procedures to manage any potential impacts. It is recommended an Air Quality Control Procedure be presented in the CEMP which sets out the procedure for managing and monitoring air emissions during construction. The following is a summary of the control measures provided in the procedure. Local weather conditions should be taken into account in determining the level and suitability of controls required.

Control Measures

- Monitor local weather conditions and cease dust generating operations when conditions result in visible dust emissions, and implement mitigation measures or until weather conditions improve;
- Erection of wind breaks such as fences or vegetative buffers at the site boundary;
- Locate stockpiles away from drainage paths, easement, kerb, or road surface, and near existing wind breaks such as trees and fences;
- Dust suppression/wind breaks on stockpiles;
- Limit stockpile height to 5 m (maximum) and size;
- Vehicles leaving the site to be cleaned of dirt and other materials to avoid tracking onto public roads;
- Enforce appropriate speed limits for vehicles on site. Recommended speed limit is <15 km/hr;
- Cover all loads entering and leaving the site; and
- Inspect the site daily using a Site Dust Control Checklist to aid with the implementation of air quality control measures.

6.2 Operations

Potential emissions from industrial developments include dust, odour and greenhouse gases (GHG).

The proposed development will include the following dust generating activities:

- Unloading and loading of materials (liquid and C&D waste);
- Material handling and sorting (liquid and C&D waste);
- Crushing and screening of C&D waste including VENM, ENM, recycled crushed concrete, brick and excavated rock products; and
- Material storage in stockpiles (aggregates from liquid waste and C&D).

Control Measures

The site will have various dust mitigation measures implemented to reduce operational dust impacts, including dust sprays, enclosures, and a custom-built vacuum hood around the crusher and screener.

Dust impacts are assessed further in Section 7.

GHG emissions are assessed further in Section 8.

6.3 ODOUR IMPACTS

Odour is not expected to be emitted from the site as there are no odour producing materials processed at the site. However, drilling mud has the potential to be odorous depending on its source or chemical presence/reactions.

The drilling mud received by the facility is non-destructive digging waste, which is a water-based drilling mud containing clay (usually bentonite) and various non-odorous chemicals. Odorous drilling mud types (including oil-based muds and synthetic based muds) which are generally used on offshore rigs, would not be received by the facility.

Under *The Treated Drilling Mud Order 2014*, the following definitions are provided:

> ***Drilling fluid** means a mixture of water and chemical additives including but not limited to bentonite, soda ash (sodium carbonate), sodium hydroxide, lime and polymers.*
>
> ***Drilling mud** means a mixture of naturally occurring rock and soil, including but not limited to materials such as sandstone, shale and clay, and drilling fluid generated during drilling operations such as horizontal directional drilling or potholing. This does not include drilling mud that has been generated by:*
>
> *(a) Deep drilling for mineral, gas or coal exploration; or*
> *(b) Drilling through contaminated soils, acid sulphate soils (ASS) or potential acid sulphate soils (PASS)*

The drilling mud would meet the above definitions to enable the treated drilling mud to be applied to land under the resource recovery exemption. The chemical additives listed above are all known to be odourless, as stated in relevant safety data sheets. One chemical of concern is barium sulphate, which has the potential to be odorous due to the presence of sulphate which could potentially be reduced to hydrogen sulphide under anaerobic conditions. Drilling mud containing barium sulphate would not be accepted at the facility.

Additionally, drilling mud received at the site would require customers agreeing to and complying with the following criteria, prior to the site accepting the drilling mud delivery:

1. A mixture of naturally occurring rock and soil, including but not limited to materials such as sandstone, shale and clay, and drilling fluid generated during drilling operations such as horizontal directional drilling or potholing.

2. Does not include drilling mud generated by:
    a. deep drilling for mineral gas or coal exploration; or
    b. drilling through contaminated soils, acid sulphate soils (ASS) or potential acid sulphate soils (PASS); or
    c. drilling through soil contaminated by a hazardous contaminant
3. Does not contain any of the following:
    a. Restricted simulation fluids
    b. Any characteristics under the Australian dangerous goods code (e.g: explosives, flammable or emitting flammable gases, oxidising, containing organic peroxides, poisonous, infectious, corrosive, toxic)
4. Free from:
    a. Detectable offensive odours;
    b. Glass, metal, plastics, rubber and coatings; and
    c. Pests or vermin infestations

As the drilling mud to be accepted would be free from detectable offensive odour (odourless), a detailed odour assessment is not considered warranted.

7. DUST IMPACT ASSESSMENT

This section assesses the effects of potential emissions on the existing ambient air quality as a direct result of the proposal. The assessment methodology, modelling configurations, results and discussion of the potential impacts as well as any recommendations on mitigation measures are described in detail.

The dust impact assessment has been undertaken in two separate scenarios:

Scenario 1 – modelled emission sources with general mitigation measures recommended and
Scenario 2 – modelled emission sources with an additional custom flexible hood and vacuum ducting applied to the crusher/screen.

7.1 EMISSION SOURCES

Emission sources for processes on site are confined to the C&D activities and drilling mud aggregate storage. The main air emissions typical of a C&D recycling facility are dust and particulates ($PM_{2.5}$, PM_{10} and total suspended particulates (TSP)). The sources of these emissions are the following:

- Screening;
- Crushing;
- Front end loader (x4);
- Truck loading;
- Truck unloading; and
- Stockpile wind erosion.

Activities associated with the drilling mud dewatering facility are performed in a closed environment and do not generate dust. The drilling mud dewatering facility and its processes have not been considered a contributing factor to dust emissions on site. However, aggregate storage bays for recovered materials from drilling mud/concrete washout water has the potential to generate dust during windblown erosion.

Wheel generated dust has not been considered as a significant source of emissions. The entire site is sealed hardstand of compacted road base which releases minimal dust. Trucks wheels will also be promptly cleaned in a wheel wash as they leave the site to remove any dust or sediments, and will only achieve minimal speeds on the site. Hence, wheel generated dust emissions are adequately controlled.

7.2 MITIGATION MEASURES

The air quality mitigation measures (for dust control) that are included in the air dispersion model and proposed development are as follows:

Scenario 1:

- All dust generating activities will have direct dust suppression sprays;
- All dust generating activities areas will have perimeter dust suppression sprays;

- Truck loading and unloading, front end loader shovelling (1-2) will occur in bays with 2-3 wall/windbreaks;
- Stockpiled materials are stored within storage bays are enclosed bays with 2-3 walls and have directs dust suppression sprays applied; and
- Activities in the southern end of the site will have additional wind breaks due to the 8.5 m walls surrounding these activities (Stockpiles 1-2 excluded).

Scenario 2:

- All dust generating activities will have direct dust suppression sprays;
- All dust generating activities areas will have perimeter dust suppression sprays;
- Truck loading and unloading, front end loader shovelling will occur in bays with 2-3 wall/windbreaks;
- Stockpiled materials are stored within storage bays are enclosed bays with 2-3 walls and have directs dust suppression sprays applied; and
- Activities in the southern end of the site will have additional wind breaks due to the 8.5 m walls surrounding these activities front end loaders 3-4, and stockpiles 1-2 excluded).
- Crusher and screen are covered by a flexible hood and vacuum ducting.

7.3 Adopted Emission Factors

The below emission factors from the NPI EETM for Mining (2012), Mining and Processing of Non-Metallic Minerals (2014) (crushed stone processing data) were utilised in this assessment to represent C&D activities on site.

As the emission factor acquired from the NPI EETM only provides the emission factor for PM_{10}, further calculations were required to estimate the emission factors for Total Suspended Particulates (TSP) and $PM_{2.5}$. For this purpose, the generalised particle size distribution for mechanically generated aggregate and unprocessed ores from US EPA's AP-42 database was used to estimate the proportion of PM_{10} to TSP and also for PM_{10} to $PM_{2.5}$. These ratios were then used to derive the emission factors for TSP and $PM_{2.5}$ (Aggregates). Table 7-2 demonstrates the adopted emission factors per activity on site. The excerpt for the generalised particle size distribution has been provided as Table 7-1.

Table 7-1: US EPA AP-42 Generalised Particle Size Distribution for Mechanically Generated Aggregate, Unprocessed Ores

Particle Size (µm)	Cumulative % ≤ Stated Size (Uncontrolled)	Minimum Value	Maximum Value	Standard Deviation
2.5	15	3	35	7
10.0	51	23	81	14

Table 7-2 shows the emission factors adopted for C&D activities on site.

Table 7-2: Emission Factors for PM_{10} from NPI EETM for Mining and Processing of Non-Metallic Minerals (2014) and Mining (2012)

Reference (NPI EETM)	Source	$PM_{2.5}$ Emission Factor (kg/tonne)	PM_{10} Emission Factor (kg/tonne)	TSP Emission Factor (kg/tonne)
Mining and Processing of Non-Metallic Minerals	Screening	0.00151	0.0043	0.0125
Mining and Processing of Non-Metallic Minerals	Crushing	0.00042	0.0012	0.0027
Mining and Processing of Non-Metallic Minerals	Loading	0.00001	0.00005	[1]0.00010
Mining and Processing of Non-Metallic Minerals	Unloading	0.000001	0.000008	[1]0.00002
Mining (overburden)	Front End Loader/ Excavator	0.0018	0.012	0.025
Mining	Wind Erosion from Stockpiles	0.03 kg/ha/hr	0.2 kg/ha/hr	0.4 kg/ha/hr

Note: [1]NPI EETM not available, estimated using US EPA's AP-42 database.

7.3.1 Reduction Factors

Reduction factors for the facility have been based on the *Emission Estimation Technique Manual for Concrete Batching and Concrete Product Manufacturing* (NPI DEH, 1999) which are shown in Table 7-3.

Table 7-3: Reduction Factors for PM_{10} for Concrete Batching Activities from NPI EETM for Concrete Batching and Concrete Products

Control	Reduction Factor (Materials Handling)	Reduction Factor (Materials Storage)
Default	-	0.3
Wind Breaks	0.7	0.7
Water Sprays	0.5	0.5
Chemical Suppression	0.2	0.2
Enclosure (2-3 walls)	0.1	0.1
Covered Stockpiles	0.0	0.0
Enclosed	0.0	-

Reduction factors shown in Table 7-3 were applied to the NPI EETM emission factors for Scenario's 1 and 2, shown below in Table 7-4 and Table 7-5. These tables show the emission reduction controls in place for each dust generating process. Where reduction factors have been multiplied for handling and storage, the factor is shown in brackets with the relevant applied factor and an explanation is provided justifying the use of multiplied reduction.

Where additional controls were applied in Scenario 2, an additional reduction factor of 0.1 was utilised to the crusher and screener as it is to be designed as an effective enclosure. T

Table 7-4: Scenario 1 Emission Reduction Factors Applied to NPI EETM Emission Factors

Processes at Proposed Site	Control in Place	Reduction Factor(s) Applied	Comments
Screening	Enclosure (2-3 walls), water sprays	0.1, 0.5 (x2)	Enclosure control applied as 8.5 m perimeter fencing encloses activity. Water sprays applied directly at the source **and** perimeter of activity area.
Crushing	Enclosure (2-3 walls), water sprays	0.1, 0.5 (x2)	Enclosure control applied as 8.5 m perimeter fencing encloses activity. Water spray controls applied directly at the source **and** perimeter of activity area.
Truck Loading	Enclosure (2-3 walls), water sprays	0.1 (x2), 0.5 (x2)	Enclosure control applied directly at source (stockpile bays are enclosed) **and** 8.5 m perimeter fencing enclosing activity. Water sprays applied directly at the source **and** perimeter of activity area.
Truck Unloading	Enclosure (2-3 walls), water sprays	0.1 (x2), 0.5 (x2)	Enclosure control applied directly at source (stockpile bays are enclosed) **and** 8.5 m perimeter fencing enclosing activity. Water sprays applied directly at the source **and** perimeter of activity area.
Front-end Loader/excavator (1 & 2) with rear walls	Enclosure (2-3 walls), water sprays	0.1 (x2), 0.5 (x2)	Enclosure control applied directly at source (stockpile bays are enclosed) **and** 8.5 m perimeter fencing enclosing activity. Water sprays applied directly at the source **and** perimeter of activity area.

Table 7-4: Scenario 1 Emission Reduction Factors Applied to NPI EETM Emission Factors

Processes at Proposed Site	Control in Place	Reduction Factor(s) Applied	Comments
Front-end Loader/excavator (3 & 4) without rear walls	Enclosure (2-3 walls), water sprays	0.1, 0.5 (x2)	Enclosure control applied as 8.5 m perimeter fencing encloses activity. Water sprays applied directly at the source **and** perimeter of activity area.
Wind erosion from Stockpiles	Enclosure (2-3 walls), water sprays	0.1, 0.5 (x2)	Enclosure control applied as 8.5 m perimeter fencing encloses activity. Water sprays applied directly at the source **and** perimeter of activity area.

Table 7-5: Scenario 2 Emission Reduction Factors Applied to NPI EETM Emission Factors

Processes at Proposed Site	Control in Place	Reduction Factor(s) Applied	Comment
Screening	Enclosure (2-3 walls), water sprays	0.1 (x2), 0.5 (x2)	Enclosure control applied as 8.5 m perimeter fencing encloses activity. Water sprays applied directly at the source **and** perimeter of activity area. Additional enclosure and vacuum ducting.
Crushing	Enclosure (2-3 walls), water sprays	0.1 (x2), 0.5 (x2)	Enclosure control applied as 8.5 m perimeter fencing encloses activity. Water spray controls applied directly at the source **and** perimeter of activity area. Additional enclosure and vacuum ducting.
Truck Loading	Enclosure (2-3 walls), water sprays	0.1 (x2), 0.5 (x2)	Enclosure control applied directly at source (stockpile bays are enclosed) **and** 8.5 m perimeter fencing enclosing activity. Water sprays applied directly at the source **and** perimeter of activity area.

Table 7-5: Scenario 2 Emission Reduction Factors Applied to NPI EETM Emission Factors

Processes at Proposed Site	Control in Place	Reduction Factor(s) Applied	Comment
Truck Unloading	Enclosure (2-3 walls), water sprays	0.1 (x2), 0.5 (x2)	Enclosure control applied directly at source (stockpile bays are enclosed) **and** 8.5 m perimeter fencing enclosing activity. Water sprays applied directly at the source **and** perimeter of activity area.
Front-end Loader/excavator (1 & 2) with rear walls	Enclosure (2-3 walls), water sprays	0.1 (x2), 0.5 (x2)	Enclosure control applied directly at source (stockpile bays are enclosed) **and** 8.5 m perimeter fencing enclosing activity. Water sprays applied directly at the source **and** perimeter of activity area.
Front-end Loader/excavator (3 & 4) without rear walls	Enclosure (2-3 walls), water sprays	0.1, 0.5 (x2)	Enclosure control applied as 8.5 m perimeter fencing encloses activity. Water sprays applied directly at the source **and** perimeter of activity area.
Wind erosion from Stockpiles	Enclosure (2-3 walls), water sprays	0.1, 0.5 (x2)	Enclosure control applied as 8.5 m perimeter fencing encloses activity. Water sprays applied directly at the source **and** perimeter of activity area.

7.3.2 Scaling dust emission rates

An iterative modelling analysis was undertaken to ensure that scenario source emissions accurately reflected the results from the on-site monitoring undertaken by NorthStar Air (Attachment 2).

In addition to the surrounding sensitive receptors, this analysis included a receptor at the location of the North Star dust monitor. It also included a comparison of source types for the crusher and screener.

It was found that scaling the NPI emission factors up by a factor of 4.5 (450%) the results for scenario 1 were representative of the PM_{10} results measured in the NorthStar Air report.

It was also found that volume source type tended to over predict the impacts form the crusher and screener compared to the area source type. The predicted impacts from using an area source type for the crusher and screen were very close the results from dust monitoring. Using area source type for these is considered representative of the site, as the crusher and screen have a large opening on the horizontal plane at ~3m height, rather than being open at multiple sides.

The emission rates presented for scenario 1 and 2 include this 4.5 (450%) factor increase.

7.4 SOURCE CONFIGURATIONS AND PARAMETERS

7.4.1 Assumptions and Emission Sources Modelled

Each potential dust emitting process at the facility was allocated a separate source in the dispersion model. Emission rates for Scenario's 1 and 2 are outlined in Table 7-7 and Table 7-7 respectively shows the source model configuration for all dust emission sources. Emission sources are described below.

The following assumptions were used in the model for C&D activities. Liquid waste processing activities were not included in the model as the processes are completely enclosed, in a wet environment and do not generate dust. However, stockpiled materials (recovered aggregates) from drilling mud water has been included in the model.

The following assumptions for modelled dust generating activities are:

- A total of 80,000 tonnes per annum of raw material processed was used to estimate emissions from the subject site for all C&D activities including truck loading, truck unloading, front end loader (x 2), excavator (x 2), aggregate crusher, aggregate screeners and stockpile sources (x 5);
- The maximum peak daily processed (crushed & screened) material usage of 48,048 tonnes of materials was used to estimate emissions from the subject site for the 24 hour daily emissions of the loading, unloading, front end loader, crusher and screener sources;
- Stockpiles were assumed to occupy 1,985 m^2 for 24 hours per day and 365 days per year. The same emission rate and area size were used to estimate both annual and 24 hours emissions;
- Release heights for truck loading and unloading was 2 m;
- Release heights for crushing, screening and front end loading activities was 3 m;
- Release height for stockpiles was 0 m; and
- All sources were modelled for 24 hours per day, 7 days per week.
- Note: Crusher and screen are covered by a flexible hood and vacuum ducting, this is applied as an additional control only for these two sources in Scenario 2.

Table 7-6: Summary of Emission Sources –Scenario 1

Source Name	Source ID (model)	Source Type	Source Area (m^2)	Release Height (m)	Daily Emission Rate (g/s)		Annual Emission Rate (g/s)		
					$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	TSP
Screening	SCRN1	Area	8	3	7.88E-03	2.25E-02	3.60E-03	1.03E-02	6.09E-02
Crushing	CRUS1	Area	8	3	1.64E-03	4.69E-03	7.49E-04	2.14E-03	7.91E-03
Truck Loading	LOAD	Volume	30	2	4.69E-07	3.13E-06	2.14E-07	1.43E-06	3.98E-06
Truck Unloading	UNLO	Volume	30	2	7.50E-08	5.00E-07	3.42E-08	2.28E-07	6.37E-07
Front-end Loader/excavator (22) with rear walls	FEL1-2	Volume	4	3	2.25E-04	1.50E-03	1.03E-04	6.85E-04	2.03E-03
Front-end Loader/excavator (2) without rear walls	FEL3-4	Volume	4	3	2.25E-03	1.50E-02	1.03E-03	6.85E-03	2.03E-02
Stockpile 1	STK1	Area	217	0	2.04E-05	1.36E-04	2.04E-05	1.36E-04	2.72E-04
Stockpile 2	STK2	Area	247	0	2.32E-05	1.54E-04	2.32E-05	1.54E-04	3.09E-04
Stockpile 3	STK3	Area	615	0	5.77E-06	3.85E-05	5.77E-06	3.85E-05	7.69E-05
Stockpile 4	STK4	Area	835	0	7.83E-06	5.22E-05	7.83E-06	5.22E-05	1.04E-04
Stockpile 5	DMAG	Area	70	0	6.56E-07	4.38E-06	6.56E-07	4.38E-06	8.75E-06

Table 7-7: Summary of Emission Sources – Scenario 2

Source Name	Source ID (model)	Source Type	Source Area (m^2)	Release Height (m)	Daily Emission Rate (g/s)		Annual Emission Rate (g/s)		
					$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	TSP
Screening	SCRN1	Volume	60	3	1.64E-04	4.69E-04	3.60E-04	1.03E-03	6.09E-03
Crushing	CRUS1	Volume	60	3	7.88E-04	2.25E-03	7.49E-05	2.14E-04	7.91E-04
Truck Loading	LOAD	Volume	30	2	4.69E-07	3.13E-06	2.14E-07	1.43E-06	3.98E-06
Truck Unloading	UNLO	Volume	30	2	7.50E-08	5.00E-07	3.42E-08	2.28E-07	6.37E-07
Front-end Loader/excavator (2) with rear walls	FEL1-2	Volume	4	3	2.25E-04	1.50E-03	1.03E-04	6.85E-04	2.03E-03
Front-end Loader/excavator (2) without rear walls	FEL3-4	Volume	4	3	2.25E-03	1.50E-02	1.03E-03	6.85E-03	2.03E-02
Stockpile 1	STK1	Area	217	0	2.04E-05	1.36E-04	2.04E-05	1.36E-04	2.72E-04
Stockpile 2	STK2	Area	247	0	2.32E-05	1.54E-04	2.32E-05	1.54E-04	3.09E-04
Stockpile 3	STK3	Area	615	0	5.77E-06	3.85E-05	5.77E-06	3.85E-05	7.69E-05
Stockpile 4	STK4	Area	835	0	7.83E-06	5.22E-05	7.83E-06	5.22E-05	1.04E-04
Stockpile 5	DMAG	Area	70	0	6.56E-07	4.38E-06	6.56E-07	4.38E-06	8.75E-06

Figure 7-1: Arrangement of Modelled Sources

7.5 AIR IMPACT MODELLING

7.5.1 Dispersion Model

The new generation air dispersion model, AERMOD ver. 9.8.0, was used for the prediction of off-site impacts associated with the air emissions from the proposed operations. AERMOD uses air dispersion based on planetary boundary layer turbulence structure and scaling concepts. The AERMOD model replaced AUSPLUME as the air dispersion model accepted by the Victorian EPA in January 2014 and is a suitable model to use for this air assessment.

The model was used to estimate the concentration impacts on receptors for each hour of input meteorology. Terrain was assumed to be elevated.

7.5.1.1 Meteorological Data

Prognostic meteorological data for the year 2015 was obtained from Lakes Environmental Services and pre-processed using AERMET, as described in Sections 5.1.1 and 5.1.2. The resultant upper air and surface data files were input to AERMOD.

7.5.2 Air Impact Modelling Results

As discussed previously, air impact modelling was undertaken for two scenarios:

Scenario 1 – modelled emission sources with general mitigation measures recommended and
Scenario 2 – modelled emission sources with an additional custom flexible hood and vacuum ducting applied to the crusher/screen.

Receptor ID's R1-10 include the nearest sensitive receptors such as residences, schools and places of worship. Receptor ID's R11-15 include the nearest industrial receptors. Receptor ID R16 is the dust monitoring device placed on-site by Northstar Air.

7.5.2.1 Scenario 1: Maximum impacts at sensitive receptors

Table 7-8 to Table 7-12 provide the results of the maximum modelled impacts for each identified receptor for Scenario 1. Isopleths for each averaging period are provided in Figure 7-2 to Figure 7-6. Background concentrations that exceed the relevant *Approved Methods* criterion are marked with red text.

Table 7-8: TSP Annual Averaging Period Modelling Results – Scenario 1

Receptor ID	Incremental Impact (µg/m³)	Background (µg/m³)	Cumulative Impact (µg/m³)	Criteria (µg/m³)
R1	0.88	34.31	35.19	90
R2	0.37		34.68	
R3	0.23		34.54	
R4	0.13		34.44	
R5	0.09		34.40	
R6	0.10		34.41	
R7	0.07		34.38	
R8	0.09		34.40	
R9	0.42		34.73	
R10	0.66		34.97	
R11	10.33		44.64	
R12	1.56		35.87	
R13	7.33		41.64	
R14	28.48		62.79	
R15	3.27		37.58	
R16	37.50		71.81	

Note: Complies / Non-compliance

Figure 7-2: TSP Annual Averaging Period Modelling Results – Scenario 1

Table 7-9: PM_{10} Annual Averaging Period Modelling Results – Scenario 1

Receptor ID	Incremental Impact (µg/m³)	Background (µg/m³)	Cumulative Impact (µg/m³)	Criteria (µg/m³)
R1	0.201	17.59	17.80	25
R2	0.09		17.68	
R3	0.06		17.65	
R4	0.03		17.62	
R5	0.02		17.61	
R6	0.03		17.62	
R7	0.02		17.61	
R8	0.02		17.61	
R9	0.102		17.69	
R10	0.17		17.76	
R11	3.15		20.74	
R12	0.43		18.02	
R13	2.04		19.63	
R14	5.69		23.28	
R15	0.71		18.30	
R16	12.21		29.80	

Note: Complies / Non-compliance

Figure 7-3: PM_{10} Annual Averaging Period Modelling Results – Scenario 1

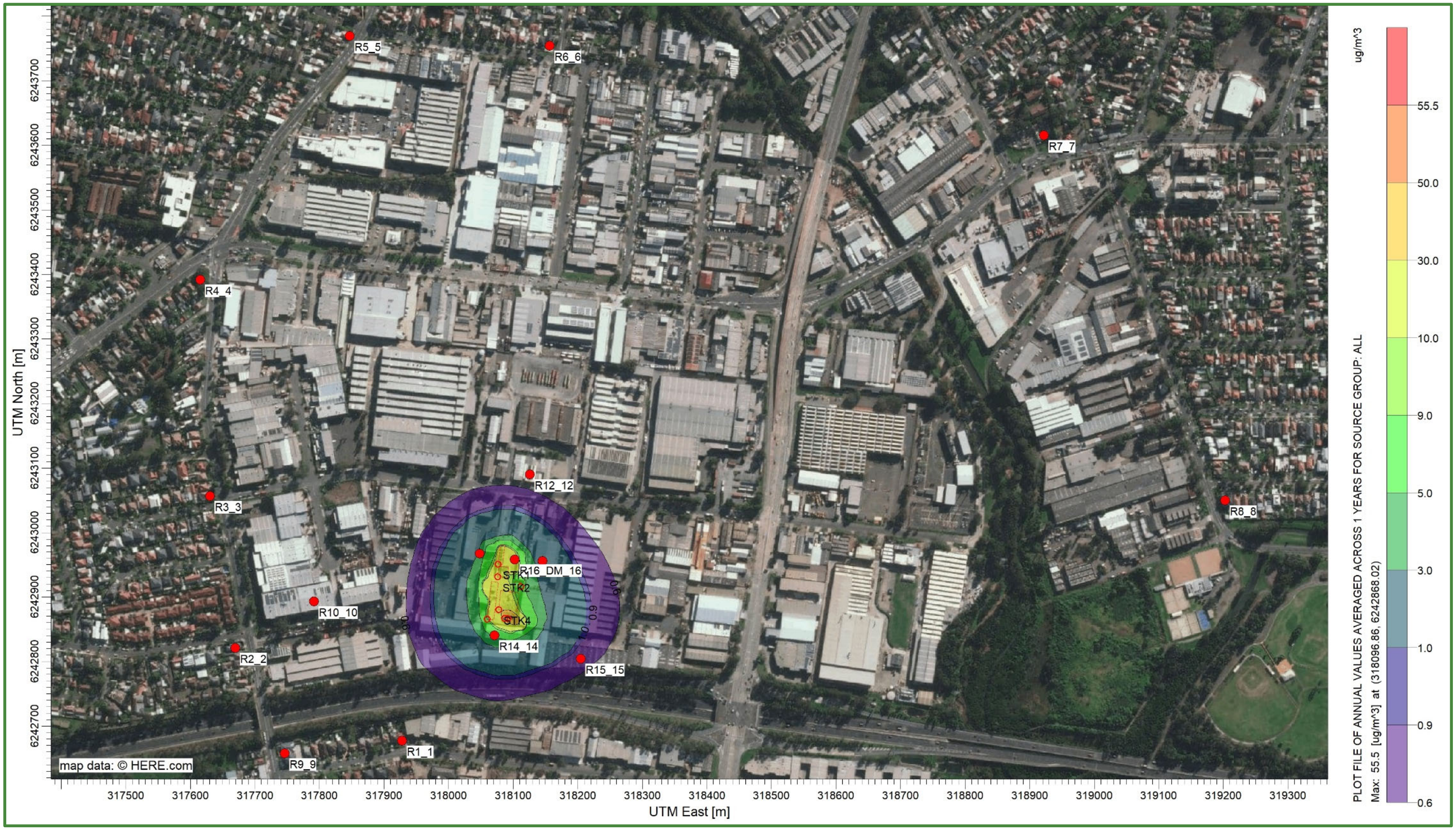


Table 7-10: $PM_{2.5}$ Annual Averaging Period Modelling Results – Scenario 1

Receptor ID	Incremental Impact (µg/m³)	Background (µg/m³)	Cumulative Impact (µg/m³)	Criteria (µg/m³)
R1	0.05	8.62	8.67	8
R2	0.02		8.64	
R3	0.01		8.63	
R4	0.01		8.63	
R5	0.01		8.63	
R6	0.01		8.63	
R7	0.00		8.62	
R8	0.01		8.63	
R9	0.02		8.64	
R10	0.01		8.66	
R11	0.56		9.18	
R12	0.09		8.71	
R13	0.41		9.03	
R14	1.75		10.37	
R15	0.20		8.82	
R16	1.96		10.58	

Note: Complies / Non-compliance

Figure 7-4: $PM_{2.5}$ Annual Averaging Period Modelling Results – Scenario 1

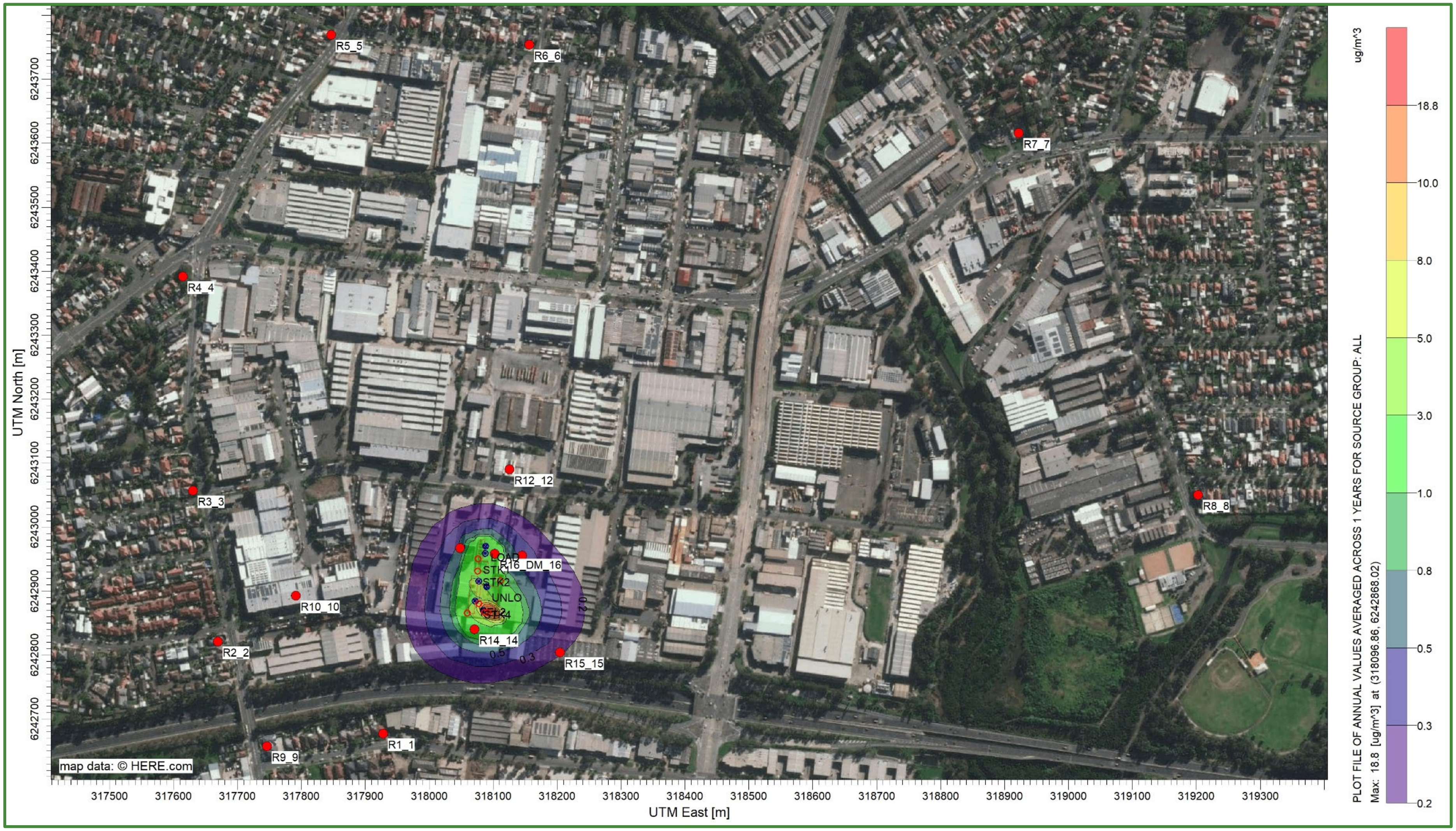


Table 7-11: PM_{10} 24 Hour Averaging Period Modelling Results – Scenario 1

Receptor ID	Incremental Impact (µg/m³)	Background (µg/m³)	Cumulative Impact (µg/m³)	Criteria (µg/m³)
R1	2.65	64.56	67.21	50
R2	2.12		66.68	
R3	1.57		66.13	
R4	0.92		65.48	
R5	0.71		65.27	
R6	0.55		65.11	
R7	0.36		64.92	
R8	0.55		65.11	
R9	1.70		66.26	
R10	4.28		68.84	
R11	19.77		84.33	
R12	4.54		69.10	
R13	16.16		80.72	
R14	43.00		107.56	
R15	14.39		78.95	
R16	54.55		119.11	

Note: Complies / Non-compliance

Figure 7-5: PM_{10} 24 Hour Averaging Period Modelling Results – Scenario 1

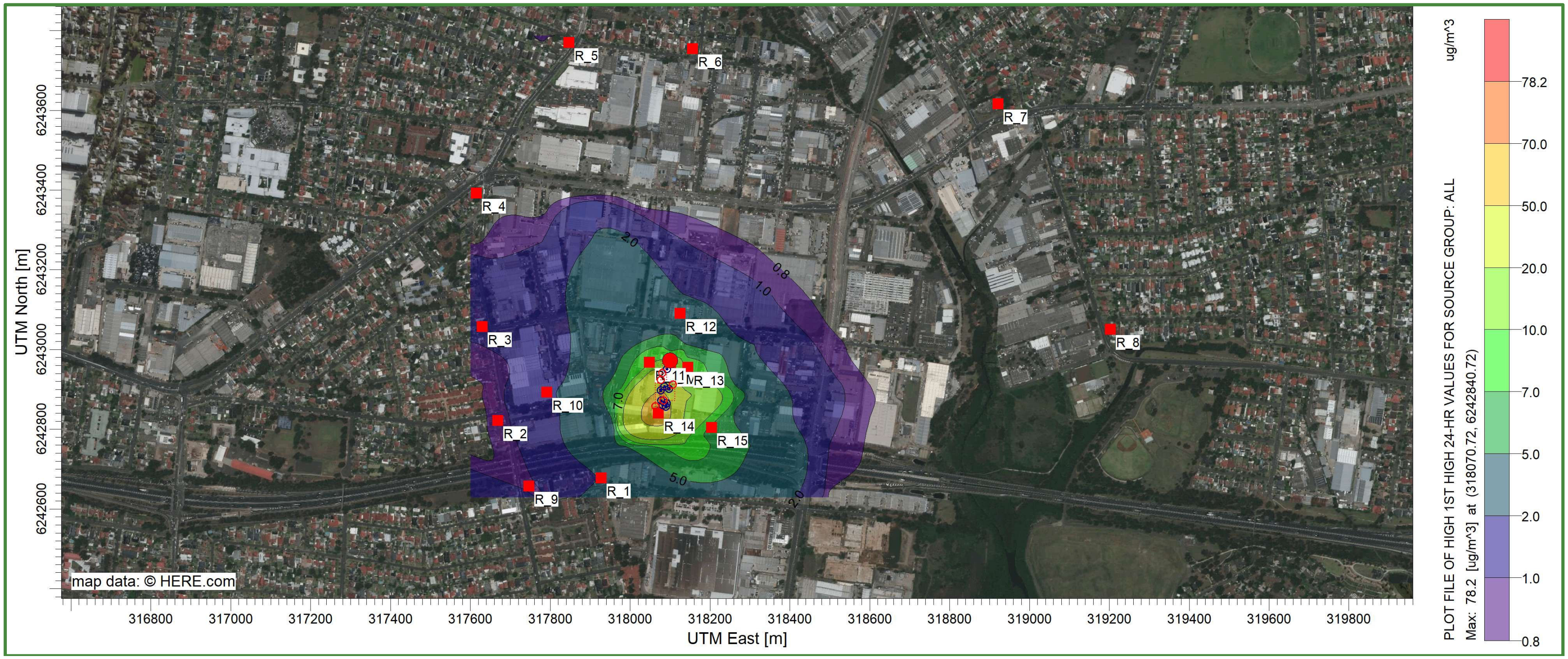
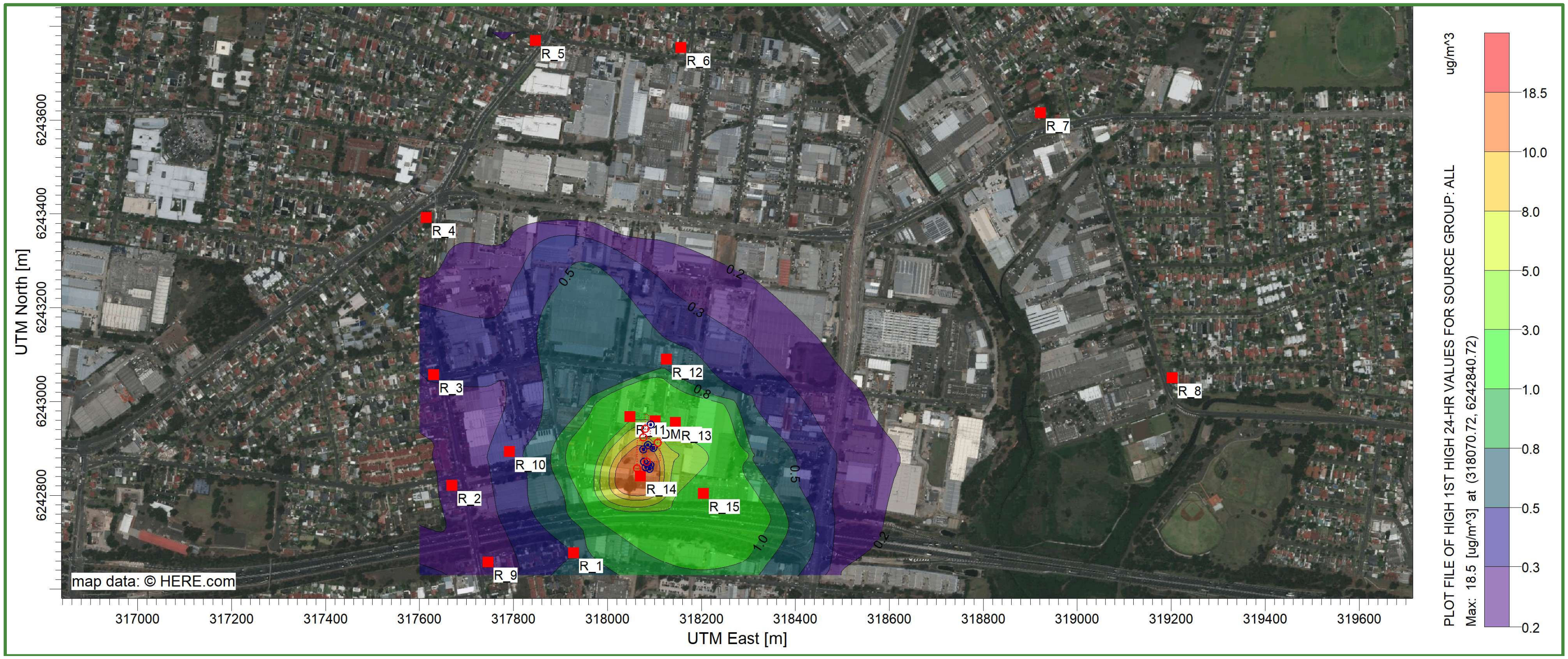


Table 7-12: $PM_{2.5}$ 24 Hour Averaging Period Modelling Results – Scenario 1

Receptor ID	Incremental Impact (µg/m³)	Background (µg/m³)	Cumulative Impact (µg/m³)	Criteria (µg/m³)
R1	0.78	37.21	37.99	25
R2	0.68		37.89	
R3	0.43		37.64	
R4	0.29		37.50	
R5	0.17		37.38	
R6	0.18		37.39	
R7	0.12		37.33	
R8	0.16		37.37	
R9	0.54		37.75	
R10	1.38		38.59	
R11	4.54		41.75	
R12	1.36		38.57	
R13	4.03		41.24	
R14	14.19		51.40	
R15	4.59		41.80	
R16	9.19		46.40	

Note: Complies / Non-compliance

Figure 7-6: $PM_{2.5}$ 24 Hour Averaging Period Modelling Results – Scenario 1



7.5.2.2 Scenario 2: Maximum impacts at sensitive receptors

Table 7-13 to Table 7-17 provide the results of the maximum modelled impacts for each identified receptor with the additional controls for the crusher and screen which are covered by a flexible hood and vacuum ducting. Isopleths for each averaging period are provided in Figure 7-7 to Figure 7-11. Background concentrations that exceed the relevant *Approved Methods* criterion are marked with red text.

Table 7-13: TSP Annual Averaging Period Modelling Results – Scenario 2

Receptor ID	Incremental Impact ($\mu g/m^3$)	Background ($\mu g/m^3$)	Cumulative Impact ($\mu g/m^3$)	Criteria ($\mu g/m^3$)
R1	0.35	34.31	34.66	90
R2	0.17		34.48	
R3	0.12		34.43	
R4	0.07		34.38	
R5	0.05		34.36	
R6	0.05		34.36	
R7	0.03		34.34	
R8	0.03		34.34	
R9	0.18		34.49	
R10	0.33		34.64	
R11	8.23		42.54	
R12	0.97		35.28	
R13	4.71		39.02	
R14	6.07		40.38	
R15	0.99		35.30	
R16	34.45		68.76	

Note: Complies / Non-compliance

Figure 7-7: TSP Annual Averaging Period Modelling Results – Scenario 2

Table 7-14: PM_{10} Annual Averaging Period Modelling Results – Scenario 2

Receptor ID	Incremental Impact (µg/m³)	Background (µg/m³)	Cumulative Impact (µg/m³)	Criteria (µg/m³)
R1	0.11	17.59	17.70	25
R2	0.06		17.65	
R3	0.04		17.63	
R4	0.02		17.61	
R5	0.02		17.61	
R6	0.02		17.61	
R7	0.01		17.60	
R8	0.01		17.60	
R9	0.06		17.65	
R10	0.11		17.70	
R11	2.77		20.36	
R12	0.32		17.91	
R13	1.56		19.15	
R14	1.66		19.25	
R15	0.30		17.89	
R16	11.66		29.25	

Note: Complies / Non-compliance

Figure 7-8: PM_{10} Annual Averaging Period Modelling Results – Scenario 2

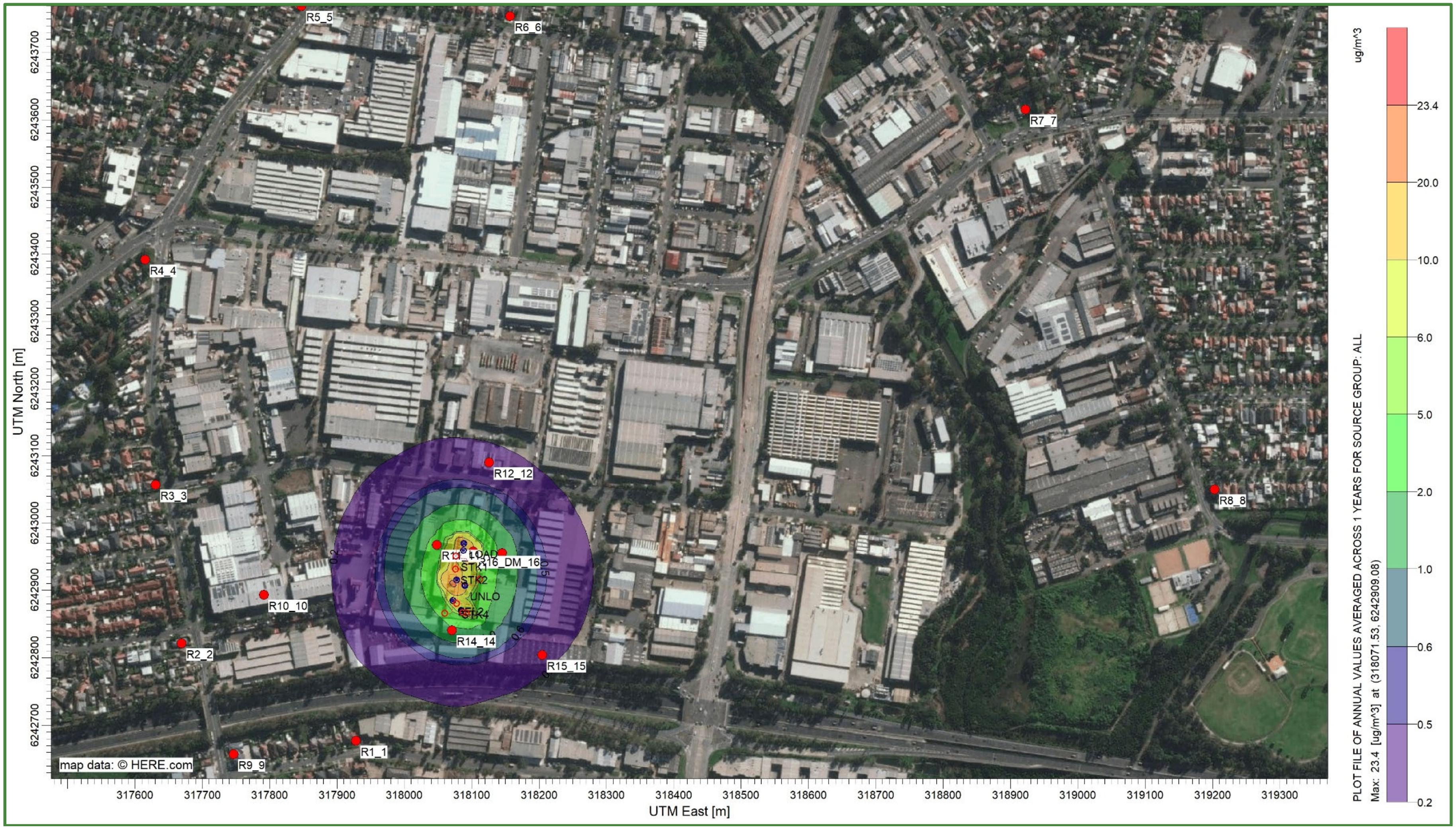


Table 7-15: $PM_{2.5}$ Annual Averaging Period Modelling Results – Scenario 2

Receptor ID	Incremental Impact (µg/m³)	Background (µg/m³)	Cumulative Impact (µg/m³)	Criteria (µg/m³)
R1	0.02	8.62	8.64	8
R2	0.01		8.63	
R3	0.01		8.63	
R4	0.00		8.62	
R5	0.00		8.62	
R6	0.00		8.62	
R7	0.00		8.62	
R8	0.00		8.62	
R9	0.01		8.63	
R10	0.02		8.64	
R11	0.42		9.04	
R12	0.05		8.67	
R13	0.25		8.87	
R14	0.34		8.96	
R15	0.05		8.67	
R16	1.77		10.39	

Note: Complies / Non-compliance

Figure 7-9: $PM_{2.5}$ Annual Averaging Period Modelling Results – Scenario 2

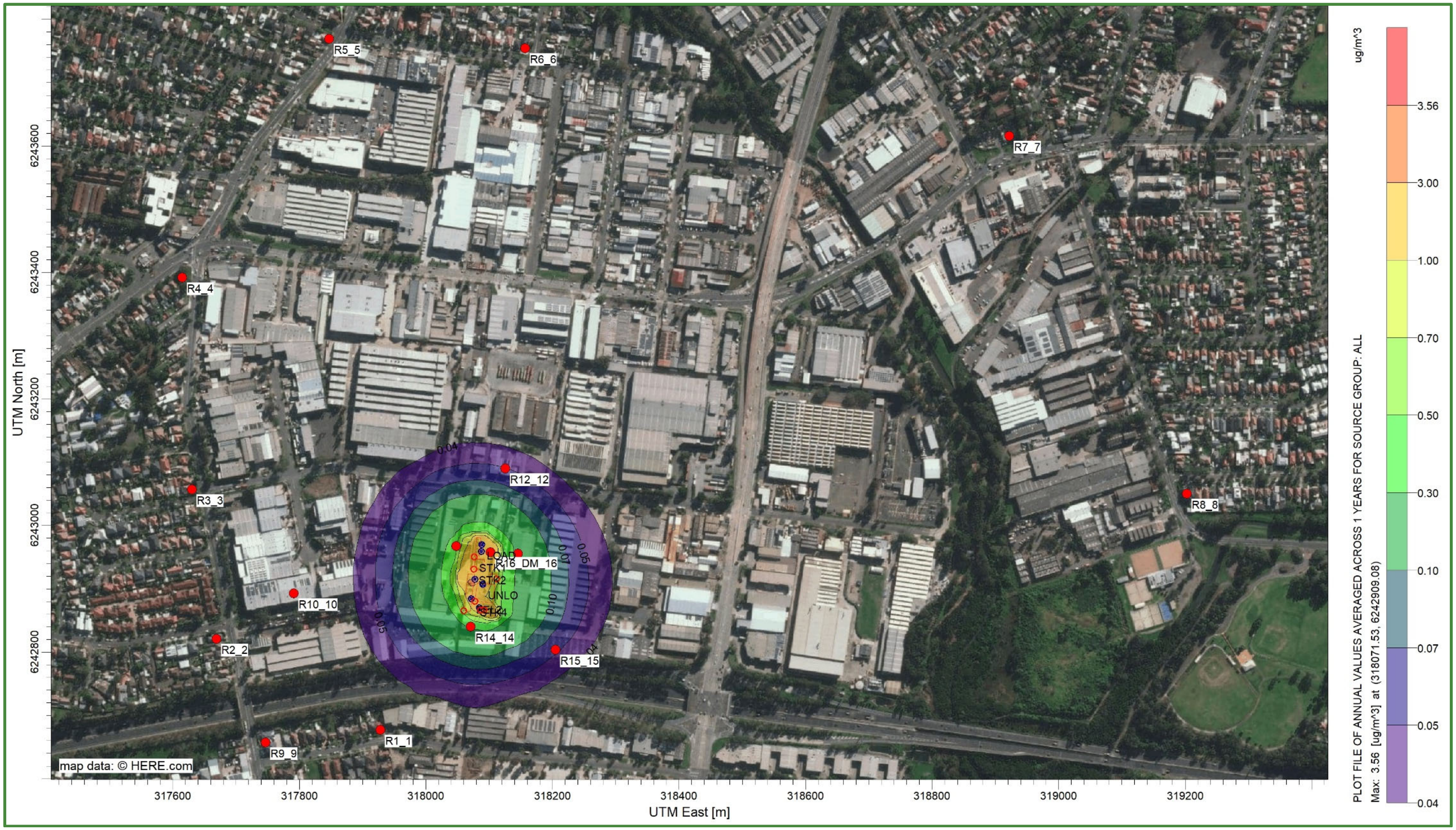


Table 7-16: PM_{10} 24 Hour Averaging Period Modelling Results – Scenario 2

Receptor ID	Incremental Impact (µg/m³)	Background (µg/m³)	Cumulative Impact (µg/m³)	Criteria (µg/m³)
R1	0.95	64.56	65.51	50
R2	0.56		65.12	
R3	0.87		65.43	
R4	0.35		64.91	
R5	0.42		64.98	
R6	0.17		64.73	
R7	0.12		64.68	
R8	0.20		64.76	
R9	0.48		65.04	
R10	0.99		65.55	
R11	16.17		80.73	
R12	2.71		67.27	
R13	9.57		74.13	
R14	12.12		76.68	
R15	3.43		67.99	
R16	50.03		114.59	

Note: Complies / Non-compliance

Figure 7-10: PM_{10} 24 Hour Averaging Period Modelling Results – Scenario 2

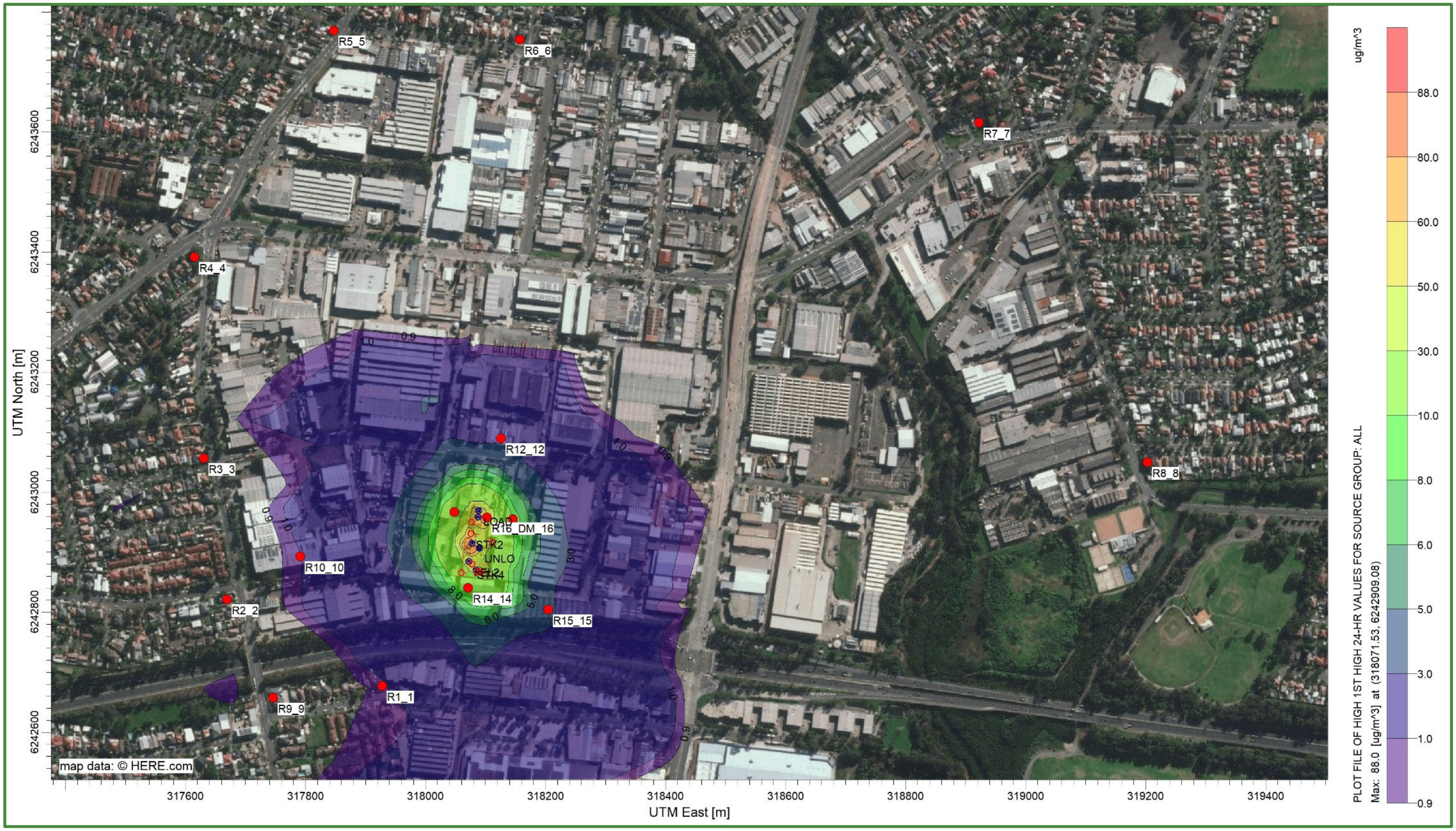
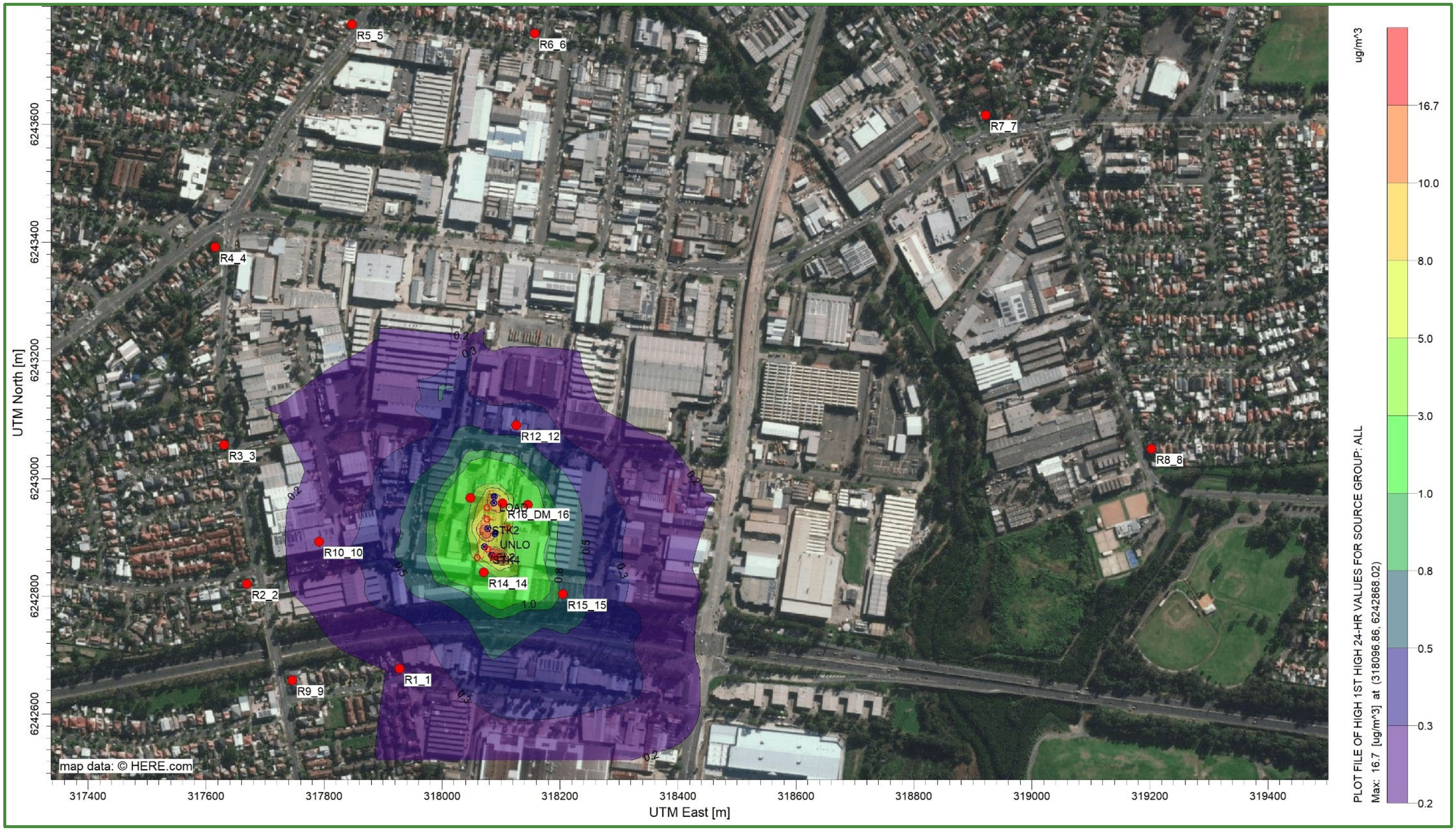


Table 7-17: $PM_{2.5}$ 24 Hour Averaging Period Modelling Results – Scenario 2

Receptor ID	Incremental Impact (µg/m³)	Background (µg/m³)	Cumulative Impact (µg/m³)	Criteria (µg/m³)
R1	0.18	37.21	37.39	25
R2	0.11		37.32	
R3	0.14		37.35	
R4	0.06		37.27	
R5	0.07		37.28	
R6	0.03		37.24	
R7	0.02		37.23	
R8	0.04		37.25	
R9	0.09		37.30	
R10	0.22		37.43	
R11	2.43		39.64	
R12	0.42		37.63	
R13	1.51		38.72	
R14	2.29		39.50	
R15	0.76		37.97	
R16	7.61		44.82	

Note: Complies / Non-compliance

Figure 7-11: $PM_{2.5}$ 24 Hour Averaging Period Modelling Results – Scenario 2



7.5.2.3 Predicted Days of Cumulative Exceedance

Due to the high background levels of PM_{10} and $PM_{2.5}$ at the site, the *Approved Methods* require a demonstration that no additional exceedances of the impact assessment criteria will occur as a result of the proposed site activities. Industrial receptor R11 (89 Gow Street, Padstow) and Scenario 2 was selected for contemporaneous impacts as it demonstrates the effectiveness of additional controls on the highest impacted receptor.

Table 7-18 and Table 7-19 summarise the contemporaneous impact and background of the top eight days of highest background concentrations and the top eight days of highest predicted increment for PM_{10} and $PM_{2.5}$ for the highest impacted receptor (R14).

Table 7-18: Summary of Top Eight Days of Contemporaneous PM_{10} Impact and Background at Industrial Receptor R11 (*Approved Methods* Criterion = 50 µg/m³) – Scenario 2

Date	PM_{10} 24 Hour Average (µg/m³)			Date	PM_{10} 24 Hour Average (µg/m³)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
6/05/2015	64.56	3.40	67.96	24/06/2015	22.68	16.17	38.85
21/08/2015	48.23	8.73	**56.96**	14/12/2015	33.92	14.34	48.26
1/07/2015	46.21	7.32	**53.53**	19/09/2015	12.44	13.66	26.10
26/11/2015	45.95	2.52	48.47	16/06/2015	10.83	13.34	24.17
7/10/2015	36.23	3.72	39.95	10/10/2015	26.99	13.28	40.27
14/12/2015	33.92	14.34	48.26	19/10/2015	20.02	13.09	33.11
1/10/2015	32.60	12.67	45.27	14/09/2015	22.67	13.01	35.68
20/11/2015	32.31	3.85	36.16	18/05/2015	18.26	12.77	31.03

✓Complies ✗ Non-compliance

Table 7-19: Summary of Top Eight Days of Contemporaneous $PM_{2.5}$ Impact and Background at Industrial Receptor R11 (*Approved Methods* Criterion = 25 µg/m³) – Scenario 2

Date	$PM_{2.5}$ 24 Hour Average (µg/m³)			Date	$PM_{2.5}$ 24 Hour Average (µg/m³)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
21/08/2015	37.21	1.34	38.55	24/06/2015	11.01	2.43	13.44
6/05/2015	19.25	0.51	19.76	14/12/2015	13.28	2.24	15.52
5/07/2015	18.37	0.7	19.07	19/09/2015	6.15	2.07	8.22
30/06/2015	17.53	1.73	19.26	1/10/2015	13.28	2.06	15.34
5/03/2015	17.52	0.62	18.14	10/10/2015	12.55	2.03	14.58
29/04/2015	16.15	1.4	17.55	16/06/2015	8.67	2.00	13.62
25/05/2015	15.84	1.09	16.93	14/09/2015	11.62	2.00	10.67
14/06/2015	15.81	1.6	17.41	19/10/2015	7.56	2.00	9.56

✓Complies ✗ Non-compliance

7.6 Discussion of Modelling Results

The following table (Table 7-20)compares the incremental impacts from Scenario 1 and Scenario 2 at the closest, most heavily impacted receptor, industrial receptor R11 (89 Gow Street, Padstow). It shows the percentage decrease achieved by installing a custom built flexible hood and vacuum ducting to cover the crusher and screen.

Table 7-20: Scenario 2 incremental impacts at industrial receptor R11, (89 Gow Street, Padstow)

Pollutant	Averaging Period	Scenario 1 Incremental Impact ($\mu g/m^3$)	Scenario 2 Incremental Impact ($\mu g/m^3$)	*Percent reduction*
TSP	Annual	10.33	8.23	20.33
PM_{10}		3.15	2.77	12.06
$PM_{2.5}$		0.56	0.42	25.00
PM_{10}	24-hour	19.77	16.17	18.21
$PM_{2.5}$		4.54	2.43	46.48

Results of air impact modelling for both scenario 1 and scenario 2 demonstrate that incremental dust levels were reduced with the inclusion of a custom hood covering applied to the crusher/screener by ~12-46% at the most heavily impacted receptor (R11; 89 Gow Street, Padstow). It is recommended that all controls listed for Scenario 2 be applied onsite on site to ensure continued compliance and further reduce dust impacts from the proposed development on all nearest receptors, both industrial and sensitive.

In cases of elevated background concentrations, the NSW EPA requires a demonstration that no additional exceedances of the impact assessment criteria will occur as a result of the proposed site activities. Contemporaneous additions assessment was conducted for the most impacted receptor (R11; 89 Gow Street, Padstow). The 24 hour averaging period for PM_{10} showed 2 additional days of exceedance, however this is attributed to the elevated background concentration levels of 48.23 $\mu g/m^3$and 46.21 $\mu g/m^3$. The 24 hour averaging period for $PM_{2.5}$ demonstrated no additional days of exceedance.

It is noted that the dust from the dewatering plant stockpiles represent negligible emissions (DMAG source in emission inventory Table 7-6 and Table 7-7) as the total dust emissions are several orders of magnitude less that more significant sources.

With the recommended controls of Scenario 2 applied at the site, the dust impacts are considered effectively controlled, and will not cause harm to human health or the environment. No additional controls are considered warranted.

8. GREENHOUSE GAS (GHG) ASSESSMENT

The following standards, sources and guidelines have been used as part of this greenhouse gas (GHG) assessment:

- Australian Standard AS ISO 14064.1: 2018– "Greenhouse gases" – "Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals";
- Department of the Environment and Energy, August 2019. Australian National Greenhouse Accounts – National Greenhouse Accounts Factors;
- Department of the Environment and Energy, October 2017. National Greenhouse and Energy Reporting System Measurement – Technical Guidelines;
- Department of Industry, Science, Energy and Resources, 2019. Australia'sNational Greenhouse Accounts, Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2019; and2019; and
- Greenhouse Gas Protocol, revised edition 2015. *Corporate Accounting and Reporting Standard*.

8.1 Direct and Indirect Emissions

Emissions are commonly classified as direct or indirect emissions, which are defined by the GHG Protocol as:

- Direct GHG emissions are emissions from sources within the boundary of an organisation and as a result of that organisations activities; and
- Indirect GHG emissions are emissions generated in the wider economy that are a consequence of the activities of the organisation, but occur at sources owned or controlled by another entity.

Direct and indirect emissions are further categorised into three broad scopes:

- Scope 1: All direct GHG emissions;
- Scope 2: Indirect emissions from consumption of purchased electricity, heat or steam; and
- Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities not covered in Scope 2, outsourced activities, waste disposal, etc.

Scope 1 GHG emissions from the proposed development are limited to diesel fuel consumption from plant and equipment operation on site. Scope 2 GHG emissions are limited to electricity consumption during site operations. Scope 3 emissions encompass a wide range of potential sources which are expected to be negligible for the proposed development. Therefore, Scope 3 GHG emissions are not assessed any further.

Scope 1 and Scope 2 GHG emissions are detailed in the following sections.

8.1.1 Direct Emissions

Direct GHG emissions from the proposed development would be generated from the consumption of diesel from the use of company owned plant, equipment and trucks. This would contribute to Scope 1 emissions.

8.1.2 Indirect Emissions

Indirect emissions from the proposed development would be generated from the consumption of purchased electricity.

8.2 EMISSION FACTORS

The National Greenhouse Accounts (NGA) Factors (August 2019) were used to determine relevant GHG emission factors for the operation of the proposed development. These are presented in Table 8-1.

Table 8-1: Greenhouse Gas Emission Factors

Source	Energy Content Factor (GJ/kL)	Emission Factor	Units	Reference
Diesel – for stationary purposes (site plant/equipment)	38.6	CO_2 = 69.9 CH_4 = 0.1 N_2O = 0.2	t CO2-e/kL	DEE (2019)
Electricity (NSW)	-	0.81	kg CO2/kWh	DEE (2019)

8.3 ESTIMATION OF GHG EMISSIONS

8.3.1 Scope 1 GHG Emissions – Consumption of Diesel

Diesel consumption during operation would be associated with plant and equipment on site including the crusher, screen, FEL's/excavators and on-site trucks.

Diesel fuel consumption has a number of GHG emission sources including carbon dioxide (CO_2) and products of incomplete combustion (methane, CH_4 and nitrous oxide, N_2O). The following formula was adopted for diesel consumption:

$$E = \frac{Q \ x \ EC \ x \ EF}{1{,}000}$$

where:

E is the amount of estimated greenhouse gas emissions in tonnes $CO_{2\text{-}e}$ (carbon dioxide equivalent)
Q is the volume of fuel combusted in kL

EC is the heat content of specific fuel type in GJ/kL
EF is the greenhouse gas emission factor specific to fuel type in kg CO_{2-e}/GJ

Calculation of Scope 1 emissions presented in Table 8-2 is estimated based on the assumptions that up to 180,000 L (180 kL) of diesel will be consumed per year for the proposed development.

Table 8-2: Estimated Scope 1 (Direct) Greenhouse Gas Emissions

Activity	Annual Consumption (GJ/year)	Emission Factor (kg CO_{2-e}/GJ)			Annual GHG Emissions (tonnes CO_{2-e})
		CO_2	CH_4	N_2O	
Consumption of Diesel	180,000	69.9	0.1	0.2	488*
				Total Annual Scope 1 GHG Emissions	488*

Note: * Results for GHG emissions are in 2 significant figures

8.3.2 Scope 2 GHG Emissions – Purchased Electricity

Scope 2 GHG emissions are associated with the consumption of purchased electricity. During operation, the drilling mud facility and office building would be connected to electricity. A review of the current electricity consumption at GSRC and an estimation of consumption with the inclusion of the new drilling mud facility has been undertaken.

The following formula was adopted for electricity consumption at the proposed development:

$$E = \frac{Q \times EF}{1{,}000}$$

Where:

E is the amount of estimated greenhouse gas in tonnes CO_2-e
Q is the quantity of purchased electricity in kWh
EF is the greenhouse gas emission factor specific to fuel type in kg CO_2-e/kWh for the state of New South Wales (0.81).

Calculation of Scope 2 emissions presented in Table 8-2 is estimated based on the assumptions that up to 576,000 kWh of electricity will be consumed per year for the proposed development.

Table 8-3: Estimated Scope 2 (Indirect) Greenhouse Gas Emissions

Activity	Annual Consumption (kWh)	Emission Factor (kg CO2/kWh)	Annual GHG Emissions (tonnes CO_{2-e})
Consumption of Electricity	576,000	0.81	467*
		Total Annual Scope 2 GHG Emissions	467*

Note: * Results for GHG emissions are in 2 significant figures

8.3.3 Summary of GHG Emissions

A summary of the above-calculated GHG emissions is shown in Table 8-4.

Table 8-4: GHG Emission Summary

Annual GHG Emissions (tonnes $CO_{2\text{-}e}$)	
Scope 1 – Diesel Consumption	488*
Scope 2 – Electricity Consumption	467*
Scope 3	Not Included
Total (Scope 1 + 2 + 3)	**955***

Note: *Results are in 2 significant figures

Annual GHG emissions for operation of the C&D and liquid waste processing facilities are estimated to be 955 t CO_2-e.

Australia's total GHG emissions as at December 2019 (the most recent inventory update) was estimated to be 532.5 Mt CO_2-e (Australian Government, Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2019). In comparison, the estimated annual GHG emission for proposed development is 0.00096 Mt CO_2-e. Therefore, the annual contribution of GHG emissions from the proposed development in comparison to the Australian GHG emissions in 2019 is approximately 0.0000018%.

8.4 Measures to Reduce GHG Emissions

Opportunities to reduce GHG emissions need to be considered as an ongoing objective within the site's Environmental Management Plan. However, the following mitigation measures are recommended:

- Source construction materials from within the vicinity of the project area;
- Maintain equipment and on-site plant/vehicles in good working order to maximise fuel efficiency; and
- Use high efficiency pumps and associated equipment in the drilling mud dewatering facility.

9. STATEMENT OF POTENTIAL AIR QUALITY IMPACTS

9.1 DUST IMPACT ASSESSMENT

The air dispersion model AERMOD was used for the prediction of off-site dust impacts associated with the air emissions from the proposed operations. Two scenarios were included in the air dispersion modelling:

Scenario 1 – modelled emission sources <u>with general mitigation measures recommended</u> and

Scenario 2 – modelled emission sources with an additional custom flexible hood and vacuum ducting applied to the crusher/screen. .

The assessment aimed to demonstrate the predicted dust impacts from site activities on neighbouring receptors with and without the use of the flexible hood and vacuum ducting applied to the crusher/screener. Preliminary dust monitoring undertaken on- and off-site demonstrate that current dust emissions from site activities exceed NSW EPA criteria.

Results of air impact modelling for both scenario 1 and scenario 2 demonstrate that incremental dust levels were reduced with the inclusion of a custom hood covering applied to the crusher/screener by ~12-46% at the most heavily impacted receptor (R11; 89 Gow Street, Padstow). It is recommended that all controls listed for Scenario 2 be applied onsite on site to ensure continued compliance and further reduce dust impacts from the proposed development on all nearest receptors, both industrial and sensitive.

In cases of elevated background concentrations, the NSW EPA requires a demonstration that no additional exceedances of the impact assessment criteria will occur as a result of the proposed site activities. Contemporaneous additions assessment was conducted for the most impacted receptor (R11; 89 Gow Street, Padstow). The 24 hour averaging period for PM_{10} showed 2 additional days of exceedance, however this is attributed to the elevated background concentration levels of 48.23 $\mu g/m^3$and 46.21 $\mu g/m^3$. The 24 hour averaging period for $PM_{2.5}$ demonstrated no additional days of exceedance.

With the proposed site activities and additional dust controls in place, it is considered that emissions to air from the site's operation are unlikely to cause harm to resident's health or the environment.

It is noted that the dust from the dewatering plant stockpiles represent negligible emissions (DMAG source in emission inventory Table 7-6 and Table 7-7) as the total dust emissions are several orders of magnitude less that more significant sources.

With the recommended controls of Scenario 2 applied at the site, the dust impacts are considered effectively controlled, and will not cause harm to human health or the environment. No additional controls are considered warranted.

9.2 GREENHOUSE GAS (GHG) ASSESSMENT

Scope 1 GHG emissions from the proposed development are limited to diesel fuel consumption from plant and equipment operation on site. Scope 2 GHG emissions are limited to electricity consumption during site operations. Scope 3 emissions encompass a wide range of potential sources which are expected to be negligible for the proposed development. Therefore, Scope 3 GHG emissions were not assessed any further.

Annual GHG emissions for Scope 1 and Scope 2 GHG emissions for the operation of the C&D and drilling mud dewatering facilities are estimated to be 955 t CO_2-e.

Australia's total GHG emissions as at December 2019 (the most recent inventory update) was estimated to be 532.5 Mt CO_2-e (Australian Government, Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2019). In comparison, the estimated annual GHG emission for proposed development is 0.00096 Mt CO_2-e. Therefore, the annual contribution of GHG emissions from the proposed development in comparison to the Australian greenhouse emissions in 2019 is approximately 0.0000018%.

9.3 CONCLUSION

Several mitigation measures are recommended to mitigate site dust impacts. With these in place, GSRC ensures continued compliance with NSW EPA criteria and further reducing dust impacts from the proposed development on all nearest receptors, industrial and sensitive.

GHG contributions from the proposed development are considered negligible.

With the proposed site activities and recommended dust controls in place, it is considered that dust and GHG emissions to air from site operations are unlikely to cause harm to health or the environment.

Matthew Taylor	Kate Barker	R T Benbow
Environmental Scientist	Environmental Scientist	Principal Consultant

10. REFERENCES

- Australian Standard AS ISO 14064.1: 2018– "Greenhouse gases" – "Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals"

- Department of Industry, Science, Energy and Resources, 2019. *Australia's National Greenhouse Accounts, Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2019*

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- National Pollutant Inventory (2012) *Emission Estimation Technique Manual for Mining*

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- United States Environmental Protection Agency (1995) *AP 42, Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources*. Available at: https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air emissionfactors(https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air emission-factors-Accessed: 17 July 2020).

11. LIMITATIONS

Our services for this project are carried out in accordance with our current professional standards for site assessment investigations. No guarantees are either expressed or implied.

This report has been prepared solely for the use of Gow Street Recycling Centre, as per our agreement for providing environmental services. Only Gow Street Recycling Centre is entitled to rely upon the findings in the report within the scope of work described in this report. Otherwise, no responsibility is accepted for the use of any part of the report by another in any other context or for any other purpose.

Although all due care has been taken in the preparation of this study, no warranty is given, nor liability accepted (except that otherwise required by law) in relation to any of the information contained within this document. We accept no responsibility for the accuracy of any data or information provided to us by Gow Street Recycling Centre for the purposes of preparing this report.

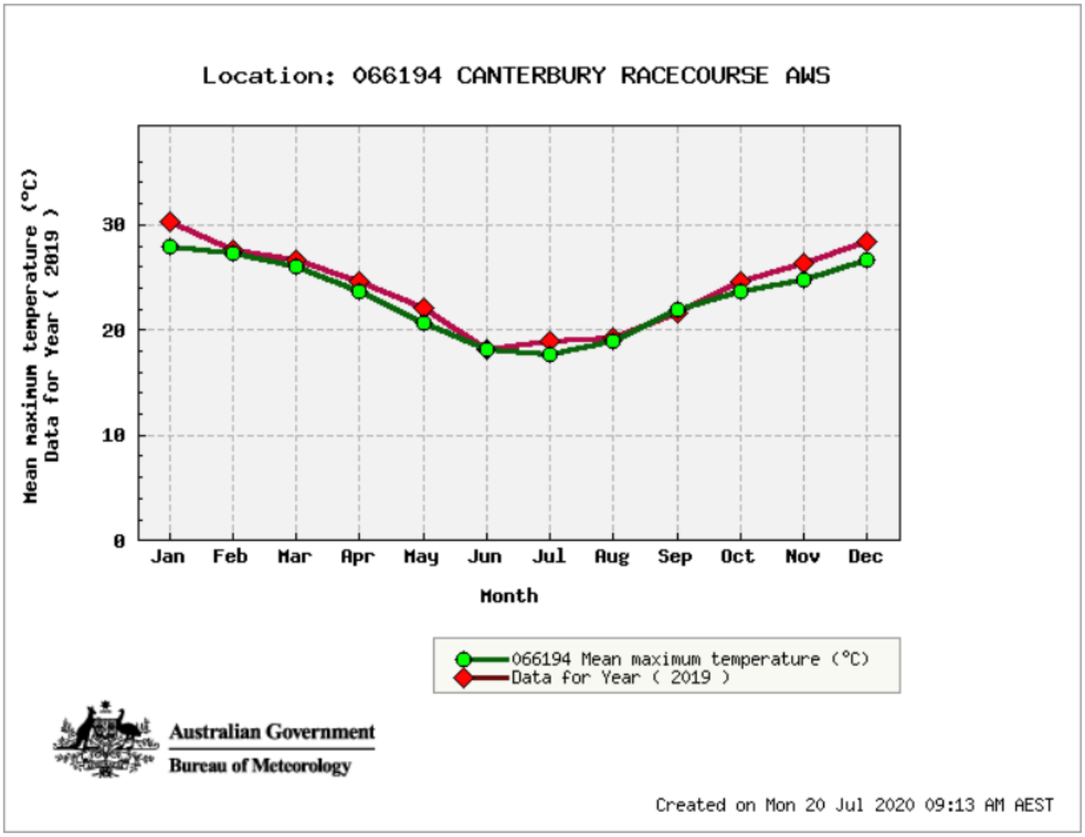
Any opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal advice.

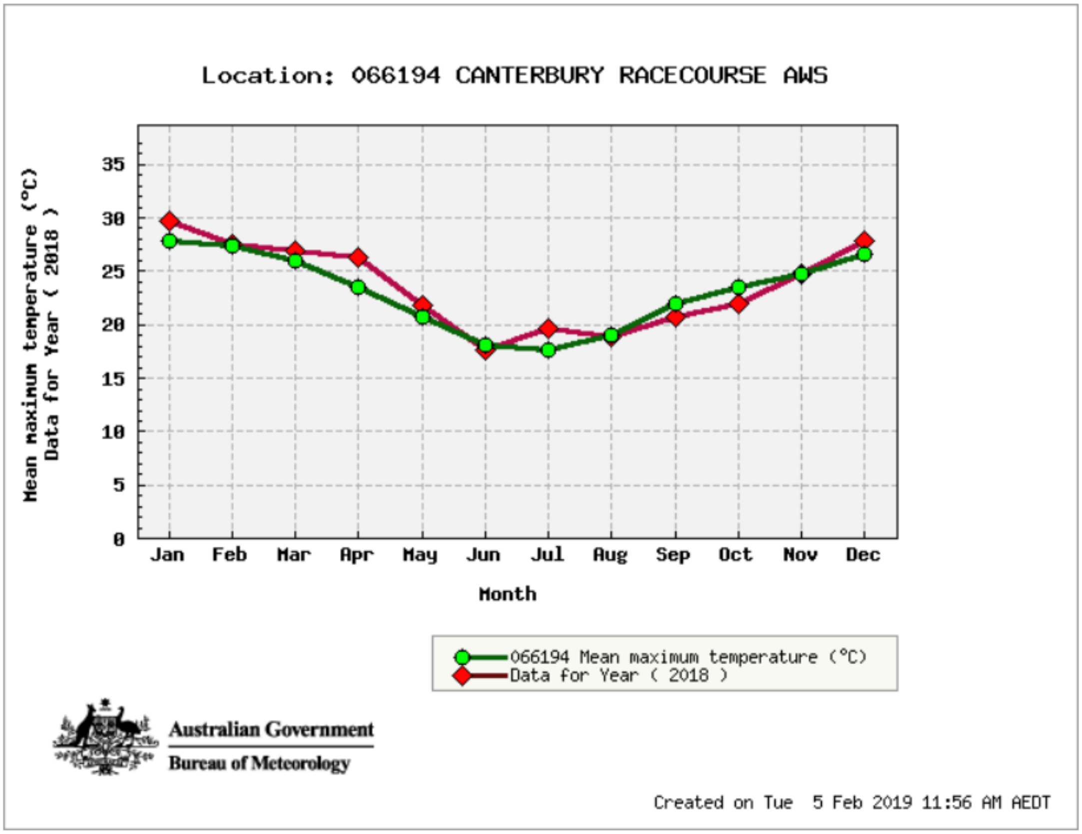
ATTACHMENTS

Attachment 1: Long-term Climate Statistics for the Referenced Meteorological Station – Canterbury Racecourse AWS, Bureau of Meteorology

Representative Year

We have selected 2015 as the most representative year for weather. The minimum mean temperature follows the overall trend relatively closely in comparison to the years preceding 2018. The maximum mean temperature is not as close to the trend as 2017, however it is still quite close and is on par with 2016 and 2018. For mean daily wind run in 2015, it is the first year preceding 2018 with a full year of data and the trend is followed more so than other years.





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Mean maximum temperature (°C)
Data for Year (2018)
35
30
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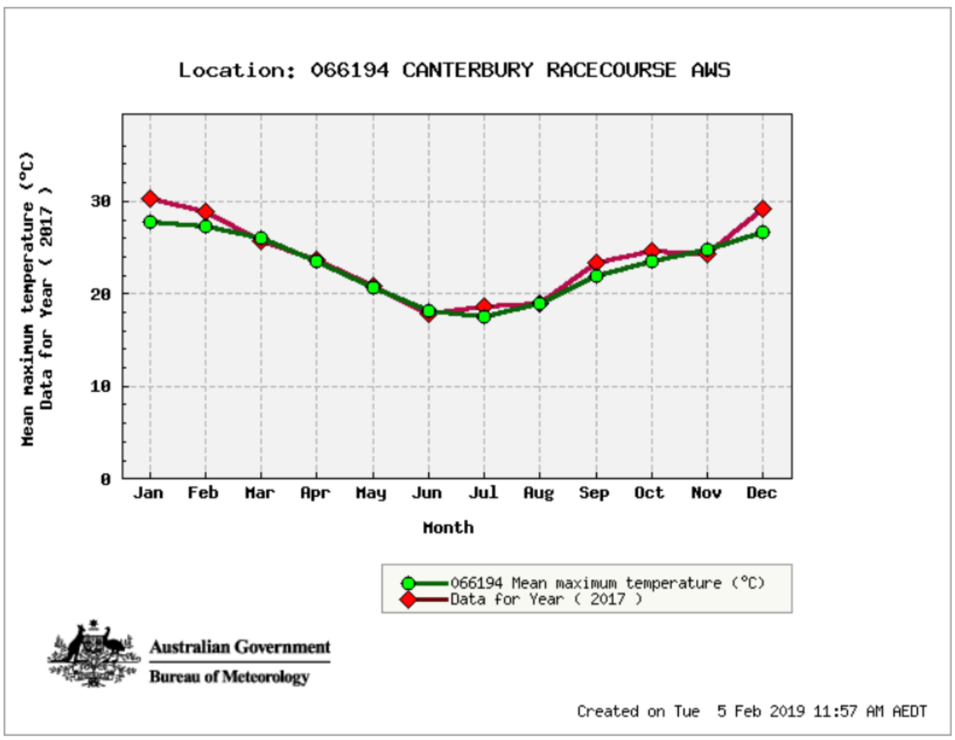
Month
066194 Mean maximum temperature (°C)
Data for Year (2018)
Australian Government
Bureau of Meteorology
Created on Tue 5 Feb 2019 11:56 AM AEDT



Location: 066194 CANTERBURY RACECOURSE AWS
Mean maximum temperature (°C)
Data for Year (2017)
30
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Australian Government
Bureau of Meteorology
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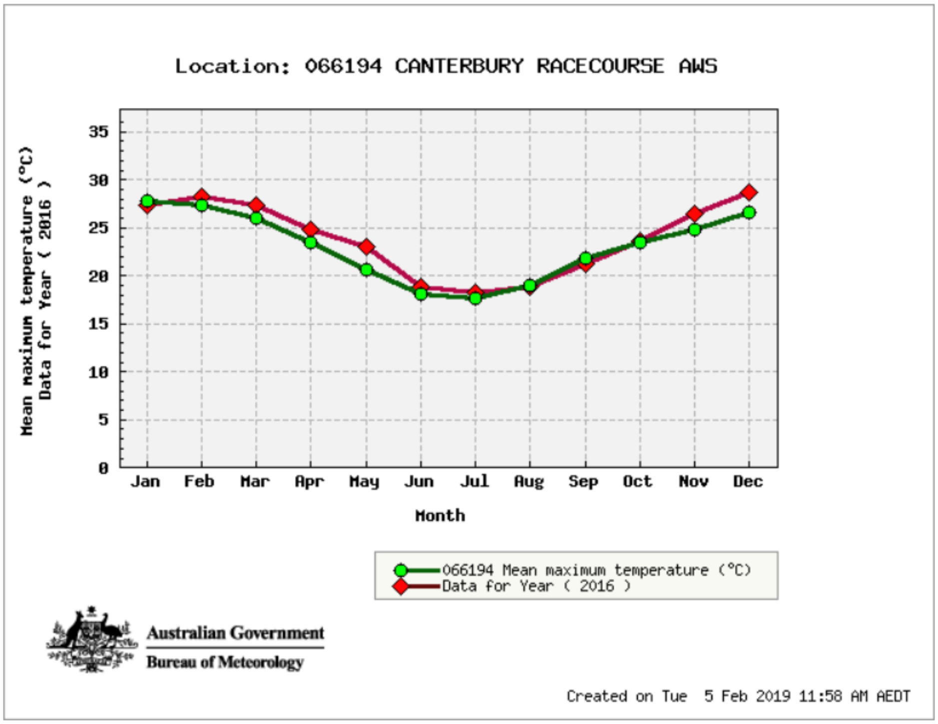

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Mean maximum temperature (°C)
Data for Year (2016)
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066194 Mean maximum temperature (°C)
Data for Year (2016)
Australian Government
Bureau of Meteorology
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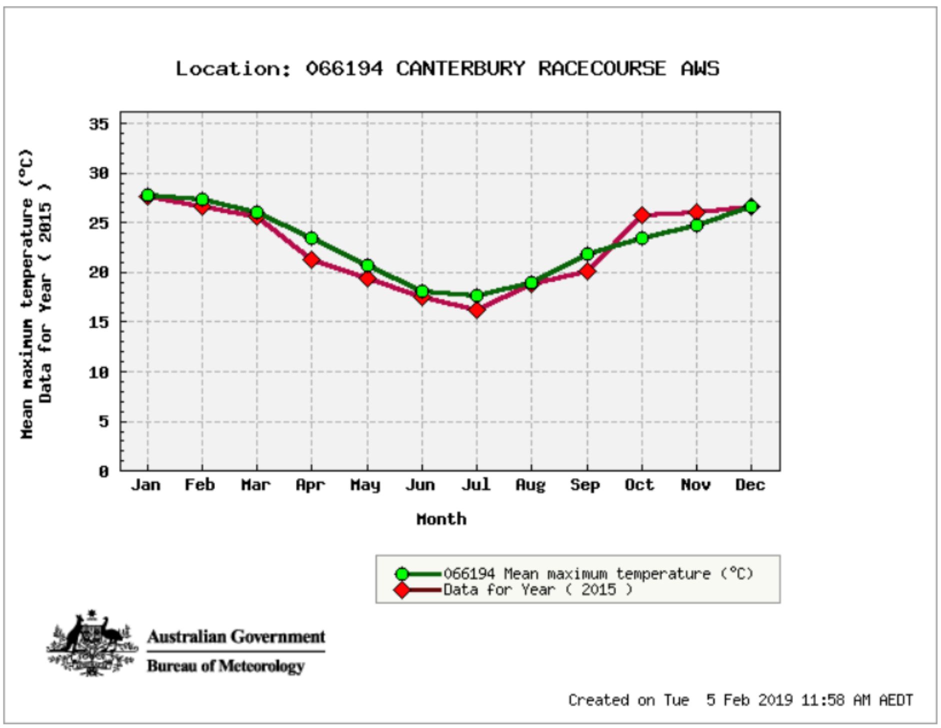

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Mean maximum temperature (°C)
Data for Year (2015)
35
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Data for Year (2015)
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Bureau of Meteorology
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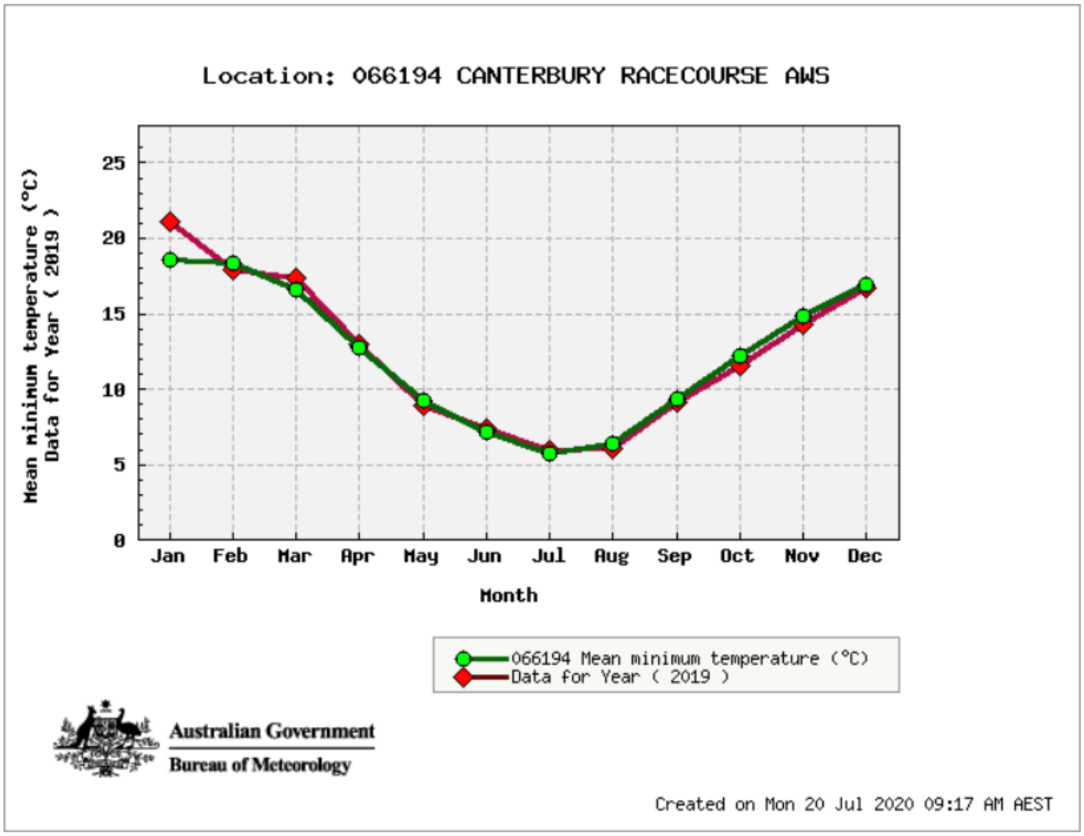

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Bureau of Meteorology
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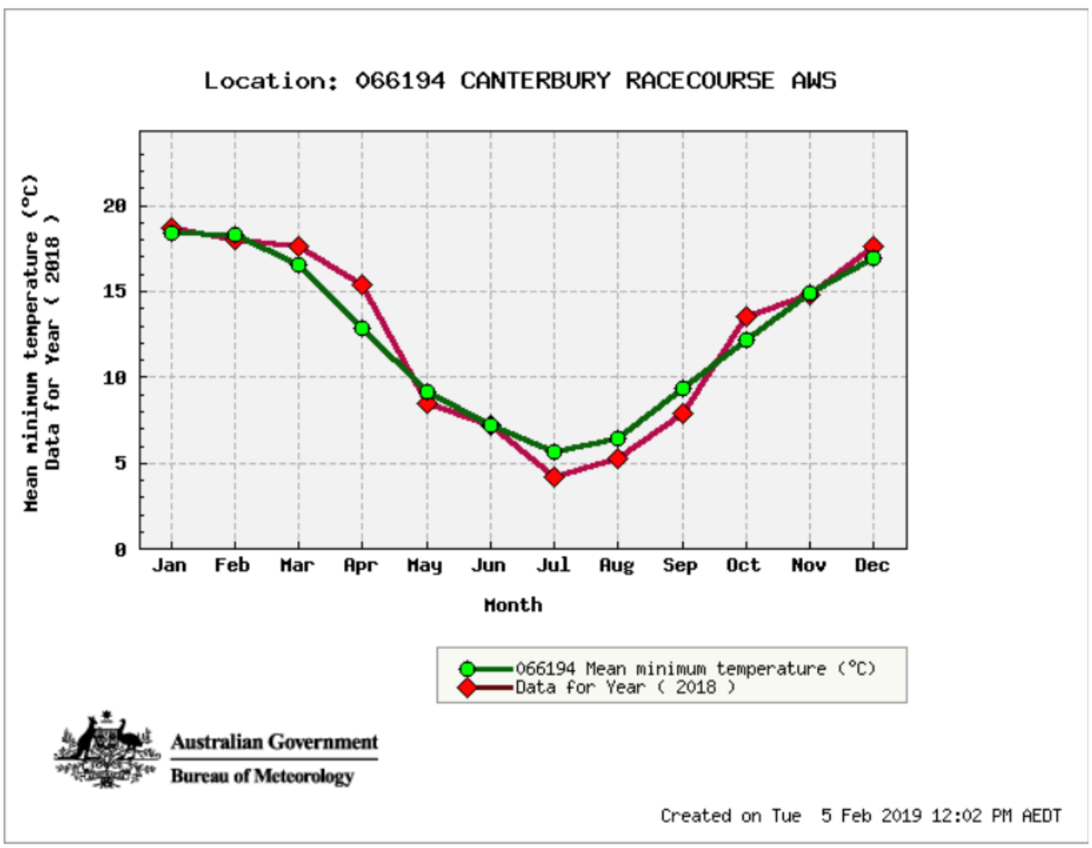

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Mean minimum temperature (°C)
Data for Year (2018)
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Data for Year (2018)
Australian Government
Bureau of Meteorology
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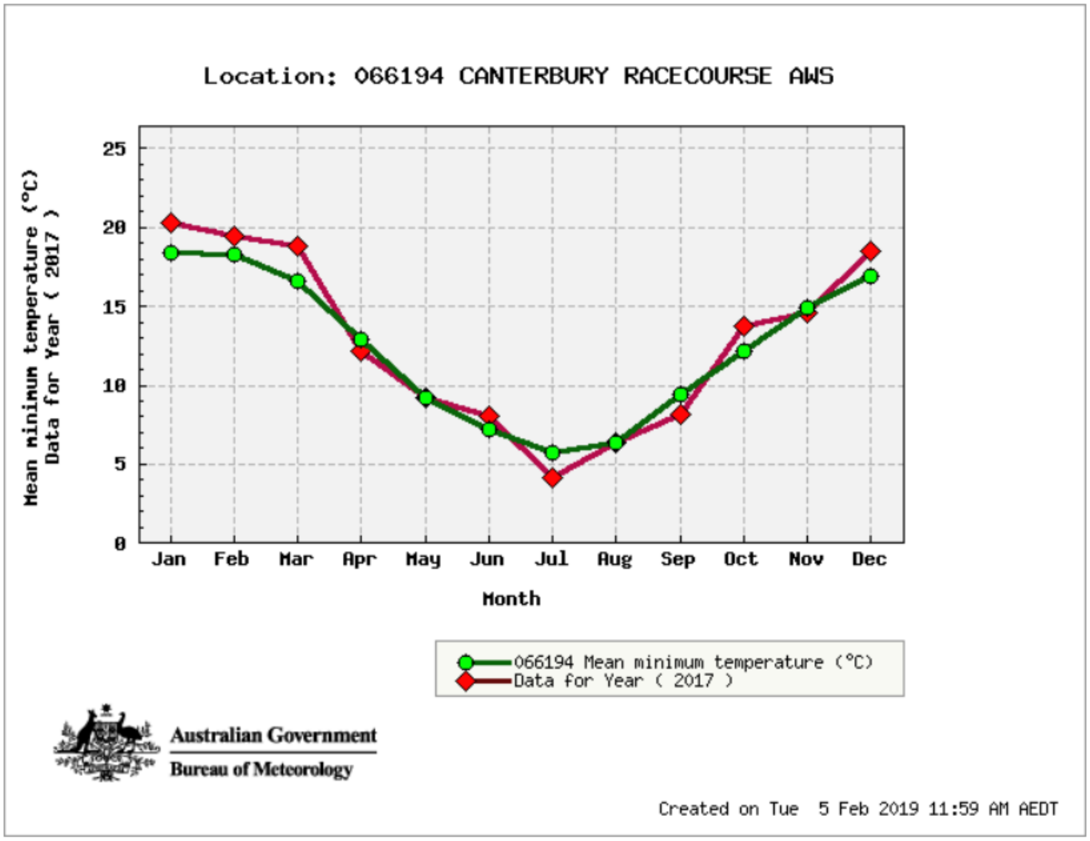
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Data for Year (2017)
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Data for Year (2017)
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Bureau of Meteorology
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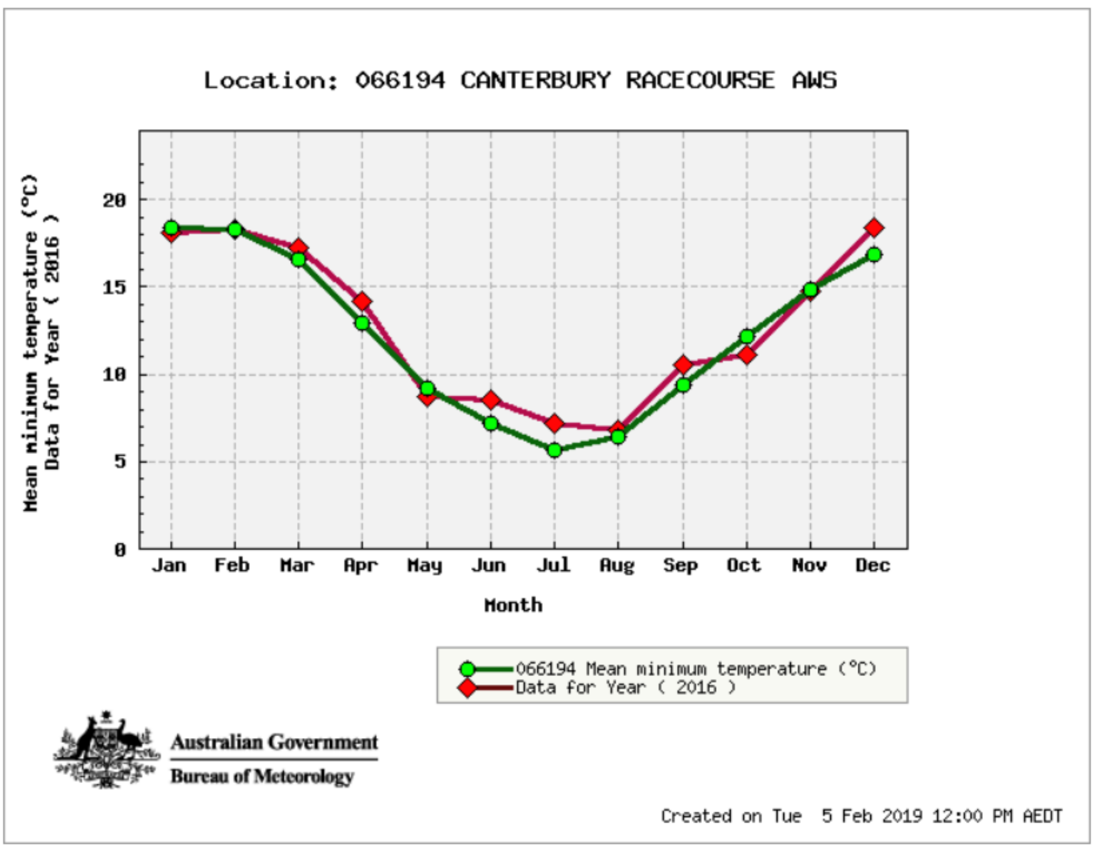
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Mean minimum temperature (°C)
Data for Year (2016)
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Data for Year (2016)
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Bureau of Meteorology
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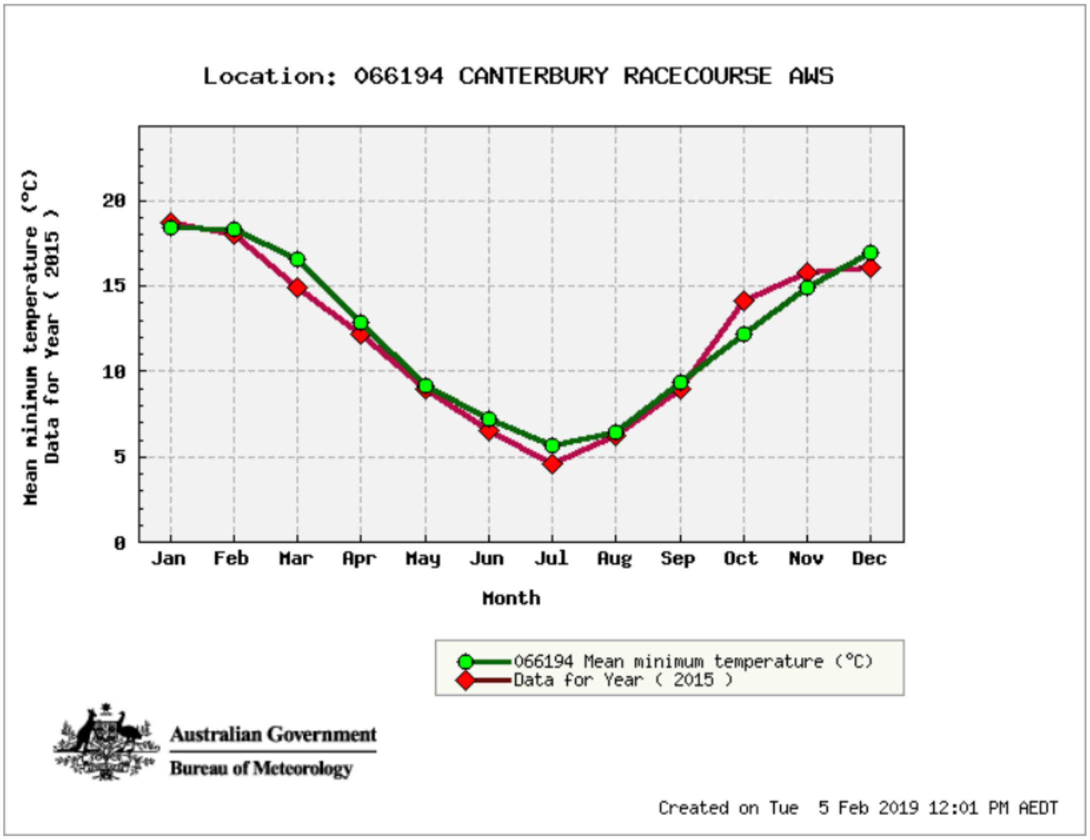
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Mean minimum temperature (°C)
Data for Year (2015)
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Bureau of Meteorology
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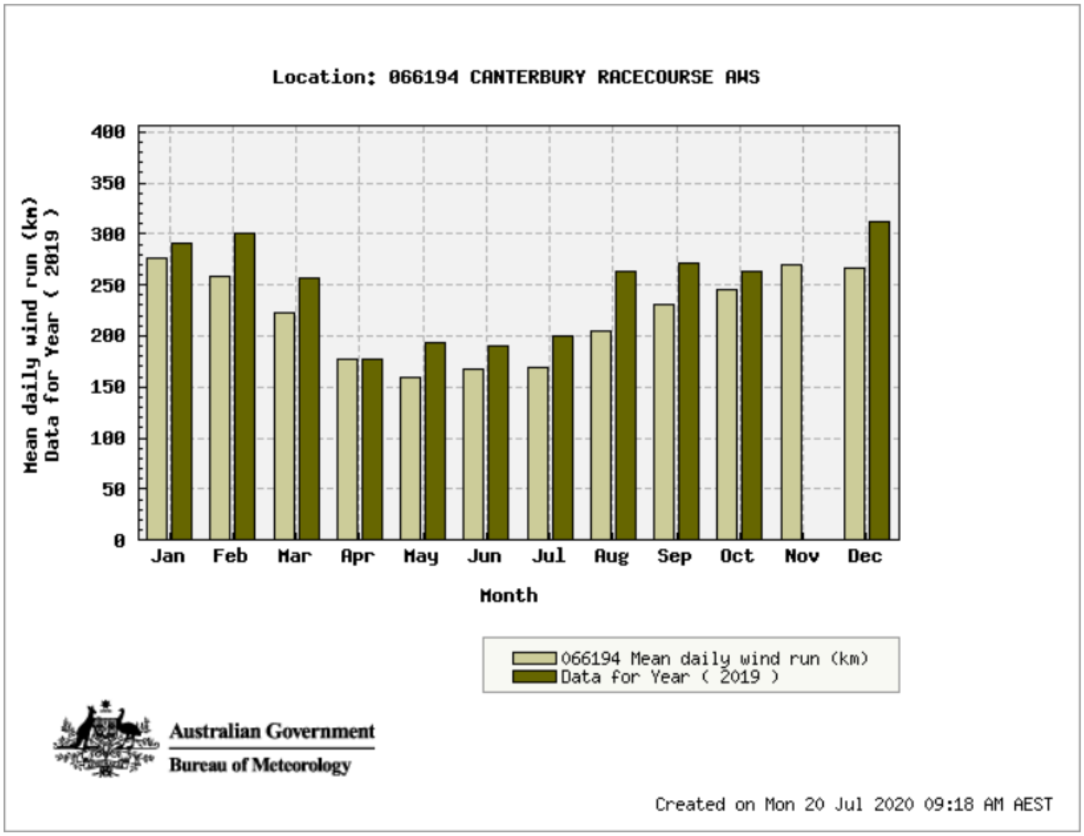
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Mean daily wind run (km)
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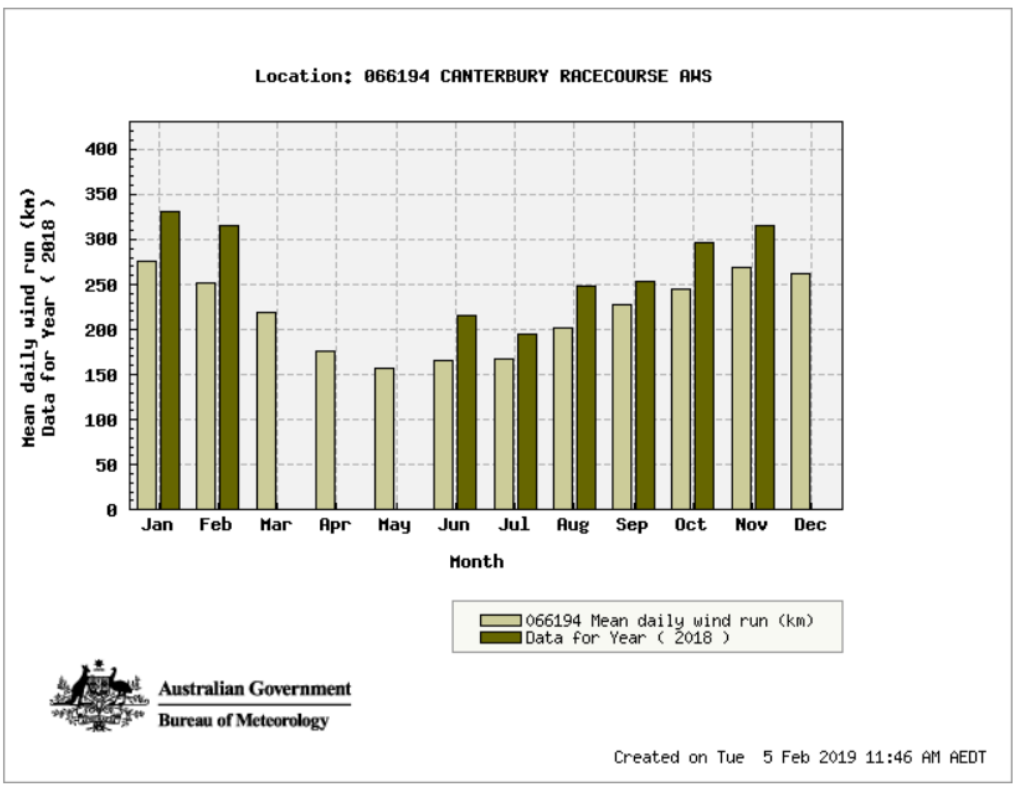
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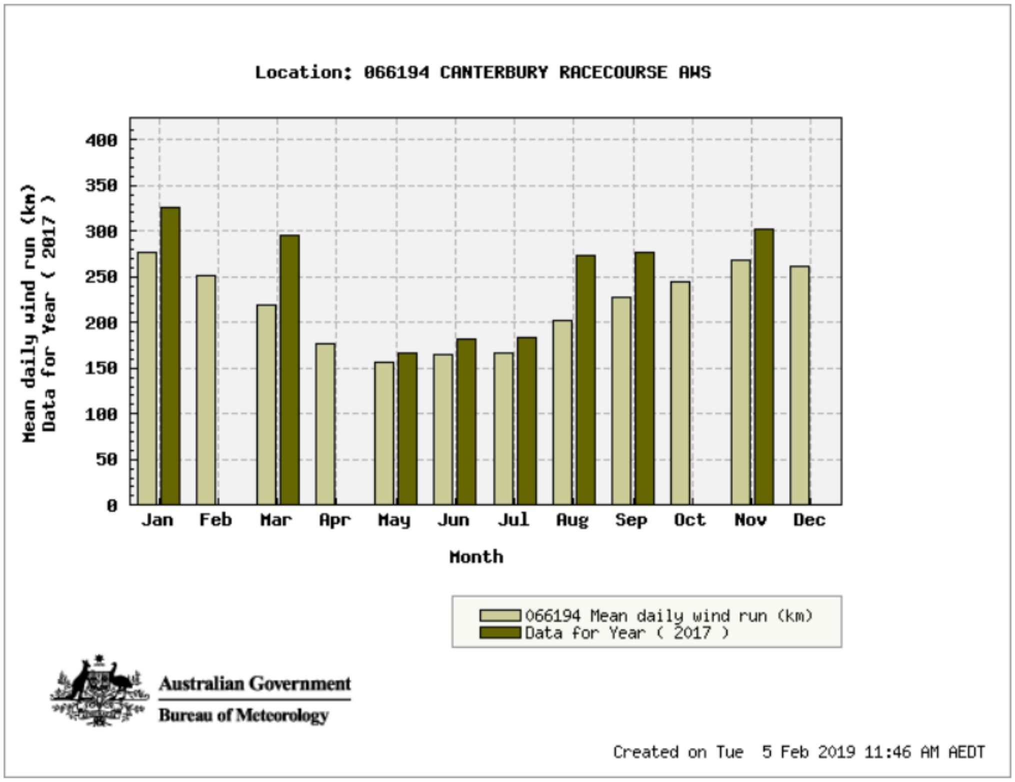

Location: 066194 CANTERBURY RACECOURSE AWS
Mean daily wind run (km)
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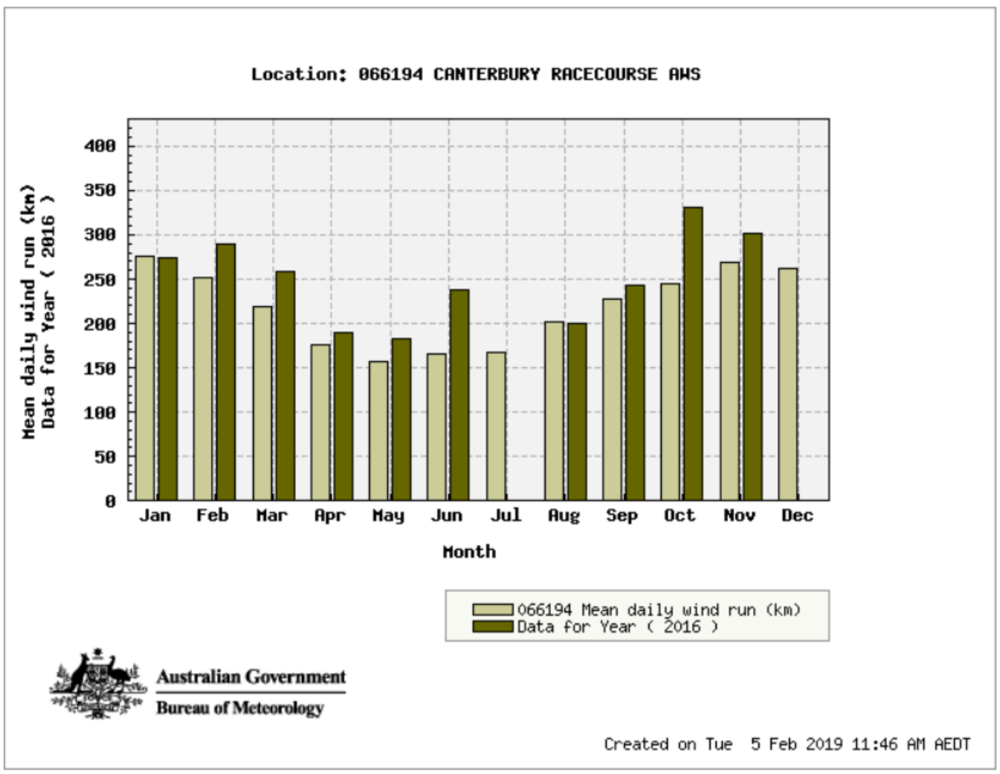

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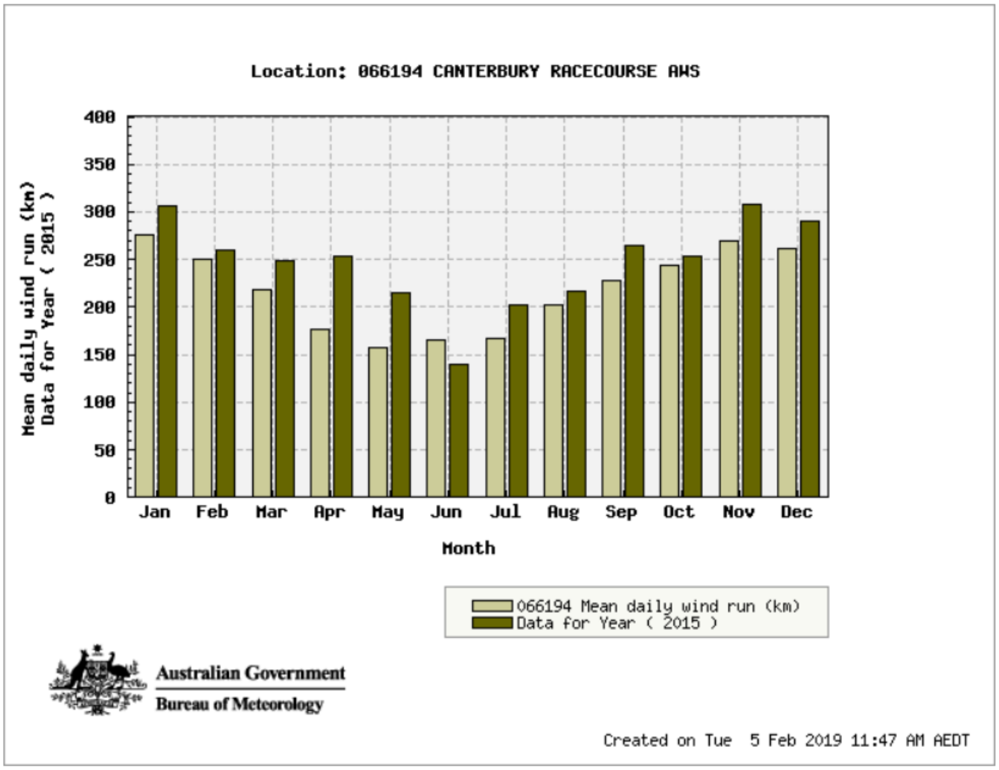
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Data for Year (2015)
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066194 Mean daily wind run (km)
Data for Year (2015)
Australian Government
Bureau of Meteorology
Created on Tue 5 Feb 2019 11:47 AM AEDT

Attachment 2: Air Quality Management Plan (Northstar Air)

This document has been prepared on behalf of **Gow Street Recycling Centre Pty Ltd** by:

Northstar Air Quality Pty Ltd,

Suite 1504, 275 Alfred Street, North Sydney, NSW 2060

www.northstarairquality.com | Tel: +61 (02) 9071 8600

Condition U1.3 – EPL 10943

Assessment of the Effectiveness of the Air Quality Management Plan

81 Gow Street, Padstow NSW 2211

Addressee(s):	**Gow Street Recycling Centre Pty Ltd**
Report Reference:	**20.1046.FR3V1**
Date:	**24 June 2020**

Quality Control

Study	Status	Prepared	Checked	Authorised
INTRODUCTION	Final	Northstar Air Quality	GCG	Final
AIR QUALITY MONITORING - BACKGROUND	Final	Northstar Air Quality	GCG	Final
AIR QUALITY MANAGEMENT PLAN	Final	Northstar Air Quality	GCG	Final
AIR QUALITY MONITORING - RESULTS	Final	Northstar Air Quality	GCG	Final
CONCLUSION	Final	Northstar Air Quality	GCG	Final

Report Status

Northstar References		Report Status	Report Reference	Version
Year	Job Number	(Draft: Final)	(R*x*)	(V*x*)
20	1046	F	R3	V1
Based upon the above, the specific reference for this version of the report is:				**20.1046.FR3V1**

Final Authority

This report must by regarded as draft and without prejudice until the above study components have been each marked as final, and the document has been signed and dated below.

24th June 2020 **Martin Doyle**

Contents

Tables

Figures

Units Used in the Report

All units presented in the report follow the International System of Units (SI) conventions, unless derived from references using non-SI units.

In this report, units formed by the division of SI and non-SI units are expressed as a negative exponent, and do not use the solidus (/) symbol.

1. INTRODUCTION

Gow Street Recycling Centre Pty Ltd (GSRC) are regulated under the *Protection of the Environment Operations Act 1997* through Environmental Protection Licence (EPL) No. 10943 for resource recovery and a waste storage facility located at Lot A DP 103140 (81 Gow Street, Padstow NSW) (the premises).

In a letter dated 25 November 2019 (ref DOC19/884876-3), NSW Environment Protection Authority (EPA) proposed to vary the conditions of EPL 10943 as follows:

- ***O3.1*** *The premises must be maintained in a condition which prevents or minimises the emission of air pollutants, including dust, from the premises.*
- ***O3.2*** *All activities conducted on the premises must be undertaken by such practical means to avoid or minimise the emission of air pollutants, including dust.*
- ***U1.1 By 10 December 2019****, licensee must engage an independent, suitably qualified and experienced person/s in the area of environmental management to:*
    - *a) Assess the effectiveness of the Operational Environmental Management Plan (OEMP) in reducing dust issues at the premises.*
    - *b) Prepare an air quality management plan that includes the following:*
        - *I. Risk assessment;*
        - *II. Proactive and reactive mitigation measures of all significant, and potentially significant, emissions source(s);*
        - *III. Key performance indicator(s);*
        - *IV. Monitoring method(s);*
        - *V. Location, frequency and duration of monitoring;*
        - *VI. Record keeping;*
        - *VII. Response mechanisms and contingency measures;*
        - *VIII. Responsibilities; and*
        - *IX. Compliance reporting*
    - *c) Conduct effective air quality monitoring regime using an appropriate air monitoring method which is incorporated into a robust management system. Air monitoring should be undertaken in accordance with an appropriate published method or Australian Standard. Air quality monitoring should be conducted for a minimum of three months period with at least one month of data to be collected to reflect current site operations prior to the implementation of identified measures.*

      An effective monitoring regime should consider data collected from a variety of sources, which are monitored on a regular basis such as:
        - *I. Meteorological monitoring (including wind)*
        - *II. High Definition Video monitoring*
        - *III. Field survey records / boundary checks*
        - *IV. Stakeholder surveys / dust diaries*
- ***U1.2 By 17 January 2020****, licensee must provide the EPA with an air quality management plan for review. The Plan must address all requirements identified in Condition U1.1.a.ii and U1.1.a.iii.*
- ***U1.3 By 1 May 2020****, licensee must provide a report detailing requirements identified in Condition U1.1.a. This Report must also include:*

- *a) A review of the environmental controls that have been implemented under the OEMP at the premises in terms of their effectiveness of reducing dust emissions and dust issues at the premises.*
- *b) A review of the operational procedures and the dust monitoring program and their effectiveness in reducing dust emissions and dust issues at the premises.*
- *c) A review of the effectiveness of all proposed mitigation measures (screening, fencing, location of plant and other measures and infrastructure modifications) taken to reduce dust.*
- *d) An update on the status of engineered barriers on the eastern, western and southern boundaries with details of their effectiveness in reducing dust.*

Northstar Air Quality Pty Ltd (Northstar) was engaged by GSRC in October 2019 to provide the required professional services. Northstar is an independent consultancy specialising in air quality matters. Dr Martin Doyle (the principal author) has over 20 years' experience in air quality and environmental management and is a Certified Air Quality Professional (CAQP) administered by CASANZ, and it is respectfully considered that these qualifications and experience meet the criteria outlined in Condition U1.1.

A report seeking to satisfy Condition U1.2 was submitted to NSW EPA on 17 January 2020 (ref 20.1046.FR2V1). A minor typographical error was assumed to be included in the proposed variation associated with Condition U1.2, specifically the reference to Condition U1.1.a.ii and U1.1.a.iii, which was assumed to refer to Condition U1.1.b and U1.1.c.

This report seeks to satisfy Condition U1.3 and outlines the results of the dust monitoring program, and the effectiveness of the air quality management plan.

1.1. Previous NSW EPA requirements

In March 2018, Northstar prepared a Dust Management Plan (DMP) for GSRC (ref 18.1062.FR1V1, dated 27 March 2018) in response to a Pollution Reduction Program (PRP) implemented by NSW EPA through conditions within EPL 10943. Those conditions required the provision of an Operational Environmental Management Plan (OEMP) which contained a Dust Management Plan detailing:

- *i. all dust generating sources at the Premises;*
- *ii. operational procedures for all dust controls at the Premises and a dust monitoring program to review and ensure the ongoing effectiveness of those controls;*
- *iii. the immediate measures that have or are being implemented to address the current dust emissions on the southern, eastern and western boundary of the Premises (i.e. screening, fencing, enclosure of dust generating plant or relocation of plant); and,*
- *iv. the proposed long-term measures to prevent any reoccurrence of dust migration from the Premises.*

The Dust Management Plan included a response to the items above and was submitted by GSRC to NSW EPA in March 2018.

In October 2019, NSW EPA wrote to GSRC indicating their intention to further vary the conditions of EPL 10943, specifically to update the requirements of the previous PRP (see above). In correspondence, NSW EPA indicated that they considered that the issues associated with dust control had not been satisfactorily resolved at the Premises, and an additional report was required to assess the effectiveness of the environmental controls implemented through the recommendations of the OEMP (March 2018).

NSW EPA proposed a variation to EPL 10943 in a letter dated 14 October 2019 (EPA letter ref DOC19/884876). The proposed variation to EPL 10943 as outlined in **Section 1** is the second proposed variation, which resulted from correspondence between Northstar, GSRC and EPA (ref 20.1046.L1V1 dated 1 November 2019).

1.2. This report

To meet the requirements of Condition U1.3, this report provides:

- An assessment of the effectiveness of the Air Quality Management Plan (AQMP) in reducing dust emissions from the premises, including a summary and review of the environmental controls and operational procedures that have been implemented under the AQMP.
- An update on the on the status of engineered barriers on the eastern, western and southern boundaries with details of their effectiveness in reducing dust.

2. AIR QUALITY MONITORING – BACKGROUND

2.1. Summary

As outlined in the Air Quality Management Plan (report 20.1046.FR1V1, dated 17 January 2020), air quality and meteorological monitoring has been performed at the premises.

The purpose of the monitoring was to demonstrate that the implemented control measures outlined in the AQMP were sufficient to appropriately manage the risks of the activities being performed at the premises. The results of this air quality monitoring campaign are not to be used to determine compliance of the development with air quality criteria as outlined in the NSW EPA Approved Methods for the Modelling of Air Pollutants in NSW (Approved Methods for modelling) document (NSW EPA, 2017). For clarity, the air quality monitoring was performed to support dust management actions at the premises.

Air quality monitoring of particulate matter with an aerodynamic diameter of 10 microns (PM_{10}) was performed using a Beta Attenuation Monitor (BAM), which has US EPA approval for PM_{10} measurement. It is an equivalent test method in accordance with the NSW EPA Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (Approved methods for sampling) document (NSW EPA, 2006).

Meteorological monitoring was also performed using a co-located meteorological monitoring station, measuring wind speed and direction at a height of approximately 1.5 m above ground level (AGL).

Monitoring commenced on 15 February 2020 and ceased on 1 June 2020 (a total monitoring period of 107 days, approximately 3.5 months). The first 60 days of the monitoring program were used to assess the impact of current air quality management measures implemented at the premises. Additional mitigation measures were implemented (refer **Section 3.2**) and monitoring continued for the next 47 days to assess the impact of those measures on particulate matter measurements.

2.2. Details of monitoring

PM_{10} and meteorological monitoring was performed to allow determination of peak particulate concentrations (10-minute averages) to allow comparison with short term activities at the premises which may otherwise be 'smoothed' over longer averaging periods.

The air quality monitoring station (AQMS) was installed at the edge of the main yard, where materials unloading and storage activities are performed. This was considered to be a suitable location as it is close enough to activities to experience particulate matter associated with those activities, whilst being at a sufficient distance for measurements not to be dominated by a single source. Photographs of the AQMS are presented in **Figure 1** and **Figure 2**.

Figure 1 AQ monitoring station (looking north)

Figure 2 AQ monitoring station (looking south)

The wind speed sensor malfunctioned between 2.00 pm on 4 March 2020 until 10.30 am on 9 March 2020. The PM_{10} monitoring unit malfunctioned between 29 April and 11 May 2020. These data have been removed from the analysis.

3. AIR QUALITY MANAGEMENT PLAN

3.1. Summary of previous risk assessment

The risk assessment outlined in report 20.1046.FR2V1 identified that without any mitigation measures applied, all activities performed at the premises would represent an unacceptable risk. The identified hazards were:

- Movement of vehicles on hardstand areas
- Unloading of material in the main yard
- Loading of the crusher/screen
- Crushing and screening of material
- Unloading of materials from the crusher/screen to temp. stockpiles
- Movement of materials about site by wheeled loader
- Loading of trucks with product material
- Wind erosion of hardstand areas
- Wind erosion of stockpiles

Correspondingly, control measures were required to reduce the associated risks as low as practicable. The controls outlined in **Table 1** were recommended. These controls were selected based on the risk assessment outlined in report 20.1046.FR2V1, but also on detailed review of the previous Dust Management Plan as outlined in Appendix A of report 20.1046.FR2V1.

Table 1 Recommended air quality management

Hazard	Recommended Control	Implementation	Contingency
Movement of vehicles on hardstand areas	Adherence to speed limits (5 $km \cdot hr^{-1}$), and installation of additional speed limit signs and speed humps [1]	Always	Monitor the effectiveness of speed hump location and relocate as required
	Operation of contract street sweeper daily, Monday to Friday and GSRC sweeper on Saturdays [2]	Always	GSRC street sweeper to be used in event of 'no show' by contractor
	Broom sweeping of required areas at least twice per day [3]	Always	None required if street sweeper and contingency adopted
	Hosing and flushing of trafficked area [4]	Always	None required if street sweeper and contingency adopted
	Use of reconfigured wheel bath [5]	Always	Hosing of vehicles (especially wheels) if wheel bath not operational
	Minimisation of drop heights [6]	Always	None available

Hazard	Recommended Control	Implementation	Contingency
Materials handling (loading and unloading)	Water sprays on all transfer points [7]	Always	Modification of activities (i.e. reduction in activity rate)
	Modification of activities in windy conditions [8]	Always	Cessation of activities
	Use of wind shielding [9]	Always	None required – engineered measure
Materials processing	Water sprays on crusher [10] and screen when possible.	Always	Modification of activities (i.e. reduction in activity rate)
Wind erosion	Water sprays [11]	Always	Modification of activities (i.e. reduction in activity rate)
	Storage of product in 3-sided bins [12]	Always	None required – engineered measure
	Use of wind shielding [9]	Always	None required – engineered measure
	Removal of fine particulates from premises [13]	Always	Non required

3.2. Updates to recommended management and mitigation measures

The review of the Dust Management Plan provided in January 2020 identified a number of recommendations, which are reproduced below. The status of these recommendations (as at June 2020) is outlined below and presented in **Table 2**.

Recommended update 1 (January 2020) – ensure that vehicles adhere to the speed limit

This might be performed in two ways

1) include additional signage to stress the importance of adherence to speed limits at the Premises.

2) introduce additional speed humps across the trafficked areas of the Premises to limit the ability of vehicles to increase speeds above the limit of 5 $km \cdot hr^{-1}$. These may be portable speed humps which can be relocated should the layout of the Premises change in the future.

Update 1 (June 2020)

Additional signage indicating the speed limit has been erected around the premises and GSRC have indicated that this is resulting in vehicle speeds being reduced.

Recommended update 2 – ensure that the Premises is swept on a daily basis

1. Arrange with the street sweeping contractor to visit the Premises before an allocated time each day, Monday to Friday. Should the contractor fail to arrive, deploy the GSRC sweeper. The GSRC sweeper should also be used on Saturdays.
2. Broom sweeping should be continued to be performed at least twice per day.

Update 2 (June 2020)

The street sweeping contractor has been visiting the site each day Monday to Friday generally between the hours of 3.00pm and 6.30pm. On days when the contract sweeper does not arrive, the GSRC sweeper is deployed.

Recommended update 3 – reconfigure the wheel bath

1. It is recommended that the wheel bath is reconfigured to ensure that clean water is used to wash vehicle wheels. It may be beneficial to implement water sprays on the approach to the wheel bath, to remove as much sediment from the vehicle chassis as possible and prevent it from entering the wheel bath. Appropriate filtration / settlement would be required prior to release to the wastewater system, to ensure water quality standards are met, and it is understood that an upgraded drainage system has recently been installed at the Premises.
2. A system of water filtration / settlement could also be implemented within the wheel bath to ensure that the wheels of vehicles are not washed with sediment laden water.

Update 3 (June 2020)

The wheel bath has not been reconfigured as yet, although additional sprinklers have been installed along the exit driveway to ensure that dust is washed off tyres and loads are damp upon exiting the premises. As can be seen in the image below, there is little evidence of track-out along the exit driveway, which is a significant improvement upon the situation from January 2020.

Recommended update 4 – complete fencing installation

1. It is recommended that the fencing is completed as a priority and as soon as possible. It is anticipated that the fencing will be completed by early March 2020.

Update 4 (June 2020)

As shown in the two photographs below, fencing along the southern, eastern and now western boundaries has been completed.

Recommended update 5 – remove fine particulate from the Premises

1. It is recommended that GSRC act to control the potential emissions of fine particulate from the Premises. Watering of the areas noted above would ensure that any wind is unlikely to act to resuspend those particles, although the removal of that source of particulate matter is a preferable long-term solution.

Update 5 (June 2020)

Fine particulate matter as identified during January 2020 has been removed from the premises in early May 2020 and is no longer a source of emissions. It will be important to ensure that this source of dust is managed through regular clean up.

Additionally, all materials are now stored in 3-sided bins as shown below. This will act to reduce the incidence of wind erosion from materials storage areas.

Recommended update 6 – provide plans of awnings to NSW EPA with timeframe for construction

1. It is recommended that GSRC provide NSW EPA with appropriately detailed plans and renders of the upgraded Premises at the earliest opportunity. These plans should enable NSW EPA to envisage the materials and processes which would be covered and controlled and provide some level of assurance that the proposed measures would act to control dust emissions from the Premises.

Update 6 (June 2020)

Design and engineering of the shade sails and supporting structure is currently being performed. NSW EPA will be notified once these plans are available.

Table 2 Proposed dust management measures – March 2018, and status – January 2020 and June 2020

Emission Control Measure	Current Procedure	Implementation Timeframe (at March 2018)	Status of Implementation (October 2019)	Further Recommendations (January 2020)	Status of Implementation (June 2020)
Speed limits	Signs to be installed to denote a 5 $km \cdot hr^{-1}$ speed limit on site.	Immediate	Signs installed at entrance.	• Recommendation to include additional signage throughout site to ensure compliance. • Recommendation to include additional speed humps to ensure compliance.	• Additional signage installed throughout site
Vacuum sweeping	To be performed twice per week, at close of business on Saturdays and Wednesdays.	Immediate	Performed daily (Mon-Fri) by contractor. GSRC purchase of street sweeper.	• Recommendation to perform contracted street sweeping by nominated time and use of GSRC street sweeper if non-compliant.	• Contract sweeper visits premises between 3pm and 7pm on weekdays. • When contract sweeper does not arrive, the GSRC sweeper is deployed.
Water flushing	Trafficked areas to be maintained in a dampened condition (visual observation) Hand held hoses to be used to direct dust build up to the edges of trafficked areas.	Immediate	Hosing and flushing of trafficked area performed daily. Washing of build up to edges of trafficked area performed daily.	• Recommendation to cease washing of build up to edges of trafficked areas.	• Water sprays act to keep working areas damp.
Manual sweeping	Manual sweeping to be performed at least twice per day (once per day on Wednesday and Saturday).	Immediate	Broom sweeping twice per day.	• None	• Broom sweeping twice per day.

Emission Control Measure	Current Procedure	Implementation Timeframe (at March 2018)	Status of Implementation (October 2019)	Further Recommendations (January 2020)	Status of Implementation (June 2020)
Water sprays	Implement water sprays on crusher at all times. Implement static water sprays when material being loaded from crusher/screen to stockpiles. Implement water sprays on screens when possible (ensuring product quality will not be compromised).	Immediate	Water sprays on crusher and screens implemented.	• None	• Water sprays on crusher and screens implemented.
Water bath	No procedure required – process already occurs	Immediate	Wheel bath emptied, cleaned and refilled daily by the street sweeping contractor. Wheel bath was noted to have a heavy sediment load, with the potential for tracking.	• Recommendation to reconfigure the wheel bath with water sprays. • Recommendation to redesign the wheel bath with appropriate filtration / sedimentation settlement to minimise the washed material being tracked out of the wheel bath.	• Additional sprays at exit to driveway to ensure truck tyres are clean and loads damp.

Emission Control Measure	Current Procedure	Implementation Timeframe (at March 2018)	Status of Implementation (October 2019)	Further Recommendations (January 2020)	Status of Implementation (June 2020)
Modification of activities	Install wind cone. Used wind cone to observe when winds exceed 4.5 m·s^{-1} and prepare to modify activities. Observe wind-blown dust – implement additional control measures. Should control measures not result in a reduction of wind-blown dust – cease activities.	Within 1 month (and by April 30 2018)	Wind cone installed.	• None.	• No updates.
Wind shielding	7 metre wind barrier to be constructed around perimeter of main yard.	Within 12 months (and by March 31 2019)	Construction of an 8.5 m fence underway, and due for completion early March 2020. Delays due to access to other land-owners property.	• Recommendation that the perimeter fencing is completed as a priority and soon as possible. • Recommendation that NSW EPA is notified immediately upon completion.	• Boundary fencing on western side of premises now completed. •
Minimise drop heights	No procedure required – process already occurs	Immediate	None required	• None	• No updates.
Water sprays	Implement static water sprays when material being handled	Immediate	Water sprays are used for every load transfer.	• None.	• No updates.
Use of 3-sided bins	3-sided bins are already in use for product	Immediate	None required	• None.	• All materials stored in 3 sided bays.

4. AIR QUALITY MONITORING – RESULTS

4.1. Introduction

As previously discussed, air quality and meteorological monitoring commenced at the premises on 15 February 2020 and ceased on 1 June 2020 (a total monitoring period of 107 days, approximately 3.5 months). The first 60 days of the monitoring program was used to assess the impact of 'current' air quality management measures implemented at the premises. Additional mitigation measures were implemented and monitoring continued for the next 47 days to assess the impact of those measures on particulate matter measurements. Those additional measures included:

- ensuring that vehicles adhered to a 5 km·hr^{-1} speed limit, through the use of additional signage.
- use of reconfigured wheel bath with the addition of 3 sprinklers up the exit driveway, ensuring dust is washed off the tyres and customers loads are damp upon exiting.
- removal of the fine dust present at the rear of the premises.
- storage of all materials in 3 sided bins/areas.

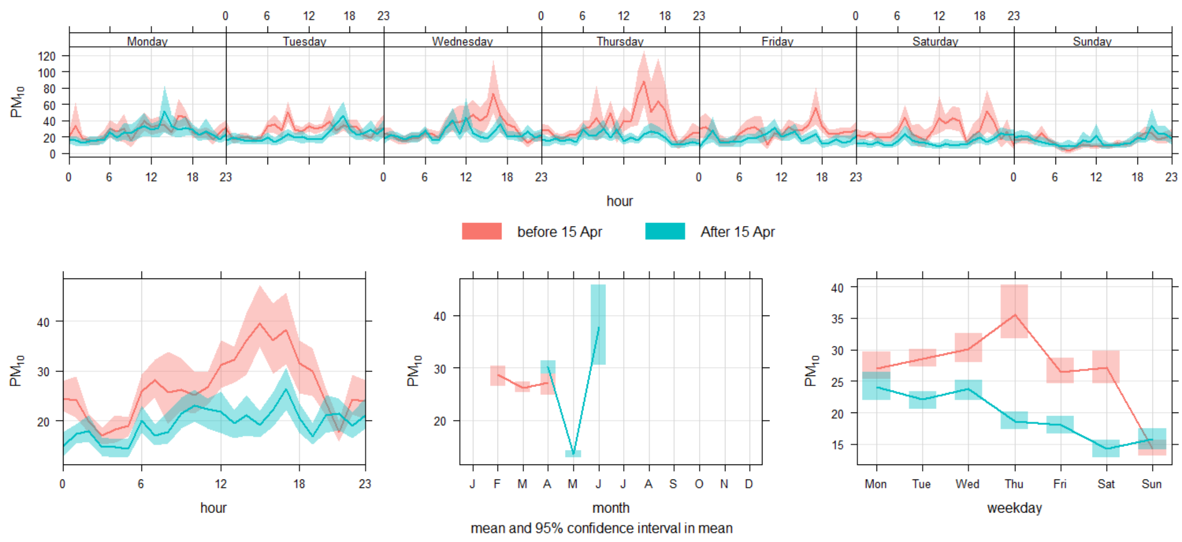
Data has been presented in the following sections which seeks to describe the particulate environment as measured at the monitoring location both pre- and post- implementation of the additional measures described above. As noted previously, it is not intended as an assessment of compliance with any air quality criterion and should not be interpreted as such.

4.2. Results

The results presented below include not only the impact of the activities being performed at the premises, but also the impact of all other sources of particulate matter. However, interpretation of the results is limited to the potential impacts from the activities at the premises. All plots are presented as 10-minute average PM_{10} measurements, and therefore should not be directly compared to the 24-hour average PM_{10} criterion.

Presented in Figure 3 are the results of the monitoring campaign split between pre 15th April (pre-implementation of additional control measures) and post 15th April (post implementation of additional control measures), showing the mean measured values (solid red and blue line) and the 95th percentile confidence interval about that mean value, by day of week, hour of day, month and weekday.

Figure 3 Variation in measured PM10 by time



The following can be interpreted from Figure 3:

- Concentrations of PM_{10} are lower on Sundays, and this is to be expected given that the premises are closed. It also suggests that sources of wind erosion are generally not a significant source of emissions when compared to all activities being performed at the premises (i.e. these are the only sources which would be 'active' when the premises are closed).

- Average concentrations of PM_{10} are shown to be lower following the implementation of the additional control measures. This is a consistent conclusion when examining concentrations measured by time of day, and day of the week, notwithstanding a slight increase in measured PM_{10} concentrations on Sundays following the implementation of additional measures. However, as previously discussed, the influence of background PM_{10} concentrations have not been considered.

- In general, the implementation of additional control measures has been shown through the monitoring data to result in a decrease in measured concentrations of PM_{10} at the premises.

- An apparent anomaly is identified in the average PM_{10} concentrations measured by month, with an increase being experienced in June. However, the monitoring period ended on 1 June and therefore the average is skewed by the low number of data points. The significantly reduced monthly average in May is more relevant.

Presented in **Figure 4** and **Figure 5** are bivariate polar plots which indicate the average PM_{10} concentration by wind speed and direction both pre- and post- implementation of the additional controls measures, respectively.

Figure 4 Polar plot – pre implementation

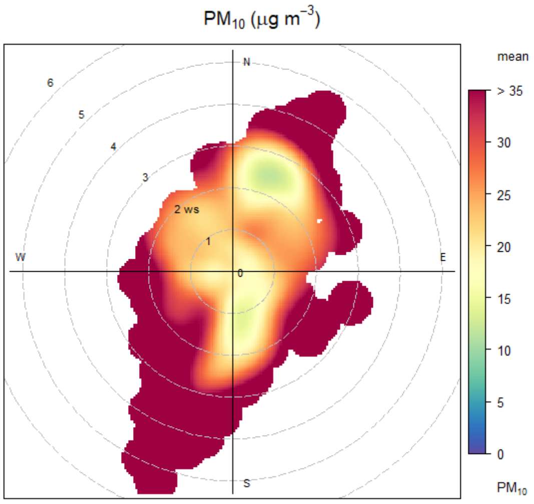
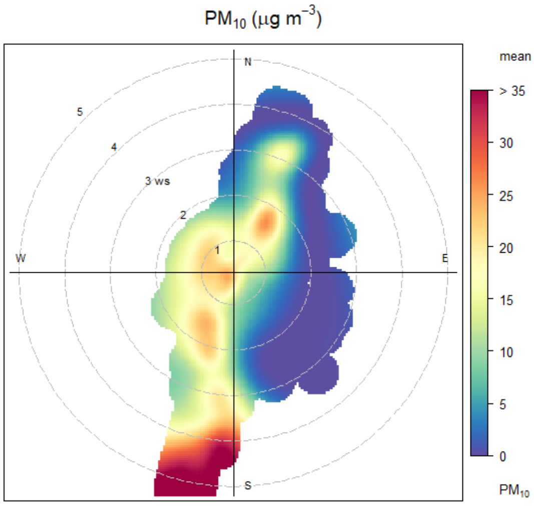


Figure 5 Polar plot – post implementation



The plots illustrate a number of conclusions:

- Concentrations of PM_{10} following the implementation of additional control measures are shown to be lower in all wind speeds and directions when compared with the pre-implementation scenario. This indicates that the additional management measures implemented are acting to reduce concentrations of PM_{10} either by limiting the availability of particulate matter (through, for example, removal of fine particulate matter around the site through sweeping, or storage of materials in 3-sided bins), or by minimising the ability of that particulate matter to be transported from source (e.g. through the minimisation of vehicle speeds).
- Prior to the implementation of additional control measures, PM_{10} concentrations were measured to be higher (>30 $\mu g \cdot m^{-3}$) in wind speeds >2 metres per second ($m \cdot s^{-1}$), particularly from the south west, which may indicate that activities and sources in that direction may be a source of particulate matter. The sources located in that direction are the crushing and screening, materials storage and unloading/loading activities.
- Following the implementation of additional control measures, concentrations of >30 $\mu g \cdot m^{-3}$ were only experienced in wind speeds >4 $m \cdot s^{-1}$ which indicates that either less erodible material is available to be mobilised in lower wind speeds, and/or that controls on activities occurring to the south west (i.e. haulage, crushing, screening and unloading/loading) are being managed to ensure that particulate availability is lowered, requiring higher wind speeds for transportation of that dust.

The plots indicate clearly that following the implementation of the additional measures, PM_{10} concentrations measured at the premises have reduced. The implemented measures are acting to reduce the availability of particulate matter which might be transported from the premises, and also acting to reduce the potential for any particulate matter to be transported.

5. CONCLUSION

The results of the air quality monitoring program indicate very clearly that the additional control measures implemented have been successful in reducing emissions of particulate matter from the operations being performed at the premises. GSRC commit to continuing the implementation of those measures.

The engineered barriers previously proposed have now been completed, with the design and engineering of the shade sail structures currently being performed. NSW EPA will be notified once the design is completed and comment requested.