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Metropolitan Coal

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1 INTRODUCTION

In accordance with Metropolitan Coal’s Project Approval 08_0149, the Metropolitan Coal 2021 Annual Review is required to be submitted by 31 March 2022. Zephyr Environmental (Zephyr) has prepared an Air Quality Monitoring and Environmental Performance Assessment Report in support of this Annual Review.

Monitoring parameters include deposited dust and PM₁₀ monitoring results, as well as meteorological monitoring from 1 January to 31 December 2021.

2 MONITORING NETWORK

The Metropolitan Coal air quality monitoring network is shown in [Figure 2-1](#). It consists of ten dust deposition gauges, a High Volume Air Sampler (HVAS) measuring PM₁₀, a Tapered Element Oscillating Microbalance (TEOM) also measuring PM₁₀, and an automatic weather station (AWS) measuring a number of meteorological parameters. The deposition gauges are static, measuring a single value each month. Similarly, the HVAS measures a single 24-hour average PM₁₀ concentration every six days while the TEOM records continuously at 10-minute intervals to enable a 24-hour average to be calculated every day of the year. The HVAS, TEOM and AWS are all co-located.

Monthly dust deposition rates are measured at the ten dust deposition gauges (DG1 to DG10) consistent with EPL 767 and the Metropolitan Coal Air Quality and Greenhouse Gas Management Plan. Their locations are shown in [Figure 2-1](#) and also described in [Table 2-1](#).

Table 2-1: Dust deposition gauges

Site ID	Address / Location
DG1	136 The Crescent - EPA ID-1
DG2	28 Old Station Road - EPA ID-2
DG3	Mine Entrance - EPA ID-3
DG4	Helensburgh Golf Course - EPA ID-4
DG5	83 Parkes Street - EPA ID-5
DG6	59 Parkes Street -EPA ID-11
DG7	32 Old Station Road - EPA ID-12
DG8	88 Parkes Street - EPA ID-13
DG9	Helensburgh Public School - EPA ID-14
DG10	Helensburgh Private School - EPA ID-15

DG4 is a control dust gauge located at the Helensburgh Golf Course some 2 kilometres (km) from the mine’s Surface Facilities Area and is not included in the assessment of the dust deposition performance indicator.

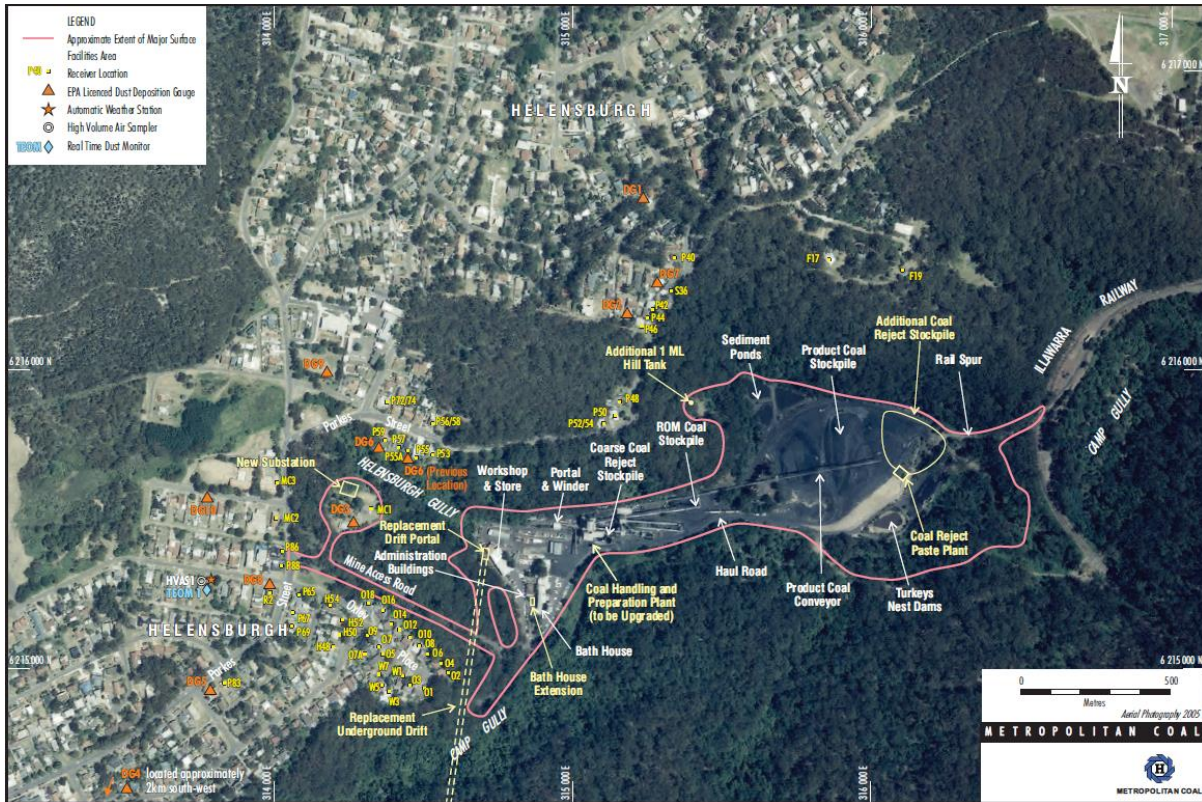


Figure 2-1: Metropolitan Coal’s air quality and meteorological monitoring network

3 AIR QUALITY CRITERIA AND PERFORMANCE INDICATORS

There are both impact assessment criteria and air quality performance indicators relevant to the Metropolitan Coal operations. These have been developed in consideration of the predicted impacts of the Project, which were included in the Metropolitan Coal Project Environmental Assessment (Helensburgh Coal Pty Ltd, 2008). Both sets of criteria are described in the following sections.

3.1 Impact assessment criteria

The Project Approval requires Metropolitan Coal to ensure that dust generated by the Project does not cause additional exceedances of the air quality impact assessment criteria listed in Tables 5, 6 and 7 of Condition 11, Schedule 4 at any residence on privately-owned land, or on more than 25% of any privately-owned land. These criteria are summarised in Table 3-1 and Table 3-2 below.

Table 3-1: Long-term and short-term impact assessment criteria for particulate matter

Pollutant	Averaging period	Criterion
Total suspended particulate (TSP)	Annual	90 µg/m ³
Particulate matter < 10 µm (PM ₁₀)	Annual	30 µg/m ³
	24-hour	50 µg/m ³

Table 3-2: Long-term impact assessment criteria for deposited dust

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
^c Deposited dust	Annual	^b 2 g/m ² /month	^a 4 g/m ² /month

^a Deposited dust is assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter – Deposited Matter - Gravimetric Method, or its latest version.

3.2 Air quality performance indicators

In accordance with the Air Quality and Greenhouse Gas Management Plan, Metropolitan Coal is also required to assess the Project against the air quality performance indicators shown in Table 3-3.

Table 3-3: Air quality performance indicators

Pollutant	Averaging period	Monitoring Point	Performance indicator ^{1,2}
PM ₁₀	24-hour	High Volume Air Sampler (HVAS)	37.5 µg/m ³
	Annual		25 µg/m ³
	10-minute	Tapered Element Oscillating Microbalance (TEOM)	³ 150 µg/m ³
	24-hour		³ 37.5 µg/m ³
Deposited dust	Annual	Metropolitan Coal Dust Gauges excluding DG4	3 g/m ² /month

¹ Total measured level excluding extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities

² Background PM₁₀ concentrations due to all other sources plus incremental increases in PM₁₀ concentrations due to the mine alone

³ Indicative performance criteria only – to be reviewed and updated with ongoing monitoring results

3.3 Other conditions

3.3.1 Greenhouse gas

In addition the air quality conditions above, Condition 10, Schedule 4 of the Project Approval requires that Metropolitan Coal implement all reasonable and feasible measures to minimise

- a) energy use on site; and
- b) the scope 1, 2 and 3 greenhouse gas emissions produced on site,

to the satisfaction of the Director-General (now secretary) of the Department of Planning and Environment (DPE). This is discussed further in Section 7.2.

3.3.2 Odour

Condition 9, Schedule 4 also requires that Metropolitan Coal does not cause or permit the emission of offensive odour from the site, as defined under Section 129 of the *Protection of the Environment Operations Act* (POEO Act). There are not considered to be any odorous emissions from the site, nor have there been any complaints regarding odour, so this is not discussed further in this report.

4 METEOROLOGICAL MONITORING

The site's AWS measures a number of parameters in real time, reporting 10-minute averages which have been used to calculate the 1-hour averages presented in this analysis. The measured meteorological parameters are listed in [Table 4-1](#).

Table 4-1: Meteorological parameters measured at the AWS

Parameter	Unit	Frequency	Height above ground
Wind speed	m/s	Continuous 10-minute average	10m
Wind direction	Degrees		10m
Sigma theta	Degrees		10m
Temperature	°C		2m and 10m
Relative humidity	%		2m
Solar radiation	W/m ²		2m
Rainfall	mm	Continuous 10-minute total	Ground level

[Figure 4-1](#) presents an annual summary of a number of these parameters, indicating the typical seasonal variations expected at the site. The total annual rainfall was recorded as 1,305 mm, with 25% of that falling in March (335 mm). November recorded the next highest rainfall of 178 mm.

The maximum temperature measured at 2 m over a 1-hour period was 37.6°C on 26th January, with a minimum of 1.2°C recorded on 11th June. The variations in average daily temperature are shown in [Figure 4-2](#).

[Figure 4-3](#) shows a similar plot for variations in daily average humidity. Relative humidity is generally higher in the cooler months, but there are also a number of days in March and November which are high during heavy rainfall.

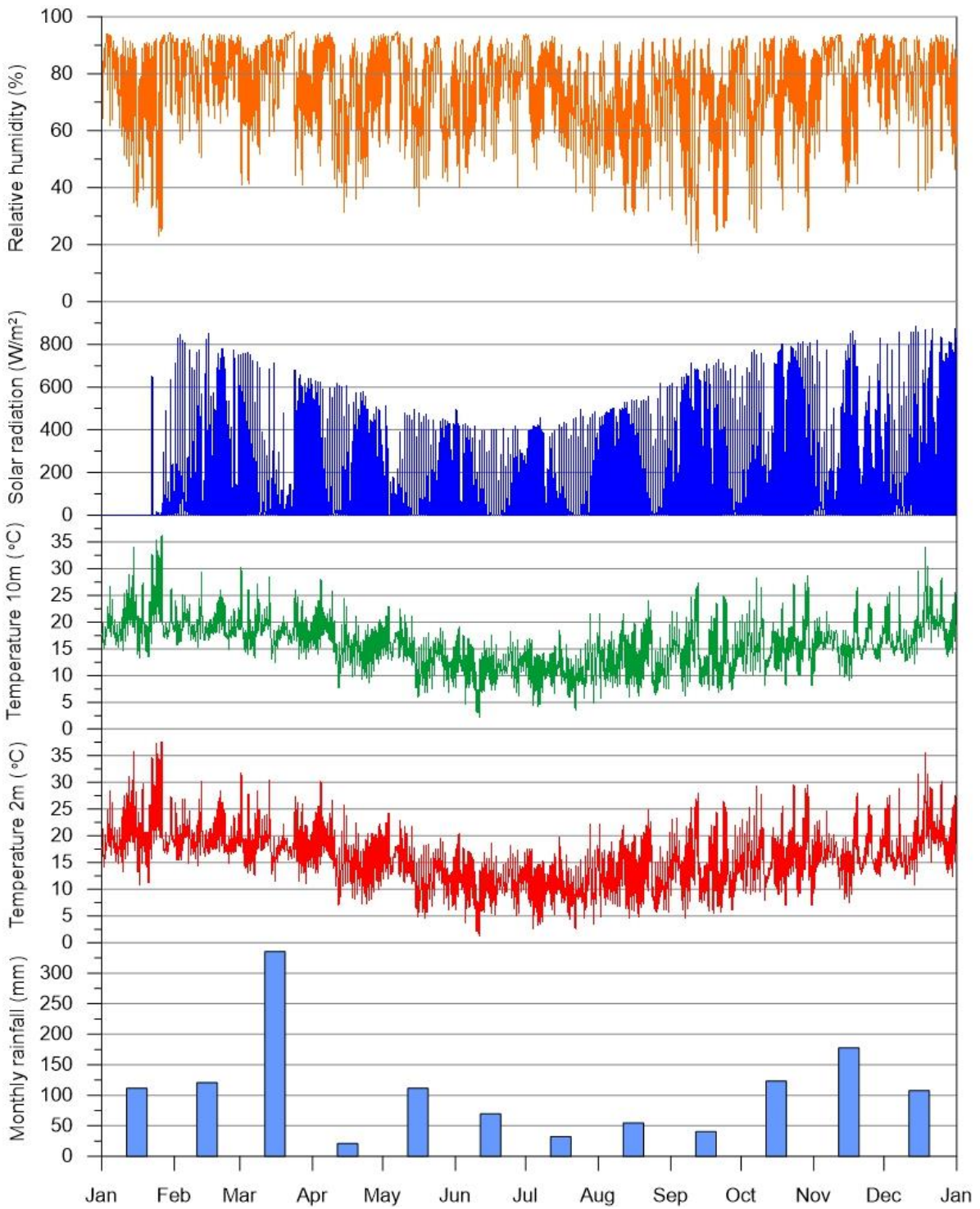


Figure 4-1: Annual summary of meteorological parameters for 2021

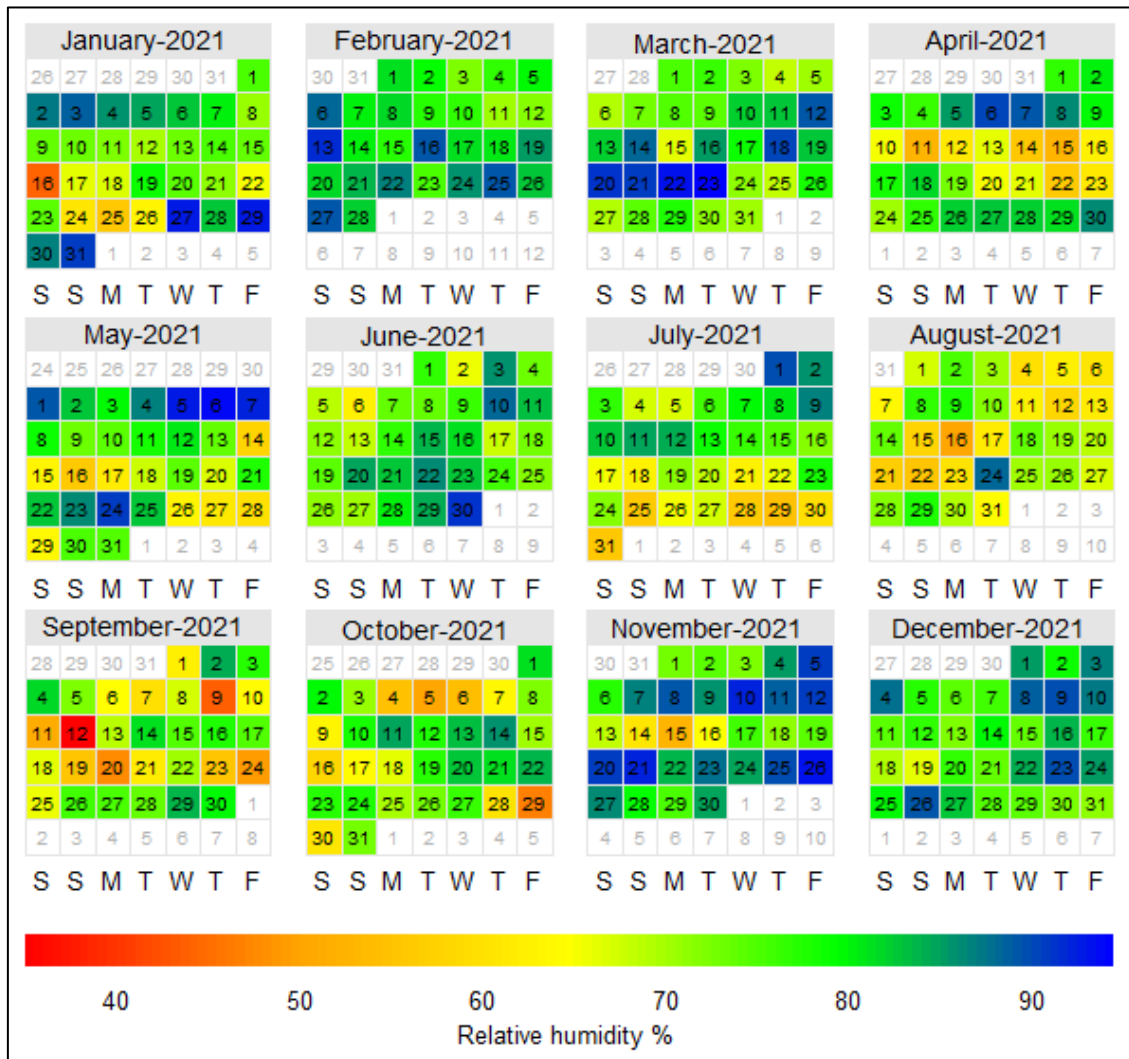


Figure 4-3: Variation in average daily humidity for 2021

Regarding wind speed and direction, [Figure 4-4](#) and [Figure 4-5](#) present the annual and seasonal variation in 1-hour wind speeds for the year, respectively. [Figure 4-6](#) shows the monthly variation.

On an annual basis, winds are predominantly from the west, northwest and southeast. Southeasterlies dominate in summer while the westerlies and north westerlies dominate in winter. Average wind speeds are low at 1.3 m/s on an annual basis, slightly higher in spring and summer and slightly lower in autumn and winter.

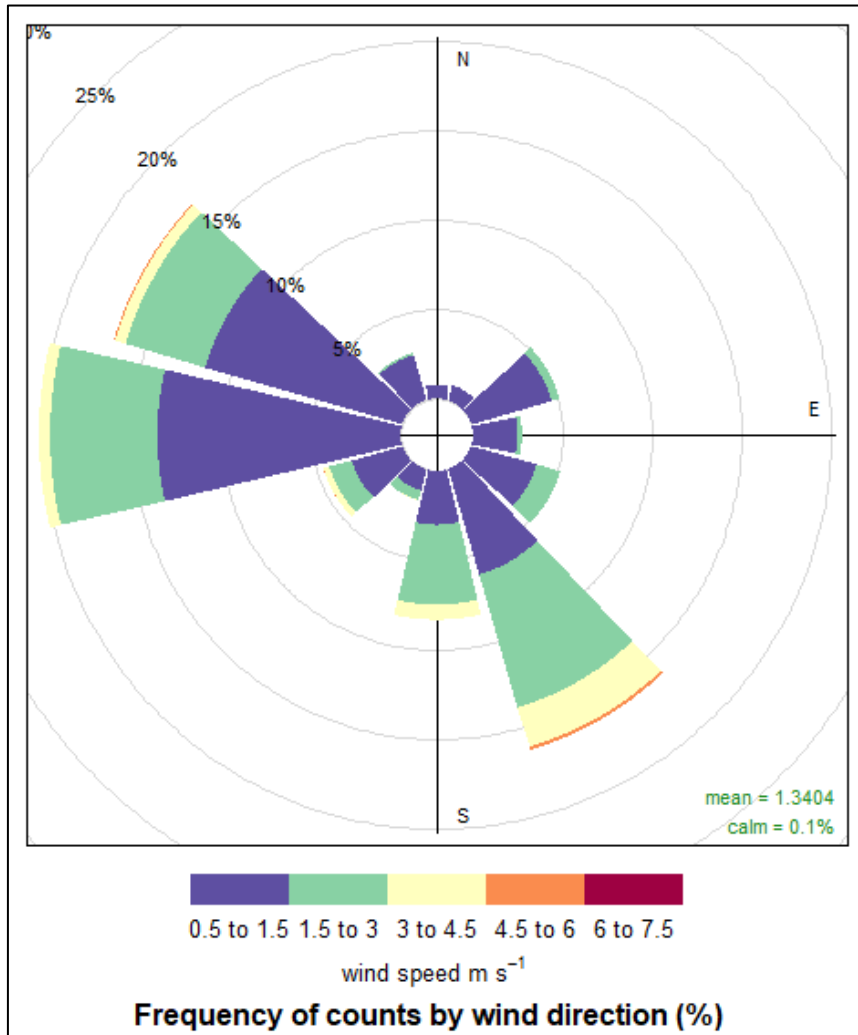


Figure 4-4: Annual windrose for Metropolitan Coal 2021

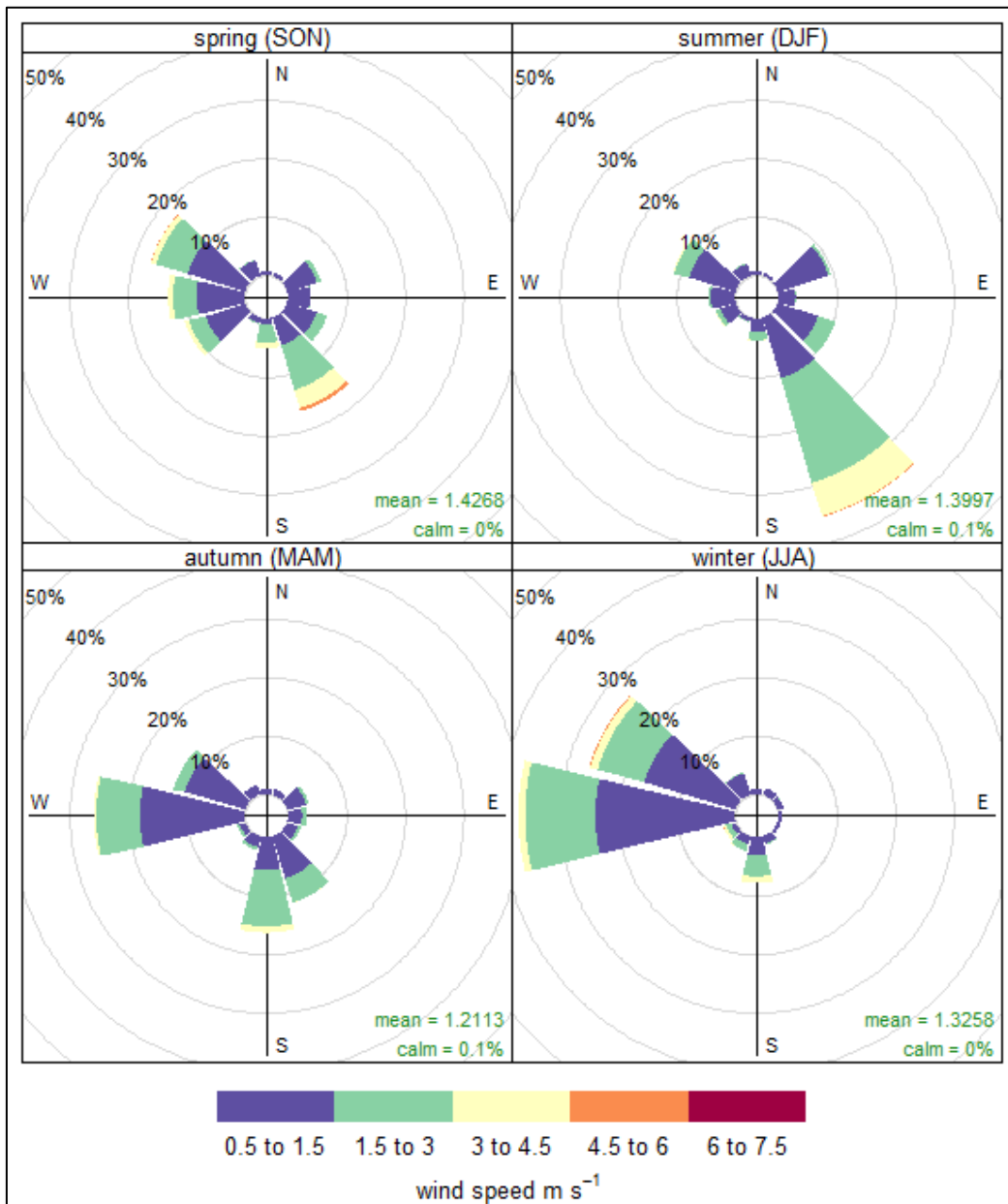


Figure 4-5: Seasonal windroses for Metropolitan Coal 2021

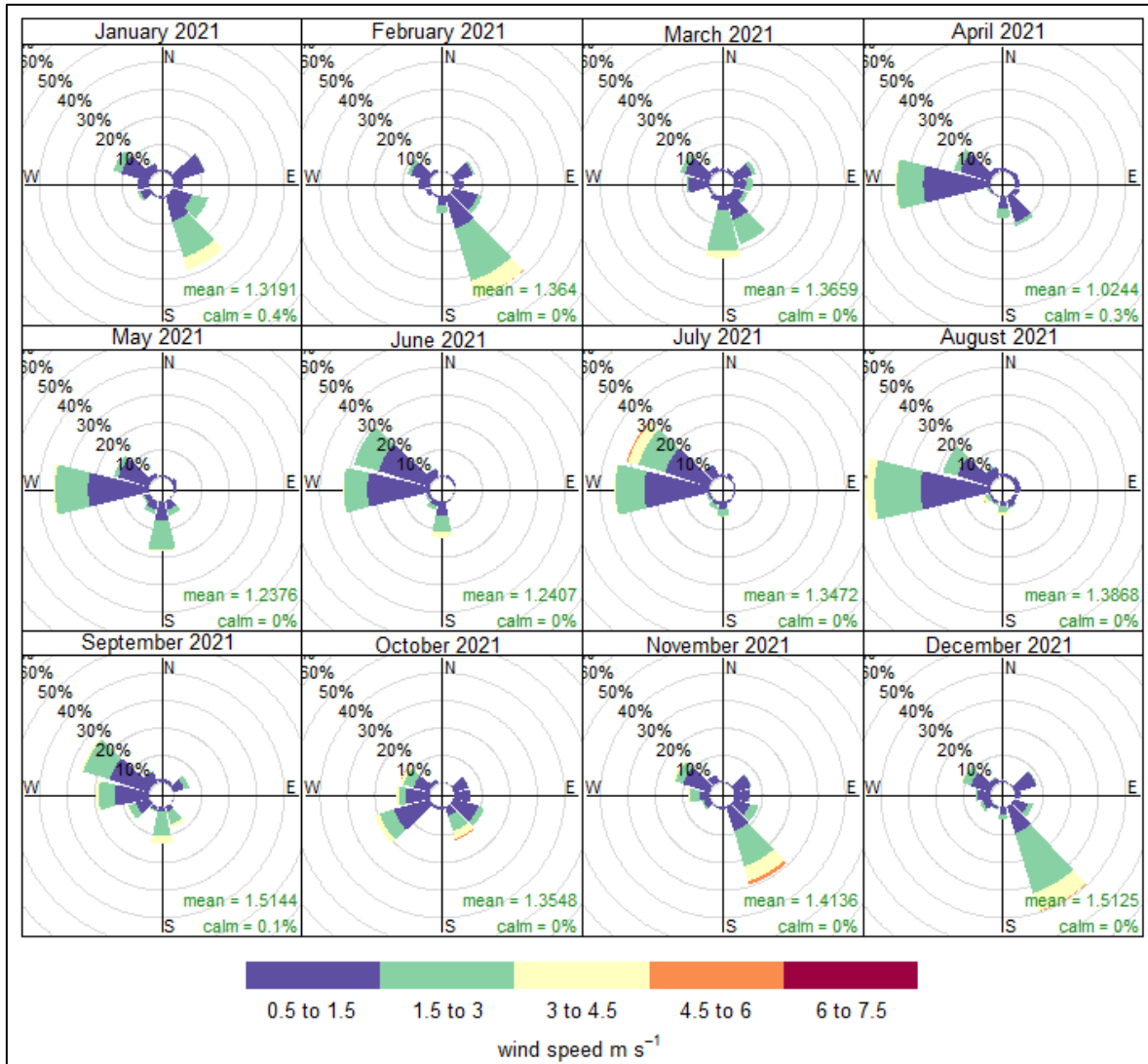


Figure 4-6: Monthly windroses for Metropolitan Coal 2021

Atmospheric stability refers to the degree of turbulence or mixing that occurs within the atmosphere and is a controlling factor in the rate of atmospheric dispersion of dust from mining operations. Highly stable conditions lead to poor dispersion while unstable conditions enable more effective dispersion of pollutants.

Atmospheric stability has been calculated using the meteorological data collected, and [Figure 4-7](#) presents the diurnal variation in atmospheric stability at Metropolitan Coal AWS. The profile shows that atmospheric instability increases during the daylight hours as the sun-generated convective energy increases, whereas stable atmospheric conditions prevail during the night-time. This profile indicates that the potential for effective atmospheric dispersion of emissions would be greatest during daytime hours and lowest during evening through to early morning hours.

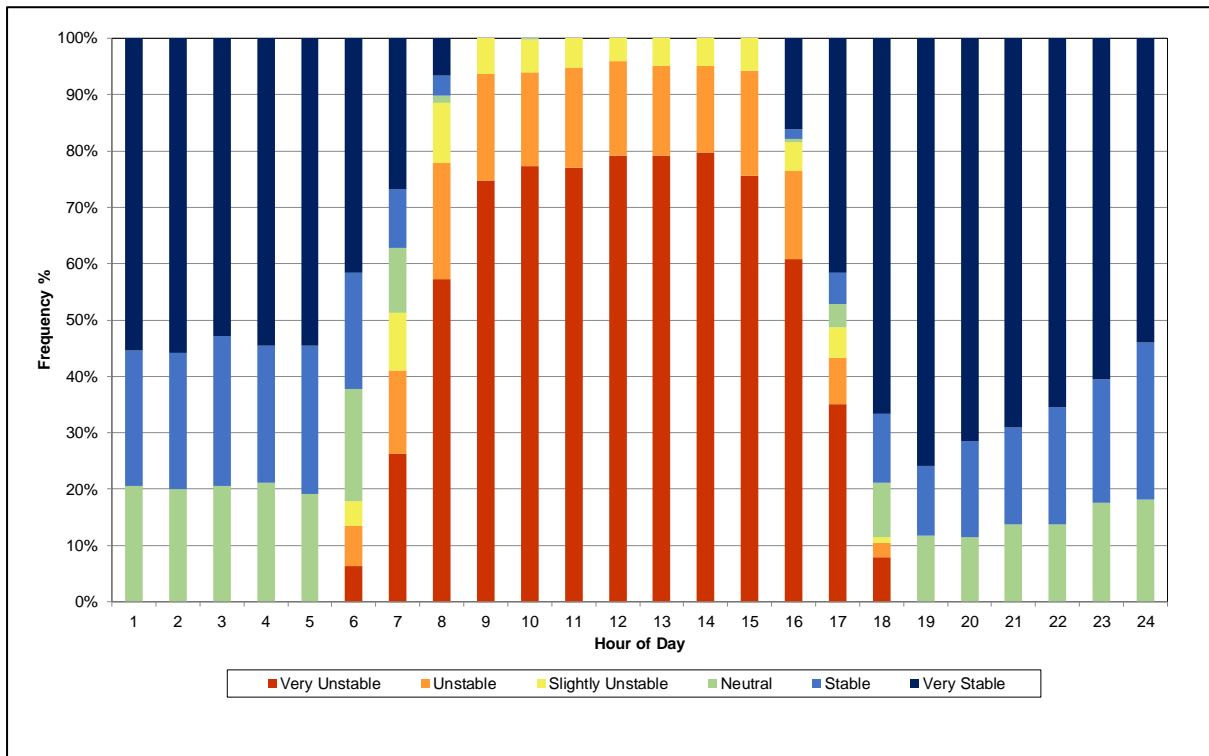


Figure 4-7: Diurnal variation in stability for Metropolitan Coal 2021

5 AIR QUALITY MONITORING

5.1 Particulate matter

5.1.1 High Volume Air Sampler (HVAS)

A HVAS is a static sampler that takes a single composite sample over a 24-hour period using a gravimetric method. The exposed filter paper can then be analysed for the particulate size fraction determined by the sample inlet used; in this case PM₁₀.

Samples from January to December were taken every six days. [Figure 5-1](#) shows each individual PM₁₀ measurement over the year, a total of 61 days were sampled (100% capture rate). The highest concentrations of 112 µg/m³ on 3 May and 86.3 µg/m³ on 9 May, were attributed to prescribed hazard reduction burning events.

The annual average PM₁₀ concentration measured by the HVAS was 12.8 µg/m³. This is lower than the previous two years of 14.1 µg/m³ (2020) and 16.4 µg/m³ (2019).

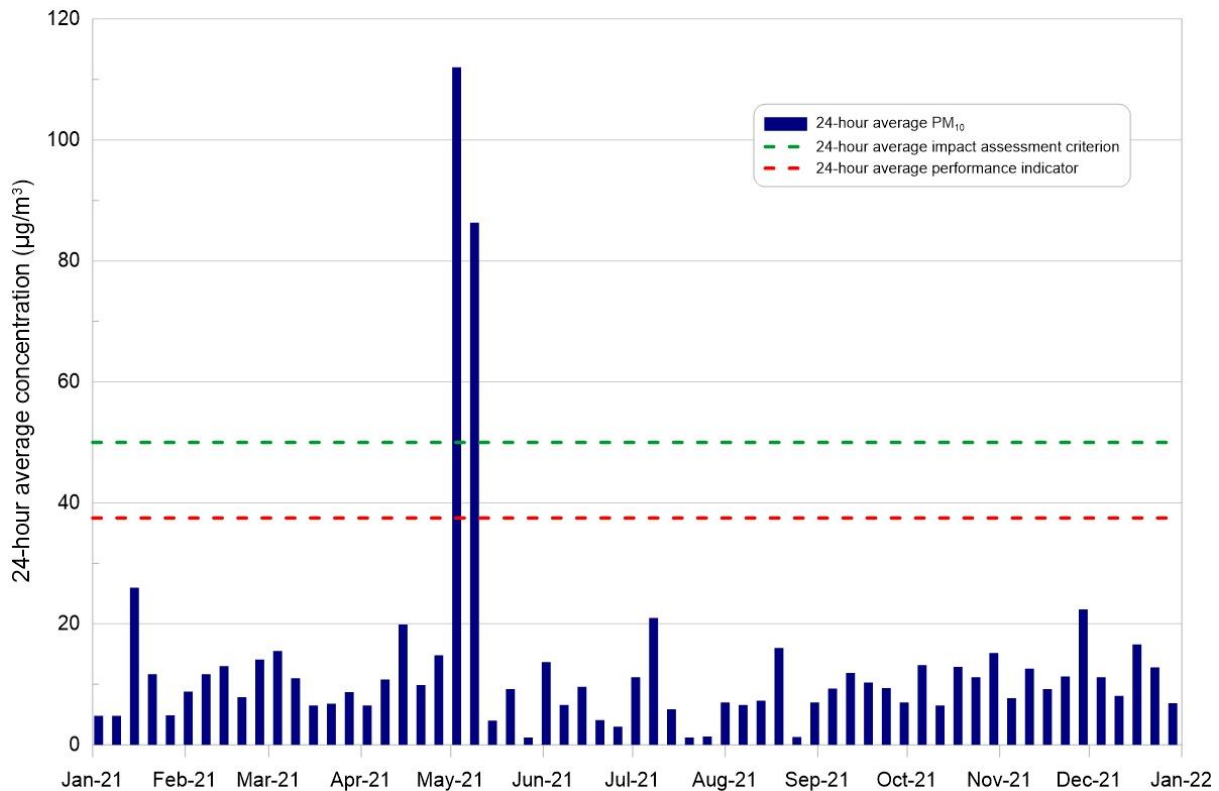


Figure 5-1: PM₁₀ measurements from the HVAS – 2021

5.1.2 Tapered Element Oscillating Microbalance (TEOM)

The TEOM, which has been co-located with the HVAS, measures PM₁₀ continuously. Measurements are made every 10-minutes and these values can be averaged into 1-hour and 24-hour concentrations. Figure 5-2 presents the available 24-hour average data, a total of 364 out of a possible 365 measurements. The highest concentration was 72 µg/m³, measured on 3 May during a prescribed hazard reduction burn event.

The annual average was 12.8 µg/m³, the same as that measured by the HVAS and lower than the previous two years of 15.3 µg/m³ (2019 and 2020).

Figure 5-3 presents the available 10-minute average PM₁₀ data, with a capture rate of 99.4%. The highest 10-minute average concentration was 310 µg/m³, measured on 3 May during a prescribed hazard reduction burn event. There were 37 measurements above the 10-minute average performance indicator of 150 µg/m³. All of these were measured on 2-3 May during the prescribed burn event.

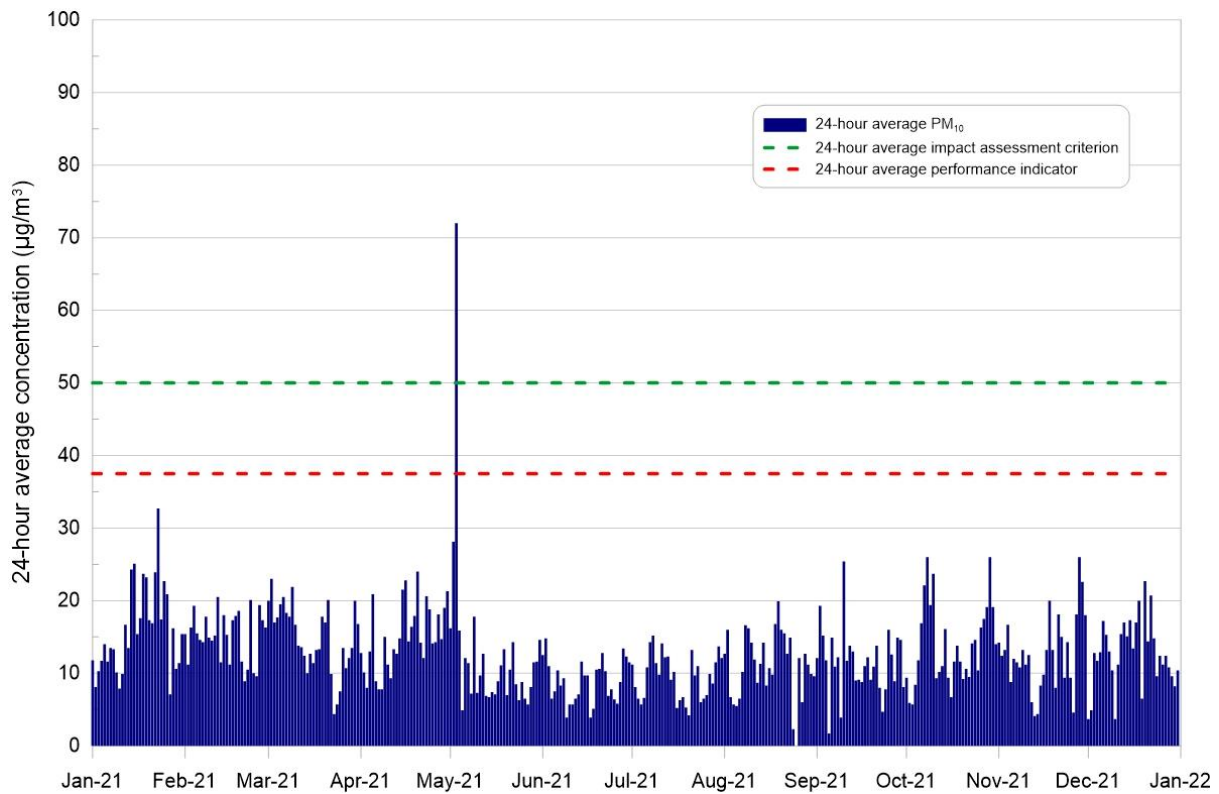


Figure 5-2: 24-hour average PM₁₀ concentrations measured by the TEOM – 2021

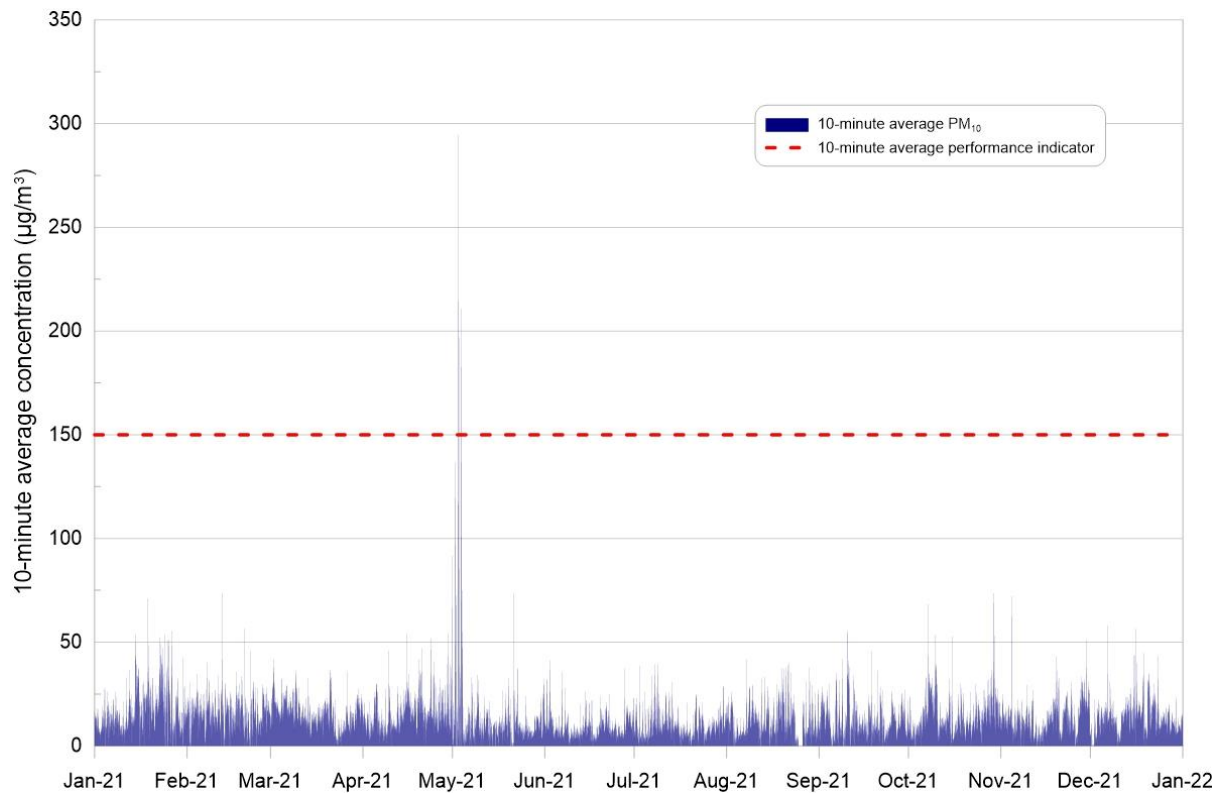


Figure 5-3: 10-minute average PM₁₀ concentrations measured by the TEOM – 2021

5.1.3 Long term PM₁₀ analysis

Figure 5-4 presents the 24-hour HVAS data for the last ten years, from January 2012 to December 2021. The data show 12 exceedances of the performance indicator over that time and six exceedances of the assessment criterion. These were almost exclusively due to regional events such as prescribed burns or bushfires. The data does not show any trend, either increasing or decreasing over the ten-year period.

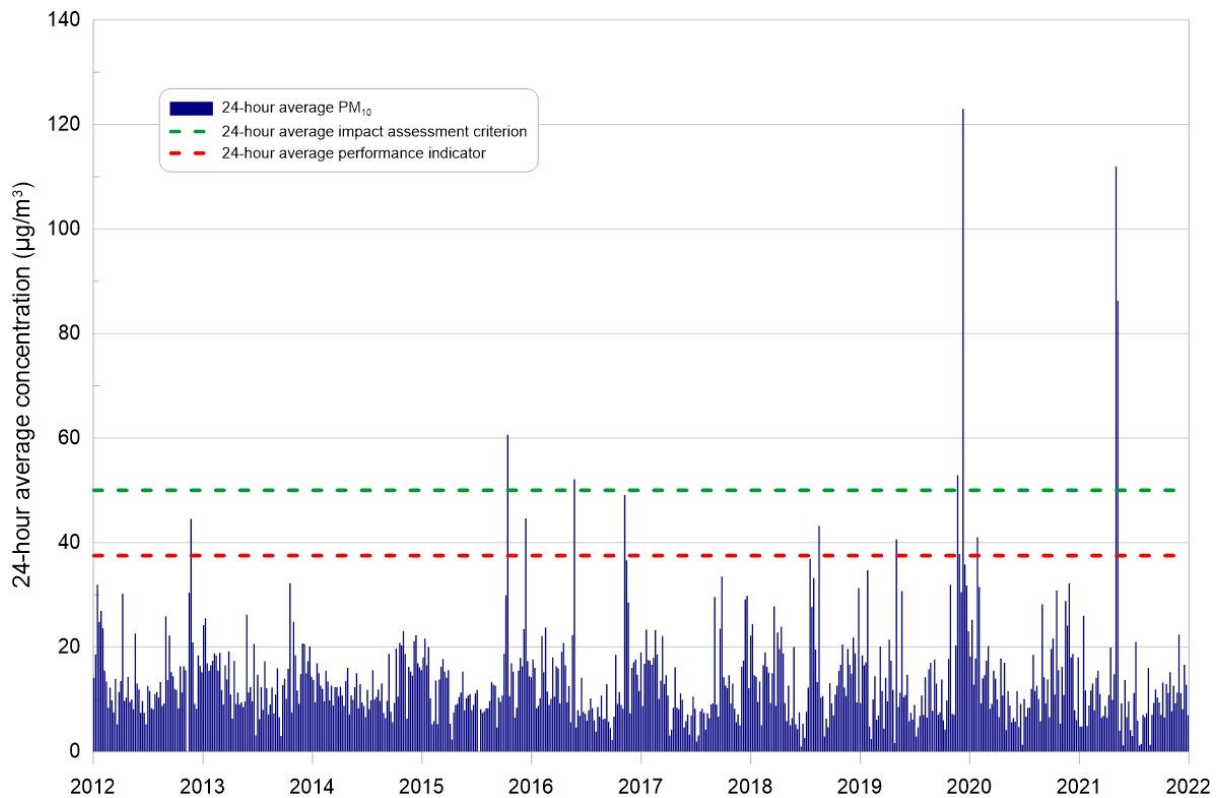


Figure 5-4: 24-hour average PM₁₀ concentrations – 2012 to 2021

Figure 5-5 shows the historical annual average PM₁₀ measurements from 2007 to 2021. The annual average PM₁₀ concentrations for 2021 are not only below the assessment criterion and performance indicator, but also below the long-term average for the site of 14.4 µg/m³. This figure indicates that the concentrations are influenced by external factors such as drought, with high annual averages in years following significant drought (2009 and 2019), and much lower concentrations in wetter years.

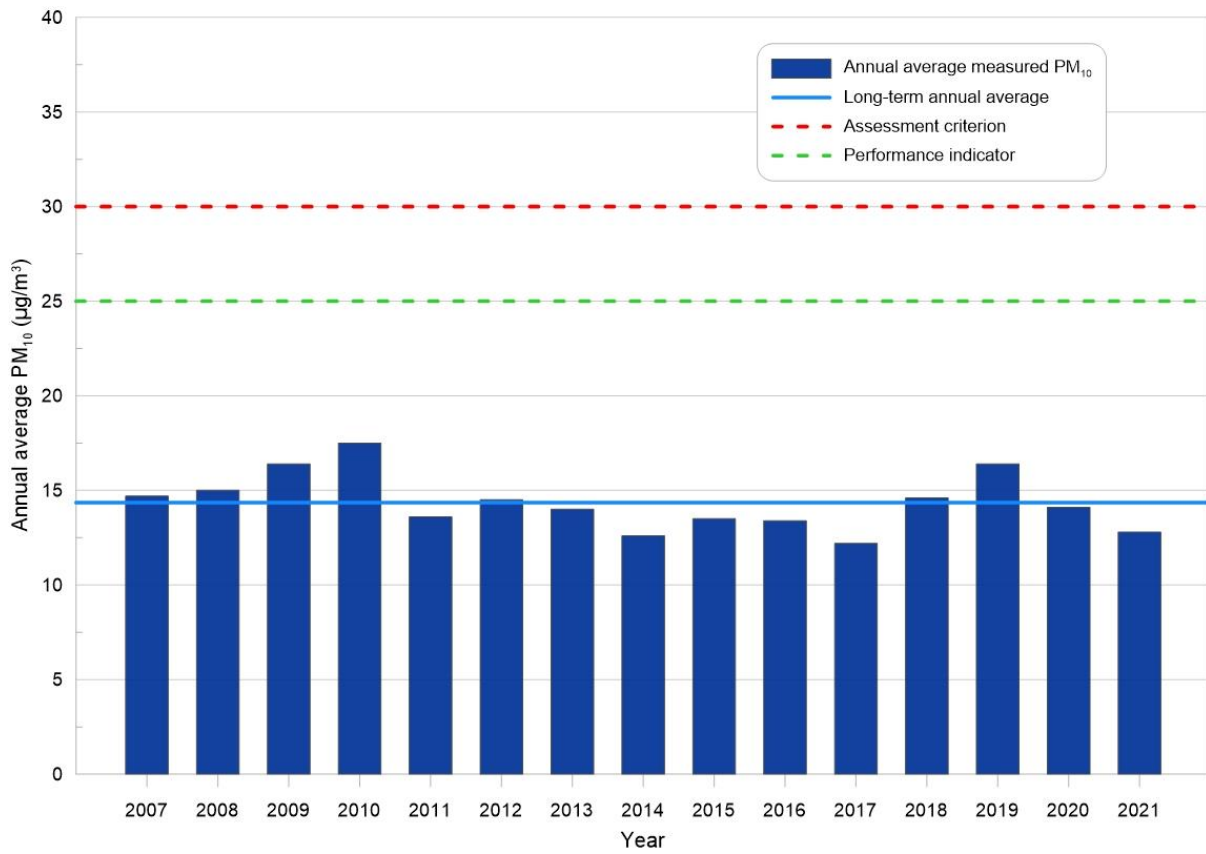


Figure 5-5: Annual average PM₁₀ concentrations – 2007 to 2021

5.2 Dust Deposition Gauges (DGs)

As noted in Section 2, there are ten DGs placed at various locations surrounding the Metropolitan Coal site. Samples are collected on a monthly basis (approximately 30 days) and then analysed in a laboratory. For the purposes of this report, the relevant indicator is total insoluble solids, and these results are summarised in [Table 5-1](#).

There was a data capture rate of 100% with 12 samples collected across all ten sites. All gauges recorded annual averages less than the assessment criterion of 4 g/m²/month and performance indicator of 3 g/m²/month.

The highest monthly result was 6.8 g/m²/month, recorded in July at DG3. DG3 also recorded the highest annual average at 1.6 g/m²/month. Only four of the 120 samples (3%) were greater than 2 g/m²/month.

This information is also presented in graphical form in [Figure 5-6](#) for monthly results, and in [Figure 5-7](#) for annual averages.

Table 5-1: Monthly and annual average dust deposition rates (insoluble solids) for 2021

Month	DG1	DG2	DG3	DG4 ^	DG5	DG6	DG7	DG8	DG9	DG10
January	0.9	0.3	0.7	0.9	0.3	0.3	1.0	0.4	0.2	0.3
February	1.1	0.4	2.0	0.5	0.2	0.4	0.7	0.5	0.5	0.4
March	2.9	0.5	1.8	1.3	0.4	0.4	0.8	0.8	0.4	3.0
April	0.9	0.1	2.6	0.5	0.2	0.2	0.4	0.5	0.9	0.4
May	0.6	0.5	0.6	0.7	0.7	0.3	0.9	0.3	0.5	0.2
June	0.2	0.5	0.8	0.8	0.2	0.1	0.2	0.2	0.2	0.2
July	0.7	0.3	6.8	0.3	0.3	0.7	0.4	0.3	0.1	0.3
August	0.4	0.5	1.0	0.3	0.4	0.3	0.4	0.4	0.5	0.4
September	0.9	0.5	0.3	0.6	0.6	0.3	0.8	0.5	0.8	1.0
October	0.8	1.2	0.9	0.5	0.7	0.7	1.8	0.7	0.8	1.0
November	1.3	0.7	0.6	0.4	0.5	0.6	0.9	0.9	0.2	0.7
December	1.7	1.2	0.7	0.7	0.6	0.4	1.3	1.2	0.6	1.1
Average	1.0	0.6	1.6	0.6	0.4	0.4	0.8	0.6	0.5	0.8

^ DG4 is a control dust gauge that is located at the Helensburgh Golf Course some 2 km from the Major Surface facilities Area and is not included in the assessment of environmental performance in Section 6.

Historical data are also presented in [Figure 5-8](#), showing the annual average deposition rates for each DG since 2010. While there are occasional elevated values at some DGs in some years, there is no apparent trend, either increasing or decreasing, across the 12 year period. However, it is noted that the annual average deposition rates at DG3 are regularly higher than at other gauges.

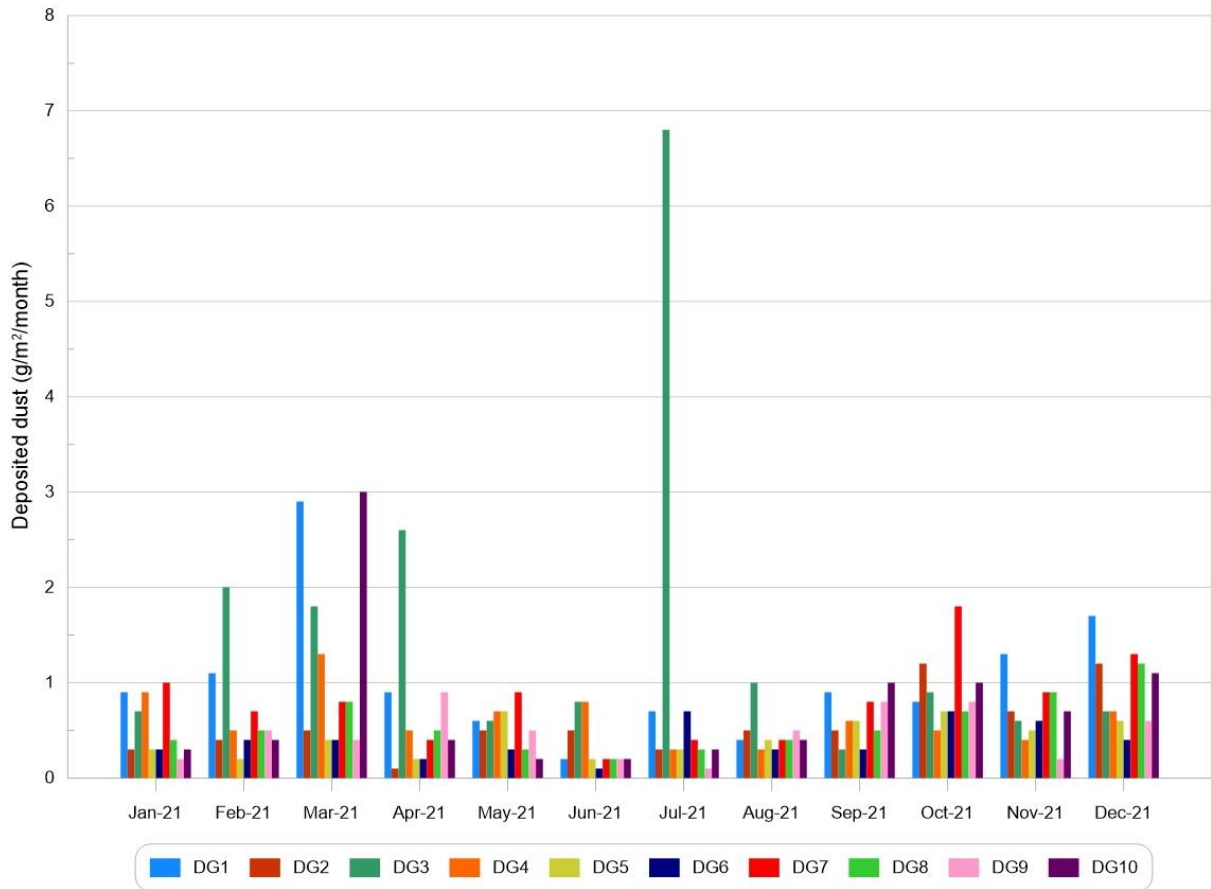


Figure 5-6: Monthly dust deposition rates measured at all dust gauges during 2021

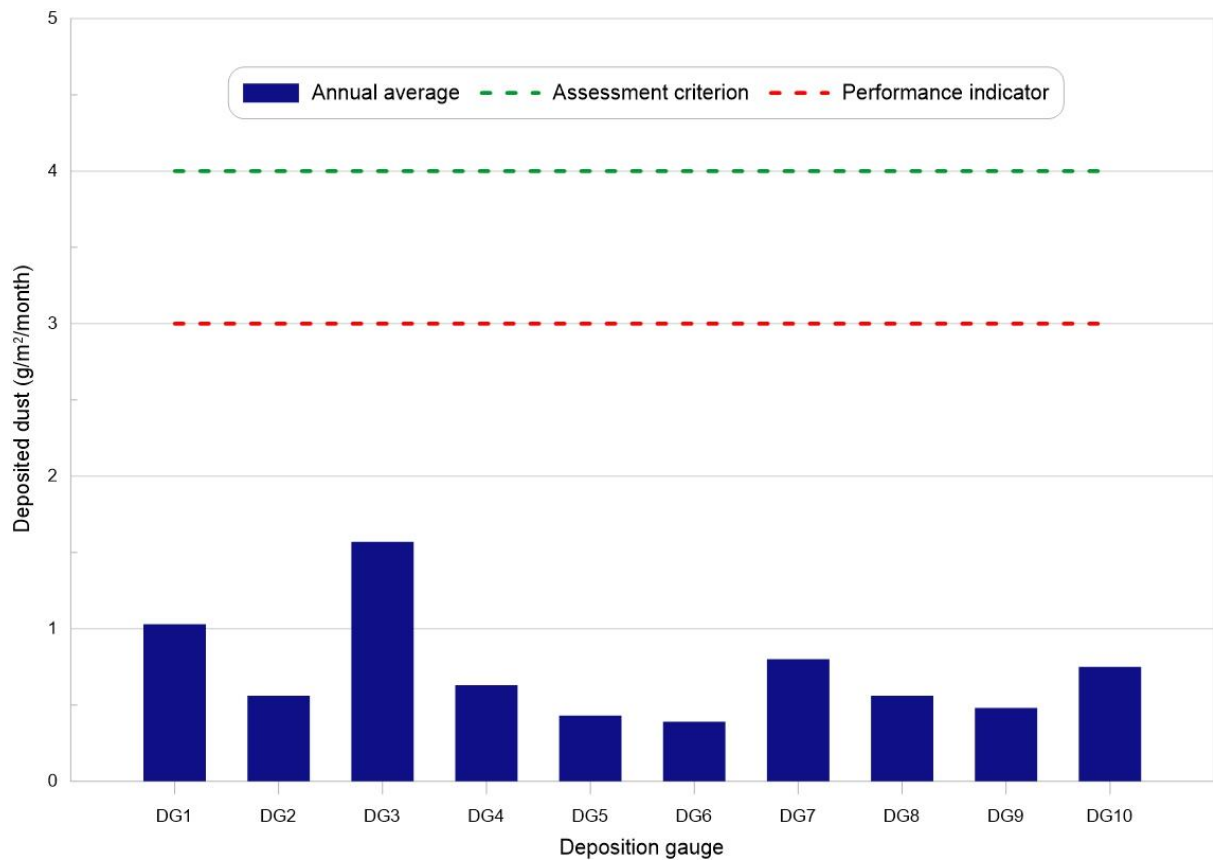


Figure 5-7: Annual average dust deposition rates for all dust gauges in 2021

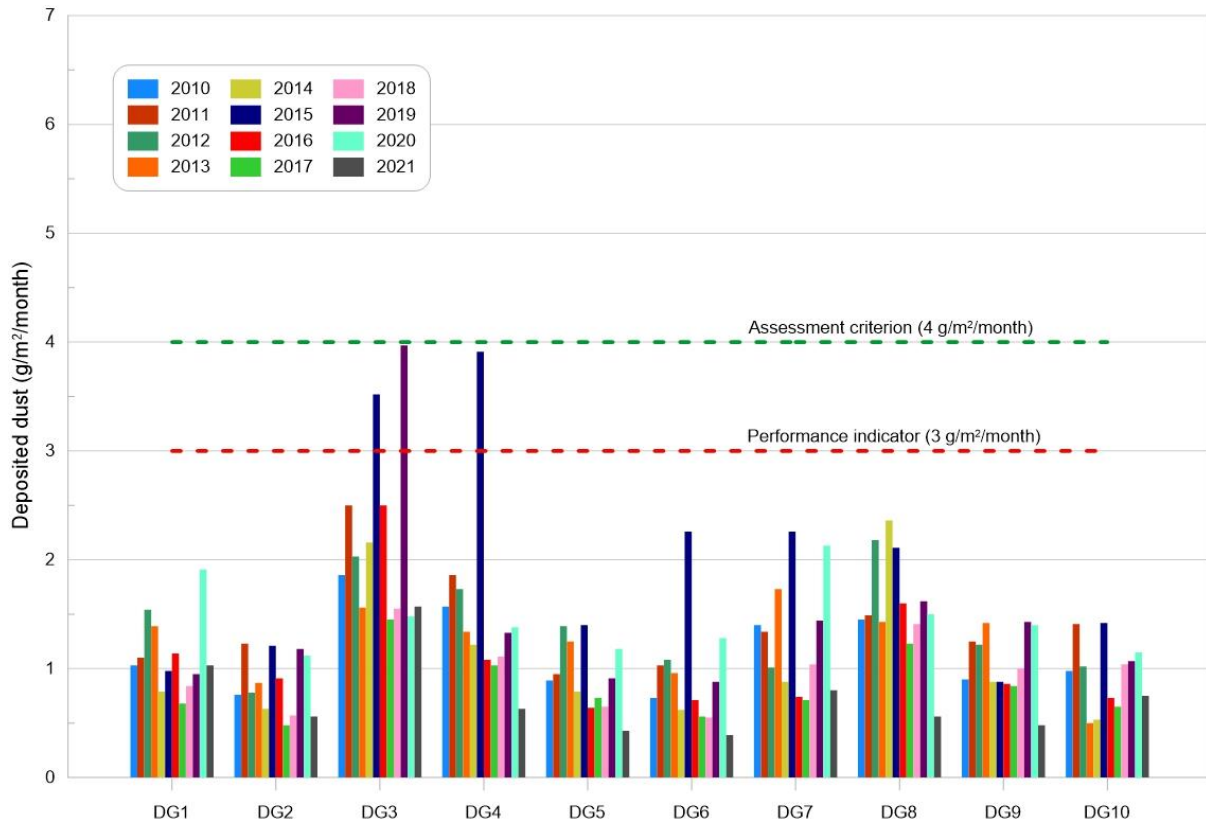


Figure 5-8: Annual average dust deposition rates for all dust gauges from 2010 to 2021

6 ASSESSMENT AGAINST CRITERIA AND PERFORMANCE INDICATORS

6.1 Impact assessment criteria

6.1.1 Particulate matter

Section 5.1 presents the results for both the HVAS and TEOM PM₁₀ monitoring. Figure 5-1 shows two exceedances of the 24-hour average 50 µg/m³ impact assessment criterion measured at the HVAS, while Figure 5-2 shows a single exceedance at the TEOM.

The highest 24-hour average PM₁₀ concentrations at the HVAS were 112 µg/m³ on 3 May and 86.3 µg/m³ on 9 May 2021. The highest 24-hour average PM₁₀ concentration at the TEOM was 72 µg/m³, measured on 3 May 2021. All three of these exceedances were measured during prescribed burning events and therefore not due to Metropolitan Coal operations.

The annual averages measured were the same for both the HVAS and TEOM at 12.8 µg/m³, well below the assessment criterion of 30 µg/m³.

6.1.2 Total suspended particulates

Total suspended particulates (TSP) are not measured directly at the HVAS. Consistent with previous reviews, annual average TSP has been estimated from the PM₁₀ measurements by applying a conservative assumption that 40-50% of the TSP is comprised of PM₁₀. This relationship applies across the majority of air sheds and has been validated through data collected by co-located TSP and PM₁₀ monitors operated for reasonably long periods of time in the Hunter Valley (NSW Minerals Council, 2000).

Based on the annual average PM₁₀ concentrations recorded by the HVAS, the annual average TSP is anticipated to be less than 25.6 µg/m³, (12.8 µg/m³ x 2); significantly below the TSP air quality impact assessment criterion of 90 µg/m³.

6.1.3 Dust deposition

As shown in Section 5.2, the annual average dust deposition rate at all dust gauges remained below the assessment criterion of 4 g/m²/month. Compliance was achieved with the long-term impact assessment criterion for dust deposition during the reporting period.

6.2 Air quality performance indicators

6.2.1 Particulate matter

Section 5.1 presents the results for both the HVAS and TEOM PM₁₀ monitoring. Figure 5-1 shows two 24-hour average concentrations above the 37.5 µg/m³ performance indicator measured at the HVAS, while Figure 5-2 shows a single occurrence at the TEOM. As described in Section 6.1.1, all three of these exceedances were measured during prescribed burning events in early May 2021. As such they are not considered exceedances of the performance indicators as prescribed burns are part of extraordinary events which are specifically excluded.

Concentrations of 10-minute average PM₁₀ measured by the TEOM are presented in Figure 5-3. As detailed in Section 5.1.2, there were 37 occasions where these 10-minute averages were above the performance indicator of 150 µg/m³. Again, all of these were measured during a prescribed burn event and are therefore not considered as an exceedance.

The annual averages measured were the same for both the HVAS and TEOM at 12.8 µg/m³, well below the performance indicator of 25 µg/m³.

6.2.2 Dust deposition

As shown in Section 5.2, the annual average dust deposition rate at all dust gauges remained below the performance indicator of 3 g/m²/month. Compliance was achieved with the long-term performance indicator for dust deposition during the reporting period.

6.3 Summary

Table 6-1 presents a summary of the assessment against impact assessment criteria and air quality performance indicators.

Table 6-1: Summary of assessment of environmental performance

Monitoring aspect	Impact assessment criteria or performance indicator	Condition met?	Comment
Air Quality Impact Assessment Criteria ¹ (Project Approval Condition 11, Schedule 4)	24-hour average PM ₁₀ (50 µg/m ³)	Yes	One exceedance of the 24-hour average PM ₁₀ impact assessment criterion of 50 µg/m ³ was observed using the TEOM instrument. This was associated with prescribed burning. There were two exceedances of the 24-hour average PM ₁₀ criterion observed using the HVAS instrument during the reporting period. These were also associated with prescribed burning.
	Annual average PM ₁₀ (30 µg/m ³)	Yes	An annual average PM ₁₀ concentration of 12.8 µg/m ³ was recorded by the HVAS monitoring instrument.
	Annual average TSP (90 µg/m ³)	Yes	Based on the annual average PM ₁₀ concentrations recorded by the HVAS monitoring instrument, the annual average TSP is anticipated to be less than 25.6 µg/m ³ , (12.8 µg/m ³ x 2); significantly below the TSP air quality impact assessment criterion of 90 µg/m ³ .
	Annual average deposited dust (4 g/m ² /month)	Yes	The annual average dust deposition rates for each of the sites indicate that compliance with the deposited dust performance indicator was achieved at every one of the dust gauges during the reporting period.
Air Quality Performance Indicator ^{2,3}	TEOM 10-minute average PM ₁₀ (150 µg/m ³)	Yes	The maximum 10-minute average PM ₁₀ concentration recorded by the TEOM was 310 µg/m ³ on 3 May 2021. There were 37 exceedances of this metric during 2-3 May as a result of prescribed burning.
	TEOM 24-hour average PM ₁₀ (37.5 µg/m ³)	Yes	There was one exceedance of the 24-hour average performance indicator concentration on 3 May, due to prescribed burning.
	HVAS 24-hour average PM ₁₀ (37.5 µg/m ³)	Yes	There were two exceedances of the 24-hour average performance indicator concentration on 3 and 9 May, both due to prescribed burning.
	Annual average PM ₁₀ (25 µg/m ³)	Yes	An annual average PM ₁₀ concentration of 12.8 µg/m ³ was recorded by the HVAS monitoring instrument.
	Annual average deposited dust (3 g/m ² /month) ⁴	Yes	The annual average dust deposition rates for each of the sites indicate that compliance with the deposited dust performance indicator was achieved at every one of the dust gauges during the reporting period.

¹ PM₁₀ air quality impact assessment criteria to be determined using HVAS data

² Total measured excluding extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities

³ Background PM₁₀ concentrations due to all other sources plus the incremental increase in PM₁₀ concentrations due to the mine alone

⁴ Dust deposition performance indicator to be assessed using DG1 to DG10 excluding DG4, which is a control dust

7 MANAGEMENT AND MITIGATION MEASURES

7.1 Air quality

A number of measures have been implemented to manage and mitigate air quality impacts at Metropolitan Coal, including:

- enclosed conveyor systems;
- the operation of automated water sprays on stockpile areas based on real-time meteorological data;
- the use of automated weather station triggered stockpile water sprays that account for wind speed and direction;
- the implementation of the recommendations of the Metropolitan Colliery Site Specific Particulate Matter Control Best Practice Assessment, including the installation of dust control sprays on the run of mine (ROM) stockpile;
- watering of haulage roads and stockpile areas with a water truck when required;
- sealed car parks and yard areas;
- planting of native plants on exposed areas to stabilise soils; and
- deployment of a real-time portable dust monitoring system to supplement the data acquired by the static air quality monitoring network.

Metropolitan Coal has also implemented the following measures to minimise dust emissions associated with off-site coal and coal reject haulage:

- offsite rail transport of Coal Wash Reject, minimising trucking;
- a project implemented to maximise coal yield thereby reducing reject trucking;
- automatic covers fitted to coal reject haulage trucks;
- all haulage vehicles are required to pass through a truck wash before leaving the site; and
- the mine entrance road is washed on an as-needed basis;

In 2015, Metropolitan Coal installed additional dust sprays at the coal wash reject stockpile. This brings the dust suppression sprays to a total of 36, covering more than 90% of stockpile surfaces.

In 2018, Metropolitan Coal installed a train wagon profiler to evenly spread and wash loose coal off the wagon gunnels after it is loaded by front end loader. The consistent profile minimises turbulence during transport, reducing coal dust emissions from the wagons.

7.2 Energy and greenhouse gas

In addition to the air quality measures discussed above, Condition 10, Schedule 4 of the Project Approval requires that Metropolitan Coal implement all reasonable and feasible measures to minimise

- a) energy use on site; and
- b) the scope 1, 2 and 3 greenhouse gas emissions produced on site,

to the satisfaction of the Director-General (now secretary) of the Department of Planning and Environment (DPE).

Scope 1 and Scope 2 greenhouse gas emissions are emissions due to the operation of the Project and consumption of electricity on-site. Scope 3 greenhouse gas emissions are emissions that will result from the off-site transport and combustion of the coal produced by the Project, plus emissions associated with the production of diesel that is used on-site.

Table 7-1 outlines the key greenhouse gas emission sources and the respective scope of emissions.

Table 7-1: Summary of Project CO₂-e emission sources

Project component	Direct emissions (Scope 1)	Indirect emissions (Scope 2)	Indirect emissions (Scope 3)
Consumption of diesel fuel to power on-site equipment	Emissions from the combustion of diesel during operations	N/A	Emissions attributable to the extraction of diesel fuel
Electricity consumption	N/A	Emissions resulting from generation of the electricity consumed during operations	Emissions attributable to the extraction of fuel used in electricity generators
Coal extraction (gas flaring and ventilation)	Emissions resulting from venting or burning methane and venting carbon dioxide (CO ₂)	N/A	N/A
Transporting product and reject coal by truck	N/A	N/A	Emissions from the combustion of diesel from third-party truck operators
Transporting product coal by train	N/A	N/A	Emissions from the combustion of diesel from third-party train operators
Steelmaking	N/A	N/A	Emissions generated from off-site coke usage for steel and iron production