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Report

MAULES CREEK COAL MINE PRP E1: MONITORING RESULTS – WHEEL GENERATED DUST

WHITEHAVEN COAL LIMITED

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1 INTRODUCTION

Maules Creek Coal Mine (MCCM) holds Environmental Protection Licence (EPL) 20221. Pacific Environment has been commissioned to prepare a report to support the submission of condition E1 (*Particulate Matter Control Best Practice Implementation – Wheel Generated*), in completing site specific monitoring of wheel generated dust emissions at Maules Creek. This report provides results from monitoring completed at MCCM on 5 August 2015 and 4 February 2016.

To satisfy the requirements of the EPL, a Monitoring Plan was developed for condition E1 which outlined the proposed monitoring method to determine the site wide haul road control efficiency (Pacific Environment, 2015).

1.1 License Requirements

Condition E1 (*Particulate Matter Control Best Practice Implementation - Wheel Generated Dust*) requires that Maules Creek must achieve and maintain a dust control efficiency of 85% or more on its haul roads. Control efficiency is calculated as:

$$CE = \frac{E_{uncontrolled} - E_{controlled}}{E_{uncontrolled}} \times 100$$

Where E = emissions rate of the activity.

To assess compliance with E1, Maules Creek must:

- Measure uncontrolled and controlled haul road emissions on at least 2 occasions using a mobile dust monitor;
- Continuously measure and record 'additional site data' including:
    - Vehicle kilometres travelled (VKT)
    - Meteorological conditions
    - Water use for dust suppression.
- Undertake silt content and soil moisture sampling during sampling events; and
- Determine if a site specific relationship can be derived between the measured control efficiency, additional site data, water use, meteorological data; and the soil moisture and silt content levels.

2 SAMPLING METHODOLOGY

2.1 Mobile Monitoring

PM_{10} emissions from haul roads were measured using the mobile system REX (Road Emissions eXpert). REX measures the concentration of wheel generated dust from the test vehicle and by comparing data collected from haul roads with and without controls, control efficiencies can be calculated.

All monitoring was conducted according to the internal Quality Management Plan for the use of REX (**Pacific Environment, 2013**). The monitoring method is described in the Monitoring Plan (**Pacific Environment, 2015**) and in greater detail in ACARP Project C20023 (**Cox & Laing, 2014**).

2.2 Sampling Approach

All active haul routes on the mine were sampled repeatedly over the sampling day. Within the full active circuit of the mine was an uncontrolled section of road, left at least 12 hours without controls (further details in **Section 2.3**).

2.3 Calculating Control Efficiency

Critical to the determination of haul road dust control efficiency is the definition of what constitutes an 'uncontrolled' section of haul road.

Seasonal changes in meteorology play a large role in the efficiency of controls applied to haul roads to manage wheel-generated dust. Conditions such as rainfall, high humidity, fog or damp are natural controls that reduce dust generated from an unsealed road. Conversely, higher ambient temperatures can cause increased evaporation, requiring more watering or suppressant to be used to meet a sufficient level of control. Road management, construction and maintenance also contribute to controlling dust.

For these reasons, it is not appropriate to calculate a control efficiency using baseline data that is heavily impacted by these seasonal conditions and management factors, where the control efficiency calculated does not have any bearing on the dust being generated (i.e. winter control efficiency being much lower than summer control efficiency). Therefore, the maximum uncontrolled data collected over all monitoring campaigns is to be used to reflect an uncontrolled baseline and applied across the year to calculate the control efficiency.

For the purposes of determination of control efficiency, we define an uncontrolled haul road as:

> *"A section of at least 150 m of an active haul road where no water has been applied for at least 12 hours prior to monitoring and hasn't been treated with chemical suppressant. Less than 0.3 mm of precipitation has been recorded at the closest meteorological station in the preceding 12 hours and ambient conditions during monitoring do not act to suppress dust (rainfall, fog, mist, high humidity, low evaporation, low wind speeds)."*

3 RESULTS

In accordance with condition E1, two rounds of REX monitoring were completed during August 2015 and 4 February 2016. For both monitoring rounds, an uncontrolled haul road with a total length of approximately 2km was established.

The results of the monitoring are shown in following sections:

- Dust control efficiency achieved on the sampling days (**Section 3.1**)
- Dust concentrations measured (**Section 3.2**)

- Additional site data, including meteorological conditions and operational factors (**Section 3.3**)
- Site specific relationships between these data (**Section 3.4**)

3.1 Dust Control Efficiency

The average control efficiency achieved during the monitoring was calculated as 92%. A summary of the control efficiency achieved during the sampling campaign and the range by circuit is shown in **Table 3-1.**

Table 3-1: Summary of REX control efficiencies

Monitoring Round	Sampling Date	Number of circuits of the active mine	Average Control Efficiency	Range of Control Efficiency by circuit
1	5 August 2015	5	96 %	93 % - 98 %
2	4 February 2016	8[1]	89 %	74 % - 93 %

Notes:
1. not all circuits included in results, see **Table 3-2**.

3.2 Dust Concentrations Measured

The average PM_{10} concentration measured during each circuit is shown in **Table 3-2**.

Table 3-2: Summary of REX measured PM_{10} concentration and control efficiencies by circuit

Monitoring Round	Sampling Date	Mine Circuit	Start Time	Average controlled PM_{10} concentration (mg/m^3)	Measured Control Efficiency (%)	Average controlled PM_{10} concentration (mg/m^3)	Maximum uncontrolled PM_{10} concentration (mg/m^3)
1	5-Aug-15	1	8:44	0.27	96	0.36	6.37
		2	9:45	0.27	96		
		3	10:42	0.37	94		
		4	12:00	0.60	91		
		5	13:22	0.26	96		
2	4-Feb-16	1	9:00	0.42	93	0.71	
		2	9:53	0.48	92		
		3	10:37	0.59	91		
		4	11:22	0.50[1]	92		
		5	13:21	1.67[2]	74		
		6	14:26	N/A[3]	N/A		
		7	15:19	0.58	91		
		8	16:05	0.74	88		

Notes:
1. Instrument failed after 19 minutes due a power cable coming loose.
2. Circuit completed following pit blasting, areas of controlled haul road not yet suppressed by water carts.
3. Extraneous data recorded due to blocking of sample inlet. Results excluded.

3.3 Additional Site Data

A summary of the meteorological conditions, as recorded by the site meteorological station, for the day of the monitoring event is presented in **Table 3-3**. Additionally, rainfall data from the site meteorological station indicates zero rainfall had occurred during the week prior to monitoring.

Table 3-3: Meteorological conditions on day of monitoring

Parameter (units)	Round 1	Round 2
Average Wind Speed (m/s)	1.4	4.2
Average 10m Temperature (°C)	6.2	25.4
Average Relative Humidity (%)	62.8	64.1
Average Barometric Pressure (hPa)	982.4	969.3
Average Solar Radiation (W/m^2)	132.4	252.8
Total Rainfall (mm)	0	0
Average control efficiency (%)	94	89

Available meteorological data from 2011 to 2016 Maules Creek meteorological station were analysed to determine the seasonal variation in meteorology at the site. **Figure 3.1** to **Figure 3.4** shows the following:

- Average monthly temperature compared to average temperature on sampling day (**Figure 3.1**)
- Average monthly humidity compared to average humidity on sampling day (**Figure 3.2**)
- Average monthly solar radiation compared to average solar radiation on sampling days (**Figure 3.3**)
- Total monthly rainfall by year (**Figure 3.4**)

The analysis shows that the sampling days where monitoring was completed are representative of changing seasonal conditions across the year.

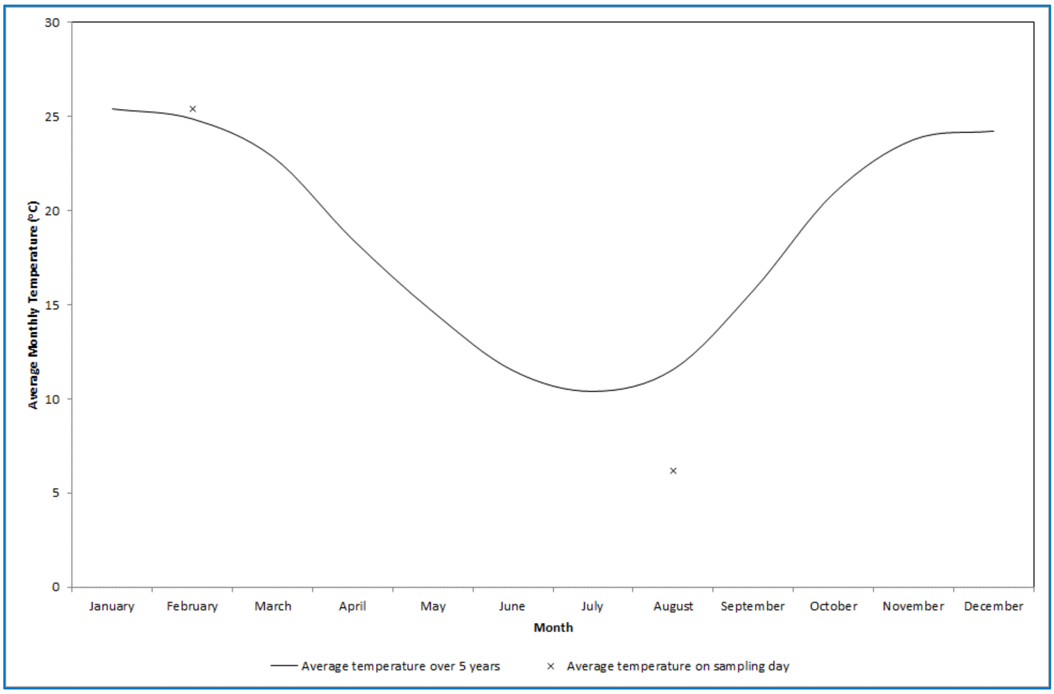

Figure 3.1: Average monthly temperature (°C) from November 2011 – February 2016 compared to average temperature on sampling day

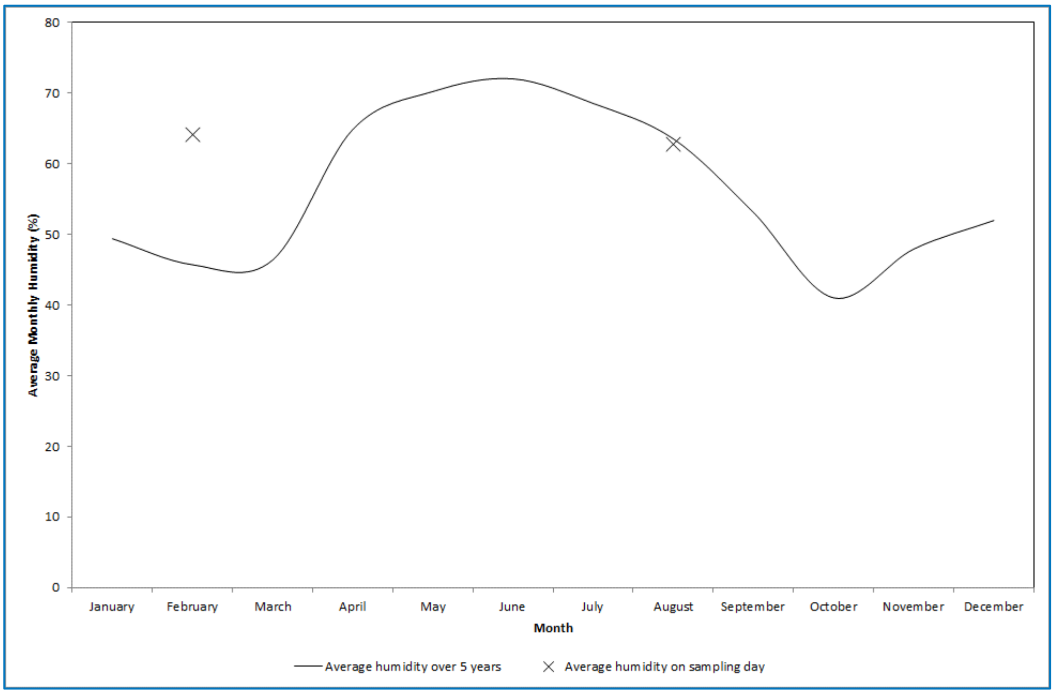

Figure 3.2: Average monthly humidity (%) from November 2011 – February 2016 compared to average humidity on sampling day

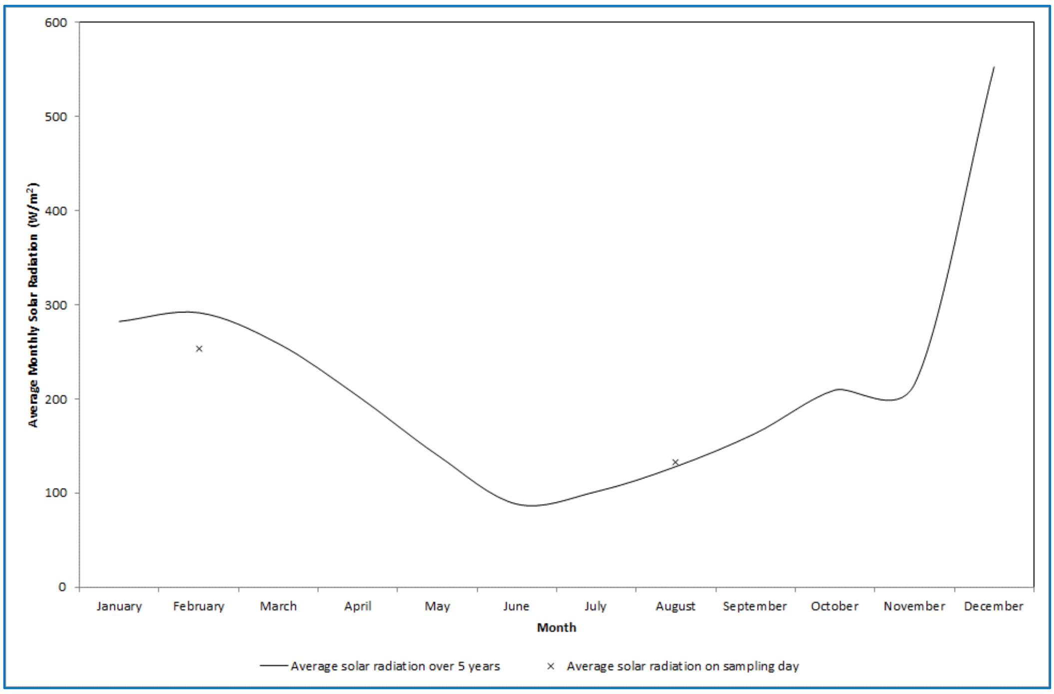

Figure 3.3: Average monthly solar radiation from November 2011 – February 2016 compared to average solar radiation on sampling day

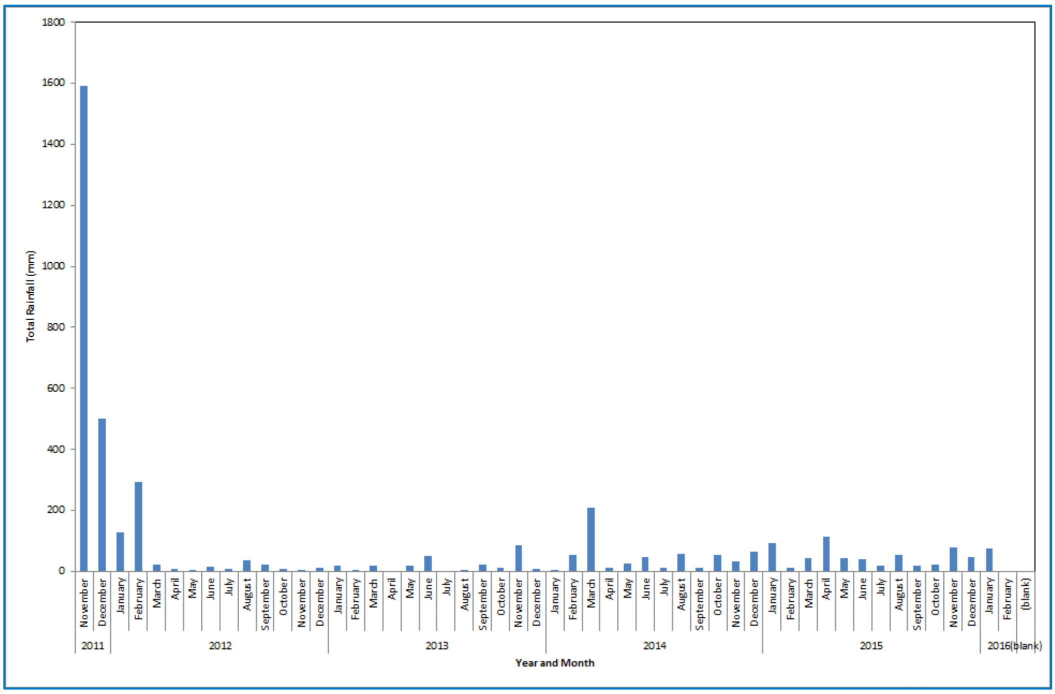

Figure 3.4: Total monthly rainfall (mm) from November 2011 – February 2016

In accordance with condition E1, additional operational data were collected for the periods of monitoring and are summarised in **Table 3.4**. The majority of operational parameters do not change between monitoring periods.

Only water was applied to controlled haul roads on site during the days of monitoring, with the exception of the ROM, which was applied with suppressant on the morning of 4 February 2016.

Table 3.4: Additional site data

Site Data	Monitoring Round 1	Monitoring Round 2
Vehicle movement routes	Excavator to dump return, Excavator to ROM return	Excavator to dump return, Excavator to ROM return
Loaded haul truck weight	EH5000 220 tonne unloaded, (overburden) 480 tonne loaded; Cat 789 100 tonne unloaded, (coal) 230 tonne loaded	EH5000 220 tonne unloaded, (overburden) 480 tonne loaded; Cat 789 100 tonne unloaded, (coal) 230 tonne loaded
Vehicle speed	Maximum 60 km/h	Maximum 60 km/h
Method of watering	Water ROM treated with suppressant during morning.	Water, ROM treated with suppressant during morning only
Water application time	Not measured	1,057,800 L applied between 07:00 and 17:00
Water application volume	WAT802 (50,000 L), WAT 803 (490,000 L), WAT863 (32,000 L), WAT814 (405,000 L)	WAT501 (70,000 L), WAT801 (132,000 L), WAT802 135,000 L), WAT 803 (280,000 L), WAT814 (20,800 L), WAT821 (420,000 L)
Water application rate	Continuous or as required	Continuous or as required

3.4 Site Specific Relationships

No site specific relationships were evident when the average dust concentrations measured were compared against the other site specific parameters. All causal relationships were systematically explored but no correlating parameters were evident for meteorological data or operational parameters. The relationships were explored for each round and for each circuit of the mine.

As demonstrated in the extensive sampling of emissions from unsealed roads completed during the ACARP project C20023 (**Cox & Laing, 2014**), there is so much variability in silt and moisture contents across a road network that there is no clear relationship between silt and moisture content and measured dust concentrations. They are also parameters that have no practical use in the real-time control of dust as once samples are collected they have to be sent to a lab for analysis.

Cox & Laing, 2014 also concluded that typically the dust concentrations measured are found to correlate most closely with average temperature, relative humidity and solar radiation. These factors should be considered when managing haul road control measures.

4 CONCLUSION

Wheel-generated dust control efficiency was assessed at Maules Creek Coal Mine on two occasions using a mobile dust monitoring system (REX). The dust control effectiveness was calculated as 96% on 5th August 2015 and 89% on 4th August 2016. MCCM EPL20221 states that control efficiency must be 85%. On average the control efficiency was measured as being 92%.

The result suggests that using water for dust suppression and dust control TARPs for operations are sufficient to maintain a dust control efficiency of 85%.

Whilst knowledge of silt and moisture content is useful in the estimation of emissions for assessment purposes, no clear relationship between measured concentrations has been determined in any other previous studies completed using REX, including the extensive sampling completed for the ACARP project.

Pacific Environment recommends:

- Controlling haul road dust will be prioritised when high temperatures, low humidity and high solar radiation conditions prevail.

5 REFERENCES

Cox J and Laing G (2014). *Mobile Sampling of Dust Emissions from Unsealed Roads*. ACARP Project C20023. Stage 2 Final Report.

Pacific Environment (2013). *Quality Management Plan – Mobile Haul Road Monitoring*. 03 January 2013.

Pacific Environment (2015). *Maules Creek Coal Special Condition E1 Monitoring Plan – Wheel Generated Dust.* 6 March 2015