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Report

BOGGABRI COAL MINE PRP U1: MONITORING RESULTS – WHEEL GENERATED DUST

BOGGABRI COAL PTY LTD

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1 INTRODUCTION

Boggabri Coal Pty Ltd (Boggabri Coal) holds Environmental Protection Licence (EPL) 12407 for the Boggabri Coal Mine. Condition U2 (*Particulate Matter Control Best Practice Implementation - Wheel Generated Dust)* requires that Boggabri Coal must achieve and maintain a dust control efficiency of 80% or more on its haul roads.

To satisfy the requirements of the EPL, a Monitoring Plan was developed for condition U2 which outlined the proposed monitoring method to determine the site wide haul road control efficiency (**Pacific Environment, 2013a**).

This report provides results from the haul road dust control efficiency monitoring for Boggabri Coal Mine.

1.1 Licence Requirements

Condition U2.1 (*Particulate Matter Control Best Practice Implementation - Wheel Generated Dust)* requires that Boggabri Coal must achieve and maintain a dust control efficiency of 80% 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.

Condition U2.2 requires that to assess compliance with U2.1, Boggabri Coal must:

- Measure uncontrolled and controlled haul road emissions on at least 2 occasions using a mobile dust monitor.
- Measure 'additional site data' including:
  - Vehicle kilometres travelled
  - Meteorological conditions
  - Water use for dust suppression
- Undertake silt content and soil moisture sampling during sampling events.
- 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.

The measurement of uncontrolled and controlled haul road PM_{10} emissions must be undertaken under varying meteorological conditions, including at those times when analysis of meteorological data indicates that elevated levels of dust are most likely at the Premises.

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 PM_{10} generated from the test vehicle and so by comparing data collected from haul roads with and without controls, control efficiencies can be calculated.

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

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 has been 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 U2, two rounds of REX monitoring have been completed during February 2013 and June 2014. 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, operational factors and the results of silt and moisture sampling (**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 %. Average control efficiency achieved during each 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	3 February 2014	4	87 %	76 % - 94 %
2	24 June 14	4	94 %	93 % - 97 %

3.2 Dust Concentrations Measured

The average PM_{10} concentration measured during each sampling campaign is shown in **Table 3.2**.

Table 3.2: Summary of REX measured PM concentration

Monitoring Round	Sampling Date	Average controlled PM_{10} concentration (mg/m^3)	Maximum average uncontrolled PM_{10} concentration (mg/m^3)
1	3 February 2014	0.313	2.487
2	24 June 14	0.137	

3.3 Additional Site Data

A summary of the meteorological conditions, as recorded by the site meteorological station, for the day of each monitoring event is presented in **Table 3.3**. The average control efficiency achieved during each day has been included for comparison.

The lowest control efficiency of 87 % was measured during conditions of higher air temperature and lower humidity. No solar radiation data was recorded during the sampling periods.

Table 3.3: Summary statistics for meteorological conditions

Parameter (units)	Round 1	Round 2
Average Wind Speed (m/s)	2.4 m/s	3.6 m/s
Average Temperature (°C)	27.8 °C	11.7 °C
Average Relative Humidity (%)	37.0 %	55.2 %
Total Rainfall (mm)	0 mm	0 mm
Average control efficiency (%)	87 %	94 %

Four and a half years of meteorological data (January 2010 – June 2014) from the Boggabri Coal site meteorological station were analysed to determine the seasonal variation in meteorology at the site. **Figure 3.1** to **Figure 3.3** 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 days (**Figure 3.2**)
- Total monthly rainfall by year (**Figure 3.3**)

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

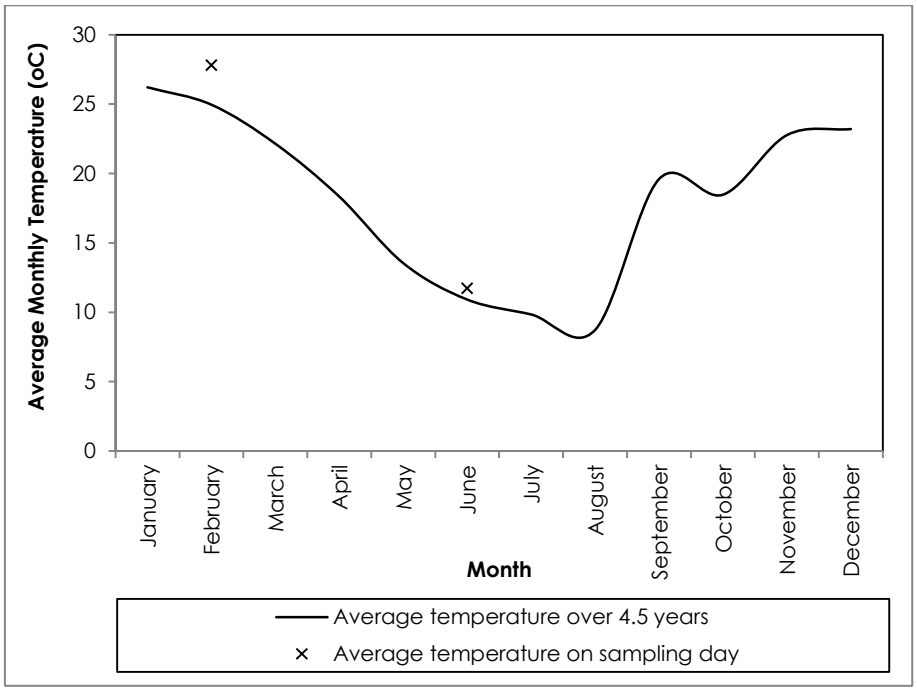

Figure 3.1: Average monthly temperature (°C) from January 2010 – June2014 compared to average temperature on sampling day

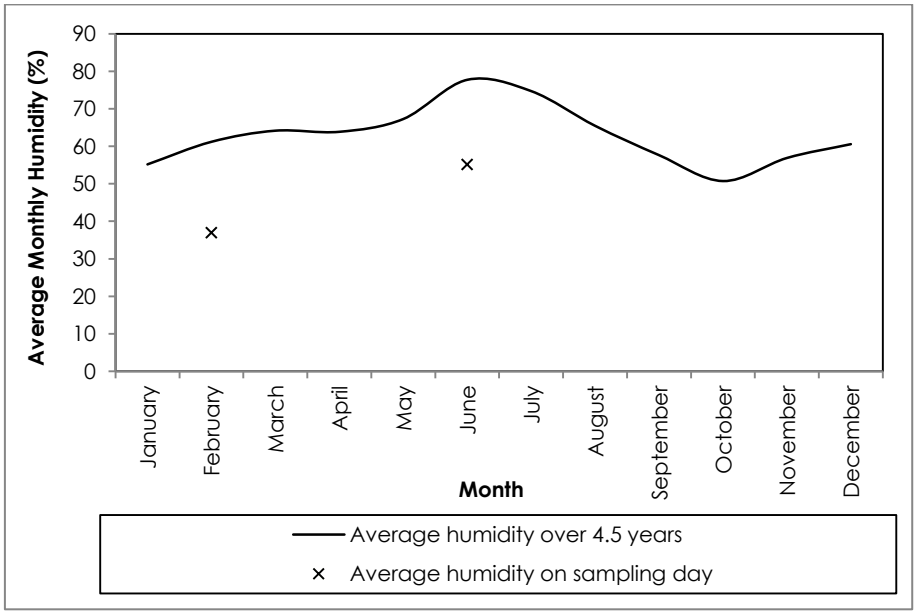

Figure 3.2: Average monthly humidity (%) from January 2010 – June2014 compared to average humidity on sampling day

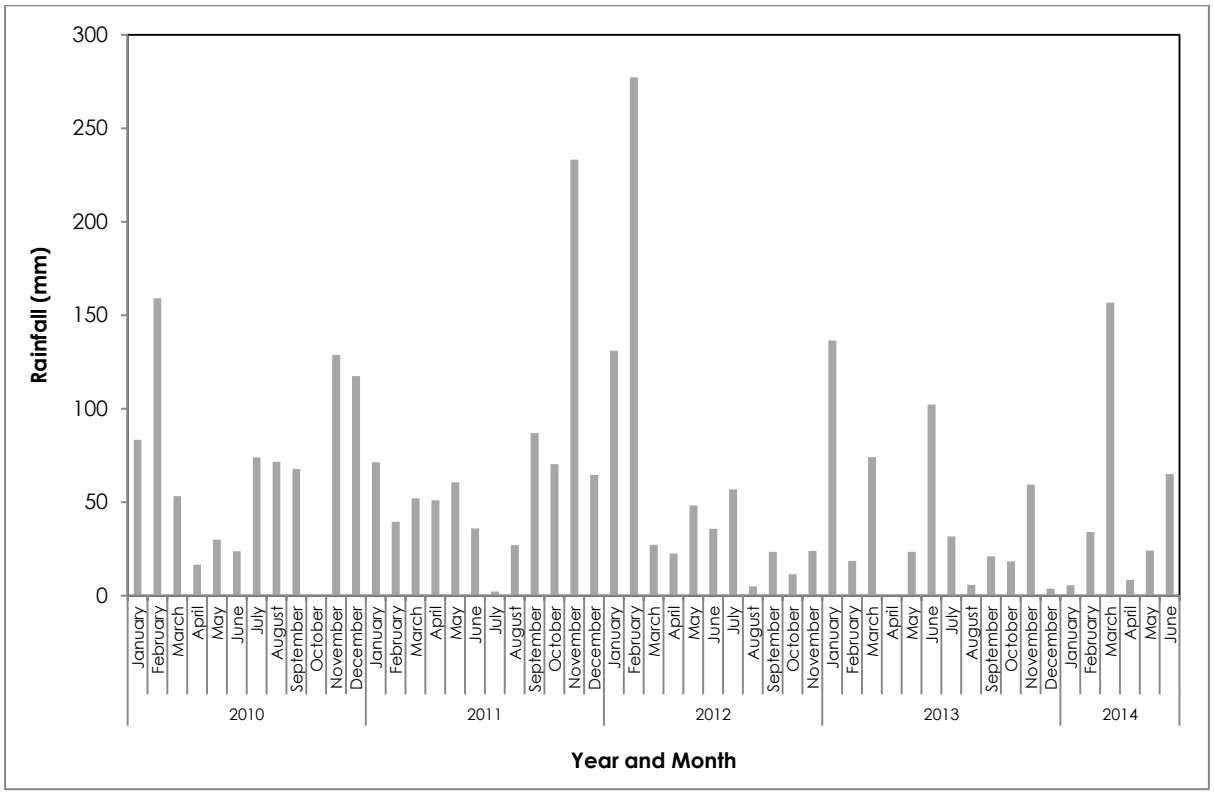

Figure 3.3: Total monthly rainfall (mm) from January 2010 – June2014

In accordance with condition U2, 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.

While only water was applied to the roads during the monitoring period, it is noted that a dust suppressant trail was completed from 3rd March – 3rd June 2014. Suppressant was applied to ROM1, ROM3 and Eastern haul road.

Table 3.4: Additional site data

Site Data	Monitoring Round 1	Monitoring Round 2
Vehicle movement routes	Pit dump, pit to ROM	Pit to dumps, pit to ROM
Loaded haul truck weight	930E 220 tonne unloaded, 520 tonne loaded; 789B & 789C 130 unloaded, 320 tonne loaded (overburden) or 270 tonne loaded (coal) or 310 tonne loaded (topsoil) or 330 tonne loaded (gravel); 785B 785C 230 tonne unloaded, 210 tonne loaded (coal or 230 tonne loaded (topsoil) or 240 tonne loaded (gravel)	930E 220 tonne unloaded, 520 tonne loaded; 789B & 789C 130 unloaded, 320 tonne loaded (overburden) or 270 tonne loaded (coal) or 310 tonne loaded (topsoil) or 330 tonne loaded (gravel); 785B 785C 230 tonne unloaded, 210 tonne loaded (coal or 230 tonne loaded (topsoil) or 240 tonne loaded (gravel)
Vehicle speed	Maximum 60 km/h	Maximum 60 km/h
Method of watering	Water	Water, some locations treated with suppressants until approximately 21 days prior to the sampling
Water application time	Not measured	Not measured
Water application volume	CAT 775 (40,000 L), CAT 777F (75,000 L), Mack (17,000 L)	CAT 775 (40,000 L), CAT 777F (75,000 L), Mack (17,000 L)
Water application rate	Continuous or as required	Continuous or as required

During each sampling campaign a bulk sample of the road surface was collected in accordance with the surface sampling methodology (**US EPA, 1993**). The samples were analysed at the laboratory for silt and moisture content, these reports are included in **Appendix A**.

Table 3.5: Results of silt and moisture sampling

Monitoring Round	Road Type	Control Level	Silt (%)	Moisture (%)
1	Permanent	Uncontrolled	6.8	0.6
	Permanent	Controlled	2.2	1.0
	Permanent	Controlled	5.9	0.2
2	Permanent	Controlled	0.7	1.8
	Permanent	Uncontrolled	1.6	1.4
	Permanent	Controlled	1.0	1.2
	Permanent	Controlled	3.7	5.2

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, operational parameters or silt and moisture content. The relationships were explored for each round and for each circuit of the mine. There was no solar radiation available during the sampling days.

Typically the dust concentrations measured are found to correlate 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 Boggabri Coal Mine on three occasions using a mobile dust monitoring system (REX). The dust control effectiveness was calculated as 87 % on 3 February 2014 and 94 % on 24 June 2014. On both occasions the site was maintaining a dust control efficiency of greater than 80 %.

A number of factors contribute to dust generation from haul roads. No site specific relationships were evident from the data collected at Boggabri Coal, when the data was compared to silt and moisture data, meteorological data and operational parameters.

However, the ACARP study has shown that consideration of site-specific operational factors is critical to minimising the level of dust generated from unsealed roads, including:

- Roads under construction.
- Roads recently graded.
- Coal operation areas.
- Roads adjacent to stockpiles.
- Highly trafficked areas.

These management measures, along with ambient temperature, relative humidity and solar radiation, should be the focus for best practice management of haul road controls.

5 REFERENCES

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

Pacific Environment (2013a). *Boggabri Coal Pollution Reduction Monitoring Plan – U2 Wheel Generated Dust*. Boggabri Coal Pty Ltd, 28 May 2013.

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

US EPA (1993). *Procedures for Sampling Surface/Bulk Dust Loading*. Appendix C.1. AP-42.

Appendix A SILT AND MOISTURE SAMPLING RESULTS

FEBRUARY 2014 SILT AND MOISTURE SAMPLING

Job Number : L107251
Client : Pacific Environment Limited
Reference/Order : 8031a
Project : Boggabri

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Analyte		Lab No / Sample ID / DL	001	002	003
NQ968 - Moisture Determination of Bulk Samples					
Total Moisture (@ 105o C)	%	0.1	0.60	1.0	0.20
NQ899 - Size Analysis of Misc.Material					
+ 31.5 mm	%	0.1	nd	nd	nd
-31.5 + 16.0 mm	%	0.1	7.6	14.7	1.2
-16.0 + 8.0 mm	%	0.1	13.0	23.7	11.5
-8.0 + 4.0 mm	%	0.1	13.1	14.7	15.1
-4.0 + 0.85 mm	%	0.1	22.7	23.5	28.5
-0.85 + 0.425 mm	%	0.1	11.3	10.5	14.0
-0.425 + 0.150 mm	%	0.1	13.4	7.9	17.4
-0.150 + 0.075 mm	%	0.1	12.1	2.8	6.4
-0.075 mm	%	0.1	6.8	2.2	5.9

DL = Detection Limit
LNR = Samples Listed not Received
-- = Not Applicable
nd = < DL
db = Dry basis

Sample Description Key (if req'd)

001	1. CRIB ROAD UNCONTROLLED - HAUL RD
002	2. WEST PIT ROAD CONTROLLED - HAUL RD
003	3. ROM ROAD CONTOLLED - HAUL RD

JUNE 2014 SILT AND MOISTURE SAMPLING

Job Number : L108838
Client : Pacific Environment Limited
Reference/Order : 8031
Project : BOGGABRI REX

Analyte		Lab No / Sample ID / DL	001	002	003	004
NQ968 - Moisture Determination of Bulk Samples						
Total Moisture (@ 105o C)	%	0.1	1.8	1.4	1.2	5.2
NQ899 - Size Analysis of Misc.Material						
+ 31.5 mm	%	0.1	nd	nd	nd	nd
-31.5 + 16.0 mm	%	0.1	54.6	25.7	18.9	10.7
-16.0 + 8.0 mm	%	0.1	23.8	34.3	44.4	21.9
-8.0 + 4.0 mm	%	0.1	8.1	16.6	20.9	18.4
-4.0 + 0.85 mm	%	0.1	8.7	14.6	8.2	24.3
-0.85 + 0.425 mm	%	0.1	1.9	3.2	3.0	7.6
-0.425 + 0.150 mm	%	0.1	1.7	3.0	2.8	10.0
-0.150 + 0.075 mm	%	0.1	0.6	1.1	0.8	3.4
-0.075 mm	%	0.1	0.7	1.6	1.0	3.7

DL = Detection Limit
LNR = Samples Listed not Received
-- = Not Applicable
nd = < DL
db = Dry basis

Sample Description Key (if req'd)

001	1-ROM RD BOGGABRI REX
002	2-WEST RD BOGGABRI REX 4-DUMP RD
003	3-NORTH RD BOGGABRI REX 2-NORTH RD
004	4-EAST RD BOGGABRI REX 3-EAST RD