Rasp Mine
Monthly Environmental Monitoring Report
April 2017

Broken Hill Operations Pty Ltd (BHOP) [a wholly owned subsidiary of CBH Resources Limited (CBH)] owns and operates the Rasp Mine (the Mine), which is located centrally within the City of Broken Hill on Consolidated Mine Lease 7 (CML7).

Mining has been undertaken within CML7 since 1885. The existing operations at the Mine Rasp Mine Project include underground mining operations, a processing plant producing zinc and lead concentrates and a rail siding for concentrate dispatch. These operations are undertaken in accordance with Project Approval (PA07_0018) granted from the then Minister for Planning on 31 January 2011, under Part3A of the Environmental Planning and Assessment Act 1979 (EP&A Act).

As the holder of an Environmental Protection Licence, 12559, BHOP is required, under Section 66(6) of the NSW *Protection of the Environment Operations Act 1997,* to publish pollution monitoring data. A link to the Licence can be found on the Rasp Mine web site.

Contents

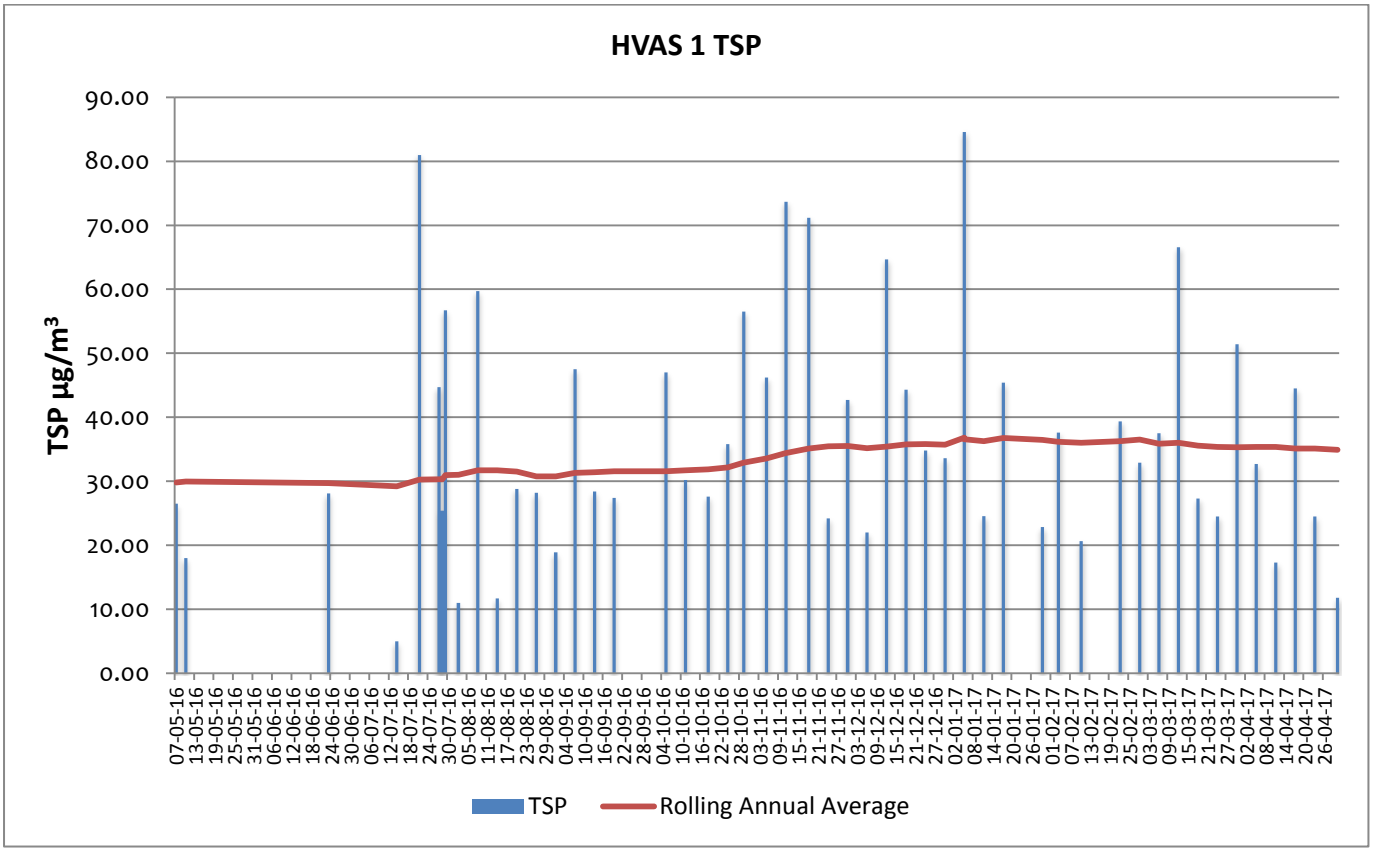
1 Air Quality

1.1 High Volume Air Samplers

There are three high volume air samplers used to measure ambient air quality at the Rasp Mine – HVAS and HVAS1 are located at the Silver Tank, central and to the south of the mine lease, and HVAS2 is located adjacent to and north of Blackwood Pit. A map indicating these locations can be found on the Rasp Mine web site. HVAS samples for total suspended particulates and lead dust, and HVAS1 and HVAS2 sample for particulate matter less than 10 microns (PM_{10}) and lead dust. Reference to the item required in the Rasp Mine Environment Protection Licence (EPL) is provided below.

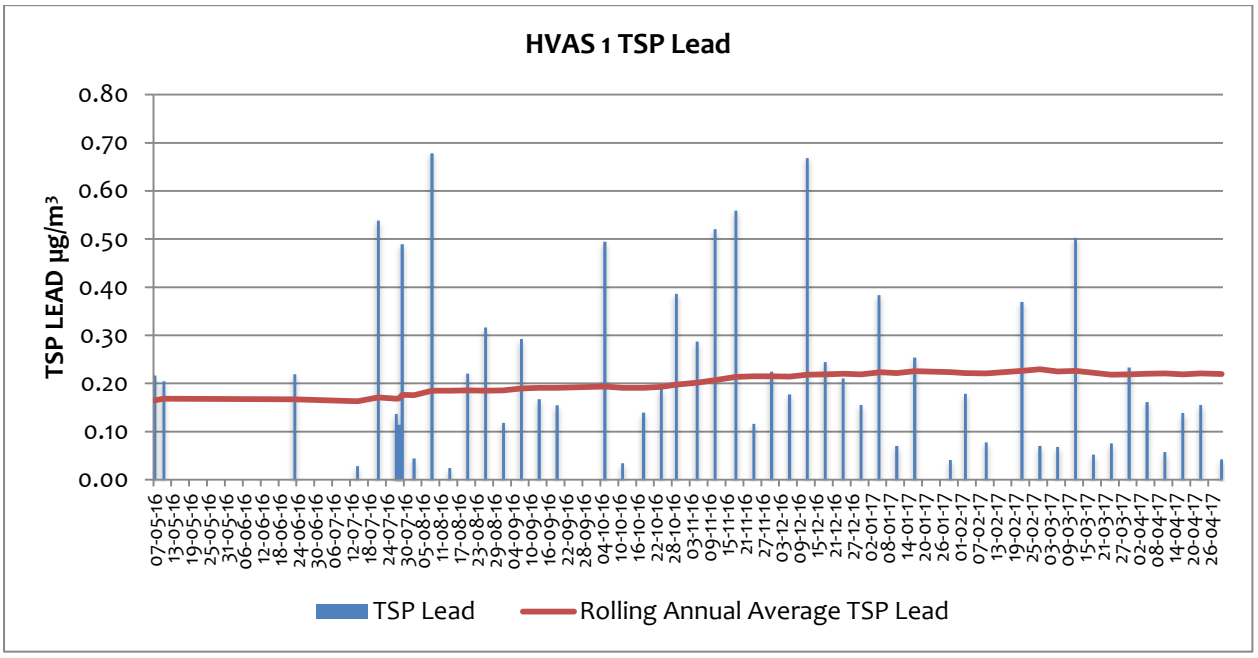
HVAS1 (EPL10) - SILVER TANK - ON SITE

DATE	TSP ($\mu g/m^3$)	Lead ($\mu g/m^3$)
05/04/2017	32.7	0.161
11/04/2017	17.3	0.057
17/04/2017	44.5	0.138
23/04/2017	24.5	0.155
30/04/2017	11.8	0.042



This monitoring unit is located on the Rasp Mine mining lease and thus no criteria applies at this point. Criteria applies to the closest residential location. However the data indicates that the annual average total suspended particles (TSP)at 36 µg/m^3 is well below the 90 µg/m^3 annual average criterion stipulated in the Rasp Mine Project Approval (07_0018) for TSP(TSP) for the nearest residential location.

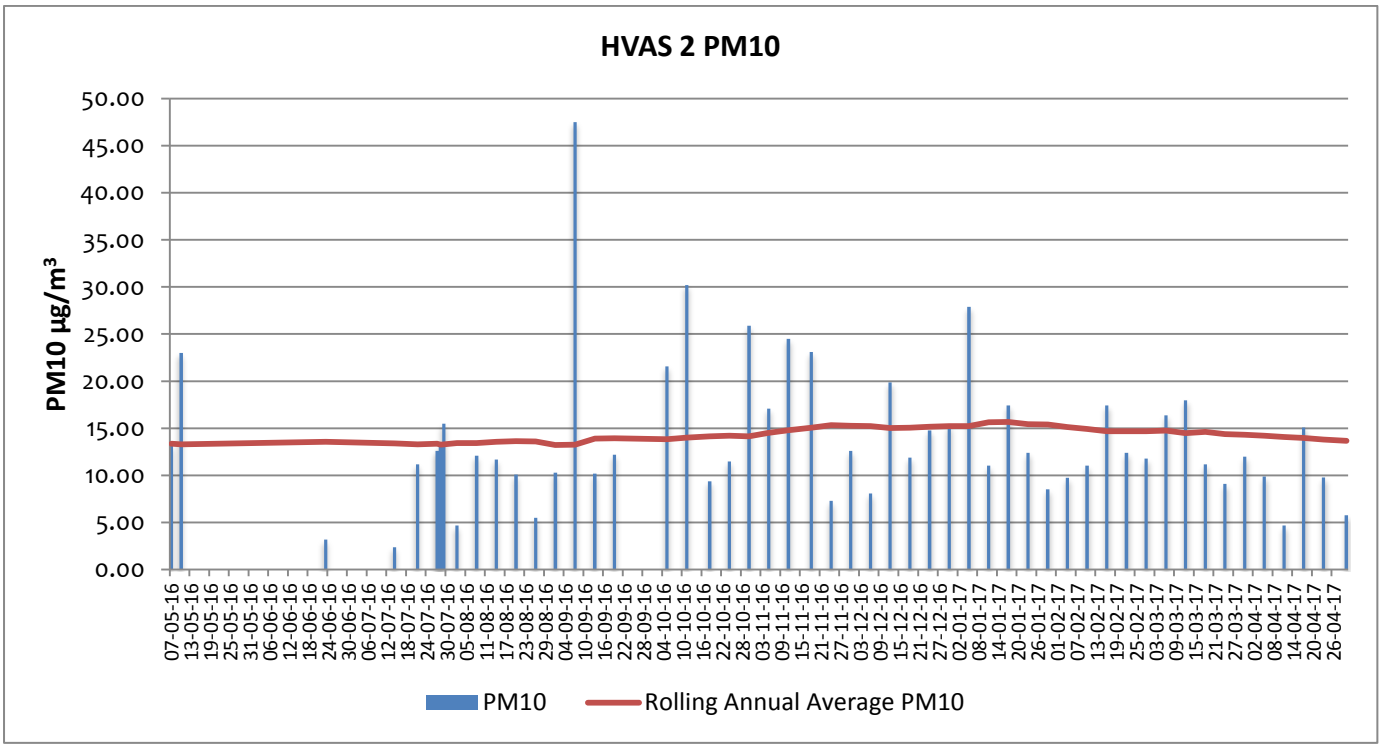
Rasp Mine is in compliance with this criterion.



Guidelines for air quality are provided by the DECCW NSW (now EPA), 2005 Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales. In regards to ambient lead dust the Rasp Mine annual averaged values are below the DECCW (2005) guideline of 0.50 µg/m^3. Rasp Mine is in compliance with this criterion.

HVAS1 (EPL11) - Silver Tank - On Site

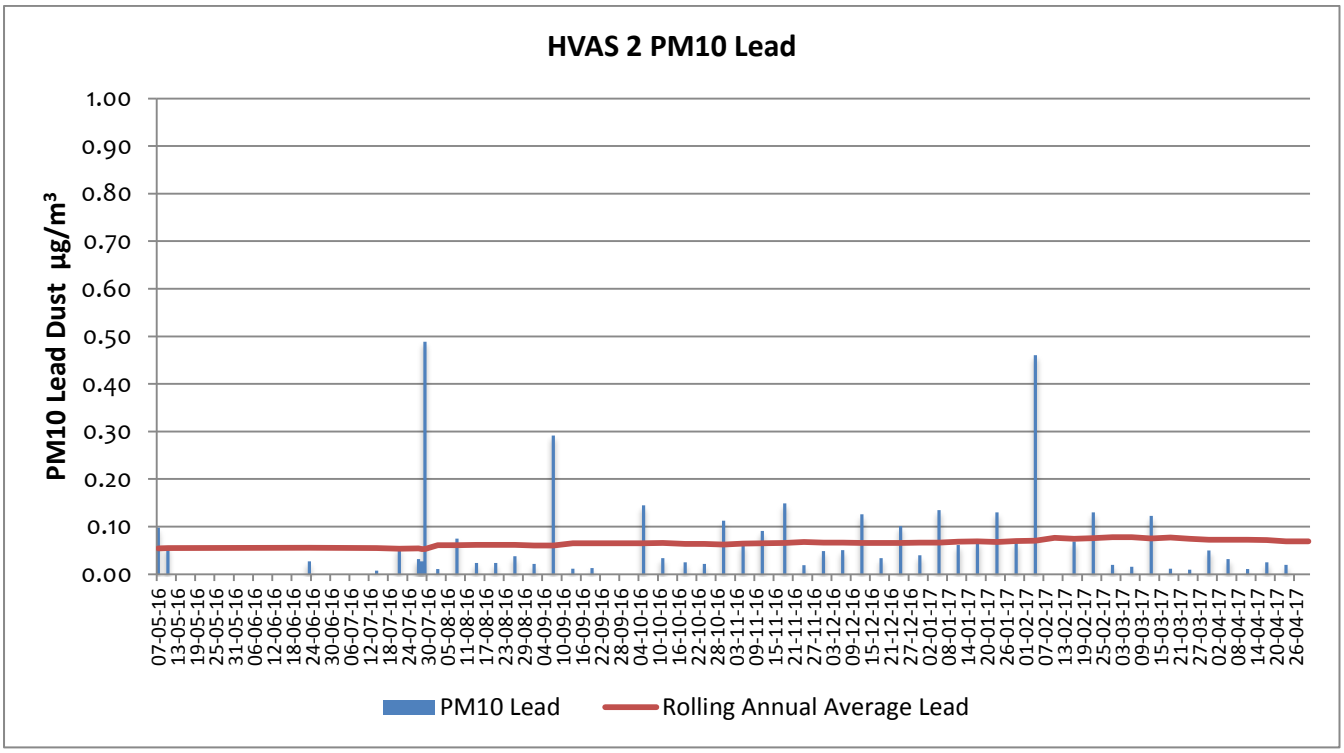
DATE	PM10 (µg/m^3)	Lead (µg/m^3)
05/04/2017	9.90	0.03
11/04/2017	4.70	0.01
17/04/2017	15.10	0.03
23/04/2017	9.80	0.02
30/04/2017	5.80	0.00



This monitoring unit is located on the Rasp Mine mining lease and thus no criteria applies at this point. Criteria applies to the closest residential location. However the data indicates that the annual average PM_{10} at 13 µg/m^3 is well below the 30 µg/m^3 annual average criterion stipulated in the Rasp Mine Project Approval (07_0018) for PM_{10} for the nearest residential location.

Rasp Mine is in compliance with this criterion.

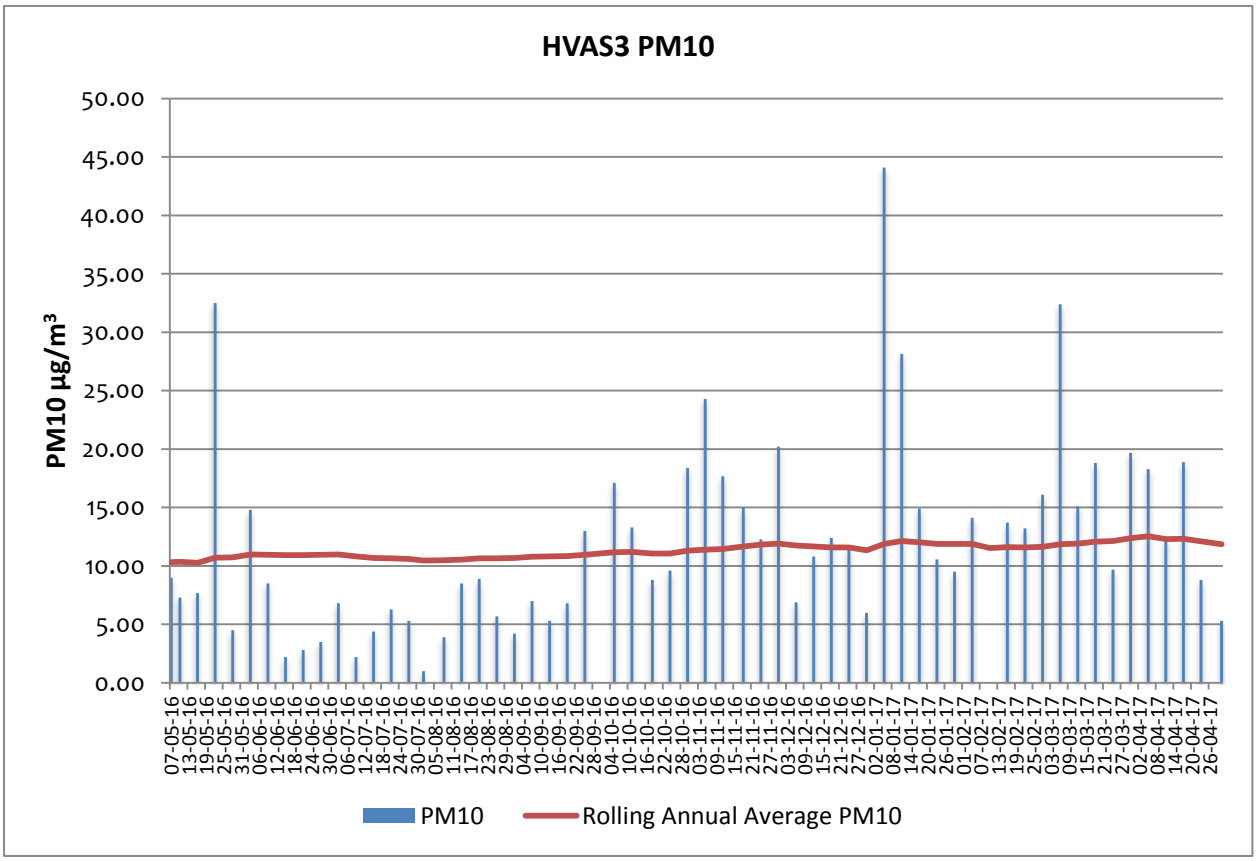
Overall the trend for PM 10 at this location remains consistent with the previous 12 months.



There is no guideline for assessing PM10 Lead dust, however , the overall the trend for lead dust at this location remains consistent with the previous 12 months.

HVAS 2 (EPL12) - Blackwood Pit – On Site

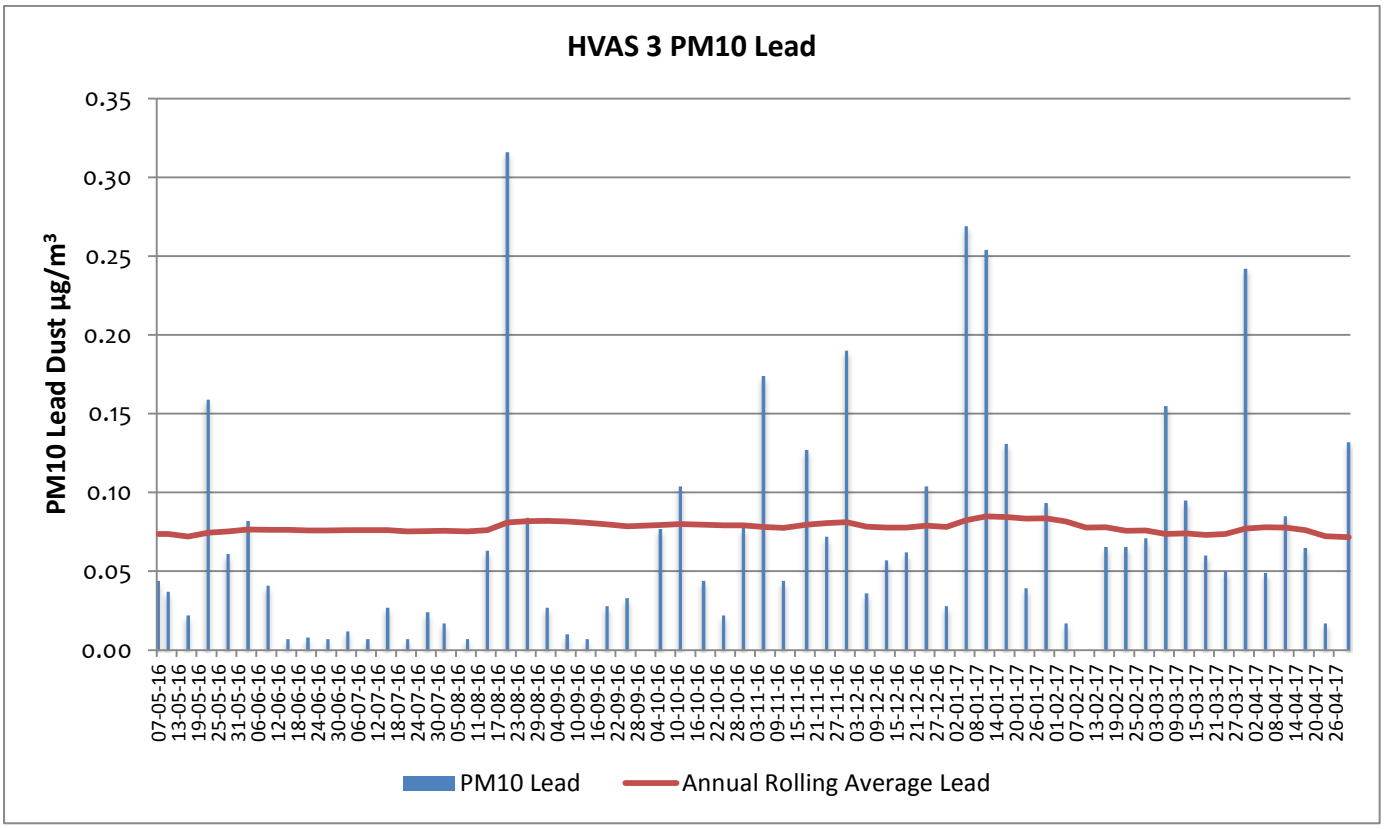
DATE	PM10 (µg/m^3)	Lead (µg/m^3)
05/004/2017	18.30	0.05
11/04/2017	12.30	0.09
17/04/2017	18.90	0.07
23/04/2017	8.80	0.02
30/04/2017	5.30	0.13



This monitoring unit is located on the Rasp Mine mining lease and thus no criteria applies at this point. Criteria applies to the closest residential location. However the data indicates that the annual average PM_{10} at 12 µg/m^3 is well below the 30 µg/m^3 annual average criterion stipulated in the Rasp Mine Project Approval (07_0018) for PM_{10} for the nearest residential location.

Rasp Mine is in compliance with this criterion.

Overall the trend for PM 10 at this location remains consistent with the previous 12 months.



There is no guideline for assessing PM10 Lead dust, however the overall the trend for lead dust at this location remains consistent with the previous 12 months.

Overall the trend for lead at this location remains low, and consistent with the previous 12 months.

1.2 Tapered Element Oscillating Microbalance Sampling (TEOM)

There are two tapered element oscillating microbalance (TEOM) sampling units used to measure ambient air quality at the Rasp Mine – TEOM1 is located off-site within the perimeter fence of Essential Water facility south of the mine lease, and TEOM2 is located adjacent to Blackwood Pit to the north of the mine lease. A map indicating these locations can be found on the Rasp Mine web site. TEOM1 and TEOM2 operate continuously and sample for particulate matter less than 10 microns (PM_{10}). Reference to the item required in the Rasp Mine Environment Protection Licence (EPL) is provided below.

TEOM1 (EPL13) – Off-site and TEOM2 (EPL14) – On Site

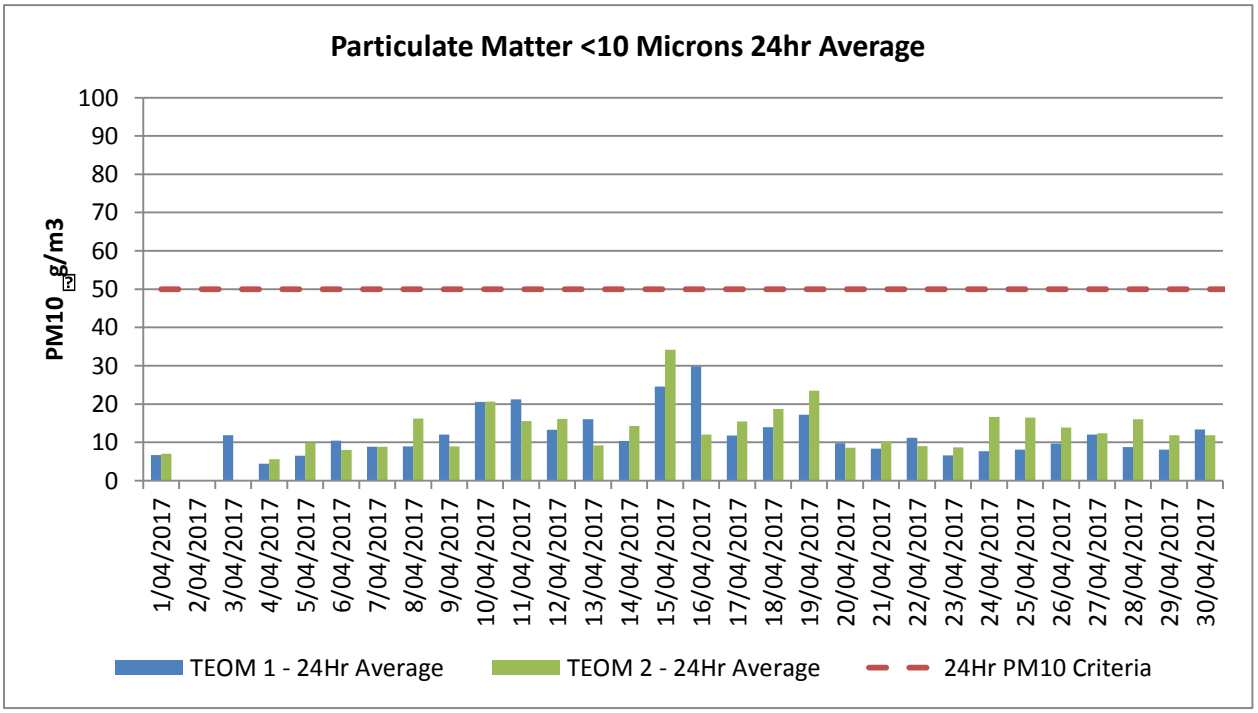
Particulate Matter <10 Microns 24Hr Average				
Date	TEOM 1 (µg/m^3)	Compliant with 50µg/m^3 24hr average?	TEOM 2 (µg/m^3)	Compliant with 50µg/m^3 24hr average?
01/04/2017	9.38	Y	18.3	Y
02/04/2017	13.63	Y	21.9	Y
03/04/2017	11.94	Y	17.7	Y
04/04/2017	17.09	Y	22.4	Y
05/04/2017	12.43	Y	14.5	Y
06/04/2017	13.65	Y	26.4	Y
07/04/2017	12.31	Y	13.1	Y
08/04/2017	13.47	Y	10.9	Y
09/04/2017	16.36	Y	18.9	Y
10/04/2017	29.52	Y	34.9	Y
11/04/2017	17.39	Y	26.4	Y
12/04/2017	10.58	Y	20.0	Y
13/04/2017	11.84	Y	16.2	Y
14/04/2017	12.74	Y	17.9	Y
15/04/2017	16.35	Y	11.0	Y
16/04/2017	17.75	Y	20.9	Y
17/04/2017	18.29	Y	21.2	Y
18/04/2017	17.06	Y	24.3	Y
19/04/2017	24.03	Y	23.5	Y
20/04/2017	33.63	Y	26.8	Y
21/04/2017	14.41	Y	10.7	Y
22/04/2017	11.60	Y	10.9	Y
23/04/2017	8.11	Y	9.3	Y
24/04/2017	7.65	Y	8.2	Y
25/04/2017	6.06	Y	6.3	Y
26/04/2017	1.88	Y	1.7	Y
27/04/2017	5.16	Y	10.0	Y
28/04/2017	8.56	Y	18.0	Y
29/04/2017	5.34	Y	15.6	Y
30/04/2017	5.92	Y	9.2	Y

The TEOM1 monitoring unit is located off-site from the Rasp Mine mining lease and thus the criteria as listed in the Project Approval (07_00180 applies at this point. There are two criterion listed in the Project Approval for PM10, 24 hour average and an annual average. The highest 24 hour average recorded at TEOM1 was 26.35 µg/m^3 on 6 April, this is well below the criteria listed of 50 µg/m^3. The rolling annual average at the end of April 2017 was 13.5 µg/m^3, again well below the listed criteria of 30 µg/m^3.

The TEOM2 monitoring unit is located on the Rasp Mine lease and thus no criteria applies at this point. Criteria applies to the closest residential location. However the data indicates that the highest daily result at 33.63 µg/m^3 is well below the listed criteria of 50 µg/m^3. The annual average PM_{10} at 15.4 µg/m^3 is well below the 30 µg/m^3 annual average criterion stipulated in the Rasp Mine Project Approval (07_0018) for PM_{10} for the nearest residential location.

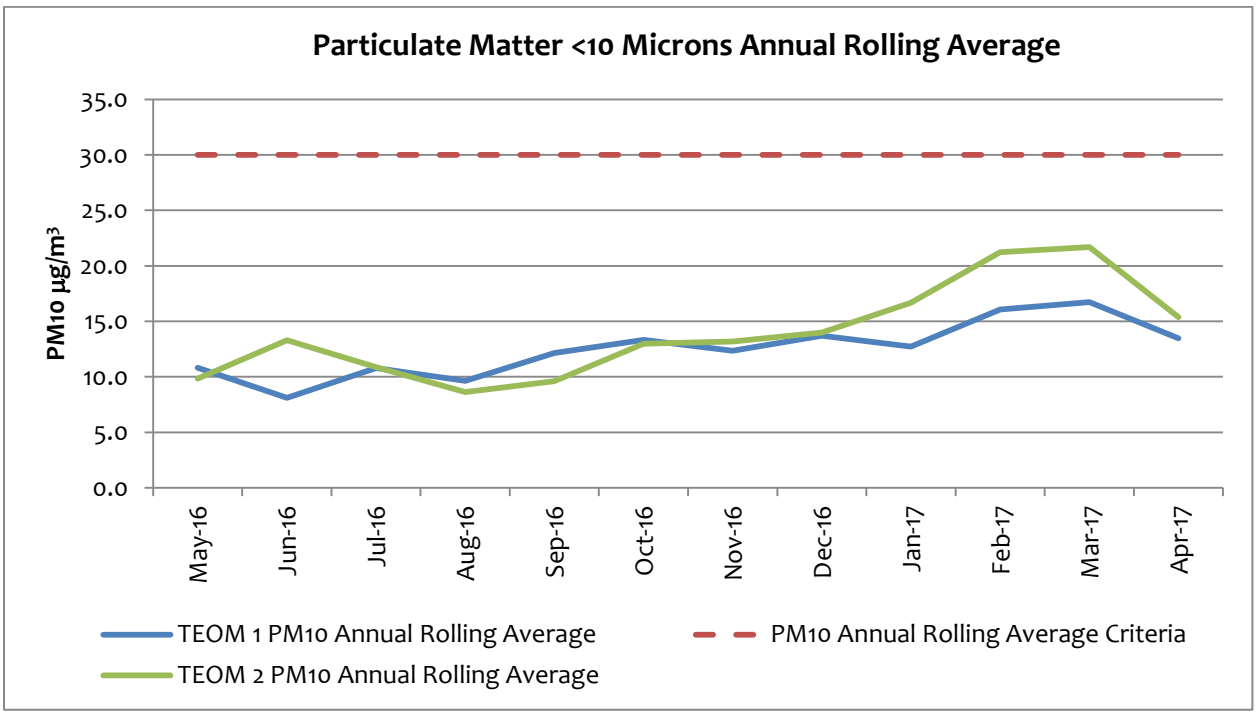
Rasp Mine is in compliance with all listed criteria.

PM10 (µg/m^3) 12 Month Rolling Average												
	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17
TEOM 1 (EPL13)	10.8	8.1	10.8	9.6	12.1	13.3	12.4	13.7	12.7	16.1	16.6	13.5
Compliant with 30µg/m^3 annual average?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
TEOM 2 EPL14	9.8	13.3	10.9	8.6	9.6	13.0	13.2	14.0	16.7	21.2	21.7	15..4
Compliant with 30µg/m^3 annual average?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y



All results were below the maximum 24 hour average of 50µg/m^3 (Project Approval PA_0017).

All 24 hour averages during the period were quite low and consistent with averages over the last 12 months.



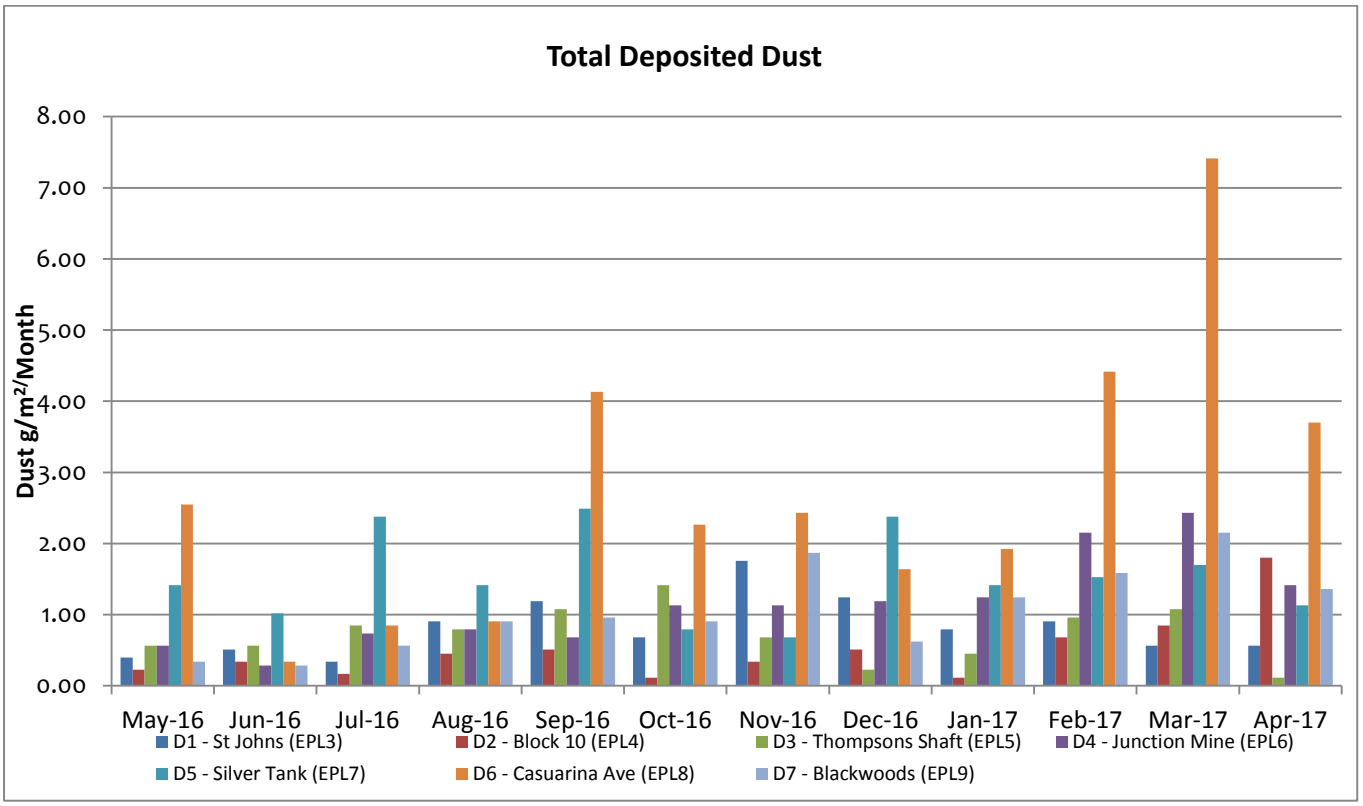
Values for PM10 are below the Project Approval (07_0018) limits of 30 µg/m^3 (annual). Rasp Mine is in compliance with this criterion.

Overall the trend for PM 10 at this location remains consistent with the previous 12 months. Elevated averages during February and March 2017 were likely due to very dry conditions throughout February and March, with these months receiving no rainfall.

1.3 Dust Deposition Sampling

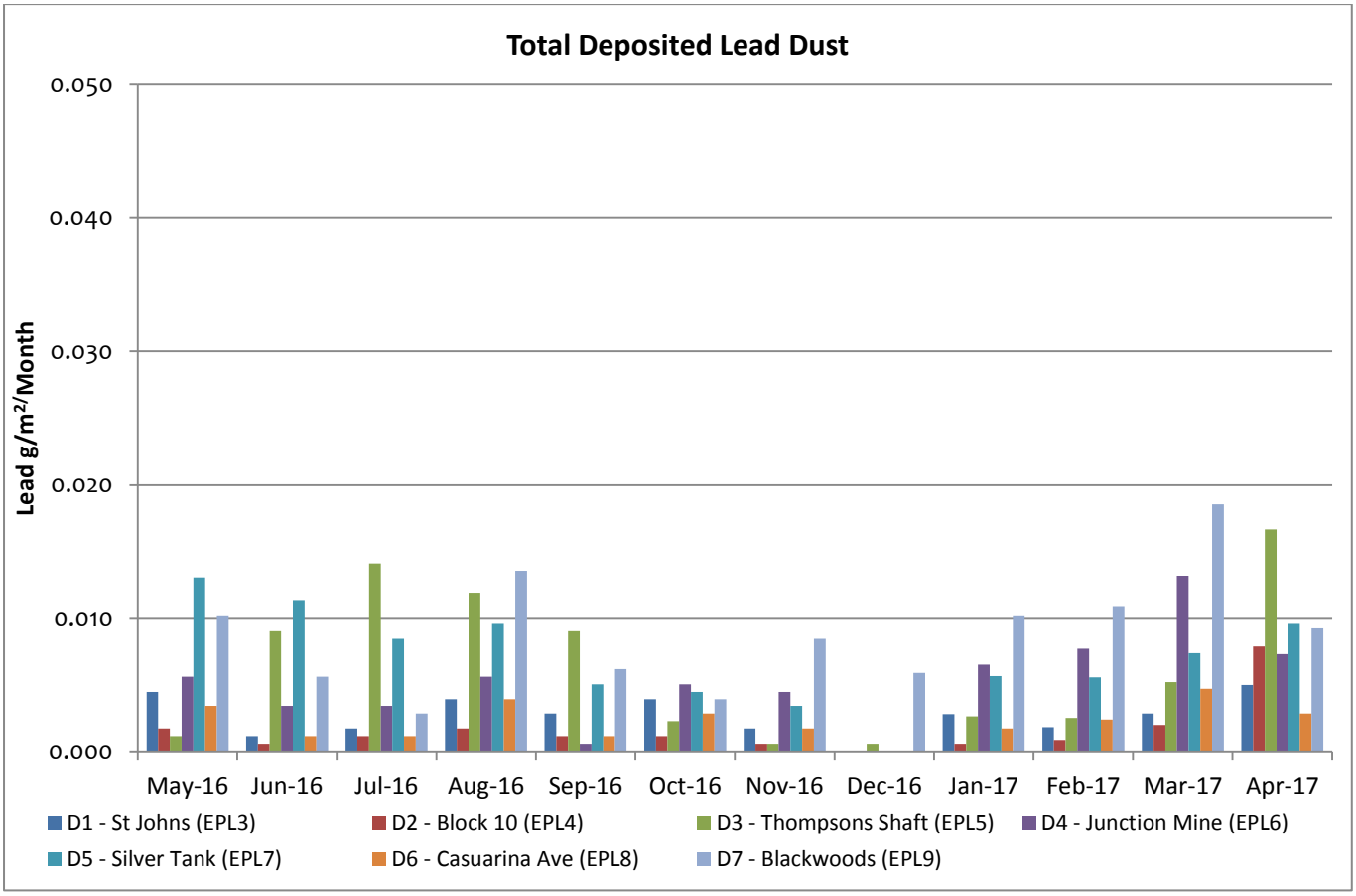
There are seven dust deposition gauges used to measure ambient air quality at the Rasp Mine – D1 to D7. D1 and D6 are located off-site, D1 near the St Johns training facility north of the Mine and D2 in Casuarina Avenue south of the Mine. D2 to D5 and D7 are located on the mine lease in various locations. A map indicating these locations can be found on the Rasp Mine web site. Dust samples are collected monthly and analysed for total deposited dust and deposited lead dust. Reference to the item required in the Rasp Mine Environment Protection Licence (EPL) is provided below.

Total Deposited Dust (g/m^{2}/Month)							
Date	D1 (off site)	D2	D3	D4	D5	D6 (off site)	D7
April 2017	0.57	1.80	0.11	1.41	1.13	3.70	1.36
Background (2010)	4.0	3.1	4.3	5.7	N/A	5.8	N/A
Maximum Mine contribution	2.0					2.0	
Maximum deposition level	4.0					4.0	
Compliant?	Y					Y	



1. Elevated total dust recorded at the offsite monitor at Casuarina Avenue appears to have been caused by motor bikes accessing the vacant lot at the rear of the property.

Total Deposited Lead (g/m^2/Month)							
Date	D1 (Off Site)	D2	D3	D4	D5	D6 (Off Site)	D7
April 2017	0.005	0.008	0.017	0.007	0.010	0.003	0.009
Background (2010)	0.0034	0.005	0.005	0.006	N/A	0.004	N/A



There is no guideline for deposited lead dust. Total deposited lead dust results remain lower than the initial measurements taken prior to commencement of operations.

1.4 Ventilation Outlets and Bag House Monitoring

There are three locations to measure pollutants from exhausts or stacks, these include the Primary Ventilation Shaft and Shaft 6, both measuring pollutants from underground firings, and the Baghouse Stack at the crusher measuring dust. All are located on site, the Primary Ventilation Shaft is located centrally and to the north of the mine lease and Shaft 6 is located centrally within the lease. The Primary Crusher Baghouse Stack is located within the area of the processing plant to the east of the lease. A map indicating these locations can be found on the Rasp Mine web site. Samples are collected quarterly and analysed for a number parameters listed in below. Reference to the item required in the Rasp Mine Environment Protection Licence (EPL) is provided below.

Quarterly sampling is undertaken in January, April, July and October.

Required parameters to be monitored are:-

- Dry gas density (kg/m^3)
- Moisture (percent)
- Molecular weight of stack gases (g/m^3)
- Temperature (degrees Celsius)
- Total Solid Particles (mg/m^3)
- Type 1 and Type 2 substances in aggregate (mg/m^3)
- Velocity (m/ sec)
- Volumetric flowrate (m^3 / sec)

In addition the following criteria apply:

Primary Ventilation Shaft (EPL1) and Shaft 6 (EPL56)

	Unit	Criteria
Nitrogen Oxides	mg/m^3	350
Volatile Organic Compounds	mg/m^3	40

Primary Ventilation Shaft (EPL1), Shaft 6 (EPL56) and Crusher Baghouse (EPL2)

	Unit	Criteria
Total Suspended particles	mg/m^3	20
Type 1 and Type 2	mg/m^3	1

Type 1 substance
Means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements.
Type 2 substance Means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements.

Primary Vent Shaft (EPL1, Crusher Baghouse (EPL)and Vent Shaft 6 (EPL56) April Results

	Unit	Criteria	Primary Vent Shaft (EPL1)	Crusher Baghouse (EPL2)	Vent Shaft 6 (EPL 56)
Nitrogen Oxides	mg/m^3	350	4.5	NA	<2.1
Volatile Organic Compounds	mg/m^3	40	<0.4	NA	<0.5
Total Suspended particles	mg/m^3	20	3.1	8.4	1.9
Type 1 and Type 2	mg/m^3	1	0.053	0.28	0.062

Rasp Mine is in compliance with all listed criteria.

2 Noise

2.1 Blasting (Vibration and Overpressure)

There are 6 vibration monitors at various locations to measure for vibration and overpressure from blast firings. These include V1 to V5 which are located off-site and V6 which is located on-site near Shaft 4. A map indicating these locations can be found on the Rasp Mine web site. In addition there are 2 roving monitors which may be used to monitor vibration and overpressure at particular locations as required. Monitors operate continuously and are automatically triggered when a blast occurs.

The following conditions apply as listed in the PA 07_0018 and EPL 12559:-

Blasting Criteria (excluding Block 7)

Location	Airblast Overpressure (dB(Lin Peak))	Ground Vibration (mm/s)	Allowable Exceedance
Residence on privately owned land (7am-7pm)	115	5	5% of the total number of blasts over a 12-month period
(7am-7pm)	120	10	0%
(7pm-10pm)	105	-	-
(10pm-7am)	95	-	-
Public Infrastructure	-	100	0%

Blasting Criteria (Block 7)

Location	Airblast Overpressure (dB(Lin Peak)	Ground Vibration (mm/s)	Allowable Exceedance
Residence on privately owned land (7am-7pm)	115	3 (interim)	5% of the total number of blasts over a 12-month period
(7am-7pm)	120	10	0%
(7pm-10pm)	105	-	-
(10pm-7am)	95	-	-
Broken Hill Bowling Club, Italio (Bocce) Club, Heritage Items within CML7	-	50	0%
Perilya Southern Operations	-	100	0%
Public Infrastructure[d]	-	100	0%

In addition the following conditions apply:-

- Production blasts may occur between 6.45 am and 7.15 pm on any day

- 1 production blast per day, with 6 per week averaged over a calendar year
- 6 development blasts per day, with 42 per week averaged over a calendar year

April Summary for Block 7:

- 0 production firings, averaging 1.0 per week over the previous calendar year
- 7 development firings, averaging 2.3 per week over the previous calendar year
- 0 Blasts recorded a ppv of >3mm/s
- 0 Blasts recorded a ppv of >10mm/s
- 0 development blasts recorded an over pressure level over 95 dBL (10pm to 7am)
- 0 development blasts recorded an over pressure level over 105 dBL (7pm to 10pm)
- 0 Blasts recorded an over pressure level over 115dBL or 120 dBL (7am to 7pm)
- 0 Blasts occurred before 7 am or after 7 pm

12 Month Summary:

- % of all blasts over 3mm/sec = **1.14%** (licence requirement <5%) calculated from 1 May 2016 until 30 April, 2017;
- % of production blasts over 3mm/sec = **3.84%** (licence requirement <5%) calculated from 1 May 2016 until 30 April, 2017

Rasp Mine is in compliance with all listed criteria.

April Summary Rest of Mine - Western Mineralisation and Main Lodes:

- 12 production firings, averaging 2.8 per week over the previous calendar year
- 145 development firings, averaging 33.9 per week over the previous calendar year
- 0 Blasts recorded a ppv of >5mm/s
- 0 Blasts recorded a ppv of >10mm/s
- 0 development blasts recorded an over pressure level over 95 dBL (10pm to 7am)
- 0 development blasts recorded an over pressure level over 105 dBL (7pm to 10pm)
- 0 Blasts recorded an over pressure level over 115dBL or 120 dBL (7am to 7pm)
- 0 Blasts occurred before 7 am or after 7 pm

12 Month Summary Rest of Mine - Western Mineralisation and Main Lodes:

- % of all blasts over 5mm/sec = **0.36%** (licence requirement <5%) calculated from 1 May 2016 until 30 April, 2017;
- % of production blasts over 5mm/sec = 4.79**%** (licence performance target <5%) calculated from 1 May 2016 until 30 April, 2017

Rasp Mine is in compliance with all listed criteria.

2.2 Noise

Noise monitoring is undertaken as per the NSW Industrial Noise Policy at a frequency of once per annum. A noise assessment was conducted in 2016, and is next due in Q4 2017.

3 Water

3.1 Groundwater

There are eighteen sampling locations for groundwater, GW01 to GW16 are installed piezometers at various locations around the mine site and are sampled quarterly. There are also two sampling locations for water pumped from underground mining, Shaft 7 and Kintore Pit, both taken from mine water settling ponds and are sampled monthly. A map indicating these locations can be found on the Rasp Mine web site Groundwater is analysed for a number of parameters including alkalinity (calcium carbonate), cadmium, calcium, chloride, electrical conductivity, iron, lead, magnesium, manganese, pH, sodium, sulphate, total dissolved solids and zinc. Reference to the item required in the Rasp Mine Environment Protection Licence (EPL) is provided below.
Groundwater monitoring is scheduled for completion in March, June, September and November.

Shaft 7 (EPL53) and Kintore Pit (EPL54) June Results

Sample Point	Alkalinity ($CaCO_3$) (mg/l)	Cd (mg/l)	Ca (mg/l)	Cl (mg/l)	EC (µS/cm^2)	Fe (mg/l)	Pb (mg/l)	Mg (mg/l)	Mn (mg/l)	pH	Na (mg/l)	SO4 (mg/l)	TDS (mg/l)	Zn (mg/l)
Shaft 7 (EPL53)	5	0.0097	855	1210	9100	<0.05	0.035	107	74.5	6.24	1320	4100	7610	12.4
Kintore Pit (EPL54)	13	0.832	527	1240	9660	<0.05	0.002	239	215	7.01	1470	4320	8310	41.9

Groundwater Bores (EPL37 - 52) April Results

Sample Point	Alkalinity ($CaCO_3$) mg/l	Cd (mg/l)	Ca (mg/l)	Cl (mg/l)	EC (µS/cm^2)	Fe (mg/l)	Pb (mg/l)	Mg (mg/l)	Mn (mg/l)	pH	Na (mg/l)	SO4 (mg/l)	TDS (mg/l)	Zn (mg/l)
GW01 (EPL37)	47	0.0994	537	2590	14100	<0.05	1.26	13.3	306	7.35	2180	4000	9560	2.41
GW02 (EPL38)	47	1.65	467	1320	11900	<0.05	1.7	294	270	6.96	1750	4780	11400	425
GW03 (EPL39)	10	1.89	555	3010	15700	<0.05	2.83	317	380	6.23	2100	4540	13900	295
GW04 (EPL40)	156	0.337	538	2680	14700	<0.05	0.065	79.9	436	7.14	2050	4390	14200	32.9
GW05 (EPL41)	134	1.51	473	2820	18000	<0.05	1.33	339	6146	6.58	2570	6760	16900	287
GW06 (EPL42)	41	0.759	508	1930	13700	<0.05	0.064	294	397	6.65	1910	4540	12700	185
GW07 (EPL43)	Insufficient depth for sample													
GW08 (EPL44)	Insufficient depth for sample													
GW09 (EPL45)	272	0.0247	721	2600	12200	<0.05	0.001	0.391	528	7.6	1280	3350	10100	1.39
GW10 (EPL46)	118	0.695	572	2560	14200	0.05	0.001	22.7	499	6.97	2150	4300	11500	34.4
GW11 (EPL47)	50	0.0675	292	399	4380	0.05	0.062	16.7	139	7.23	552	1800	3610	28.1

GW12 (EPL48)	Insufficient depth for sample
GW13 (EPL49)	Insufficient depth for sample
GW14 (EPL50)	Insufficient depth for sample
GW15 (EPL51)	Insufficient depth for sample
GW16 (EPL52)	Insufficient depth for sample

3.2 Surface Water Sample Record

There are seven sampling locations for surface water, these include surface water basins located on the mine lease to capture and retain rainfall and two locations up and down stream of an ephemeral creek located south of the mine lease boundary. A map indicating these locations can be found on the Rasp Mine web site. Surface water is analysed for a number of parameters including cadmium, chloride, electrical conductivity, lead, manganese, pH, sodium, sulphate, total dissolved solids and zinc. Reference to the item required in the Rasp Mine Environment Protection Licence (EPL) is provided below.

Surface Water Table May 2016 to April 2017

EPA Identification Number	Frequency	Comment
EPL29 (Federation Way culvert) S31-1	2 x per year , six months apart	Sampled 9/5/16, 21/7/16
EPL31 (Ryan Street Dam) S49	2 x per year , six months apart	Sampled 21/7/16 & 5/10/16
EPL32 (adjacent olive grove) S1A	2 x per year , six months apart	Sampled 9/5/16 & 21/7/16
EPL33 (Behind Bowls Club) S9-B2	2 x per year , six months apart	Sampled 9/5/16, 21/7/16
EPL34 (Horwood Dam) Horwood Dam	2 x per year , six months apart	Sampled 9/5/16, 21/7/16, 19/10/16
EPL35 (Upstream Bonanza St)	2 x per year , six months apart	Sampled 1/8/16, 20/9/16 & 14/12/16
EPL36 (Downstream Sydney Rd)	2 x per year , six months apart	Sampled 1/8/16 & 20/9/16

Due to the ephemeral nature of the surface water bodies the sample frequency of six months apart can be difficult to achieve. Sample times are dictated by the availability of water.

Surface Water April Results

Sample Point	Alkalinity ($CaCO_3$) (mg/l)	Cd (mg/l)	Ca (mg/l)	Cl (mg/l)	EC ($\mu S/cm^2$)	Fe (mg/l)	Pb (mg/l)	Mg (mg/l)	Mn (mg/l)	pH	Na (mg/l)	SO4 (mg/l)	TDS (mg/l)	Zn (mg/l)
S31-1	4	0.193	52	2	389	0.05	0.272	4.94	6	6.58	19	134	304	22.4

(EPL29)														
S9-B (EPL33)	10	0.12	56	50	715	0.05	0.73	6.83	8	6.56	48	221	519	22.4

4 Weather Data

The weather station continuously monitors the following parameters as per point 55 of the Environmental Protection Licence.

The following parameters are required to be recorded each month as listed in the EPL 12559:-

Rasp Mine Weather Station (EPL55)

Parameter	Sampling method	Units of measure	Averaging period	Frequency
Temperature at 10 metres	AM-4	degrees Celsius	15 minutes	Continuous
Wind Direction at 10 metres	AM-4	degrees in a clockwise direction from True North	15 minutes	Continuous
Wind Speed at 10 metres	AM-4	metres per second	15 minutes	Continuous
Rainfall	AM-4	millimetres	1 hour	Continuous
Sigma theta	AM-2 & AM-4	degrees	15 minutes	Continuous

The continuous data can be viewed at any time at the following web site using the username and password.

www.loggermonitor.com/login

user: CBHAdmin

pass: brokenhill

Summary reports for all licence parameters are available from the website.

The weather station was not operational from March 28. This incident was reported to the NSW EPA.

5 Data Log

Sample	Result Received
Hi Volume Samples	23-May-17
TEOM	01-Apr-17
Dust Deposition	26-May-17
Water	9-May-17
Blast Vibration and overpressure	01-Apr-17
Weather	01-Apr-17

6 Correction Log

There are no corrections to the previous reports.