16 September 2019

Ref: 171356/8637

Muswellbrook Coal Company
PO Box 123
Muswellbrook NSW 2333

RE: SEPTEMBER 2019 NOISE MONITORING RESULTS – MUSWELLBROOK COAL MINE

This letter report presents the results of noise compliance monitoring, commencing at about 10.00 pm on Thursday 5th of September, 2019, for the Muswellbrook Coal Company (MCC) mine at Muscle Creek Road, Muswellbrook. The monitoring was undertaken as per the requirements of D.A. 205/2002 and detailed in the Noise Management Plan (NMP) for the mine.

Attended Noise Monitoring Program

Noise monitoring was undertaken in accordance with the NMP as summarised below.

All attended monitoring and equipment maintenance and calibration is conducted in accordance with the Noise Policy for Industry (NPI) and AS1055 – Acoustics, Description and Measurement of Environmental Noise.

Attended noise monitoring is undertaken monthly by an independent noise consultant. Each attended noise survey will be conducted during night periods only. If it is identified during the noise monitoring that the mining noise from the operation is exceeding the criteria, MCC will be notified and the operations will be modified as required. Monitoring at the location(s) where the noise levels are elevated will be undertaken again with a minimum break of 75 minutes between monitoring.

The noise criteria for MCC apply under all meteorological conditions except for the following:

i. Wind speeds greater than 3m/s at 10m above ground level; or

ii. Stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10m above ground level; or

iii. Stability category G temperature inversion conditions.

To determine compliance with the Leq (15 min) operational noise criteria the modification factors detailed in Section 4 of the NPI must be applied, as appropriate, to the measured noise levels.

Due to the distance of the mine from each residence, the monitoring of LA1 (1minute) at the facade is not considered necessary and will be conducted at the property boundary.

The attended noise monitoring locations are detailed in **Table 1** and shown in **Figure 1**.

Table 1
Noise Monitoring Locations

Location	Description
R13	Sandy Creek Road
R15	Queen St
R17	Queen St
R25	Sandy Creek Road
R32	Muscle Creek Road

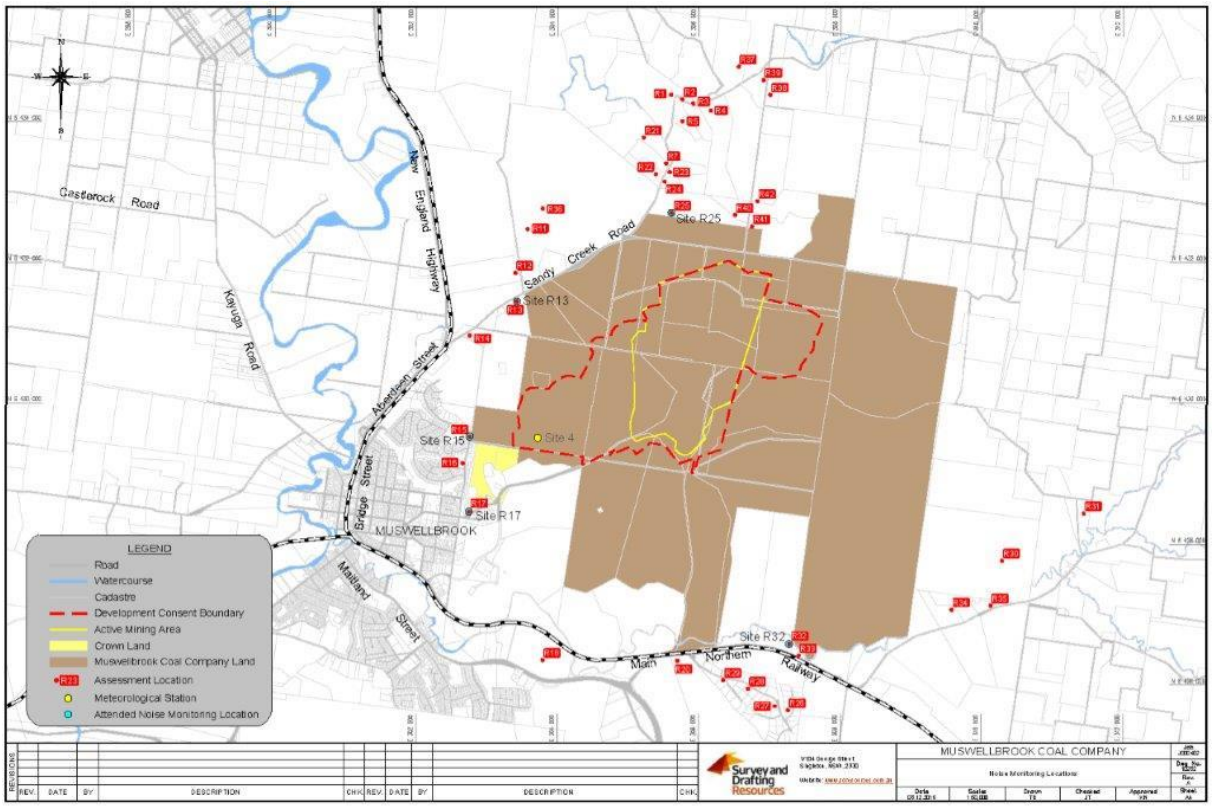


Figure 1 – Noise Monitoring Locations

Noise criteria for all assessment locations shown in Figure 1 are detailed in **Appendix I** to this report.

Monitoring Equipment

Attended noise monitoring was conducted with a Brüel & Kjær Type 2250 Precision Sound Analyser. This instrument has Type 1 characteristics as defined in AS1259-1990 “Sound Level Meters” and has current NATA calibration. Field calibration is carried out at the start and end of each monitoring period. Calibration certificates are attached as **Appendix II** to this report.

A-weighted noise levels were measured over the 15 minute monitoring period with data acquired of 1 second statistical intervals and the meter set to “fast” response. Each 1 second measurement is accompanied by a third-octave band spectrum from 20 - 20k Hz which is required for analysing NPI ‘modifying factors’.

Time based field notes allow for determination of the relative contributions to the overall noise level of all significant noise sources.

Measurement Analysis

The MCC compliance noise criteria are based on a 15 minute Leq noise level. The 15 minute Leq noise level for each monitoring period is shown in the tables below. Where the noise from MCC was audible Bruel & Kjaer "*Evaluator*" analysis software was used to quantify the contribution of the mine and other significant noise sources to the overall level. Mine noise from MCC is shown in the table in bold type.

All noise levels shown are in dB(A) Leq (15 min) unless otherwise detailed.

MCC Operations

Operational details for MCC on 5th September, 2019 are shown in **Appendix III**.

Noise Compliance Assessment

The results of the noise measurements are shown in **Table 2**.

Table 2
MCC Operational Noise Monitoring Results – 5 September 2019

Location	Time	dB(A), Leq	MCC Contribution dB(A), Leq	Criterion dB(A) Leq	dB(A), L1 (1min)[1]	Criterion dB(A), L1 (1min)[1]	Stability Class[2]/ Wind speed (m/s)/dir°	Compliant Met Conditions?	Identified Noise Sources[3]
R13 Sandy Creek Rd.	10:18 pm	37	36	41	43	45	F/2.1/131	No	**MCC (36)**, train (31), frogs (25)
R15 Queen St.	10:42 pm	33	30	37	40	45	F/1.4/143	Yes	**MCC (30)**, traffic (30), frogs and bats (22)
R17 Queen St.	11:00 pm	36	22	35	40	45	F/1.3/130	Yes	Trains (35), traffic (28), **MCC (22)**
R25 Sandy Creek Rd.	10:00 pm	38	38	42	42	45	F/2.2/133	No	**MCC (38)**
R32 Muscle Creek Rd.	11:25 pm	27	n/a	35	n/a	45	F/1.2/121	Yes	Frogs & birds (27), **MCC inaudible**

1. L1 (1 min) from MCC mine noise only
2. See text regarding stability class
3. See text regarding MCC noise sources

The results in Table 2 show that, under the operational and meteorological conditions at the time, noise from MCC did not exceed the relevant noise criteria at any time or location during the monitoring period.

The mine operated weather station malfunctioned on the night of 5th September. Wind speed data were obtained from the auxiliary met station located at MCC Site 7 (Nisbet), which is to the north of the mine site. This auxiliary met station does not record stability conditions. MCC provided stability class based on horizontal wind speed, sigma theta and delta T using tables in "Estimating the Flammable Mass of a Vapor Cloud" by John L. Woodard 1998 American Institute of Chemical Engineers – Appendix A "Atmospheric Stability Classification Schemes" and Ready Tools – Pasquill Stability Classes.

The data from the auxiliary met station and the calculated stability class shows that the noise monitoring was done under non-compliant met conditions at Locations R13 and R25. The non-compliance was due to the conditions being "*Stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10m above ground level*". The non-compliant F class stability conditions and south easterly winds would be noise enhancing to receivers at Locations R13 and R25. It is noted that the noise emissions from MCC were in compliance with the relevant criterion at these receivers under the noise enhancing atmospheric conditions.

Mine noise was audible and measureable at all monitoring locations. At all locations the mine noise was attributable to general mine hum and engine revs. At Locations R13 and R25 there were occasional louder revs which were most likely attributable to loaded haul trucks travelling uphill.

Data from those times where MCC operations were audible were analysed using the *"Evaluator"* software. This analysis showed the noise did not contain any tonal or impulsive components as per definitions in the NPI.

The methodology for analysing the low frequency noise modifying factor correction in the NPI is shown in extract below.

Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements in the range 10– 160 Hz	Measure/assess source contribution C- and A-weighted Leq,T levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and: • where any of the one-third octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2-dB(A) positive adjustment to measured/predicted A- weighted levels applies for the evening/night period • where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dB and cannot be mitigated, a 5-dB(A) positive adjustment to measured/predicted A- weighted levels applies for the evening/night period and a 2- dB(A) positive adjustment applies for the daytime period.	2 or 5 dB[2]	A difference of 15 dB or more between C- and A-weighted measurements identifies the potential for an unbalance spectrum and potential increased annoyance. The values in Table C2 are derived from Moorhouse (2011) for DEFRA fluctuating low-frequency noise criteria with corrections to reflect external assessment locations.

Table C2 : One-third octave low-frequency noise thresholds.

Hz/dB(Z)	One-third octave dB(Z) Leq (15 min) threshold level												
Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB(Z)	92	89	86	77	69	61	54	50	50	48	48	46	44

The correction applies to the mine noise component only. There are many sources of low frequency noise in the acoustic environment of each receiver area (including noise from road and rail traffic and from rail track works). In many cases the C minus A level is greater than 15dB due to these other noise sources. In most instances the screening criteria will be the one third octave analysis. Should the mine noise not comply with this then the C minus A analysis will be applied.

Tables 3, **4**, **5**, and **6** show the low frequency noise analysis for the periods where the mine noise was able to be accurately isolated from the overall measurement during the monitoring at Locations R13, R15, R17, and R25 respectively.

Table 3
Low Frequency Noise Analysis – 5 September 2019

Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
R13 Sandy Ck Rd.	<36	36.1	42.9	39.4	44.3	44.5	45.8	45.6	42.3	43.5	43.1	43.2	38.3
dB(Z) Criterion	92	89	86	77	69	61	54	50	50	48	48	46	44
Exceedance	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 4
Low Frequency Noise Analysis – 5 September 2019

Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
R15 Queen St.	<34	34.7	39.3	36.9	42.5	41.3	42.7	43.9	41.1	45.3	41.1	39.7	36.1
dB(Z) Criterion	92	89	86	77	69	61	54	50	50	48	48	46	44
Exceedance	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 5
Low Frequency Noise Analysis – 5 September 2019

Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
R17 Queen St.	<37	37.0	41.5	38.1	37.8	36.4	34.4	35.6	37.2	32.5	31.1	29.5	25.9
dB(Z) Criterion	92	89	86	77	69	61	54	50	50	48	48	46	44
Exceedance	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 6
Low Frequency Noise Analysis – 5 September 2019

Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
R25 Sandy Ck Rd.	<44	44.0	48.0	44.4	45.2	44.4	47.8	48.2	43.3	44.5	45.0	43.1	37.5
dB(Z) Criterion	92	89	86	77	69	61	54	50	50	48	48	46	44
Exceedance	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

The results in Tables 3 to 6 (inclusive) show that there is no requirement to apply a low frequency noise modifying factor correction to the measured noise levels at any of the noise monitoring locations.

In addition to the operational noise, the noise from MCC must not exceed **45 or 47 dB(A) L1 (1 min)** between the hours of 10 pm and 7 am (see Appendix I for details of noise criteria at various receiver locations). This is to minimise the potential for sleep disturbance as a result of individual loud noises from the mine.

The compliance measurement locations are different for each of the operational and sleep disturbance noise. That is, the sleep disturbance criterion is typically applicable at 1m from the facade of a bedroom window.

To avoid undue disturbance to residents the L1 (1 min) noise level from the operational measurements are used to show general compliance with the sleep disturbance criterion. That is, as the distance between the noise source and the operational noise monitoring location is significantly greater than the distance between the operational noise monitoring location and the sleep disturbance monitoring location (i.e. 1m from the facade of the house) there will be little variation in L1 (1 min) levels between the two monitoring locations.

It must be noted, however, that the sleep disturbance criterion is applicable at the outside of a bedroom window. As the internal layout of each residence is not known, to consider a worst case, the bedroom windows were assumed to be facing towards the mine.

As shown in Table 2, during the night time measurement circuit the L1 (1 min) noise from MCC did not exceed 45 dB(A) at any monitoring location.

At each of the locations where the mine noise was audible (R13, R15, R17 and R25) the measured L1 (1 min) noise was attributable to relatively loud haul truck engine revs.

We trust this report fulfils your requirements at this time, however, should you require additional information or assistance please contact the undersigned on 4954 2276.

Yours faithfully,

SPECTRUM ACOUSTICS PTY LIMITED

Author:

Ross Hodge
Acoustical Consultant

Review:

Neil Pennington
Acoustical Consultant

Appendix I

Noise criteria from Development Consent DA205/2002 (Locations as per Figure 1).

Location	Day	Evening	Night	
	$L_{Aeq(15\ minute)}$	$L_{Aeq(15\ minute)}$	$L_{Aeq(15\ minute)}$	$L_{A1\ (1\ minute)}$
R1, R2, R3, R4, R17, R26, R27, R28, R29, R30, R31, R32, R33, R34, R35, R37, R38, R39	35	35	35	45
R5	36	36	36	45
R7	38	38	38	45
R11	39	39	39	45
R12	39	39	39	45
R13	41	41	41	45
R14	38	38	38	45
R15	37	37	37	45
R16	36	36	36	45
R17	35	35	35	45
R18	45	38	37	47
R20	45	38	37	47
R21	37	37	37	45
R22	39	39	39	45
R23	39	39	39	45
R24	40	40	40	45
R25	42	42	42	45
R36	38	38	38	45
R40	42	42	42	45
R41	42	42	42	45
R42	40	40	40	45

Note: All levels are in dB(A)
Note: Following further consultation with the community it has been identified that R11 is a stable complex, not a residence, so the criteria listed in the table above do not apply.

Appendix II

Calibration Certificates

Brüel & Kjær

Australian Calibration Laboratory
Suite 2, 6-10 Talavera Road, North Ryde NSW 2113, Australia
Accredited for compliance with ISO/IEC 17025 - Calibration. Laboratory No. 1301

NATA
WORLD RECOGNISED ACCREDITATION

CERTIFICATE OF CALIBRATION

Certificate No: CAU1800652 Page 1 of 10

CALIBRATION OF:

Sound Level Meter:	Bruel & Kjaer	2250	No: 2747794
Microphone:	Bruel & Kjaer	4189	No: 2733511
Preamplifier:	Bruel & Kjaer	ZC-0032	No: 15339
Supplied Calibrator:	N/A	N/A	No: N/A
Software version:	BZ7224 Version 4.6	Pattern Approval:	PTB
Instruction manual:	BE1712-22	Identification:	N/A

CUSTOMER:

Spectrum Acoustics Pty Ltd
30 Veronica Street
Cardiff NSW 2285

CALIBRATION CONDITIONS:

Preconditioning: 4 hours at 23 °C
Environment conditions: *see actual values in **Environmental conditions** sections*

SPECIFICATIONS:

The Sound Level Meter has been calibrated in accordance with the requirements as specified in IEC61672-1:2013 class 1. Procedures from IEC 61672-3:2013 were used to perform the periodic tests.

PROCEDURE:

The measurements have been performed with the assistance of Brüel & Kjær Sound Level Meter Calibration System B&K 3630 with application software type 7763 (version 7.2 - DB: 7.20) and test procedure 2250-4189.

RESULTS:

	Initial calibration		Calibration prior to repair/adjustment
X	Calibration without repair/adjustment		Calibration after repair/adjustment

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

Date of Calibration: 25/06/2018 Certificate issued: 26/06/2018

Sajeeb Tharayil
Calibration Technician

Jan Rasmussen
Approved signatory

Reproduction of the complete certificate is allowed. Part of the certificate may only be reproduced after written permission.

Brüel & Kjær

Australian Calibration Laboratory
Suite 2, 6-10 Talavera Road, North Ryde NSW 2113, Australia
Accredited for compliance with ISO/IEC 17025 - Calibration. Laboratory No. 1301

NATA

CERTIFICATE OF CALIBRATION

No.: CAU1900185

CALIBRATION OF:

Calibrator:	Brüel & Kjær	4231	No: 2466354
Description:	Acoustical Calibrator		
Identification:	N/A		
IEC Class: 1			

CUSTOMER:

Spectrum Acoustics Pty Ltd
30 Veronica Street
Cardiff NSW 2285

CALIBRATION CONDITIONS:

Preconditioning:	4 hours at 23 °C		
Environment conditions:	Air temperature:	23.8	°C
	Air pressure:	100.5	kPa
	Relative Humidity:	57.2	%RH

SPECIFICATIONS:

The acoustic calibrator has been calibrated in accordance with the requirements as specified in IEC60942.

PROCEDURE:

The measurements have been performed with the assistance of Brüel & Kjær acoustic calibrator calibration application software Type 7794 using calibration procedure 4231 Complete

RESULTS:

- ☐ Initial Calibration
- ☐ Calibration before repair/adjustment
- ☒ Recalibration without repair/adjustment
- ☐ Calibration after repair/adjustment

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the calibrator under calibration.

Date of Calibration: 14/03/2019

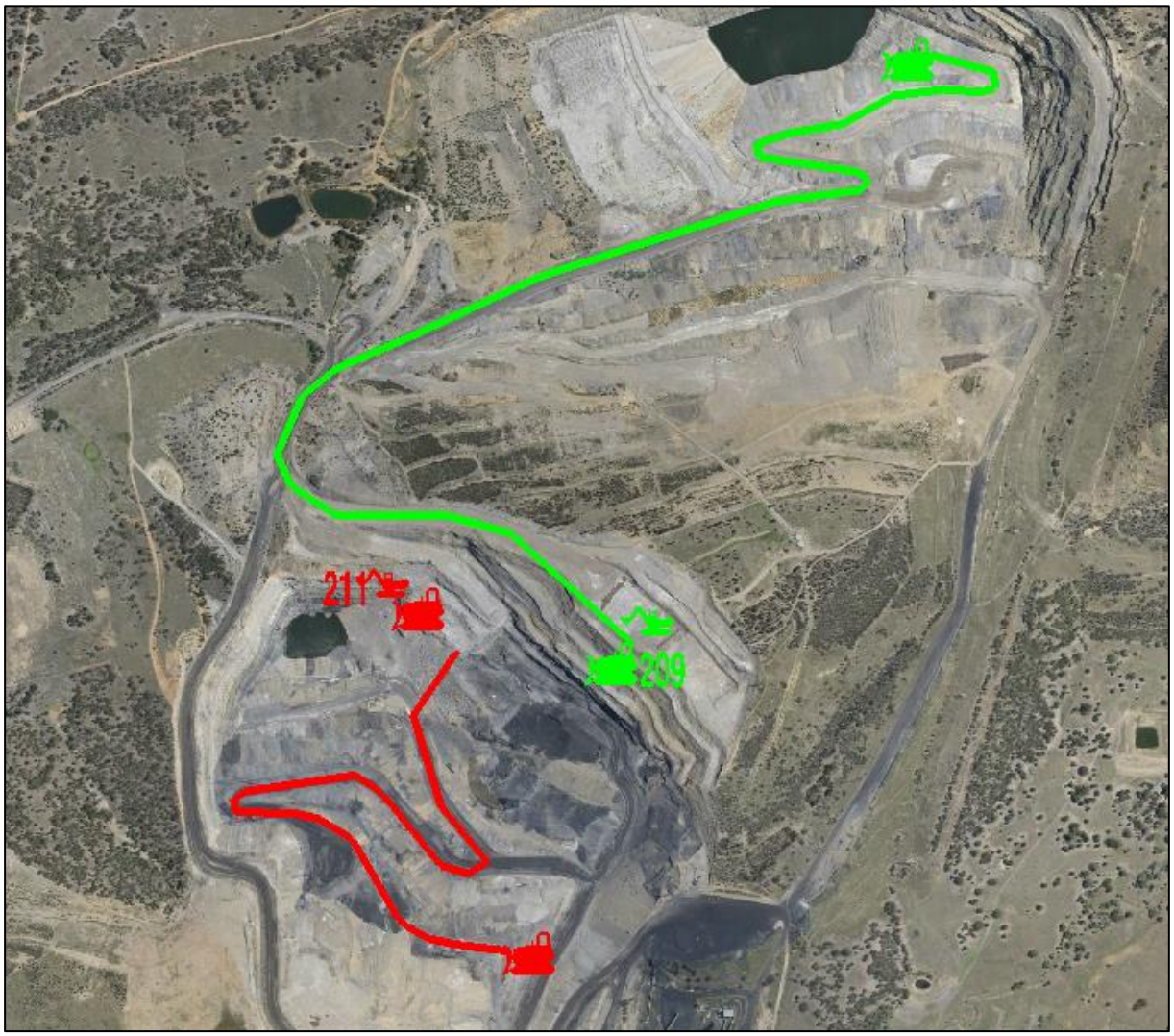
Certificate issued: 14/03/2019

Craig Patrick
Approved Signatory

Reproduction of the complete certificate is allowed. Part of the certificate may only be reproduced after written permission.

Appendix III

Operational Details – 5 September 2019 (10.00 pm to 12.00 am)

For that period mining was carried out as follows;

- 209, 2 x D10 dozer, 5 x Hitachi 3500 trucks in S22 hauling waste to the RL115 dump in Pit 2
- 211, 2 x D10 and 4 x Hitachi 3500 trucks in Strip 21 hauling Fleming waste to RL228 in Pit 1
- 323 on ROM crushing Lewis coal running with 1 x CAT 777. No washing
- 1 x 777 watercarts, 2 x graders in Pit 1
- No drilling