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## **Vipac Engineers & Scientists**

### **Duralie Coal Pty Ltd**

## **Duralie Operations - Environmental Quarterly Survey 2016**

### **April 2016 Noise Compliance Assessment**




# **DURALIECOAL**

Part of the Yancoal Australia Group

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<b>Report Title: April 2016 Noise Compliance Assessment</b> <b>Job Title: Duralie Operations - Environmental Quarterly Survey 2016</b>														
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## EXECUTIVE SUMMARY

### Environmental Noise Survey

An Environmental Compliance Noise Monitoring Survey has been carried out in the rural environment surrounding the Duralie Coal Mine (DCM) Site, Stroud Road, NSW. The survey was requested by Duralie Coal Pty Ltd to ascertain the degree of compliance of noise emissions generated from the operation of Duralie Coal Mine with licence and project approval conditions.

Direct temperature inversion measurements were conducted during the entire survey utilising the Duralie Coal Inversion Tower Infrastructure. These measurements were used to ascertain temperature lapse rates and atmospheric stability classes during the survey period, the results of which are presented in **Appendix A** of this report.

The following table provide a summary of the noise impacts associated with Duralie Coal Mine operations on all landowners that currently surround the coal-mining lease, monitored during the April 2016 Environmental Compliance Assessment.

Owner/ Tenant	Monitored - Predicted DCPL Noise Levels <sup>1</sup>				Noise Criteria		
	dB(A) <sub>L<sub>Aeq</sub>(15 minute)</sub>				dB(A) <sub>L<sub>Aeq</sub>(15 Minute)</sub>		
	Day	Evening	Night 1	Night 2	Day	Evening	Night
Bailey <sup>2</sup>	24	24	24	25	35	35	35
Bragg	17	19	14	14	35	35	35
Fisher-Webster	Nil	Nil	Nil	Nil	35	35	37
Gillard	0	0	1	4	35	35	35
Hamann-Pixelu PL	18	18	14	18	35	35	39
Hare-Scott <sup>2</sup>	23	24	25	30	35	35	35
Hattam <sup>2</sup>	32	33	34	35	35	35	35
Holloway	13	13	10	13	35	35	35
Holmes <sup>2</sup>	33	27	21	22	35	35	35
James	17	16	13	15	35	35	35
Lyll	29	21	30	30	35	39	40
Mahony <sup>2</sup>	29	23	25	26	35	35	35
Morgan	3	6	11	10	35	35	35
Oleksiuk & Carmody	20	18	15	18	35	35	35
Relton <sup>2</sup>	15	16	15	20	35	35	35
Richards	15	16	12	16	35	35	35
Schultz	16	7	16	17	35	35	35
Wards River Village	Nil	Nil	Nil	Nil	35	35	35
Weismantel	22	19	14	16	35	35	35
Wielgosinski	20	20	14	14	35	35	35
Woodley	28	30	30	27	35	35	35
Zulumovski(North) <sup>2</sup>	29	29	Nil	26	35	35	35

Note <sup>1</sup> Nil Denotes an unmeasurable noise contribution from the mine

<sup>2</sup> Owned by Duralie Coal Pty Ltd(DCPL) or private agreement in place between DCPL and the residence

The mine operating noise emissions were within the noise criteria of 35dB<sub>L<sub>Aeq</sub></sub> at all monitoring locations for the Day, Evening, Night 1 and Night 2 survey periods during the April 2016 compliance survey

It is Vipac's professional opinion that the noise emissions produced by Duralie Coal Mine during the April 2016 DCM Environmental Quarterly Survey complied with the noise criteria set out in **Section 4** of this report based on the results and outcomes presented above.

## RAIL NOISE SURVEY

As outlined in Section 4 of this report, all of the train-monitoring results presented in this assessment are to be used for general information purposes only and are not DCM compliance requirements.

Vipac conducted Duralie shuttle train pass-by monitoring during the 2015 & 2016 quarterly monitoring regime at TN1 (Craven) and augmented the monitoring program conducted at TN2 (Wards River) by splitting the monitoring location into two separate locations TN2-South (southern end of Wards River village) and TN2-North (northern end of Wards River village) to better assess the rail noise from the Duralie shuttle within Wards River.

The noise emanating from the Duralie shuttle train complied with the  $L_{Amax}$  and  $L_{Aeq}$  pass-by noise goals at the TN2 South (Wards River South) location with the rail horn excluded from the measurement for this quarter monitoring period and complied with the  $L_{Amax}$  noise goal at TN2 North (Wards River North) and TN1 (Craven) but failed to comply with the  $L_{Aeq}$  pass-by noise goal at these locations.

It is noted that the Duralie Shuttle did not sound its horn as it passed the crossing at TN2 South (Wards River South) thus the noise level results with the rail horn included and excluded are the same. However the results complied with the  $L_{Amax}$  and  $L_{Aeq}$  pass-by noise goals for the pass-by.

The noise emissions associated with the Duralie shuttle train pass-by were therefore deemed to fail to comply with the noise goals set out in the DCM Noise Management Plan, at the TN1-Craven, and TN2-North (Wards River) for this the April 2016 monitoring period. TN2 South complied with the noise goals for this monitoring period.

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## 1 INTRODUCTION

Vipac Engineers & Scientists Ltd. (Vipac) was commissioned to conduct an Environmental Noise Compliance Assessment in the rural environment surrounding the Duralie Coal Mine (DCM) site, located off Bucketts Way, NSW.

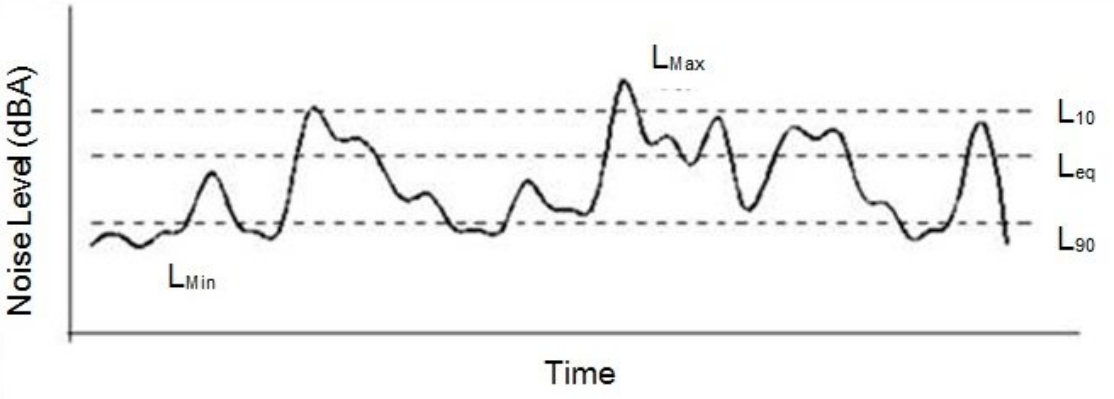
The purpose of the assessment was to conduct an ambient noise survey in accordance with the NSW Project Approval (08\_0203) Condition 2 - Schedule 3, as amended by order of the Land and Environment Court on 10<sup>th</sup> November 2011, first modified on the 1<sup>st</sup> November 2012 and further modified on the 5<sup>th</sup> December 2014, the Environmental Protection Authority (EPA) Environment Protection License (EPL 11701) Section L4 "Noise Limits" and the Duralie Coal Mine Noise Management Plan.

Noise monitoring surveys were conducted at five locations and a reference site surrounding the DCM, which commenced at 10.20 hrs, 05/4/2016 and concluded at 00.30 hrs, on 07/04/2016.

### 1.1 DEFINITIONS OF ACOUSTIC TERMS

**Table 1** provides the definitions of common acoustic terms and is presented as an aid to understanding this report.

**Table 1: Acoustical Terms and Definitions**

	
Term	Definition
dB(A)	A unit of measure in decibels (A) of sound pressure level which has its frequency characteristics modified by a filter ("A weighted") so as to more closely approximate the frequency response of the human ear.
Leq	Equivalent continuous Noise Level – which, lasting for as long as a given noise event has the amount of acoustic energy as the given event.
L <sub>Aeq</sub>	Equivalent continuous Noise Level in the A weighting and is the descriptor used for the assessment of noise compliance.
L <sub>90</sub>	The noise levels that is equalled or exceeded for 90% for the measurement period. An indicator of the mean minimum noise levels as is used in Australia as the descriptor for the background or ambient noise (usually in dBA)
L <sub>10</sub>	The noise levels that is equalled or exceeded for 10% of the measurement period. L <sub>10</sub> is an indicator of the mean maximum noise level and is generally used in Australia as the descriptor for intrusive noise (usually in dBA)
L <sub>1</sub>	The noise levels that is equalled or exceeded for 1% of the measurement period.
Sound Pressure Level (SPL)	Sound pressure is the pressure deviation from the ambient (average, or equilibrium) atmospheric pressure, caused by a sound wave.
1.25kHz Filter	A 1.25kHz filter is applied to the measurements taken to screen out high frequency noises not associated with the operation of the mine. E.g. birds calls and insect noise



## **2 DURALIE COAL MINE**

### **2.1 SITE DESCRIPTION**

Duralie Coal Mine (DCM) is located east of Bucketts Way between the villages of Stroud Road and Wards River, NSW.

### **2.2 DESCRIPTION OF OPERATION**

The following activities have the potential to generate noise during DCM operations:

- Operation of mobile equipment (e.g. excavators, loaders, haul trucks, dozers, graders, water carts and drilling rigs) for:
  - Vegetation removal and stripping/stockpiling of soil resources;
  - Open cut development and production; and
  - Haulage of Run Of Mine (ROM) Coal and mine waste;
- Operation of fixed plant (e.g. ROM bin, ROM coal conveyor, bin loading/unloading, lighting plant and pit pumps); and,
- Rail transportation of coal from the mining lease.

## **3 METHODOLOGY**

Ambient noise level measurements were conducted in accordance with the requirements of the EPA (and the Office of Environment and Heritage (OEH)), and as detailed in the Australian Standard AS1055-1989, "Acoustics – Description and Measurement of Environmental Noise, Part 1 General Procedures" and the NSW Industrial Noise Policy (INP).

### **3.1 OPERATOR ATTENDED NOISE SURVEYS**

Operator-attended noise surveys were conducted at each monitoring location to quantify ambient noise levels and the contributed levels of noise emitted from current DCM operations. The compliance noise survey consists of a day, an evening and two night surveys for each monitoring location. The timing of each of the survey periods is presented below: -

- Daytime - conducted between 10:20 to 14:40 on 5<sup>th</sup> April 2016
- Evening - conducted between 19.33 to 21.33 on 5<sup>th</sup> April 2016
- Night Survey 1 - conducted between 22.00 on 5<sup>th</sup> April 2016 to 00:10 on 6<sup>th</sup> April 2016
- Night Survey 2 - conducted between 22.00 on 6<sup>th</sup> April 2016 to 00:26 on 7<sup>th</sup> April 2016.
- Duralie Shuttle measurements - conducted on the 5<sup>th</sup> & 6<sup>th</sup> April 2016.

The mine noise contribution can be determined using the following methods:

- When the Mine noise emissions are continuous in nature, the contribution is determined by noting the instantaneous sound level meter reading when the mine operations are clearly audible and dominate the measurement environment.
- When the mine noise emissions are transient or frequency specific the contribution is determined by analysing the time trace and frequency spectra recordings to remove extraneous noise source/s from the measurement environment.
- Alternatively, the contribution from the mine can be determined by noting the relative audibility of the operations/activities, at otherwise quiet times, compared to the current background noise levels.

## 3.2 INSTRUMENTATION

### 3.2.1 ATTENDED MEASUREMENTS

Attended noise measurements were taken with a Brüel & Kjær (B&K) 2250 integrating sound level meter (SLM), fitted with a B&K 4189 ½ inch diameter Electret microphone and a windshield. This instrument has performance characteristics within the requirements of Class 1 accuracy in accordance with AS 1259 and AS IEC 61672 and has the capability to measure steady, fluctuating, intermittent and/or impulsive sound, and to compute and display percentile noise levels for the measuring period.

During attended surveys, the B&K 2250 SLM was used to record a 1/3-octave time trace of each 15-minute measurement enabling detailed analysis of the acoustic environment.

Noise levels over the 15-minute measurement periods were calculated and stored in the B&K 2250 at the monitoring location during the surveys. The identifiable noise sources and their contributions were ranked in order of prominence.

A Rion Sound Level Calibrator was used to calibrate the SLM prior to measurement and checked at the conclusion of the surveys. The calibration check results are summarised in **Table 2**.

**Table 2: Instrumentation Parameters**

Equipment Calibration Parameters			
Equipment	Serial No.	Last NATA Lab Cal	Next Lab Cal Due
Attended Measurements			
Brüel & Kjær 2250 Class 1 Integrating Sound Level Meter	2590530	12/08/2015	11/08/2017
Hand Held Calibration Check Results	Check		Acceptable?
Tuesday 5 <sup>th</sup> April 2016	94.0, $\Delta = 0.0$		Yes
Wednesday 6 <sup>th</sup> April 2016	93.9, $\Delta = 0.1$		Yes
Thursday 7 <sup>th</sup> April 2016	93.9, $\Delta = 0.1$		Yes

## 3.3 MONITORING LOCATIONS

Monitoring locations for the attended noise survey are summarised in **Table 3** and illustrated in **Appendix B**.

**Table 3: Monitoring Locations**

Location ID	Resident/ Owner	Address
NM1	Woodley <sup>1</sup>	See map of noise monitoring locations in <b>Appendix B</b>
NM2	Zulumovski North	
NM3	Mahony	
NM4	Fisher-Webster	
REF	Duralie Road	
Additional Monitoring Location 1	Wards River Village	

Note: Duralie Road is Yancoal owned land used as a Reference noise monitoring location. An additional monitoring survey is carried out within Wards River Village due to complaints that have been received on occasion from receptors in the village and also due to variations noted under adverse weather conditions during previous surveys.

In addition, one train pass-by measurement was conducted at each of the monitoring locations listed in **Table 4**.

<sup>1</sup>Woodley property has recently been purchased by the Thompson Family but will retain the title of the Woodley until a License revision.



**Table 4: Rail Monitoring Locations**

Location ID	Monitoring Site	Address
TN2	Wards River Village	See map of noise monitoring locations in <b>Appendix B</b>
TN1	Craven	

Weather Data was sourced from the Duralie Weather station for this compliance survey. The Duralie Mine weather station compound is located on the mining lease. Meteorological data from this location is collected by the mine management and provided to Vipac for analysis. Additionally temperature data is sourced from Duralie Coal's Inversion tower infrastructure in order to calculate the localised temperature inversion for each 15-minute period.

Data is presented in 15-minute intervals in **Appendix A** including meteorological parameters such as wind direction, average wind speed, temperature, sigma-theta, rainfall and calculated inversion strength.

## 4 NOISE CRITERIA

### 4.1 EPL NOISE LIMITS

The EPA's Environmental Protection Licence (EPL 11701 dated 20<sup>th</sup> Aug 2014) Section *L4 Noise Limits* part *L4.1* specifies the following noise limits and locations as presented in **Table 5**.

**Table 5: EPL Noise Limits and Locations**

Location	Noise Limits (Day, Evening, Night)	Noise Limits (Night)
	Intrusive Criteria dB LAeq 15-minute	Noise Criteria dB LA1 (1-minute)
NM1 Woodley	35	45
NM2 Zulumovski North	35	45
NM3 Mahony	35	45
NM4 Fisher-Webster	35 (day/evening), 37 (night)	45
REF Duralie Road	N/A	N/A
Additional Monitoring Location: Wards River	35	45

Parts *L4.2 (a)* and *L4.8* specify additional conditions regarding noise:

*L4.2 (a) with the  $L_{eq}$  (15-minute) noise limits in condition 4.1, the noise measurement equipment must be located:*

*Approximately on the property boundary, where any dwelling is situated 30 metres or less from the property boundary closest to the premises; or*

*Within 30 metres of a dwelling façade, but not closer than 3 m, where any dwelling on the property is situated more than 30 metres from the boundary closest to the premises.*

*Noise from the premises is to be measured at a distance within 30 metres of the locations identified in *L4.1* to determine compliance with this condition.*

*L4.8 The noise limits set out in condition in *L4.1* apply under all meteorological conditions except for the following:*

- wind speeds greater than 3 metres/second at 10 metres above ground level; or*
- Temperature Inversion conditions up to 3 degrees Celsius/100m and wind speeds greater than 2 metres/second at 10 metres above the ground level; or*
- Temperature inversion conditions greater than 3 degrees Celsius/100m.*

## 4.2 PROJECT APPROVAL LIMITS

Duralie Coal Pty Ltd (DCPL) obtained approval from the Department of Planning for the Duralie Coal Mine extension Section 96(2) Modification – Notice of Modification dated 30<sup>th</sup> July 2006 (DA No. 169/99). Additionally DCPL was granted approval for the Duralie Extension Project under Section 75J of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act) on 26<sup>th</sup> November 2010 (NSW Project Approval [08\_0203]). On 10<sup>th</sup> November 2011, the NSW Project Approval (08\_0203) was amended by Order of The Land and Environment Court of NSW and additional approval for extension to the operation hours of the Duralie Coal shuttle was granted to DCPL. NSW Project Approval (08\_0203) was first modified on the 1<sup>st</sup> November 2012 and further modified on the 5<sup>th</sup> December 2014, the Environmental Protection Authority (EPA) Environment Protection License (EPL 11701) Section L4 “Noise Limits” and the Duralie Coal Mine Noise Management Plan.

The relevant noise criteria are described in Schedule 3, Condition No. 2 of the NSW Projects Approval (08\_0203) and are reproduced below.

### SCHEDULE 3 ENVIRONMENTAL PERFORMANCE CONDITIONS

#### Noise Criteria

2. Except for the land referred to in Table 1 (of Schedule 3), the Proponent shall ensure that the noise generated by the project does not exceed the criteria in Table 2 (of Schedule 3) at any residence on privately owned land or on more than 25 per cent of any privately-owned land.

**Table 2: Noise criteria dB(A) (Table 2 of Schedule 3)**

Location	Day	Evening	Night	
	L <sub>Aeq</sub> (15 minute)	L <sub>Aeq</sub> (15 minute)	L <sub>Aeq</sub> (15 minute)	L <sub>A1</sub> (1 minute)
172 - Lyall	35	39	40	45
126 – Hamamn Pixalu Pl	35	35	39	45
123 – Oleksiuk & Carmody				
173 – Trigg & Holland	35	36	37	45
116 - Weismantel				
127 – Fisher-Webster	35	35	37	45
131(1) - Relton				
180(1) - Thompson	35	36	36	45
95 – Smith & Ransley	35	35	36	45
144 - Wielgosinski				
169 - Williams	35	36	35	45
177 - Thompson				
All other privately-owned land	35	35	35	45

Notes:

- To identify the locations referred to in Table 2, refer to the figure in Appendix 3; and
- Noise generated by the project is to be measured in accordance with the relevant procedures and exemptions (including certain meteorological conditions) of the NSW Industrial Noise Policy.

However these criteria do not apply if the Proponent has a written agreement with the relevant landowner to exceed the criteria, and the Proponent has advised the Department in writing of the terms of this agreement.

## 4.3 RAIL NOISE

Duralie Coal Mine - Noise Management Plan Section 4.2.2 specifies the following noise limits in clause L2.2:

*“It is the objective of this license to progressively reduce noise levels to the goals of 65dB(A)Leq , (daytime from 7am – 10pm), 60dB(A)Leq (night-time from 10pm –7am) and 85dB(A) (24hr) max pass-by noise, at one metre from the façade of affected residential properties through the implementation of the Pollution*

### Reduction Programs”.

In addition Section 7.6 of the Duralie Coal Mine Noise Management Plan stipulates the following with regard to rail noise:

*“Rail Noise monitoring and reporting against the other rail noise performance criteria described in Section 4 will be undertaken for general information purposes only (i.e. they are not DCM compliance requirements).”*

Additionally Schedule 3 Condition 4(e) of the DCPL Extension Project Approval stipulates:

*“On privately owned land between the Stratford and Duralie mines where the maximum pass-by rail traffic noise from the Project exceeds 85dBA, the Proponent shall implement additional noise mitigation measures (such as double glazing, insulation, and/or air conditioning) at the residence in consultation with the owner. These measures must be reasonable and feasible.”*

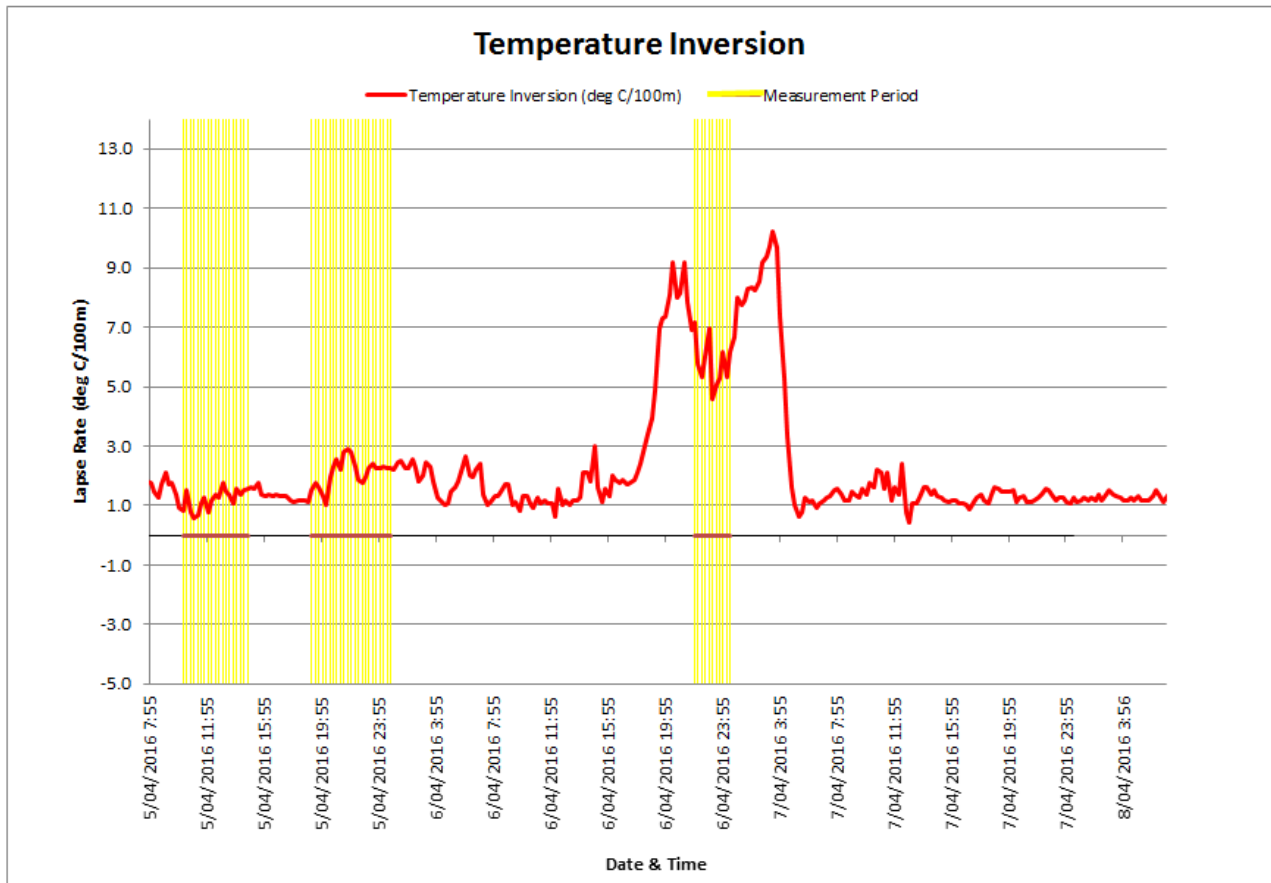
## 5 TEMPERATURE INVERSION CONDITIONS

Typically at DCM, temperature inversion strength and occurrence is determined by utilizing the inversion tower data provided by the Duralie Coal Mine and calculating the lapse rate and Pasquill Stability Categories.

This section presents graphically the calculated temperature inversion results for the survey period. A comparison against predicted inversion results is presented in **Appendix A** of this report.

**Figure 1** below presents the calculated lapse rate from the measurement data collect by the inversion towers and indicates that there is a high occurrence of moderate to strong temperature inversions. Due to the presence of moderate to strong temperature inversions throughout the evening and night survey periods there is a strong probability of noise enhancements. The times at which each of the compliance surveys were conducted are highlighted in yellow for ease of presentation.

**Figure 1 : DCM Temperature Inversion Tower Measured (Lapse rate) Results 05/04/2016 – 07/04/2016**



## 6 NOISE SURVEY RESULTS

The results of the day, evening, and night-time operator attended surveys under prevailing weather conditions are presented in the following sections, together with a description of audible sounds and their contribution. Noise events such as passing road, rail and air traffic, wildlife noise and other extraneous noise sources have been excluded from the measurement data, with the excluded periods being highlighted in yellow in the survey graphs (*Figures 2 - 25*).

### 6.1 NOISE SURVEY WEATHER CONDITIONS

The weather conditions at the time of each of the attended noise measurement as obtained from direct measurement at each monitoring location are presented in **Table 6**.

**Table 6: Attended Noise Measurement Times & Prevailing Weather Conditions**

Weather Parameters						
Location	Measurement Start Time (hrs.)	Temp. °C	Cloud Cover (Okta)	Wind Speed <sup>1</sup> (ms <sup>-1</sup> )	Wind Direction	Rainfall (mm)
<b>Day Survey 05/04/2016</b>						
Woodley	10:20	25.1	0/8	4.2	North	0
Zulumovski	14:22	26.8	0/8	3.5	North	0
Mahony	12:58	27.4	0/8	3.0	North	0
Fisher- Webster	14:02	27.3	0/8	3.8	North	0
Duralie Road	12:36	27.6	0/8	2.5	North	0
Wards River Village	11:37	26.5	0/8	3.0	North	0
<b>Evening Survey 05/04/2016</b>						
Woodley	21:13	20.2	0/8	4.5	North	0
Zulumovski	19:32	21.6	0/8	3.2	North	0
Mahony	20:41	20.6	0/8	2.9	North	0
Fisher- Webster	19:56	21.2	0/8	2.6	North	0
Duralie Road	20:19	21.0	0/8	2.1	North	0
Wards River Village	19:09	22.1	0/8	4.1	North	0
<b>Night Survey 1, 05/04/2016-06/04/2016</b>						
Woodley	22:00	19.3	0/8	4.1	North	0
Zulumovski	23:13	19.1	0/8	3.3	North	0
Mahony	22:53	19.0	0/8	3.5	North	0
Fisher- Webster	23:32	19.1	0/8	4.2	North	0
Duralie Road	22:33	19.3	0/8	3.6	North	0
Wards River Village	23:55	18.5	0/8	3.0	North	0
<b>Night Survey 2, 06/04/2016-07/04/2016</b>						
Woodley	00:04	20.9	0/8	4.0	North	0
Zulumovski	22:21	22.3	0/8	4.2	North	0
Mahony	23:25	21.2	0/8	3.1	North	0
Fisher- Webster	22:43	21.6	0/8	4.0	North	0
Duralie Road	23:05	22.0	0/8	3.9	North	0
Wards River Village	22:00	22.0	0/8	4.0	North	0

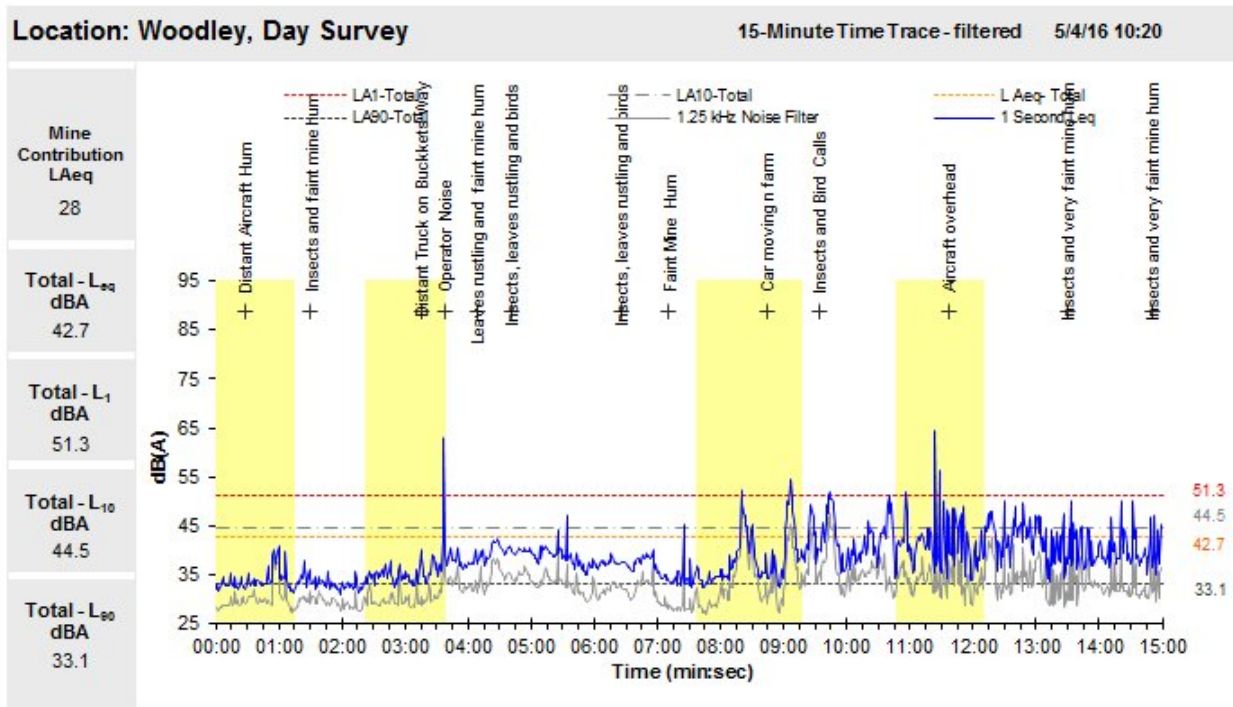
Note 1 Wind speed was checked at each location during attended noise monitoring. Noise measurements were only conducted where weather conditions were within acceptable levels at the microphone position.

### 6.2 NOISE SURVEY MINE OPERATIONS

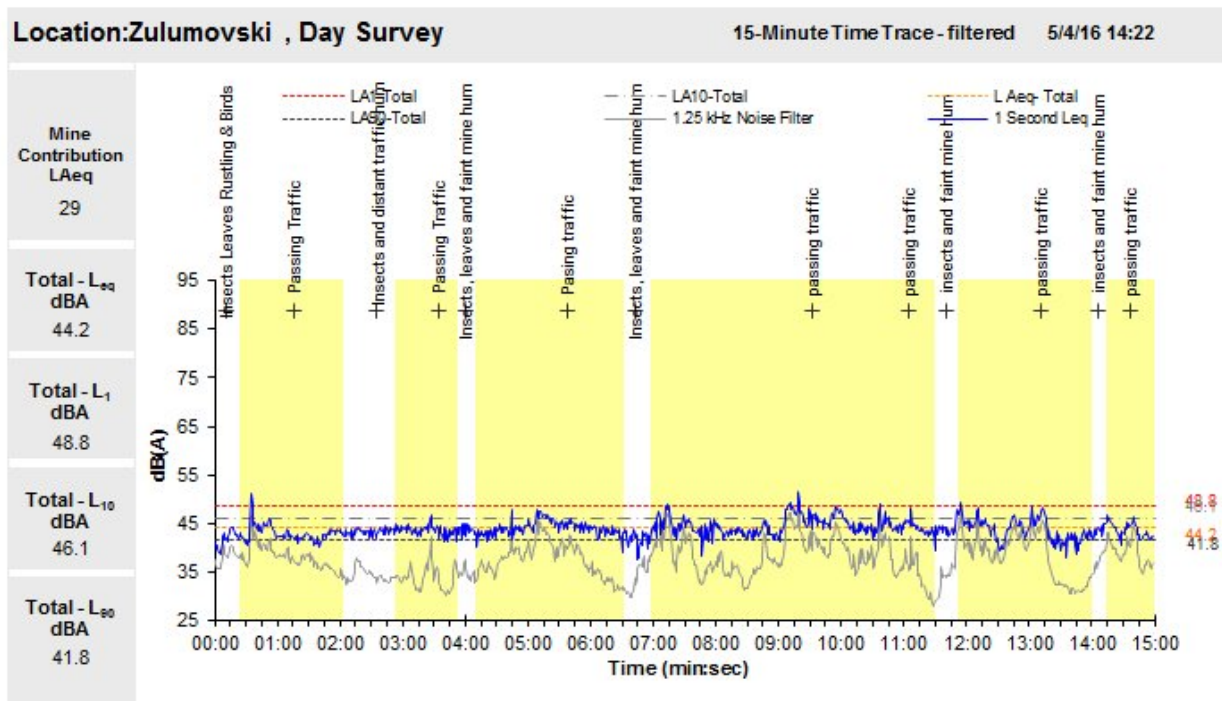
DCM provided Vipac with information for reporting on mining plant, equipment and operations with correlating times and location. A full description of the Mine Operations and Activities are provided in **Appendix C** of this report.

### 6.3 DAY SURVEY

### 6.3.1 ATTENDED MEASUREMENT RESULTS – DAY SURVEY



**Figure 2: Day Survey, Woodley**



**Figure 3: Day Survey, Zulumovski**



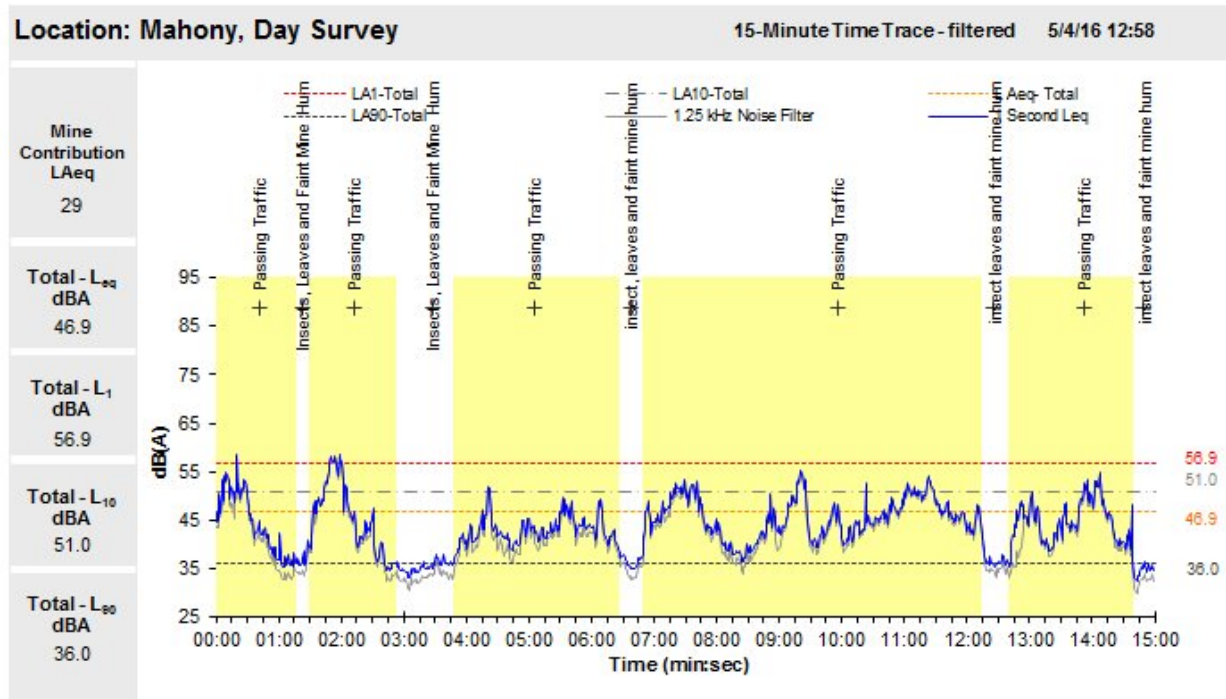


Figure 4: Day Survey, Mahony

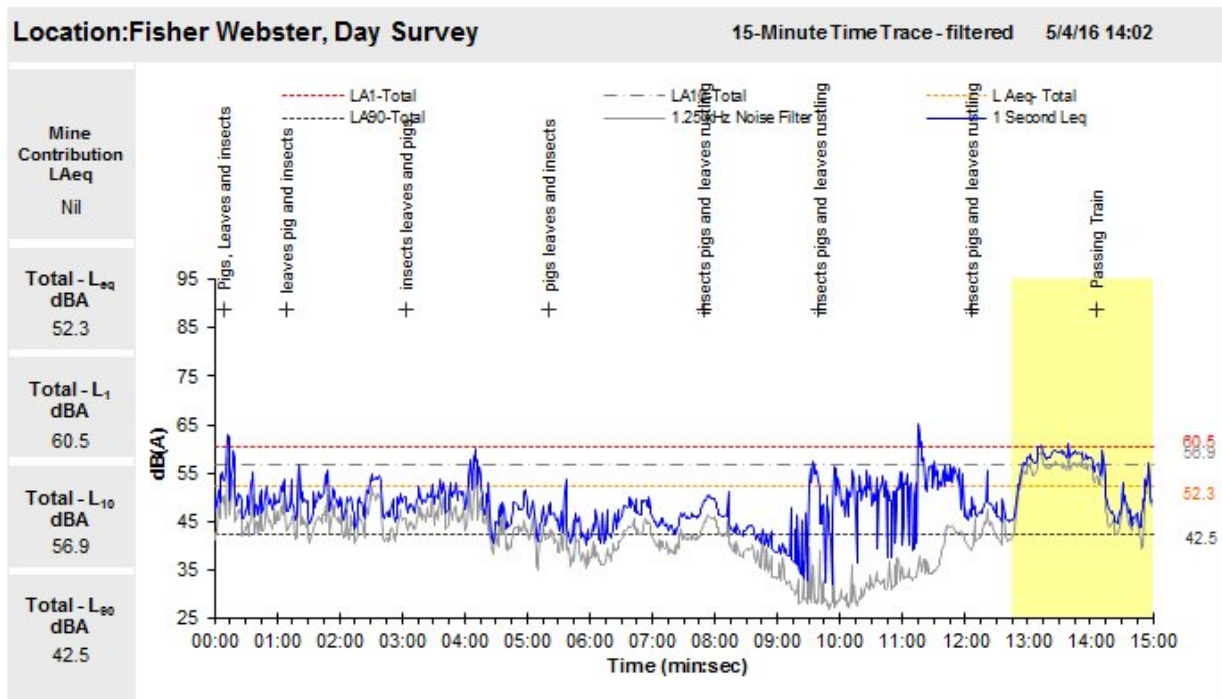


Figure 5: Day Survey, Fisher-Webster



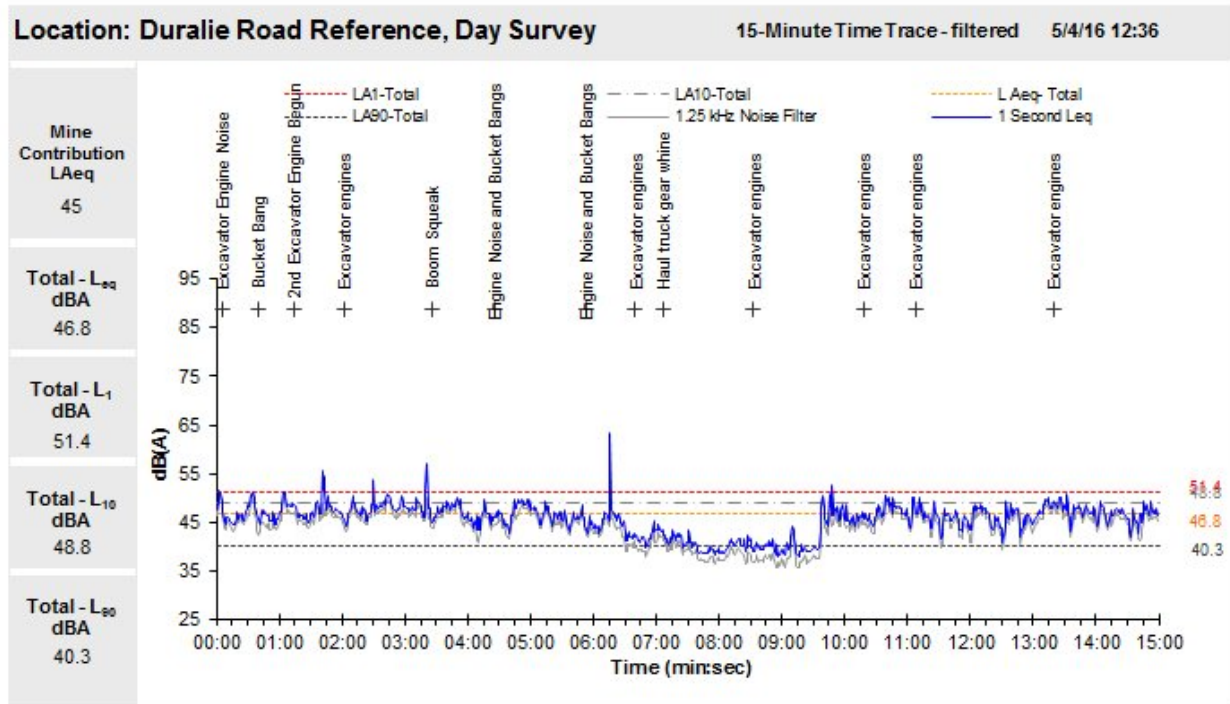


Figure 6: Day Survey, Duralie Road

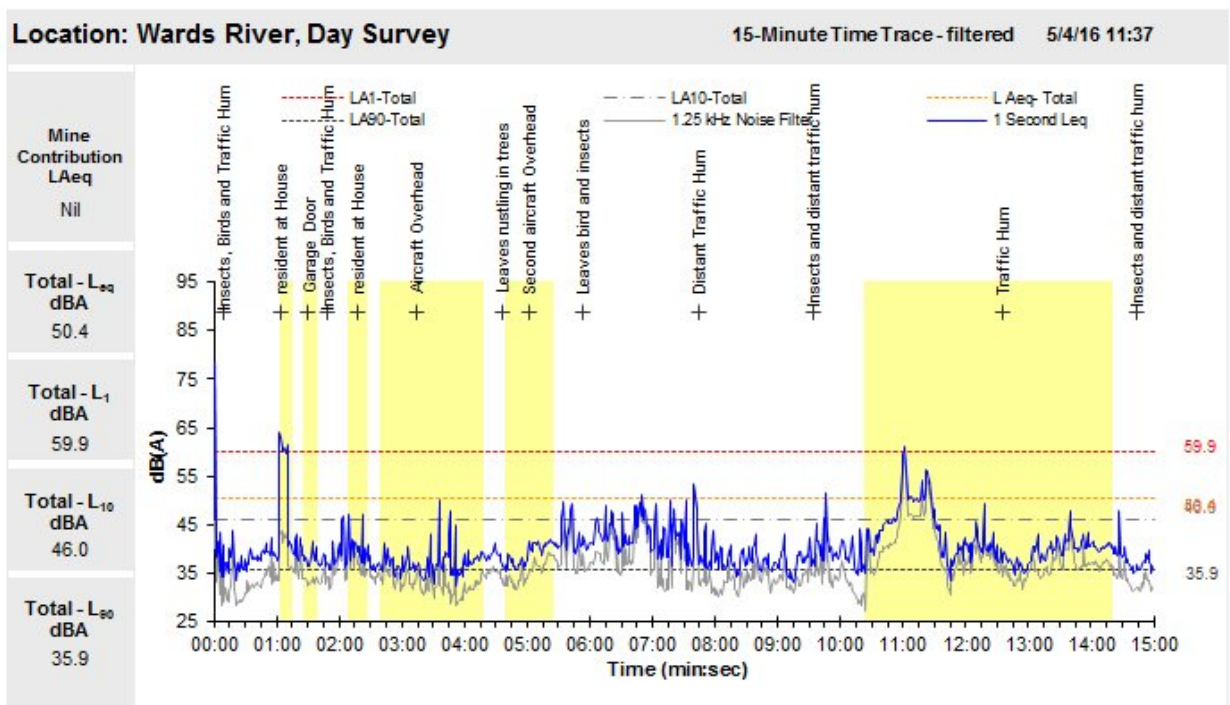


Figure 7: Day Survey, Wards River

### 6.3.2 ANALYSIS OF DAY ATTENDED SURVEY

#### Summary of Audible Noises during the Day Survey Period

The mine noise emissions at the reference site (REF Duralie Road) measured 45dB  $L_{Aeq}$  during typical operations on the mine lease. Audible noise sources that contributed to this result consisted of excavation activities such as excavator operations and haul truck movements operating on excavation strips. Noise emissions measured at Duralie Road were representative of mine operations for this survey period.

Noise from DCM operations was audible at the Woodley, Zulumovski and Mahony monitoring locations during the day survey periods conducted on the 05<sup>th</sup> April 2016.

Excluding extraneous noise sources (i.e. frequent road traffic movements, continuous sounds from birds, insects, dogs and occasional passing air and rail traffic) from the overall noise measurement resulted in the mine noise contribution determined at each monitoring location, which are summarised below. The audible noise sources at the monitoring locations consisted of passing road, rail and air traffic, insect and wildlife noise and general farm noise.

Prevailing weather conditions were characterised by clear skies with medium strength winds blowing from a predominantly northerly direction on the 5<sup>th</sup> April during the daytime survey period based on the observations of the onsite engineer.

#### Summary of Measured Mine Noise

The DCM  $L_{Aeq}$  noise contributions for the day survey are as follows:

- 28dB  $L_{Aeq}$  15-minute at NM1 Woodley.
- 29dB  $L_{Aeq}$  15-minute at NM2 Zulumovski.
- 29dB  $L_{Aeq}$  15-minute at NM3 Mahony.
- Nil at NM4 Fisher Webster.
- 45dB  $L_{Aeq}$  15-minute at Ref. Duralie Road.
- Nil at Wards River.

## 6.4 EVENING SURVEY

### 6.4.1 ATTENDED MEASUREMENT RESULTS - EVENING SURVEY

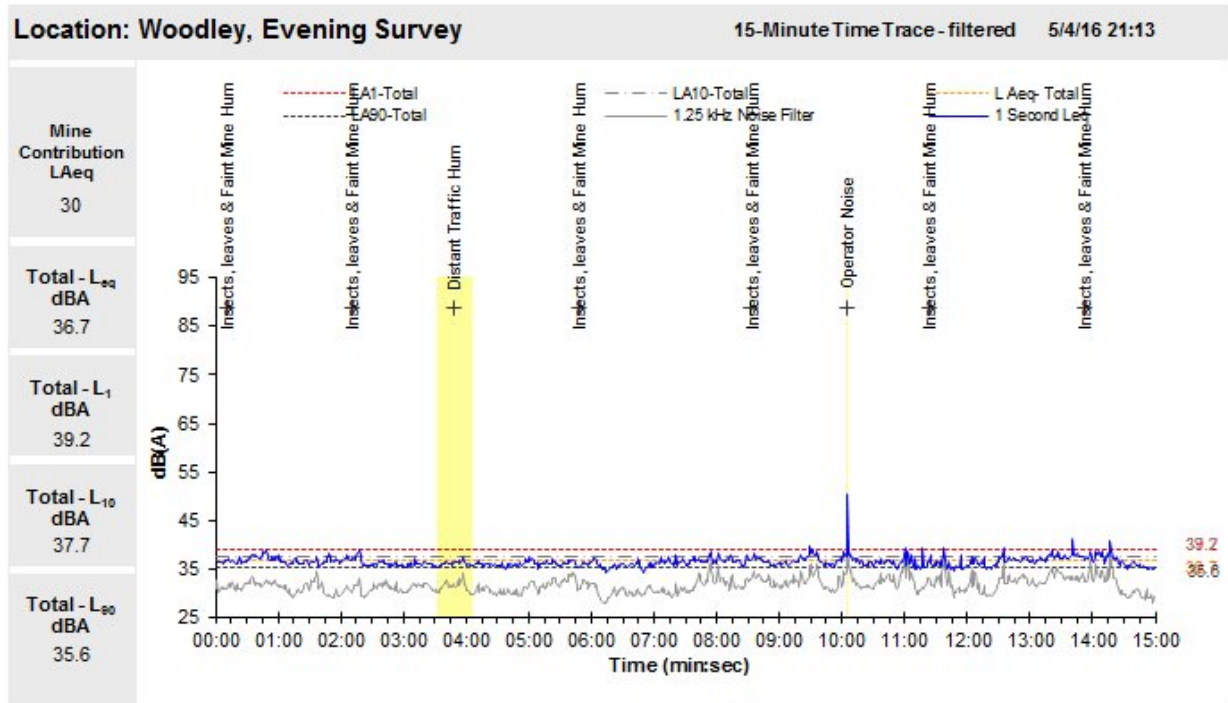


Figure 8: Evening Survey, Woodley

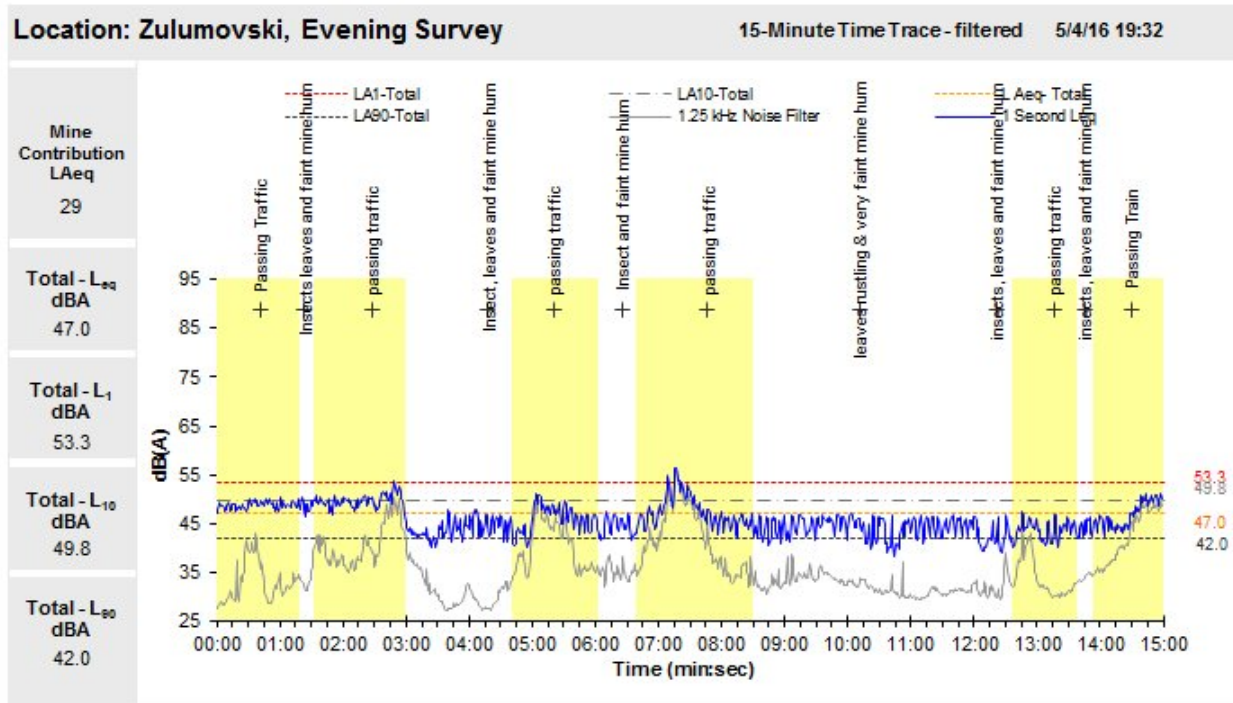


Figure 9: Evening Survey, Zulumovski

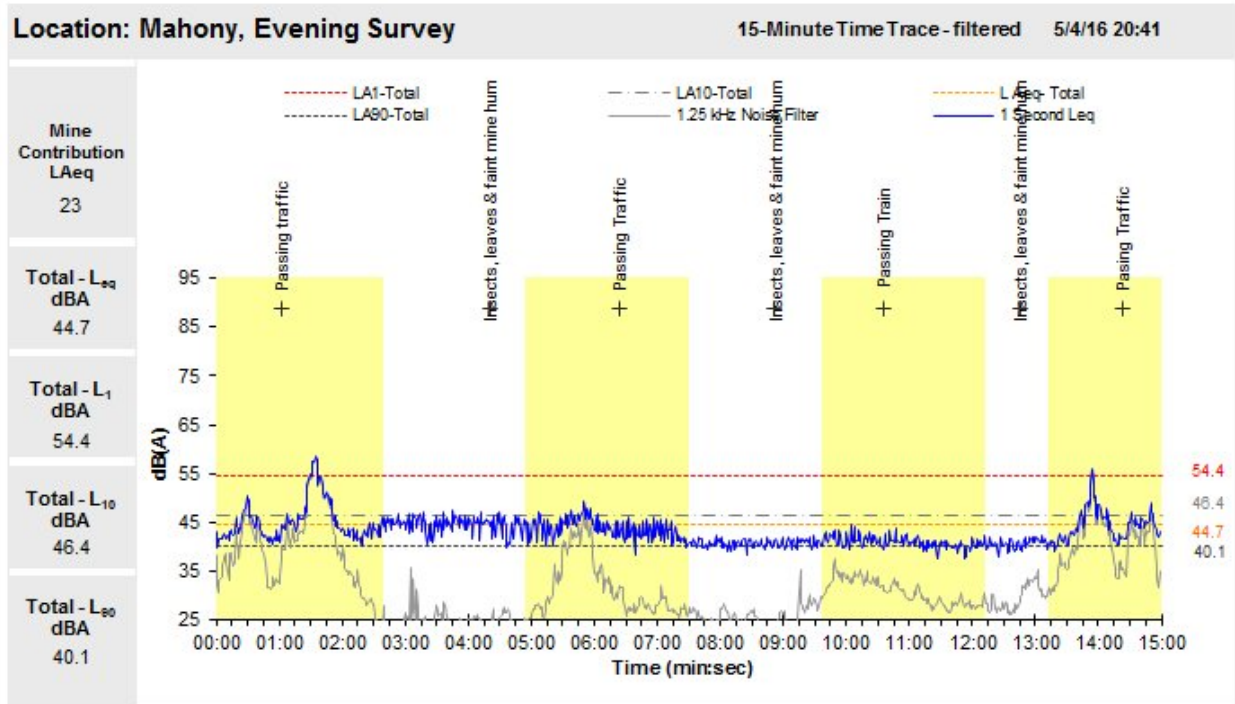


Figure 10: Evening Survey, Mahony

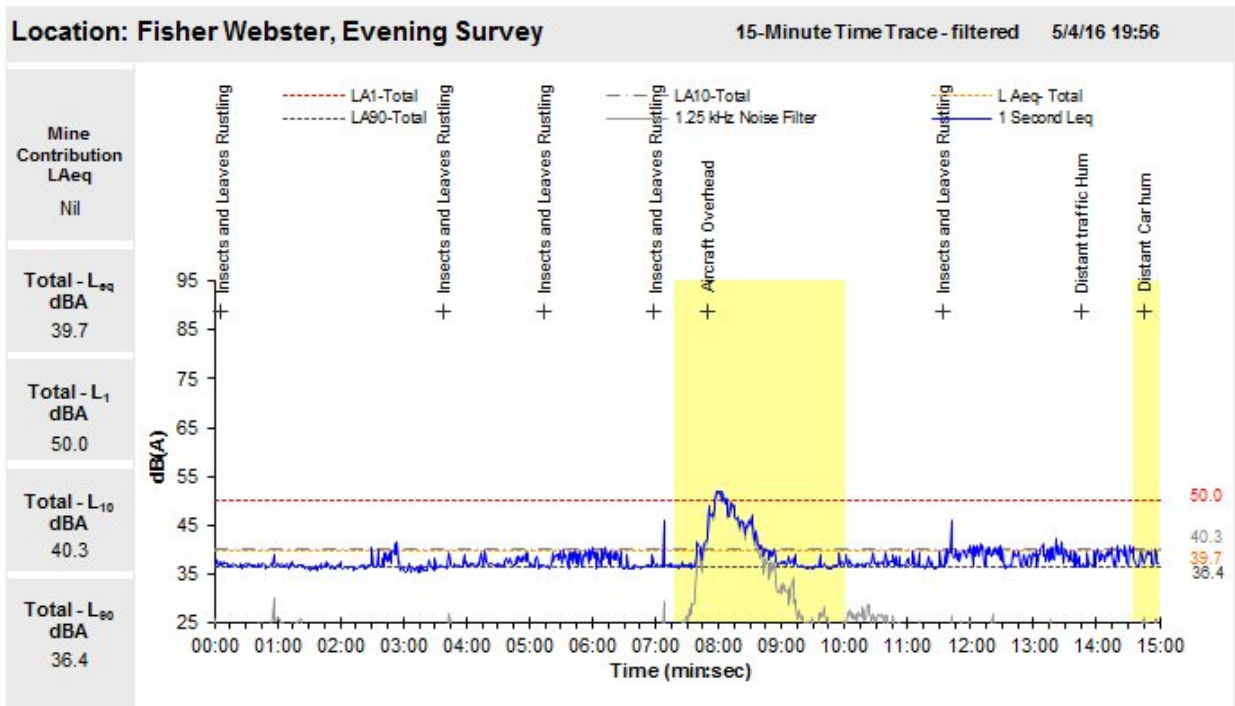


Figure 11: Evening Survey, Fisher-Webster



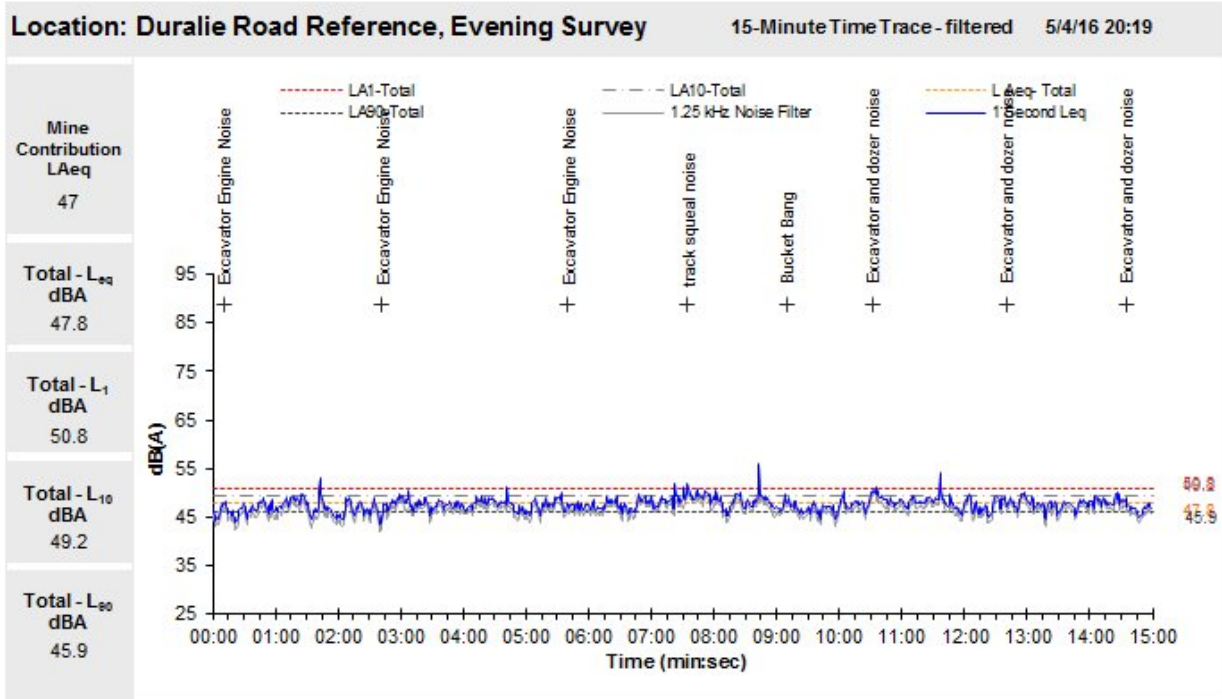


Figure 12: Evening Survey, Duralie Road

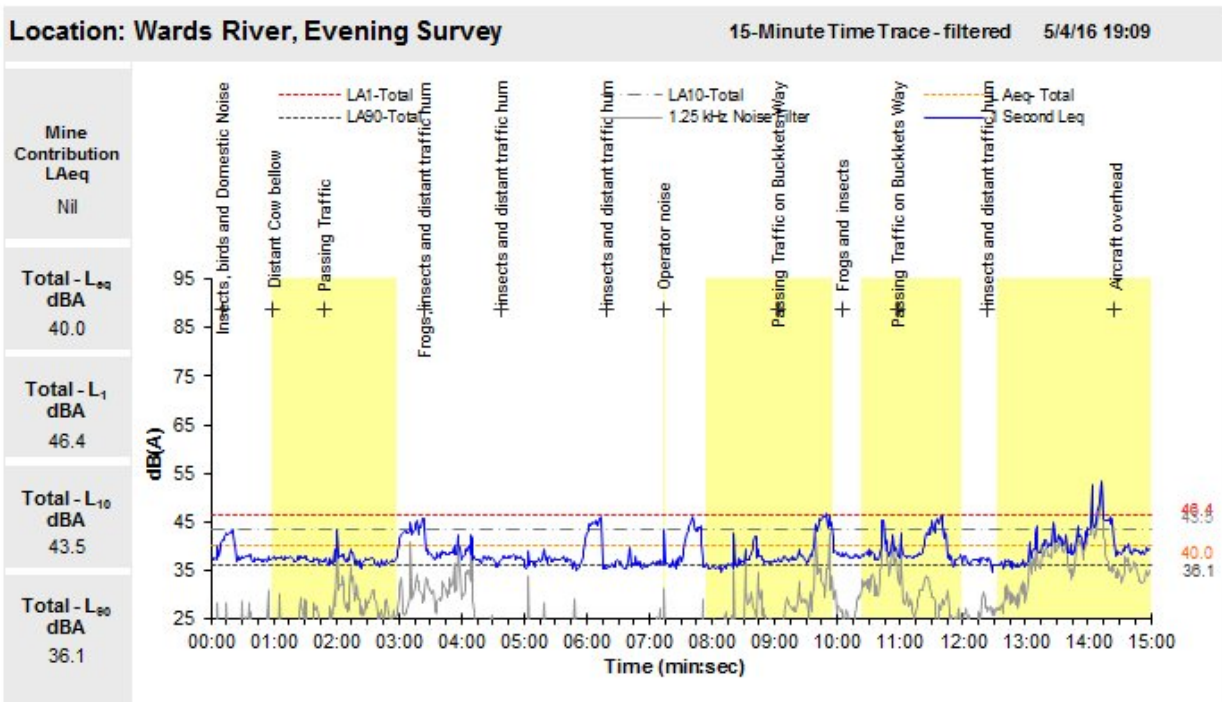


Figure 13: Evening Survey, Wards River

#### 6.4.2 ANALYSIS OF EVENING ATTENDED SURVEY

##### Summary of Audible Noises during the Evening Survey Period

The mine noise emissions at the reference site (REF Duralie Road) measured 47dB  $L_{Aeq}$  during typical operations on the Mine lease. Noise emissions measured at Duralie Road were representative of mine operations for this survey period.

Noise emissions from DCM operations were audible at the Woodley, Zulumovski and Mahony monitoring locations during the evening survey period conducted on 5<sup>th</sup> April 2016. The audible mining operations at the noise sensitive receivers consisted of excavator and haul truck engine operations.

Excluding extraneous noise sources (i.e. frequent road traffic movements, continuous sounds from birds, insects, dogs and occasional passing rail traffic) from the overall noise measurement resulted in the mine noise contribution being determined at each monitoring location, which are summarised below.

Prevailing weather conditions at the time were characterised by clear skies with moderate wind conditions blowing from a northerly direction, combined with weak to moderate temperature inversion conditions as calculated from the Duralie Inversion Tower Infrastructure throughout the evening survey period.

##### Summary of Measured Mine Noise

The DCM  $L_{Aeq}$  noise contributions for the evening survey period are as follows:

- 30dB  $L_{Aeq}$  15-minute at NM1 Woodley.
- 29dB  $L_{Aeq}$  15-minute at NM2 Zulumovski.
- 23dB  $L_{Aeq}$  15-minute at NM3 Mahony.
- Nil at NM4 Fisher Webster.
- 47dB  $L_{Aeq}$  15-minute at Ref Duralie Road.
- Nil at Wards River.



## 6.5 NIGHT SURVEY 1

### 6.5.1 ATTENDED MEASUREMENT RESULTS - NIGHT SURVEY 1

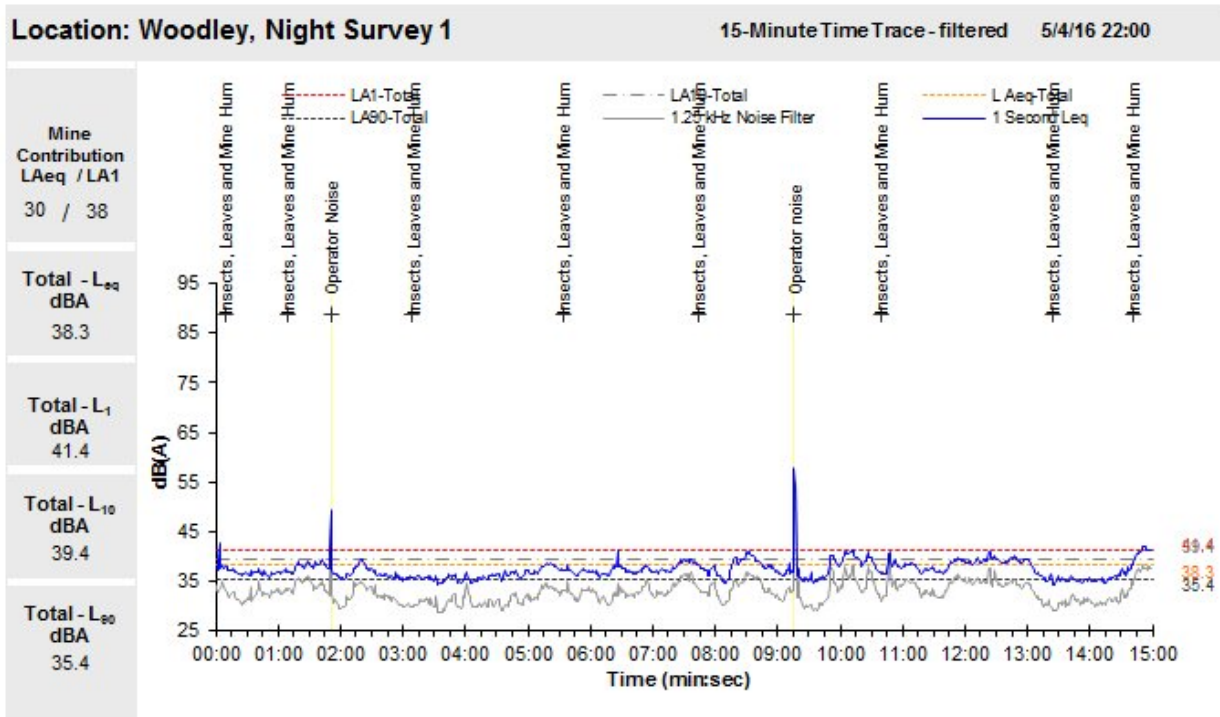


Figure 14: Night Survey 1, Woodley

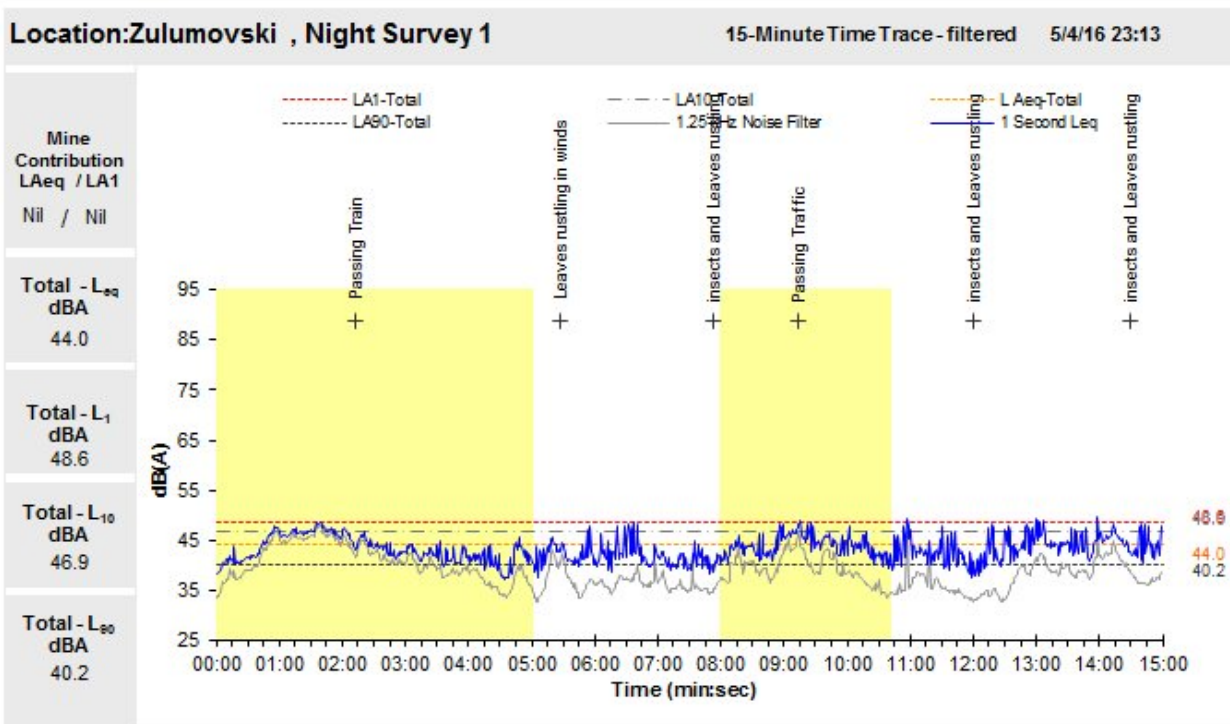


Figure 15: Night Survey 1, Zulumovski

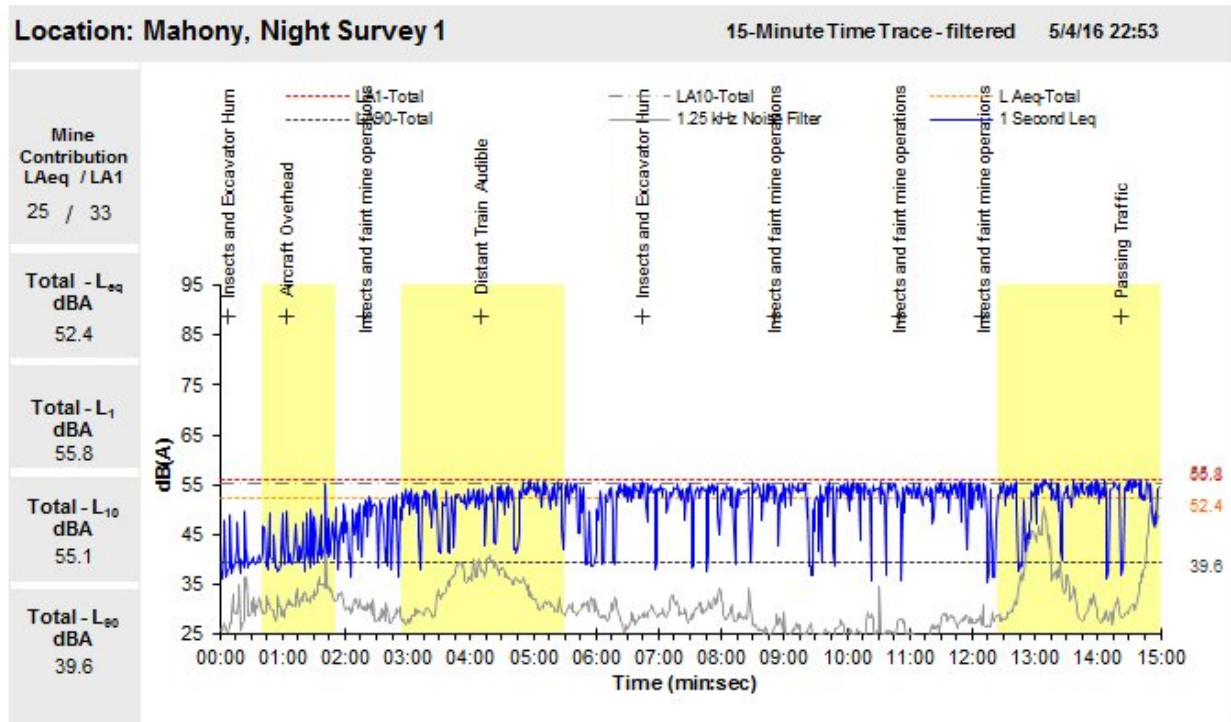


Figure 16: Night Survey 1, Mahony

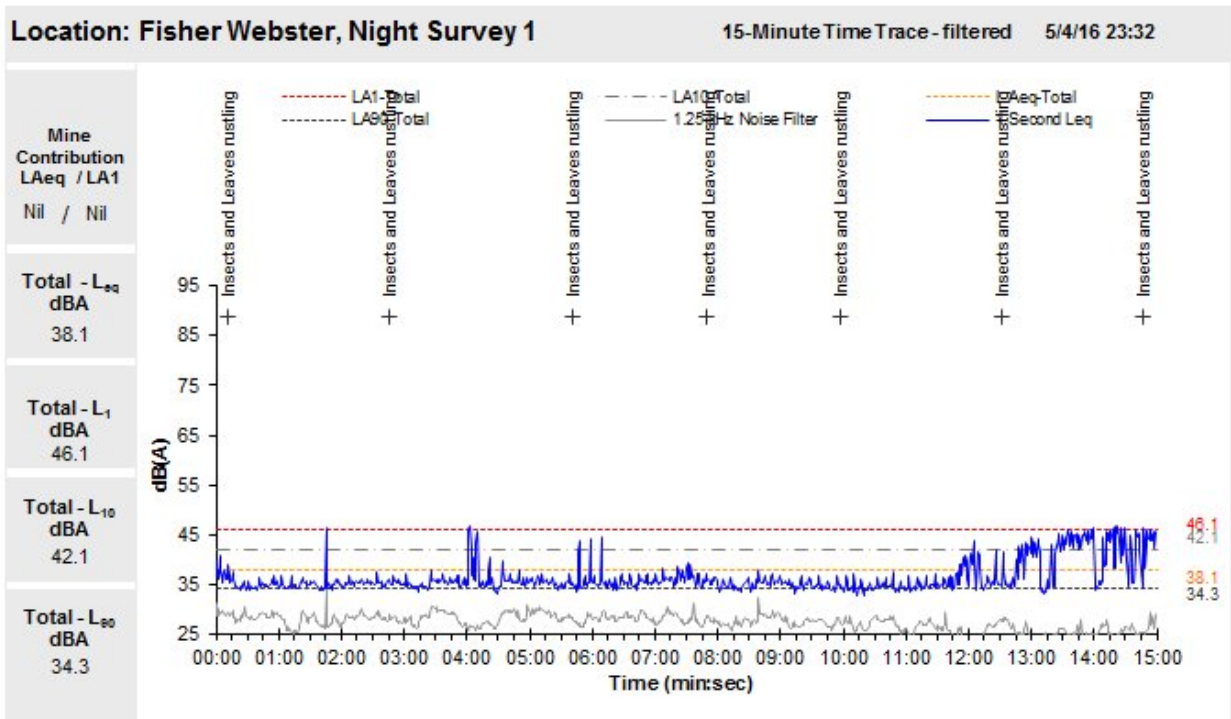


Figure 17: Night Survey 1, Fisher-Webster

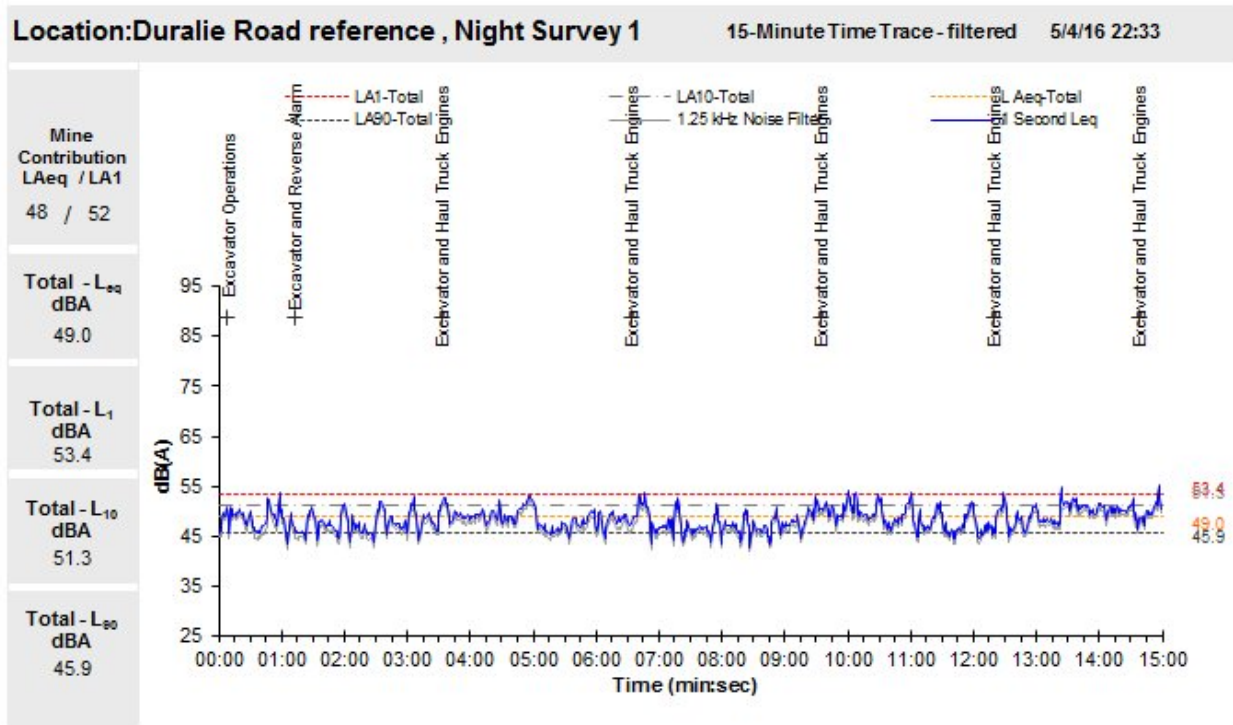


Figure 18: Night Survey 1, Duralie Road

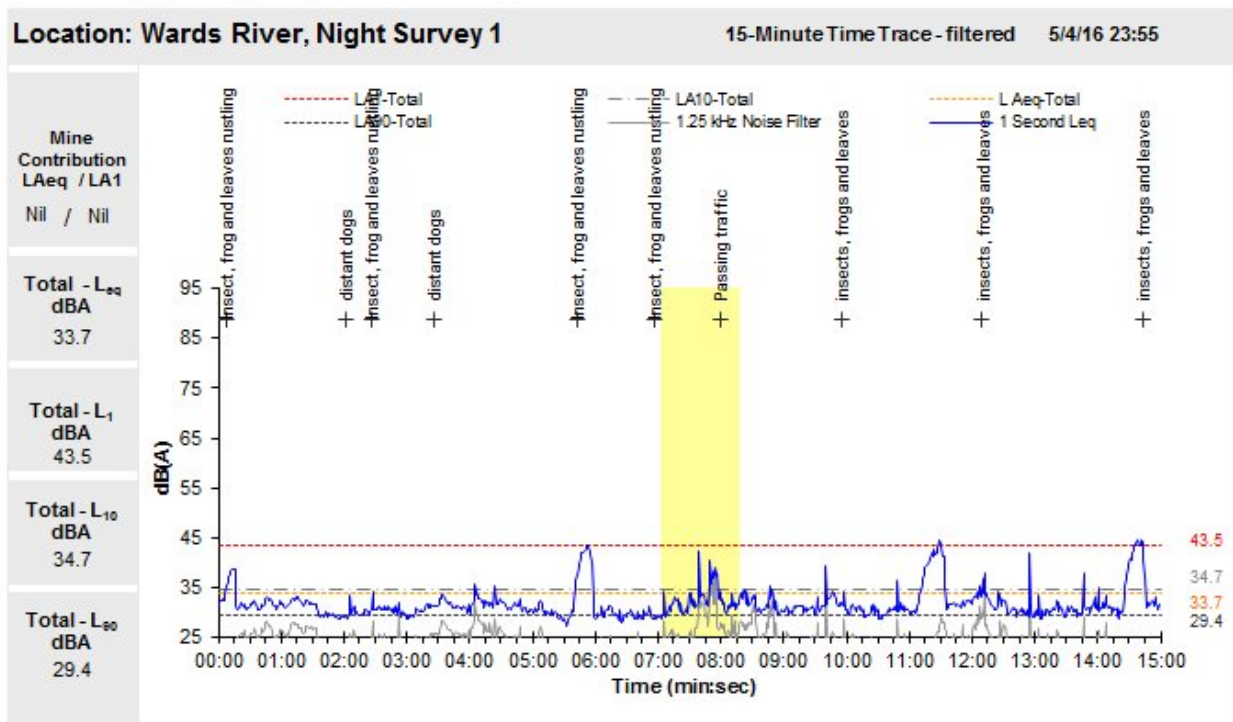


Figure 19: Night Survey 1, Wards River

## 6.5.2 ANALYSIS OF NIGHT ATTENDED SURVEY 1

### Summary of Audible Noises during the Night Survey Period 1

The mine noise emissions at the reference site (REF Duralie Road) measured 48dB  $L_{Aeq}$  during typical operations on the Mine lease on the night of 5<sup>th</sup> – 6<sup>th</sup> April 2016. Audible noise sources that contributed to this result consisted of excavation activities such as excavator operations and haul truck movements operating on excavation strips. Noise emissions measured at Duralie Road were representative of mine operations for this survey period.

Noise from DCM operations was audible at the Woodley and Mahony monitoring locations during the first night survey conducted on 5<sup>th</sup> – 6<sup>th</sup> April 2016. The audible mining operations at the noise sensitive receivers consisted of excavator operations, dozer operations including track slap and haul truck.

Excluding extraneous noise sources (i.e. road traffic movements, sounds from birds, insects, dogs and occasional passing rail traffic) from the overall noise measurement resulted in the mine noise contribution being determined at each monitoring location, which are summarised below.

Prevailing weather conditions were characterised by clear skies with medium strength wind conditions blowing from a northerly direction with moderate temperature inversion conditions throughout the survey periods on the Night Survey 1.

The DCM  $L_{Aeq}$  noise contributions for the first night survey period are as follows:

- 30dB  $L_{Aeq}$  15-minute at NM1 Woodley.
- Nil at NM2 Zulumovski.
- 25dB  $L_{Aeq}$  15-minute at NM3 Mahony.
- Nil at NM4 Fisher Webster.
- 48dB  $L_{Aeq}$  15-minute at Ref Duralie Road.
- Nil at Wards River.

The DCM  $L_{A1}$  (1 minute) contributions for the first night survey period are as follows

- 38dB  $L_{A1}$  (1-minute) at NM1 Woodley.
- Nil at NM2 Zulumovski.
- 33dB  $L_{A1}$  (1-minute) at NM3 Mahony.
- Nil at NM4 Fisher Webster.
- 52dB  $L_{A1}$  (1-minute) at Ref Duralie Road.
- Nil at Wards River.



## 6.6 NIGHT SURVEY 2

### 6.6.1 ATTENDED MEASUREMENT RESULTS - NIGHT SURVEY 2

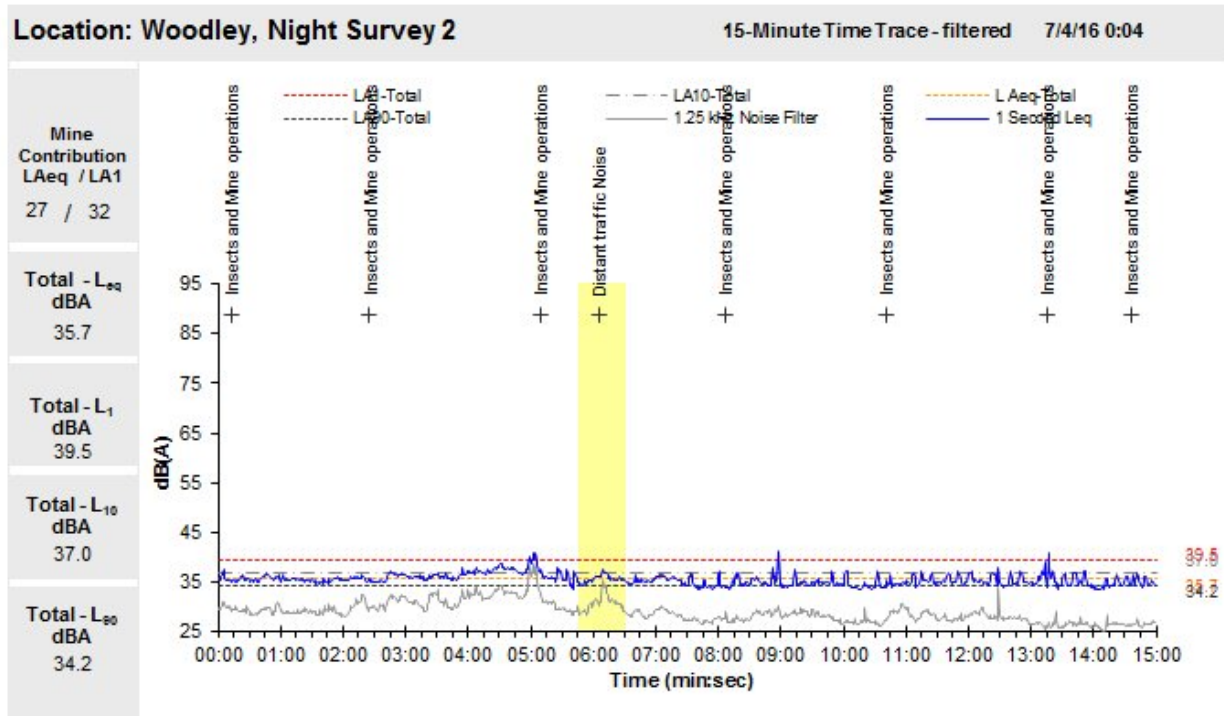


Figure 20: Night Survey 2, Woodley

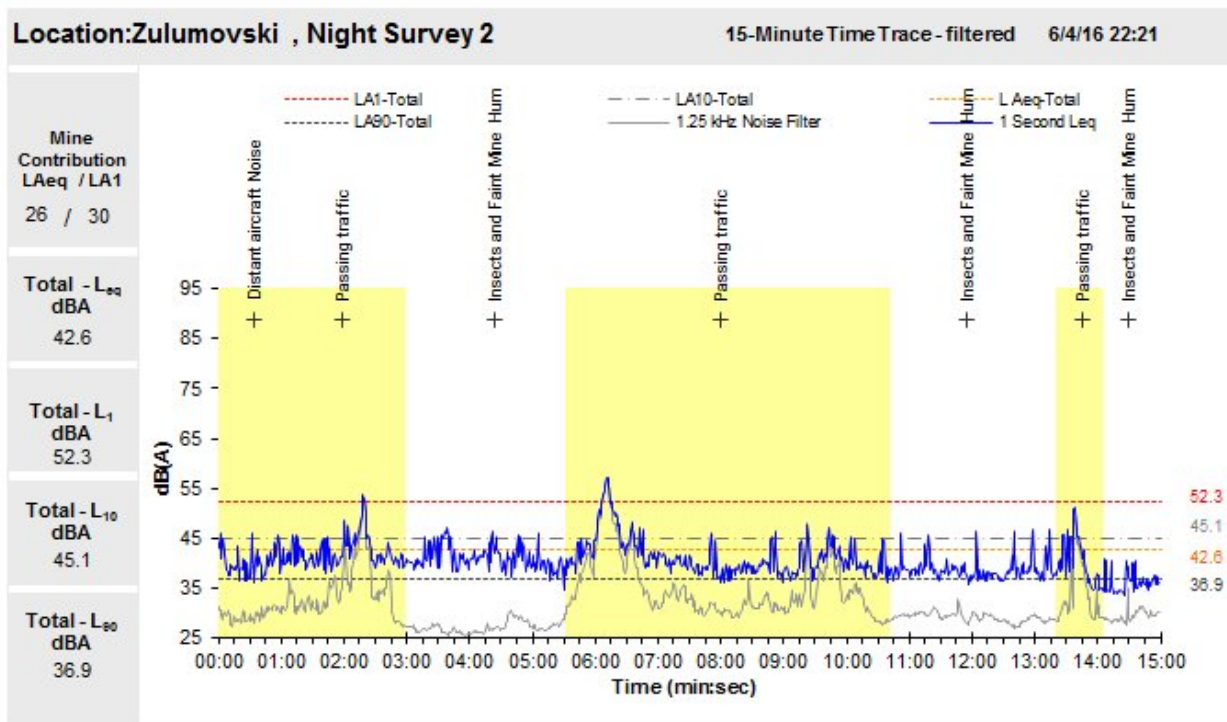


Figure 21: Night Survey 2, Zulumovski

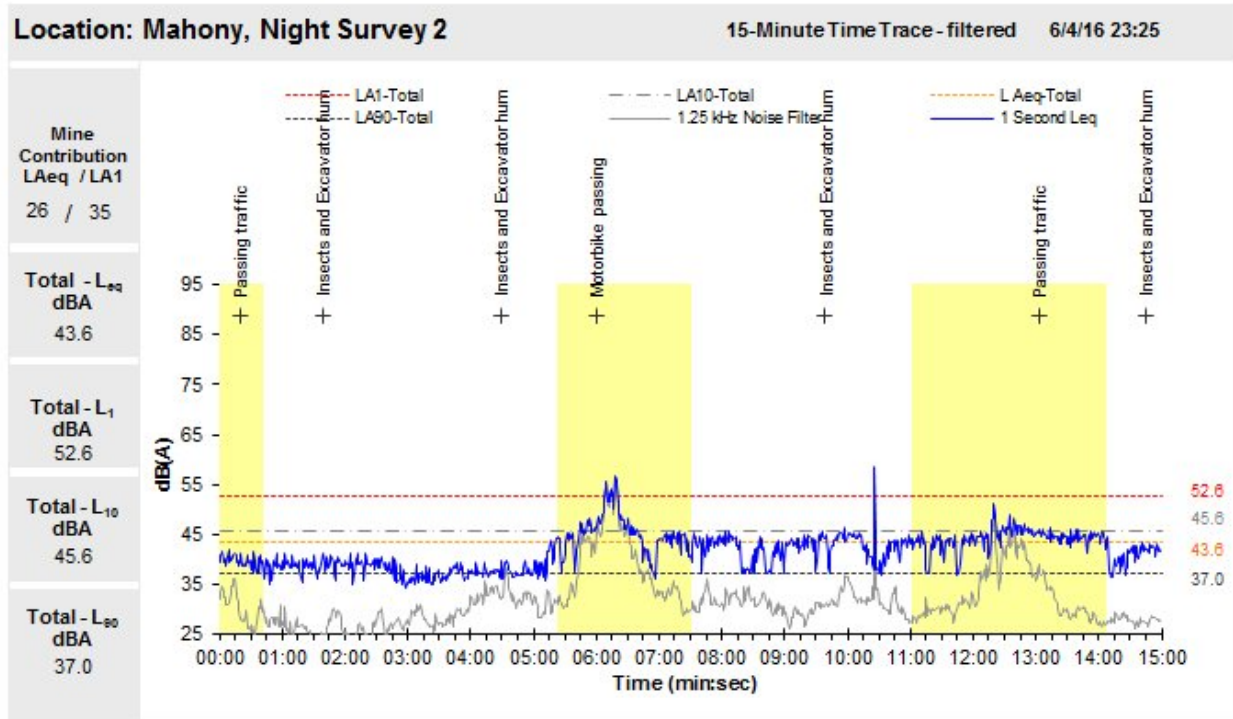


Figure 22: Night Survey 2, Mahony

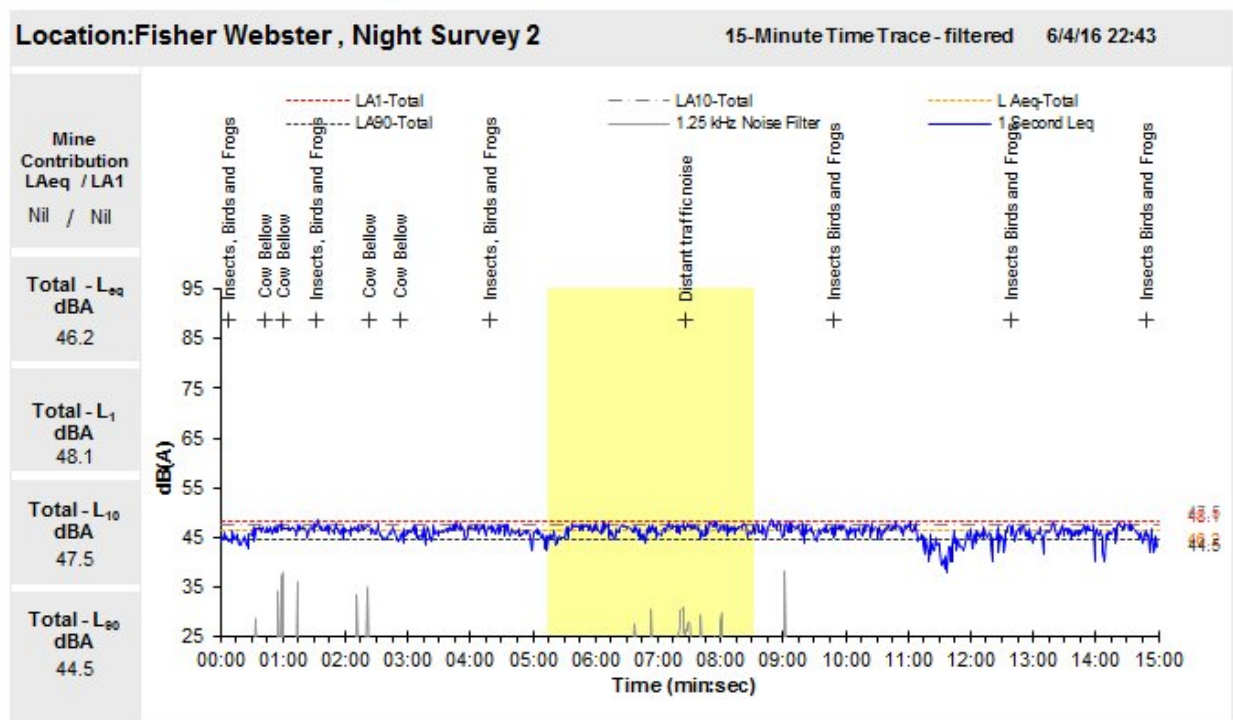


Figure 23: Night Survey 2, Fisher Webster



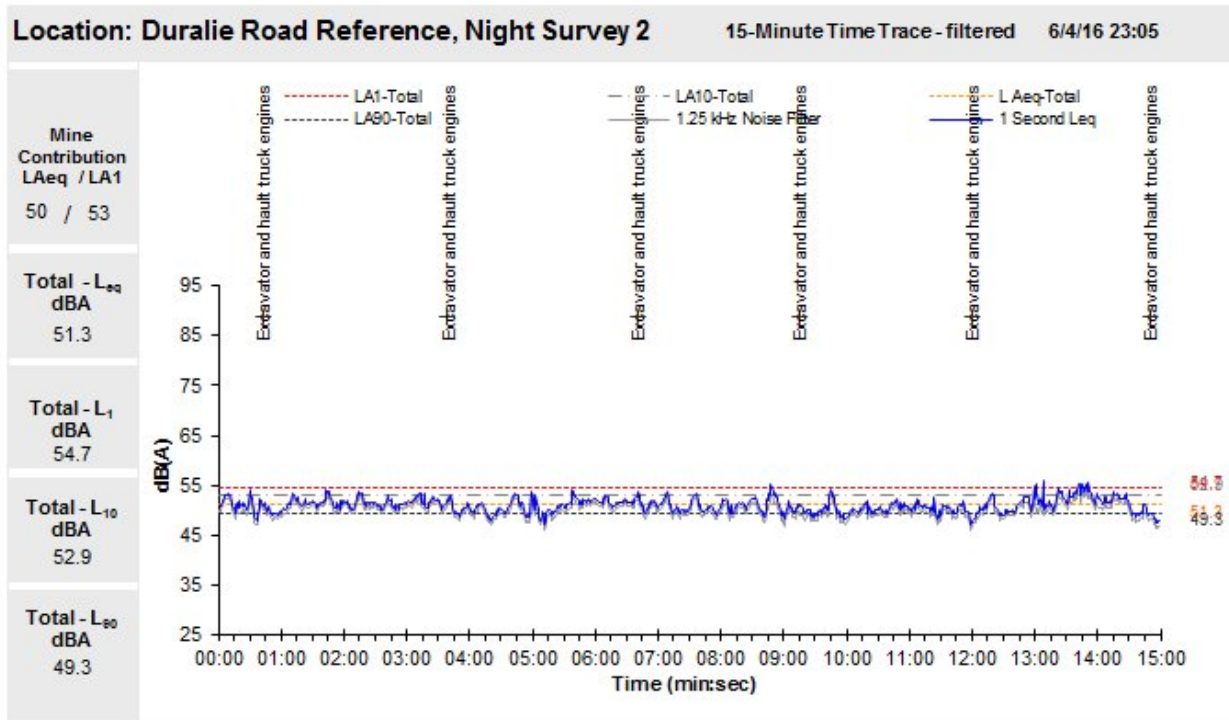


Figure 24: Night Survey 2, Duralie Road

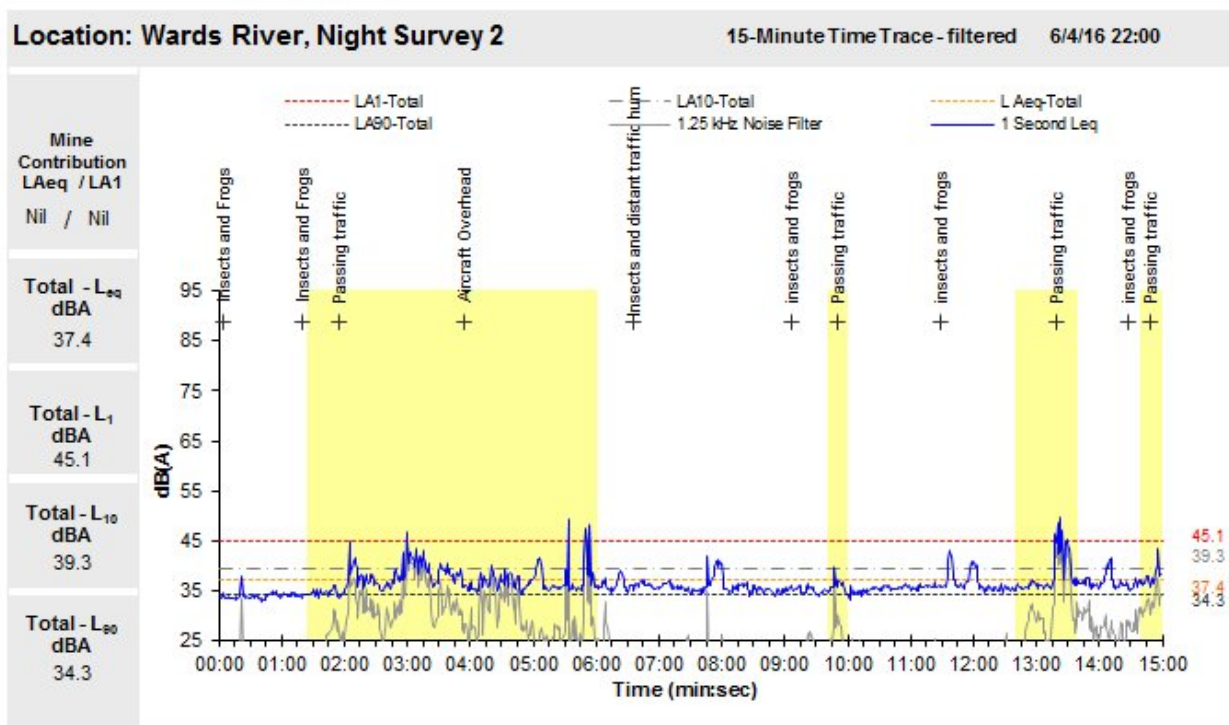


Figure 25: Night Survey 2, Wards River

## 6.6.2 ANALYSIS OF NIGHT ATTENDED SURVEY 2

### Summary of Audible Noises during the Night Survey Period 2

The Mine noise emissions at the reference site (REF Duralie Road) measured 50dB  $L_{Aeq}$  during typical operations on the Mine lease. Audible noise sources that contributed to this result consisted of excavation activities such as excavator operations; haul truck movements and track dozers operating on excavation strips. Noise emissions measured at Duralie Road were representative of mine operations for this survey period.

The mine operations were audible at the Woodley, Zulumovski and Mahony monitoring locations during the Night Survey 2, conducted on 6<sup>th</sup> – 7<sup>th</sup> April 2016. Excluding extraneous noise sources (i.e. road traffic movements, sounds from birds, insects, dogs and occasional passing rail traffic) from the overall noise measurement resulted in the mine noise contribution determined at each monitoring location, which are summarised below.

Prevailing weather conditions were characterised by predominantly clear conditions during the night with still to moderate wind conditions combined with strong temperature inversion conditions throughout the second night survey period.

### Summary of Measured Mine Noise

The DCM  $L_{Aeq}$  noise contributions for the second night survey period are as follows:

- 27dB  $L_{Aeq}$  15-minute at NM1 Woodley.
- 26dB  $L_{Aeq}$  15-minute at NM2 Zulumovski.
- 26dB  $L_{Aeq}$  15-minute at NM3 Mahony.
- Nil at NM4 Fisher Webster.
- 50dB  $L_{Aeq}$  15-minute at Ref Duralie Road.
- Nil at Wards River.

The DCM  $L_{A1}$  (1 minute) contributions for the second night survey period are as follows:

- 32dB  $L_{A1}$  (1-minute) at NM1 Woodley.
- 30dB  $L_{A1}$  (1-minute) at NM2 Zulumovski.
- 35dB  $L_{A1}$  (1-minute) at NM3 Mahony.
- Nil at NM4 Fisher Webster.
- 53dB  $L_{A1}$  (1-minute) at Ref Duralie Road.
- Nil at Wards River.

## 7 RAIL NOISE RESULTS

**Table 7** presents the results of the attended Duralie shuttle pass-by assessment. These measurements were conducted at locations TN1 (Craven), TN2 (Wards River) as shown in **Appendix B** and are assessed against the criteria set out in **Section 4.3** of this report. Measurements were conducted in accordance with AS 2377: 2002 *Acoustics – Methods for the measurement of rail bound vehicle noise*.

**Table 7: Attended Rail Monitoring Results**

Monitoring Site	Time, Date	Distance to track	L <sub>Amax</sub> dB Train	L <sub>Amax</sub> dB Train(Horn Excluded)	L <sub>Aeq</sub> Train Pass-by dB (Horn included)	L <sub>Aeq</sub> Train Pass-by dB Train (Horn Excluded)
TN2 South - Wards River	6/4/16 10:27	65m	64	64	56	56
TN2 North - Wards River	5/4/16 11:57	65m	90	78	72	66
TN1 - Craven	5/4/16 13:44	34m	84	84	68	68

## 8 COMPLIANCE ASSESSMENT

This section presents the compliance assessment for the measured DCM noise emissions for each of the survey periods as well as an assessment of the rail noise monitoring with NMP noise target goals.

### 8.1.1 COMPLIANCE ASSESSMENT SUMMARY – DAY SURVEY PERIOD

DCM operational L<sub>Aeq15-minute</sub> noise emissions during the day attended monitoring period under the prevailing weather conditions are summarised in **Table 8**. The results indicate noise levels at all monitoring locations were within criterion limits during the daytime survey.

**Table 8: Received Noise Level (L<sub>Aeq</sub> (15-minute)) at Monitoring Locations under prevailing weather conditions – Daytime**

Monitoring Locations	Sound Pressure Level dB L <sub>Aeq</sub> (15-minute)	Noise Criteria dB L <sub>Aeq</sub> (15-minute)	Excursion dB(A)
NM1 Woodley	28	35	0
NM2 Zulumovski North	29	35	0
NM3 Mahony	29	N/A	0
NM4 Fisher-Webster	Nil	35	0
REF1 Duralie Road	45	N/A	0
Additional Monitoring Location Wards River	Nil	35	0

### 8.1.2 COMPLIANCE ASSESSMENT SUMMARY – EVENING SURVEY PERIOD

DCM operational L<sub>Aeq15-minute</sub> noise emissions during the evening attended monitoring period under the prevailing weather conditions are summarised in **Table 9**. The results indicate noise levels at all monitoring locations complied with the criterion during the evening survey period.

**Table 9: Received Noise Level (L<sub>Aeq</sub> (15-minute)) at Monitoring Locations under prevailing weather conditions – Evening**

Monitoring Locations	Sound Pressure Level dB L <sub>Aeq</sub> (15-minute)	Noise Criteria dB L <sub>Aeq</sub> (15-minute)	Excursion dB(A)
NM1 Woodley	30	35	0
NM2 Zulumovski North	29	35	0
NM3 Mahony	23	N/A	0
NM4 Fisher-Webster	Nil	35	0
REF1 Duralie Road	47	N/A	0
Additional Monitoring Location Wards River	Nil	35	0

### 8.1.3 COMPLIANCE ASSESSMENT SUMMARY – NIGHT SURVEY PERIOD

DCM operational  $L_{Aeq15-minute}$  and  $L_{A1 (1-minute)}$  noise emissions during the first and second night attended monitoring survey periods under the prevailing weather conditions are summarised respectively in **Table 10** and **Table 11**. The results indicate noise levels at all monitoring locations were within criterion limits during the night-time surveys. The results presented in **Table 10** indicate that the  $L_{Aeq (15-minute)}$  noise levels at all monitoring locations were within criterion limits during the night-time survey periods. The results presented in **Table 11** indicate that the  $L_{A1 (1-minute)}$  noise levels at all monitoring locations were within criterion limits during the night-time survey periods.

**Table 10: Received Noise Level ( $L_{Aeq (15-minute)}$ ) at Monitoring Locations under prevailing weather conditions – Night-time**

Monitoring Locations	Sound Pressure Level dB $L_{Aeq (15-minute)}$		Noise Criteria dB $L_{Aeq (15-minute)}$	Excursion dB(A)	
	Night 1	Night 2		Night 1	Night 2
NM1 Woodley	30	27	35	0	0
NM2 Zulumovski North	Nil	26	35	0	0
NM3 Mahony	25	26	N/A	0	0
NM4 Fisher-Webster	Nil	Nil	37	0	0
REF1 Duralie Road	48	50	N/A	0	0
Additional Monitoring Location Wards River	Nil	Nil	35	0	0

**Table 11: Received Noise Levels ( $L_{A1 (1-minute)}$ ) at Monitoring Locations under prevailing weather conditions – Night-time**

Monitoring Locations	Sound Pressure Level dB $L_{A1 (1-minute)}$		Noise Criteria dB $L_{A1 (1-minute)}$	Excursion dB(A)	
	Night 1	Night 2		Night 1	Night 2
NM1 Woodley	38	32	45	0	0
NM2 Zulumovski North	Nil	30	45	0	0
NM3 Mahony	33	35	N/A	0	0
NM4 Fisher-Webster	Nil	Nil	45	0	0
REF1 Duralie Road	52	53	N/A	0	0
Additional Monitoring Location Wards River	Nil	Nil	45	0	0

## 9 NOISE MODEL PREDICTION

The mine contributed noise emissions from mining and process operations for each monitoring location were calculated using a noise model with the operational data provided by Duralie Coal Mine. The model inputs incorporated the following:

- Current sound power levels of mobile plant and fixed machinery associated with the mine;
- Prevailing meteorological conditions over the attended noise monitoring period;
- Operator attended noise-monitoring results.

The current mine production, operations and weather data were supplied by Duralie Coal Mine, as detailed in **Appendix A** and **Appendix C**.

Calculated day, evening and night contributed noise emissions from Duralie Coal Mine at each owner/tenant location are presented in **Table 12**.

A comparison of the model predictions and actual operator attended noise level measurements is also presented in **Table 12**. Contributed mine noise emissions at most locations generally agree with the modelled noise level prediction and the operator attended measured  $L_{Aeq}$  noise levels conducted between the 5<sup>th</sup> – 7<sup>th</sup> April 2016 at all landowners and tenants that currently surround the coal-mining lease.

Some variances are experienced between the attended measurements and the predicted at the Mahony and Woodley monitoring locations. The variances at the Mahony monitoring location are consistent with those noted during the last three quarterly surveys. It may be attributed to short-term operations that were occurring on the eastern side of the mine during the measurements that are not listed on the operations records provided to Vipac. The variance at Woodley location experienced during the Night 1 survey mainly seems to be attributed to the change in weather. The weather measured by the DCM weather station does not agree with that noted by the Vipac onsite engineer and also differs from that noted during the evening time survey which was conducted only a half hour prior to the night-time survey. This sudden change in weather measured by the DCM weather station resulted in a 10dB difference from the results predicted for the evening survey (i.e. 15dB(A)) compared to those predicted for the night survey (i.e. 25dB(A)) during the same mine operations. As the wind direction measured by the DCM weather station showed a sudden change in wind direction, which was not experienced by the Vipac onsite engineer, it resulted in the change in the predicted levels from 15 to 25dB(A). It is the opinion of Vipac that the weather, in particular the wind direction, measured by the DCM weather station during the Woodley evening survey period was not representative of that prevailing in the environment surrounding the Woodley monitoring location.

**Table 12: Environmental Noise Levels –05<sup>th</sup> -07<sup>th</sup> April 2016**

Owner/ Tenant	Monitored - Predicted DCPL Noise Levels <sup>1</sup>								Noise Criteria		
	dB(A) <sub>L<sub>Aeq</sub>(15 minute)</sub>								dB(A) <sub>L<sub>Aeq</sub>(15 Minute)</sub>		
	Day	Evening	Night 1	Night 2	Day	Evening	Night		Day	Evening	Night
Bailey <sup>2</sup>	24	24	24	25	35	35	35				
Bragg	17	19	14	14	35	35	35				
Fisher-Webster	Nil	20	Nil	21	Nil	19	Nil	23	35	35	37
Gillard	0	0	1	4	35	35	35				
Hamann-Pixelu PL	18	18	14	18	35	35	39				
Hare-Scott <sup>2</sup>	23	24	25	30	35	35	35				
Hattam <sup>2</sup>	32	33	34	35	35	35	35				
Holloway	13	13	10	13	35	35	35				
Holmes <sup>2</sup>	33	27	21	22	35	35	35				
James	17	16	13	15	35	35	35				
Lyll	29	21	30	30	35	39	40				
Mahony <sup>2</sup>	29	27	23	28	25	18	26	21	35	35	35
Morgan	3	6	11	10	35	35	35				
Oleksiuk & Carmody	20	18	15	18	35	35	35				
Relton <sup>2</sup>	15	16	15	20	35	35	35				
Richards	15	16	12	16	35	35	35				
Schultz	16	7	16	17	35	35	35				
Wards River Village	Nil	16	Nil	19	Nil	13	Nil	7	35	35	35
Weismantel	22	19	14	16	35	35	35				
Wielgosinski	20	20	14	14	35	35	35				
Woodley	28	24	30	15	30	25	27	25	35	35	35
Zulumovski(North) <sup>2</sup>	29	30	29	27	Nil	25	26	27	35	35	35

Note <sup>1</sup> Nil Denotes an unmeasurable noise contribution from the mine

<sup>2</sup> Owned by Duralie Coal Pty Ltd(DCPL) or private agreement in place between DCPL and the residence



## 10 DISCUSSION AND CONCLUSION

### 10.1 ENVIRONMENTAL NOISE SURVEY

An Environmental Compliance Noise Monitoring Survey has been carried out in the rural environment surrounding the Duralie Coal Mine (DCM) Site, Stroud Road, NSW. The survey was requested by Duralie Coal Pty Ltd to ascertain the degree of compliance of noise emissions generated from the operation of Duralie Coal Mine with licence and project approval conditions.

Direct temperature inversion measurements were conducted during the entire survey utilising the Duralie Coal Inversion Tower Infrastructure. These measurements were used to ascertain temperature lapse rates and atmospheric stability classes during the survey period, the results of which are presented in **Appendix A** of this report.

The mine operating noise emissions were within the noise criteria of  $35\text{dBL}_{\text{Aeq}}$  at all monitoring locations for the Day, Evening, Night 1 and Night 2 survey periods during the April 2016 compliance survey.

It is Vipac's professional opinion that the noise emissions produced by Duralie Coal Mine during the April 2016 DCM Environmental Quarterly Survey complied with the noise criteria set out in **Section 4** of this report based on the results and outcomes presented above.

### 10.2 RAIL NOISE SURVEY

As outlined in Section 4 of this report, all of the train-monitoring results presented in this assessment are to be used for general information purposes only and are not DCM compliance requirements.

Vipac conducted Duralie shuttle train pass-by monitoring during the 2015 & 2016 quarterly monitoring regime at TN1 (Craven) and augmented the monitoring program conducted at TN2 (Wards River) by splitting the monitoring location into two separate locations TN2-South (southern end of wards River village) and TN2-North (northern end of Wards River village) to better assess the rail noise from the Duralie shuttle within Wards River.

The noise emanating from the Duralie shuttle train complied with the  $L_{\text{Amax}}$  and  $L_{\text{Aeq}}$  pass-by noise goals at the TN2 South (Wards River South) location with the rail horn excluded from the measurement for this quarter monitoring period and complied with the  $L_{\text{Amax}}$  noise goal at TN2 North (Wards River North) and TN1 (Craven) but failed to comply with the  $L_{\text{Aeq}}$  pass-by noise goal at these locations.

It is noted that the Duralie Shuttle did not sound its horn as it passed the crossing at TN2 South (Wards River South) thus the noise level results with the rail horn included and excluded are the same. However the results complied with the  $L_{\text{Amax}}$  and  $L_{\text{Aeq}}$  pass-by noise goals for the pass-by.

The noise emissions associated with the Duralie shuttle train pass-by were therefore deemed to fail to comply with the noise goals set out in the DCM Noise Management Plan, at the TN1-Craven, and TN2-North (Wards River) for this the April 2016 monitoring period. TN2 South complied with the noise goals for this monitoring period.



## Appendix A: WEATHER DATA

Date	Time	Ave Air Temp (deg C)	Ave Wind Dir (deg)	Ave Sigma (deg)	Ave Wind Spd (m/s)	Total Rain (mm)	Inversion Tower Lapse Rate (deg/100m)
5/04/2016	8:00	18.6	300.75	12.0	3.6	0	1.8
5/04/2016	8:15	19.6	216.67	11.7	3.5	0	1.4
5/04/2016	8:30	20.5	245.46	14.0	3.3	0	1.3
5/04/2016	8:45	21.0	329.52	9.3	4.1	0	1.7
5/04/2016	9:00	21.7	311.77	14.1	3.8	0	2.1
5/04/2016	9:15	22.5	256.51	16.5	3.5	0	1.7
5/04/2016	9:30	22.9	267.75	16.9	4.0	0	1.8
5/04/2016	9:45	23.8	241.87	16.4	3.2	0	1.4
5/04/2016	10:00	24.2	211.64	19.7	3.9	0	0.9
5/04/2016	10:15	24.7	48.36	16.0	5.0	0	0.8
5/04/2016	10:30	25.0	76.69	16.2	5.0	0	1.5
5/04/2016	10:45	25.1	38.53	15.4	5.0	0	0.8
5/04/2016	11:00	25.4	65.42	20.8	4.1	0	0.6
5/04/2016	11:15	25.8	50.49	17.7	4.2	0	0.7
5/04/2016	11:30	26.3	200.99	32.0	3.5	0	1.1
5/04/2016	11:45	26.7	149.22	21.4	4.2	0	1.3
5/04/2016	12:00	26.8	59.11	18.5	3.6	0	0.8
5/04/2016	12:15	27.0	56.69	18.2	3.9	0	1.2
5/04/2016	12:30	27.3	122.06	35.8	3.1	0	1.4
5/04/2016	12:45	27.7	210.54	18.1	3.4	0	1.3
5/04/2016	13:00	27.4	51.64	24.0	3.8	0	1.8
5/04/2016	13:15	27.2	58.01	18.5	4.5	0	1.4
5/04/2016	13:30	27.1	65.16	16.2	5.0	0	1.4
5/04/2016	13:45	27.4	55.78	19.1	4.0	0	1.1
5/04/2016	14:00	27.6	75.73	26.1	4.1	0	1.6
5/04/2016	14:15	27.5	57.6	17.4	3.9	0	1.4
5/04/2016	14:30	27.5	43.77	12.4	3.9	0	1.5
5/04/2016	14:45	27.5	51.4	18.4	4.0	0	1.6
5/04/2016	15:00	27.4	42.94	14.4	4.7	0	1.6
5/04/2016	15:15	27.1	65.04	15.8	4.4	0	1.6
5/04/2016	15:30	26.9	61.05	14.8	4.8	0	1.8
5/04/2016	15:45	26.4	61.61	15.1	5.6	0	1.4
5/04/2016	16:00	26.2	57.44	15.1	4.9	0	1.3
5/04/2016	16:15	25.9	55.08	13.4	5.0	0	1.4
5/04/2016	16:30	25.4	59.9	13.2	5.9	0	1.3
5/04/2016	16:45	25.0	55.63	14.6	4.6	0	1.4
5/04/2016	17:00	24.6	47.07	13.1	4.8	0	1.3
5/04/2016	17:15	24.2	46.79	15.1	3.9	0	1.3
5/04/2016	17:30	23.7	48.65	19.1	3.1	0	1.3
5/04/2016	17:45	23.3	59.16	19.0	2.9	0	1.2
5/04/2016	18:00	22.9	47.13	15.0	2.9	0	1.1
5/04/2016	18:15	22.7	40.6	14.7	3.7	0	1.2
5/04/2016	18:30	22.4	142.55	19.2	2.3	0	1.2
5/04/2016	18:45	22.0	187.04	11.5	3.0	0	1.2
5/04/2016	19:00	22.1	120.95	14.1	4.5	0	1.1
5/04/2016	19:15	21.9	37.82	13.0	4.4	0	1.5
5/04/2016	19:30	21.6	30.05	12.0	3.5	0	1.8
5/04/2016	19:45	21.3	30	11.2	3.2	0	1.6
5/04/2016	20:00	21.2	32.99	11.4	3.0	0	1.3
5/04/2016	20:15	21.0	29.89	12.1	3.0	0	1.0
5/04/2016	20:30	20.8	106.49	16.4	2.6	0	1.9
5/04/2016	20:45	20.6	198.31	11.3	2.9	0	2.3
5/04/2016	21:00	20.3	147.11	10.3	4.6	0	2.6
5/04/2016	21:15	20.2	162.87	9.9	5.5	0	2.2
5/04/2016	21:30	20.0	239	10.0	4.1	0	2.8
5/04/2016	21:45	19.8	318.03	9.4	3.8	0	2.9



Date	Time	Ave Air Temp (deg C)	Ave Wind Dir (deg)	Ave Sigma (deg)	Ave Wind Spd (m/s)	Total Rain (mm)	Inversion Tower Lapse Rate (deg/100m)
5/04/2016	22:00	19.6	327.98	9.4	4.1	0	2.8
5/04/2016	22:15	19.5	311.79	9.1	4.4	0	2.3
5/04/2016	22:30	19.3	333.73	7.9	4.2	0	1.9
5/04/2016	22:45	19.1	305.46	11.6	3.5	0	1.8
5/04/2016	23:00	19.0	301.51	9.9	3.5	0	1.9
5/04/2016	23:15	19.0	306.95	9.4	3.3	0	2.3
5/04/2016	23:30	19.0	308.14	8.4	4.4	0	2.4
5/04/2016	23:45	19.0	321.23	9.0	4.8	0	2.3
6/04/2016	0:00	18.7	277.95	9.2	4.0	0	2.3
6/04/2016	0:15	18.4	330.35	9.7	3.9	0	2.3
6/04/2016	0:30	18.3	324.69	9.3	4.3	0	2.3
6/04/2016	0:45	18.1	297.75	9.0	4.7	0	2.3
6/04/2016	1:00	18.1	193.74	9.4	4.4	0	2.2
6/04/2016	1:15	18.0	304.16	9.5	4.8	0	2.4
6/04/2016	1:30	17.9	335.54	7.5	5.2	0	2.5
6/04/2016	1:45	17.9	295.52	8.6	5.1	0	2.3
6/04/2016	2:00	17.9	301.96	8.9	5.4	0	2.3
6/04/2016	2:15	17.6	289.2	8.7	5.8	0	2.6
6/04/2016	2:30	17.5	180.67	9.9	5.8	0	2.3
6/04/2016	2:45	17.6	144.3	8.4	6.4	0	1.8
6/04/2016	3:00	17.4	128.31	8.7	6.4	0	2.0
6/04/2016	3:15	17.3	226.77	7.9	5.8	0	2.4
6/04/2016	3:30	17.4	202.79	9.3	5.9	0	2.3
6/04/2016	3:45	17.4	247.3	10.0	5.9	0	1.8
6/04/2016	4:00	17.4	229.9	9.2	5.2	0	1.3
6/04/2016	4:15	17.1	194.99	8.9	4.8	0	1.2
6/04/2016	4:30	16.9	189.41	9.3	4.9	0	1.0
6/04/2016	4:45	16.9	229.96	10.2	5.2	0	1.1
6/04/2016	5:00	16.8	265.73	10.7	5.1	0	1.4
6/04/2016	5:15	16.7	302.35	9.1	4.6	0	1.6
6/04/2016	5:30	16.7	298.04	11.6	4.1	0	1.8
6/04/2016	5:45	16.7	306.82	11.6	3.5	0	2.3
6/04/2016	6:00	16.6	323.35	11.3	2.8	0	2.6
6/04/2016	6:15	16.5	254.49	14.7	3.0	0	2.0
6/04/2016	6:30	16.4	210.24	15.2	2.0	0	1.9
6/04/2016	6:45	16.7	204	13.3	2.2	0	2.2
6/04/2016	7:00	17.1	205.37	11.8	3.1	0	2.4
6/04/2016	7:15	17.7	96.84	16.3	3.0	0	1.4
6/04/2016	7:30	18.3	165.42	18.4	2.3	0	1.0
6/04/2016	7:45	19.3	189.85	35.0	1.9	0	1.1
6/04/2016	8:00	19.9	136.5	16.1	2.7	0	1.3
6/04/2016	8:15	20.5	147.57	15.4	2.9	0	1.3
6/04/2016	8:30	21.1	148.99	15.1	3.0	0	1.4
6/04/2016	8:45	22.1	206.57	17.3	2.9	0	1.7
6/04/2016	9:00	22.8	171.29	15.1	3.9	0	1.7
6/04/2016	9:15	23.4	214.51	12.6	3.9	0	1.0
6/04/2016	9:30	24.3	169.89	18.1	3.5	0	1.1
6/04/2016	9:45	25.0	201.7	14.9	4.8	0	0.8
6/04/2016	10:00	25.6	196.8	13.2	4.7	0	1.3
6/04/2016	10:15	26.5	267.62	12.3	4.4	0	1.3
6/04/2016	10:30	27.0	91	14.4	4.5	0	1.1
6/04/2016	10:45	27.7	51.98	14.2	4.2	0	0.9
6/04/2016	11:00	28.3	147.96	16.7	4.1	0	1.3
6/04/2016	11:15	28.9	243.2	23.4	3.3	0	1.1
6/04/2016	11:30	29.7	203.27	27.0	2.7	0	1.2
6/04/2016	11:45	30.3	120.58	22.6	2.8	0	1.1
6/04/2016	12:00	30.6	85.34	25.0	2.6	0	1.1



Date	Time	Ave Air Temp (deg C)	Ave Wind Dir (deg)	Ave Sigma (deg)	Ave Wind Spd (m/s)	Total Rain (mm)	Inversion Tower Lapse Rate (deg/100m)
6/04/2016	12:15	31.0	68.17	26.1	2.3	0	0.6
6/04/2016	12:30	31.6	119.98	54.4	1.5	0	1.6
6/04/2016	12:45	32.2	115.87	45.5	2.4	0	1.0
6/04/2016	13:00	31.9	75.32	13.9	3.4	0	1.2
6/04/2016	13:15	32.5	148.54	52.1	2.2	0	1.0
6/04/2016	13:30	32.4	57.25	21.9	2.7	0	1.2
6/04/2016	13:45	32.4	89.69	28.3	1.7	0	1.2
6/04/2016	14:00	32.7	164.13	60.0	1.7	0	1.3
6/04/2016	14:15	32.7	229.69	43.0	1.2	0	2.1
6/04/2016	14:30	33.0	169.64	54.8	1.2	0	2.1
6/04/2016	14:45	32.9	177.5	78.2	1.5	0	1.8
6/04/2016	15:00	33.5	283.51	39.3	2.0	0	3.0
6/04/2016	15:15	33.4	264.69	32.7	1.3	0	1.6
6/04/2016	15:30	33.2	180.12	71.2	1.7	0	1.1
6/04/2016	15:45	32.7	72.17	27.8	2.1	0	1.6
6/04/2016	16:00	32.6	57.83	18.1	2.9	0	1.3
6/04/2016	16:15	31.8	50.21	17.4	3.6	0	2.0
6/04/2016	16:30	30.9	49.03	10.5	4.3	0	1.9
6/04/2016	16:45	30.2	47.38	10.7	4.9	0	1.8
6/04/2016	17:00	29.5	51.52	11.5	4.0	0	1.9
6/04/2016	17:15	29.0	67.56	19.9	3.3	0	1.7
6/04/2016	17:30	28.6	159.83	23.9	2.9	0	1.8
6/04/2016	17:45	27.9	119.49	16.9	3.4	0	1.9
6/04/2016	18:00	27.4	28.23	11.3	3.5	0	2.1
6/04/2016	18:15	27.1	128.55	16.2	3.2	0	2.4
6/04/2016	18:30	26.6	289.99	10.2	3.2	0	3.0
6/04/2016	18:45	26.2	300.1	9.8	3.5	0	3.4
6/04/2016	19:00	25.7	295.43	9.4	2.9	0	4.0
6/04/2016	19:15	25.5	327.15	9.0	3.3	0	4.9
6/04/2016	19:30	25.2	332.8	9.3	3.1	0	7.0
6/04/2016	19:45	25.0	286.58	10.5	3.6	0	7.3
6/04/2016	20:00	24.7	307.72	8.3	3.4	0	7.3
6/04/2016	20:15	24.4	329.26	9.4	3.7	0	8.1
6/04/2016	20:30	24.0	333	7.8	3.7	0	9.2
6/04/2016	20:45	23.6	332.02	5.9	3.4	0	8.0
6/04/2016	21:00	23.1	330.46	7.8	3.3	0	8.2
6/04/2016	21:15	22.8	336.13	6.4	3.6	0	9.2
6/04/2016	21:30	22.7	342.37	5.8	3.8	0	7.9
6/04/2016	21:45	22.4	340.67	7.0	3.8	0	6.9
6/04/2016	22:00	22.2	339.36	6.7	4.0	0	7.2
6/04/2016	22:15	22.2	337	5.8	4.2	0	5.8
6/04/2016	22:30	22.0	337.93	7.0	3.7	0	5.3
6/04/2016	22:45	21.9	341.34	6.9	4.0	0	6.0
6/04/2016	23:00	21.8	323.96	9.3	3.9	0	7.0
6/04/2016	23:15	21.7	325.54	7.1	4.2	0	4.6
6/04/2016	23:30	21.4	245.17	11.7	3.1	0	5.1
6/04/2016	23:45	21.2	310.98	8.1	3.5	0	5.3
7/04/2016	0:00	21.2	306.22	8.9	4.0	0	6.2
7/04/2016	0:15	21.1	263.25	9.5	3.9	0	5.3
7/04/2016	0:30	21.0	274.87	12.9	3.6	0	6.2
7/04/2016	0:45	20.8	145.22	13.0	3.0	0	6.7
7/04/2016	1:00	20.1	267.55	31.0	1.5	0	8.0
7/04/2016	1:15	19.6	80.59	29.7	0.9	0	7.7
7/04/2016	1:30	19.6	155.07	20.9	1.1	0	7.9
7/04/2016	1:45	19.7	171.27	35.6	1.0	0	8.3
7/04/2016	2:00	19.5	74.55	20.5	1.0	0	8.4
7/04/2016	2:15	19.3	187.83	62.4	0.5	0	8.2



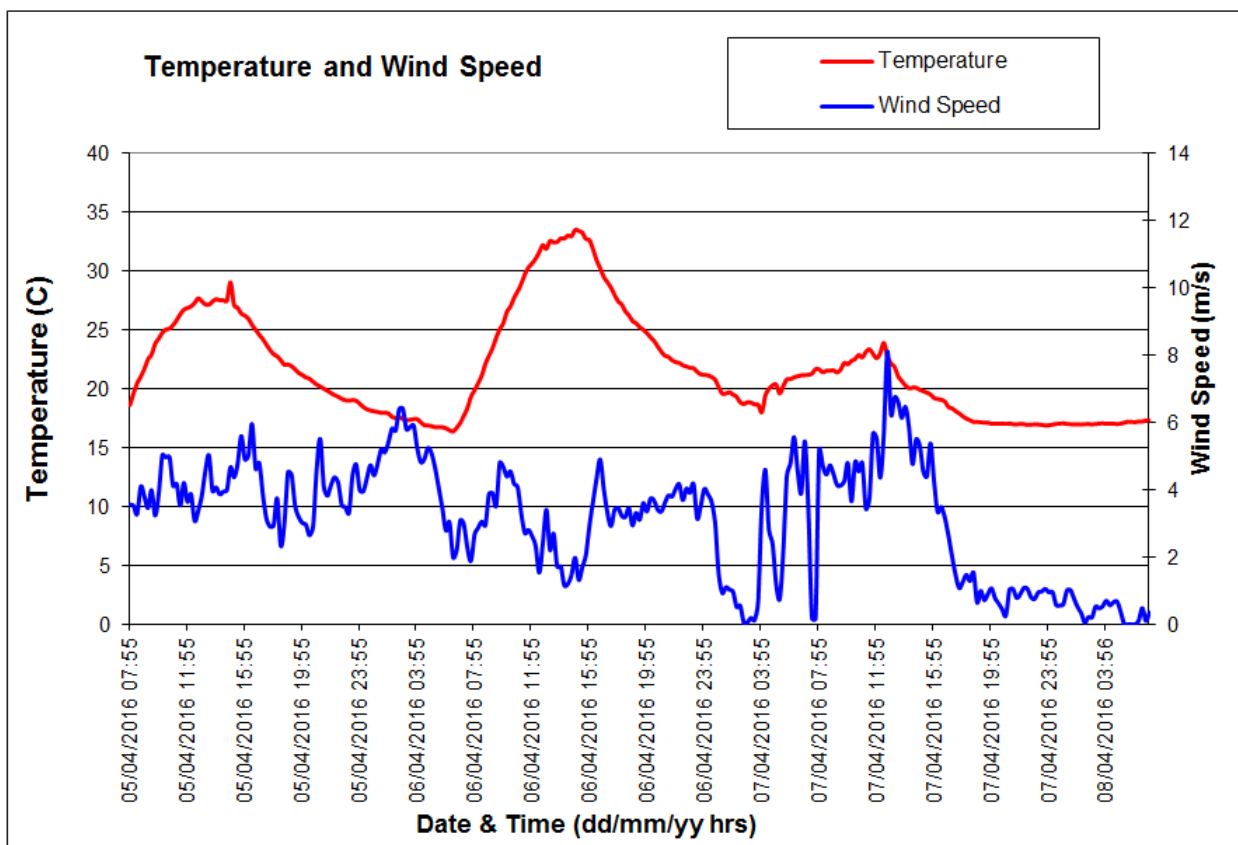
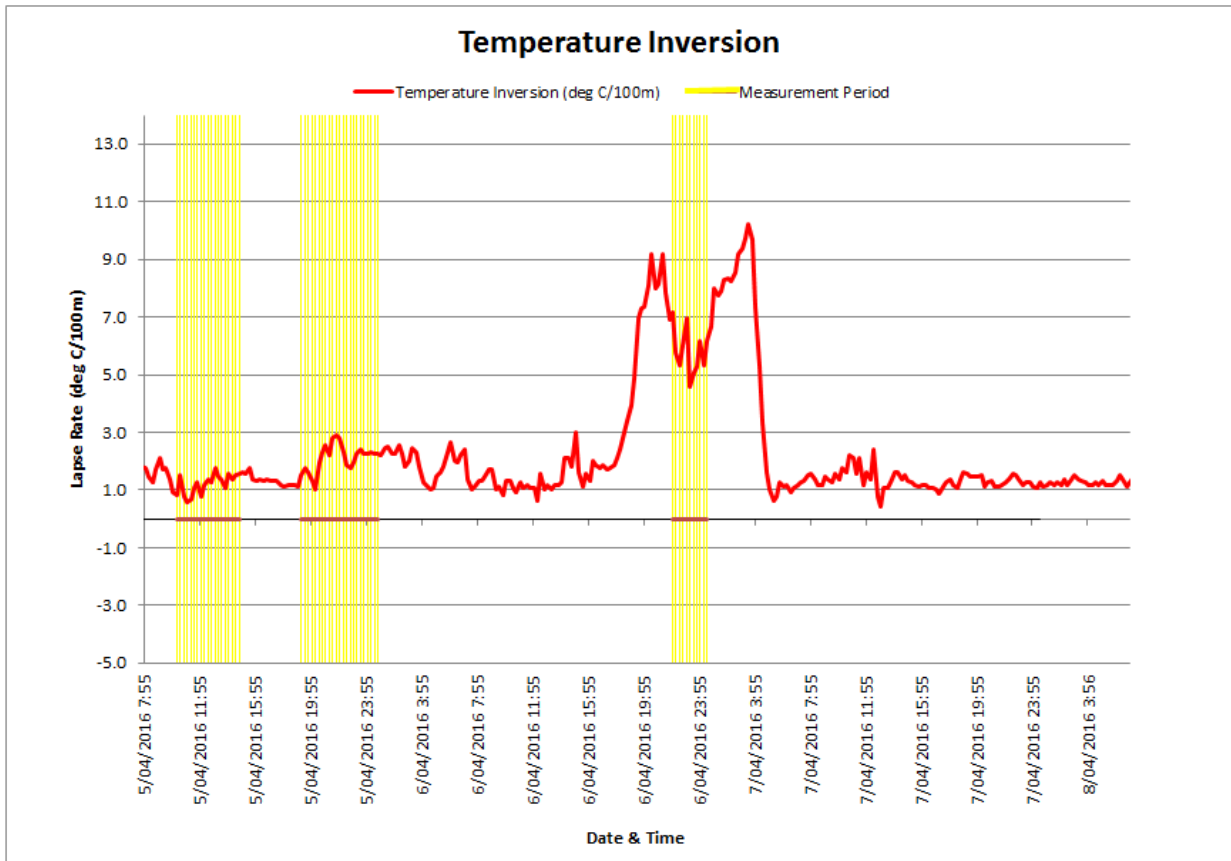
Date	Time	Ave Air Temp (deg C)	Ave Wind Dir (deg)	Ave Sigma (deg)	Ave Wind Spd (m/s)	Total Rain (mm)	Inversion Tower Lapse Rate (deg/100m)
7/04/2016	2:30	18.8	205.85	48.4	0.6	0	8.5
7/04/2016	2:45	18.7	192.46	29.1	0.1	0	9.2
7/04/2016	3:00	18.8	174.03	66.0	0.1	0	9.4
7/04/2016	3:15	18.8	140.98	63.4	0.2	0	9.7
7/04/2016	3:30	18.7	151.92	33.2	0.1	0	10.2
7/04/2016	3:45	18.6	188.5	20.8	0.7	0	9.7
7/04/2016	4:00	18.0	166.74	21.5	3.5	0	7.3
7/04/2016	4:15	19.4	167.97	14.5	4.6	0	5.3
7/04/2016	4:30	20.0	180.86	9.5	2.8	0	3.3
7/04/2016	4:45	20.3	183.25	11.9	2.4	0	1.6
7/04/2016	5:00	20.3	211.79	62.0	1.2	0	1.0
7/04/2016	5:15	19.6	257.2	30.5	0.8	0	0.6
7/04/2016	5:30	20.2	208.04	18.3	2.2	0	0.8
7/04/2016	5:45	20.8	199.69	9.6	4.4	0	1.3
7/04/2016	6:00	20.8	189.63	14.3	4.8	0	1.1
7/04/2016	6:15	21.0	179.61	11.0	5.6	0	1.2
7/04/2016	6:30	21.1	188.37	8.1	4.5	0	0.9
7/04/2016	6:45	21.1	194.66	9.0	3.9	0	1.1
7/04/2016	7:00	21.1	188.77	11.2	5.4	0	1.2
7/04/2016	7:15	21.2	182.74	11.4	3.4	0	1.3
7/04/2016	7:30	21.3	173.38	13.9	0.2	0	1.3
7/04/2016	7:45	21.7	168	20.0	0.2	0	1.5
7/04/2016	8:00	21.6	167.58	16.3	5.2	0	1.6
7/04/2016	8:15	21.4	164.79	19.7	4.7	0	1.4
7/04/2016	8:30	21.5	164.52	21.5	4.5	0	1.2
7/04/2016	8:45	21.5	175.74	15.2	4.7	0	1.2
7/04/2016	9:00	21.6	156.58	25.1	4.5	0	1.4
7/04/2016	9:15	21.4	173.55	12.3	4.1	0	1.4
7/04/2016	9:30	21.6	178.78	12.8	4.1	0	1.3
7/04/2016	9:45	22.2	171.19	16.4	4.3	0	1.6
7/04/2016	10:00	22.1	165.14	17.9	4.8	0	1.4
7/04/2016	10:15	22.4	164.9	24.3	3.7	0	1.8
7/04/2016	10:30	22.5	172.54	16.7	4.8	0	1.6
7/04/2016	10:45	22.9	160.86	24.5	4.5	0	2.2
7/04/2016	11:00	22.6	173.26	14.8	4.8	0	2.1
7/04/2016	11:15	23.1	164.17	22.8	3.4	0	1.6
7/04/2016	11:30	23.3	172.33	17.1	3.7	0	2.1
7/04/2016	11:45	23.0	170.74	12.3	5.7	0	1.2
7/04/2016	12:00	22.6	174.21	12.8	5.5	0	1.6
7/04/2016	12:15	23.0	169.01	17.1	4.4	0	1.4
7/04/2016	12:30	23.9	187.72	18.0	5.7	0	2.4
7/04/2016	12:45	22.8	176.02	13.0	8.1	0	0.8
7/04/2016	13:00	22.1	189.01	14.5	6.2	0	0.4
7/04/2016	13:15	21.8	176.67	16.3	6.7	0	1.1
7/04/2016	13:30	21.0	178.53	12.1	6.6	0	1.1
7/04/2016	13:45	20.7	174.84	16.8	6.1	0	1.3
7/04/2016	14:00	20.3	164.2	18.6	6.5	0	1.6
7/04/2016	14:15	20.0	182.45	13.9	5.9	0	1.6
7/04/2016	14:30	20.1	168.52	17.8	4.8	0	1.4
7/04/2016	14:45	20.1	153.74	25.5	5.5	0	1.5
7/04/2016	15:00	19.9	164.41	17.8	5.3	0	1.3
7/04/2016	15:15	19.8	171.31	17.4	4.5	0	1.3
7/04/2016	15:30	19.7	170.54	15.9	4.4	0	1.2
7/04/2016	15:45	19.5	163.92	22.0	5.4	0	1.1
7/04/2016	16:00	19.2	168.16	14.0	4.2	0	1.2
7/04/2016	16:15	19.1	166.18	19.0	3.3	0	1.2
7/04/2016	16:30	19.1	170.55	13.9	3.5	0	1.1

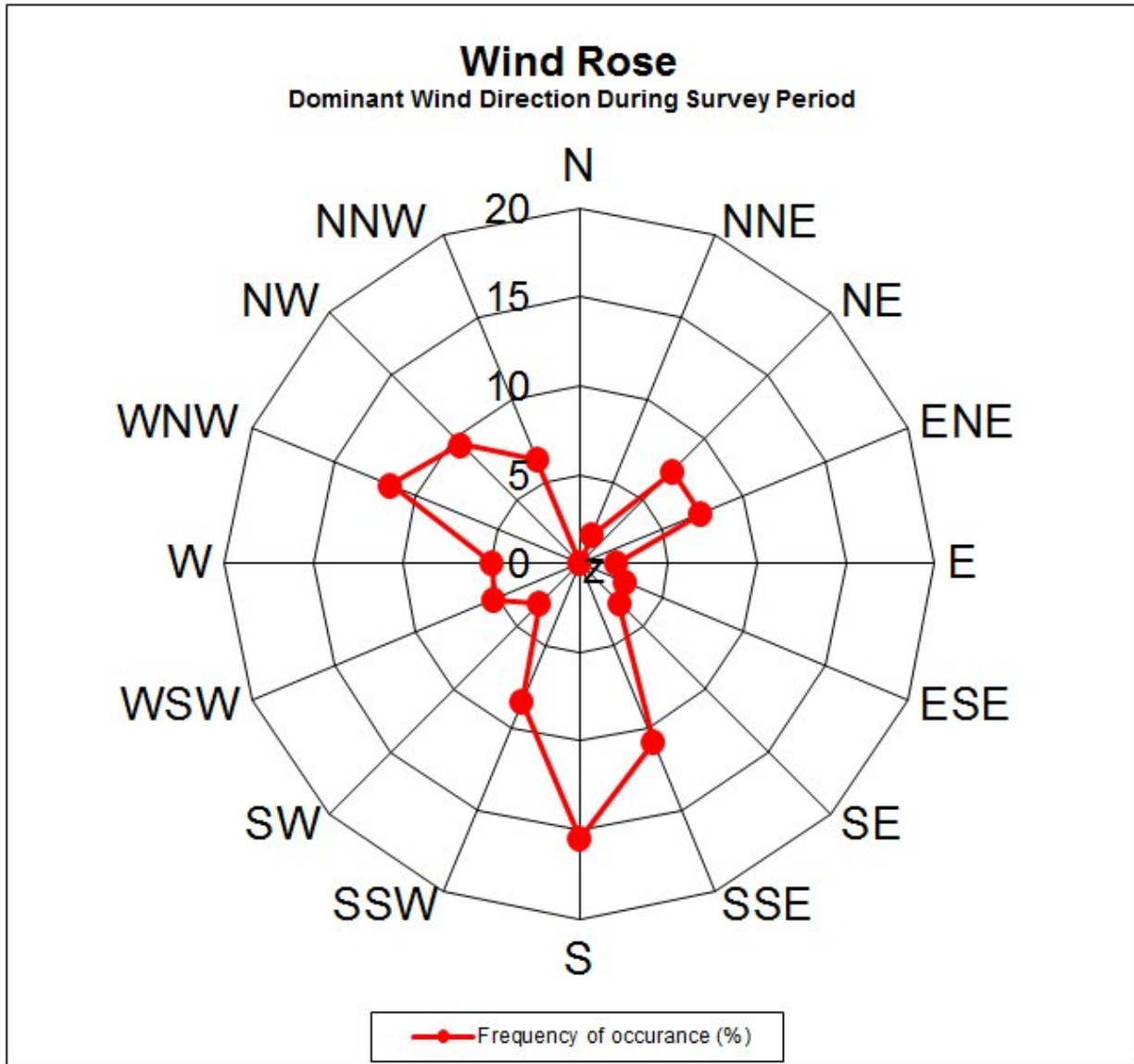
30 May 2016





Date	Time	Ave Air Temp (deg C)	Ave Wind Dir (deg)	Ave Sigma (deg)	Ave Wind Spd (m/s)	Total Rain (mm)	Inversion Tower Lapse Rate (deg/100m)
7/04/2016	16:45	18.9	171.48	17.8	3.2	0	1.1
7/04/2016	17:00	18.4	187.92	21.3	2.6	0	1.0
7/04/2016	17:15	18.3	208.26	12.0	2.0	0	0.9
7/04/2016	17:30	18.1	212.28	16.4	1.5	0	1.1
7/04/2016	17:45	17.9	249.27	32.8	1.1	0	1.3
7/04/2016	18:00	17.7	285.61	19.6	1.3	0	1.4
7/04/2016	18:15	17.5	320.66	12.6	1.5	0	1.2
7/04/2016	18:30	17.3	309.05	14.0	1.3	0	1.1
7/04/2016	18:45	17.2	286.87	9.1	1.5	0.2	1.4
7/04/2016	19:00	17.2	224.63	67.8	0.6	0	1.6
7/04/2016	19:15	17.1	301.99	11.7	1.0	0	1.6
7/04/2016	19:30	17.1	302.9	21.0	0.7	0	1.4
7/04/2016	19:45	17.1	300.96	10.6	0.9	0	1.4
7/04/2016	20:00	17.0	302.14	7.2	1.1	0	1.4
7/04/2016	20:15	17.0	301.26	9.9	0.8	0	1.5
7/04/2016	20:30	17.0	286.65	11.7	0.6	0	1.1
7/04/2016	20:45	17.0	291.99	16.6	0.4	0	1.3
7/04/2016	21:00	17.0	265.37	49.6	0.3	0	1.3
7/04/2016	21:15	17.0	273.89	40.8	1.0	0	1.1
7/04/2016	21:30	17.0	287.95	6.7	1.1	0.2	1.1
7/04/2016	21:45	17.0	291.9	9.1	0.8	0	1.2
7/04/2016	22:00	17.0	280.33	11.2	0.9	0	1.3
7/04/2016	22:15	17.0	297.09	11.0	1.1	0	1.4
7/04/2016	22:30	16.9	304.68	7.2	1.1	0	1.6
7/04/2016	22:45	16.9	317.31	8.5	0.8	0	1.5
7/04/2016	23:00	17.0	301.54	7.7	0.8	0	1.4
7/04/2016	23:15	17.0	323.55	14.1	0.9	0	1.2
7/04/2016	23:30	16.9	325.35	14.5	1.0	0	1.3
7/04/2016	23:45	16.9	312.42	11.5	1.1	0	1.3
8/04/2016	0:00	16.9	307.25	11.1	1.0	0	1.1
8/04/2016	0:15	16.9	316.76	8.3	1.0	0	1.1
8/04/2016	0:30	17.0	313.68	14.0	0.6	0	1.3
8/04/2016	0:45	17.0	243.38	28.7	0.6	0	1.1
8/04/2016	1:00	17.1	82.36	15.5	0.6	0	1.2
8/04/2016	1:15	17.0	192.48	25.4	1.0	0	1.3
8/04/2016	1:30	17.0	121.66	14.5	1.0	0	1.2
8/04/2016	1:45	17.0	258.12	42.3	0.8	0	1.3
8/04/2016	2:00	17.0	284.63	19.6	0.5	0	1.2
8/04/2016	2:15	17.0	216.77	26.6	0.3	0	1.4
8/04/2016	2:30	17.0	271.61	31.0	0.1	0	1.2
8/04/2016	2:45	17.0	261.14	19.7	0.2	0	1.4
8/04/2016	3:00	17.0	295.98	23.3	0.2	0	1.5
8/04/2016	3:15	17.0	248.76	18.6	0.5	0	1.4
8/04/2016	3:30	17.0	283.4	43.4	0.5	0	1.3
8/04/2016	3:45	17.1	298.33	42.2	0.5	0	1.3
8/04/2016	4:00	17.0	300.71	14.9	0.7	0	1.2
8/04/2016	4:15	17.0	305.67	13.5	0.6	0	1.2
8/04/2016	4:30	17.0	268.03	13.7	0.7	0	1.3
8/04/2016	4:45	17.0	291.11	22.2	0.7	0	1.2
8/04/2016	5:00	17.0	294	23.6	0.4	0	1.3
8/04/2016	5:15	17.1	216.19	76.8	0.0	0	1.2
8/04/2016	5:30	17.2	196.32	41.3	0.0	0	1.2
8/04/2016	5:45	17.2	236.95	11.5	0.0	0	1.2
8/04/2016	6:00	17.2	250.13	25.3	0.0	0	1.3
8/04/2016	6:15	17.2	169.28	51.7	0.1	0	1.5
8/04/2016	6:30	17.2	128.11	15.3	0.5	0	1.4
8/04/2016	6:45	17.3	151.33	39.8	0.1	0	1.1





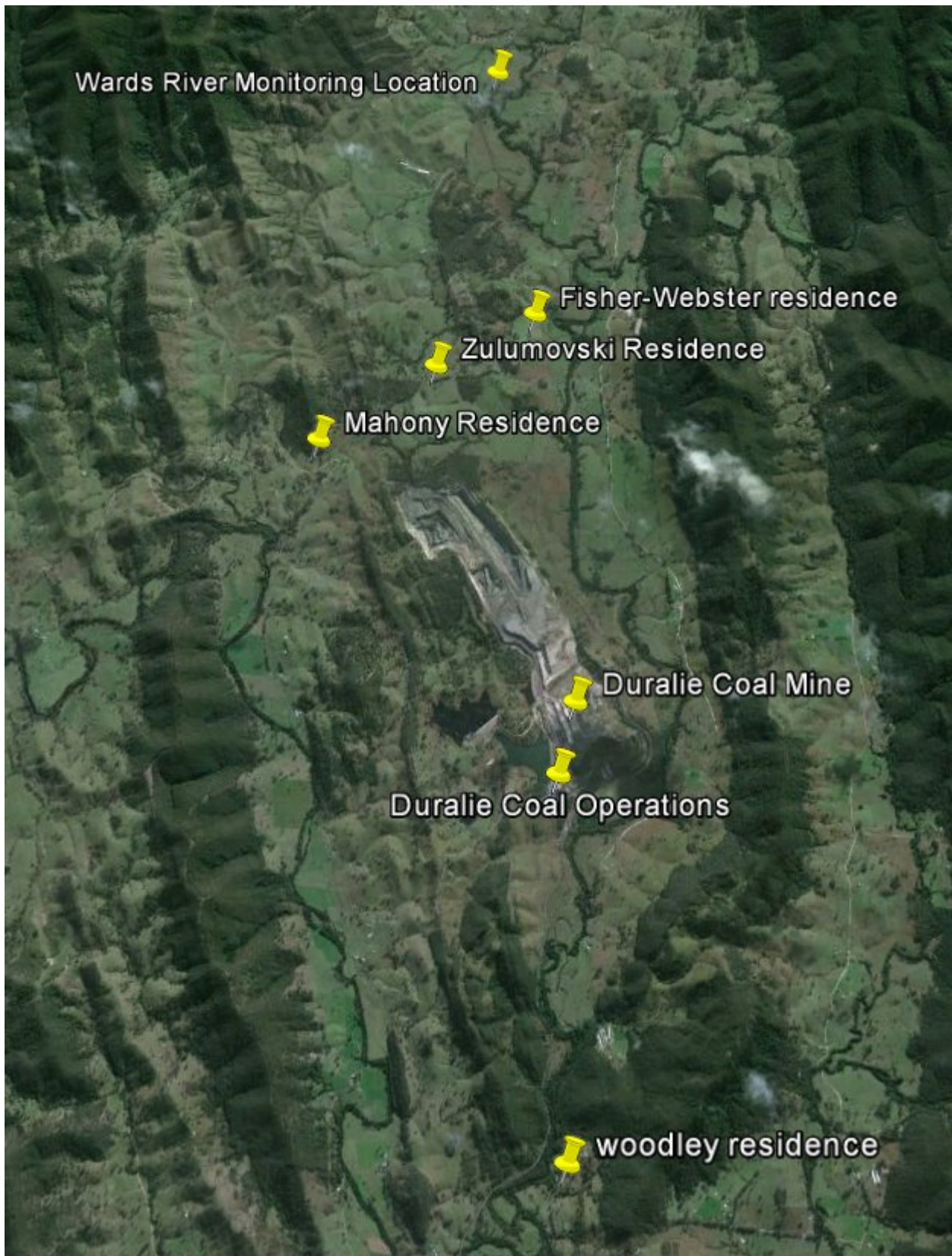


## Appendix B: LOCALITY MAP AND SURVEY LOCATIONS

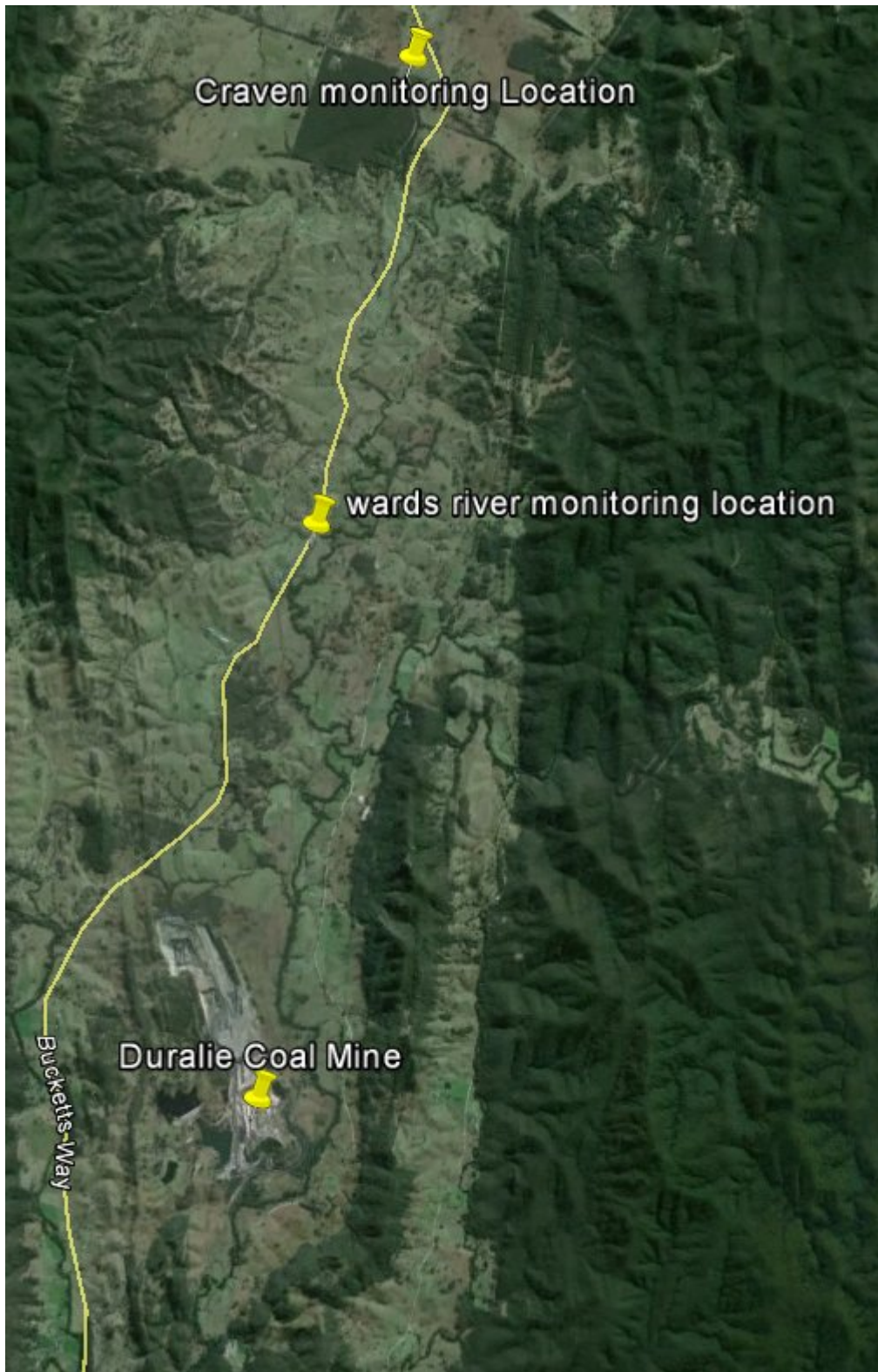


The monitoring locations at the Woodley and Wards River properties are located further from the Mine Site. An additional Locality Map illustrating those monitoring locations is provided below.











## **Appendix C: OPERATIONS**

**05<sup>th</sup> April 2016 Night Shift**

**06<sup>th</sup> April 2016 Day Shift**

**06<sup>th</sup> April 2016 Night Shift**