Appendix 3

Noise Impact Assessment by Spectrum Acoustics Pty Limited

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Project No: 14960

Noise Impact Assessment
Werris Creek Coal Mine – Modification 2
Werris Creek, NSW

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EXECUTIVE SUMMARY

A Noise Impact Assessment (NIA) has been prepared for a proposed modification of operations at the Werris Creek Coal Mine ("the Mine") near Werris Creek, NSW.

The assessment is based on or refers to the NSW Environment Protection Authority (EPA) *NSW Industrial Noise Policy* (2000). A brief summary of noise criteria, results and recommendations arising from this assessment is presented below.

Operational Noise Criteria

The Mine operates under the noise criteria of Project Approval (PA) 10_0059, Schedule 3, Condition 1, established for residential receivers on land surrounding the Mine Site (see below).

Noise Criteria

1. The Proponent shall ensure that the noise generated by the project (including noise generated on the Werris Creek Rail Spur) does not exceed the criteria in Table 1 at any residence on privately-owned land or on more than 25 percent of any privately-owned land.

Table 1: Noise criteria

Location	Day dB(A) $L_{Aeq(15\ min)}$	Evening & Night dB(A) $L_{Aeq(15\ min)}$	Night dB(A) $L_{A1\ (1\ min)}$
R18	40	37	45
R10, R11, R14	39	39	45
R20, R21	39	37	45
R12	38	38	45
R96	38	37	45
R7, R8, R9, R24	37	37	45
R22, R98	36	36	45
All other privately-owned land	35	35	45

Notes:
- *To interpret the locations referred to in Table 1, see the applicable figure in Appendix 3; and*
- *Noise generated by the project is to be measured in accordance with the relevant requirements and exemptions (including certain meteorological conditions) of the NSW Industrial Noise Policy.*

However, these criteria do not apply if the Proponent has an agreement with the relevant owner/s of these residences/land to generate higher noise levels, and the Proponent has advised the Department in writing of the terms of this agreement.

Since establishment of these noise criteria, several receivers have been acquired by the Proponent (R14, R15, R18 and R20) and other properties (16, 64 and 97) have been identified as having an entitlement to construct a residence. Considering a noise model calibrated using monthly noise monitoring results, the NIA reviews the likely noise levels that would be received at each of the receivers (and properties with building entitlement) against the existing noise criteria.

Summary of Findings

Noise modelling predicts that continued operations under the proposed modification would be acoustically indistinguishable from the current operations at assessed receivers. Based on noise modelling results, a criterion of 38dB(A), $L_{eq(15min)}$ is recommended for the currently vacant land (Properties 16, 64 and 97) with building entitlement. Noise monitoring in accordance with the NMP will be adequate to determine continuing compliance with the noise criteria.

A worst case noise level of 38 dB(A) has been predicted at both R96 and R98 where criteria of 37 dB(A) and 36 dB(A) are currently applicable. A level of 37 dB(A) has also been predicted at R22 where the criterion is currently 36 dB(A). Since the ongoing operation of the mine will incorporate the reasonable and feasible

noise controls which arose from the LOM project, it is recommended that these worst case predicted levels be adopted as noise criteria for these three receivers. This is consistent with the eight other receivers surrounding the site which have predicted noise levels above 35 dB(A) and have been adopted as the project specific noise level criteria for those receivers. Other than the specific examples identified above, noise modelling indicates that for the other eight receivers the existing noise criteria are adequate.

In the event of three additional operating haul trucks being added to the current fleet at a future stage of the project; noise modelling has identified that attenuated trucks can achieve the revised noise criteria outlined above and is recommended to satisfy the existing reasonable and feasible noise control principle.

Proposed off-site campaign haulage of coal to the Gunnedah CHPP will not result in exceedances of traffic noise criteria at any receivers during day (7am – 6pm), evening (6pm – 10pm) or night (10pm – 7am). There is no proposal to run trucks during the night period.

1.0 INTRODUCTION

1.1 Objectives of the Modification

The Applicant's objectives in developing the Mine are identified in *Section 2.1* of RWC (2015). The Applicant's objectives in modifying PA10_0059 are as follows.

- To ensure that the proposed modifications are undertaken in a way that conforms within the assessed and approved Mine site boundary.
- To reduce, to the maximum extent practicable, the overall environment impact to the Mine.
- To minimise, to the maximum extent practicable, the impact on the local community and other stakeholders.
- To ensure that the ongoing operation of the Mine can continue in a safe and reliable manner.

1.2 Overview of the Proposed Modifications

The proposed modifications include the following activities which are identified on **Figure 1** (RWC, 2015).

- A small lateral extension of the Out-of-Pit Overburden Emplacement to the west (~6ha)[1].
- A northerly extension of the 400m to 445m AHD benches of the Overburden Emplacement by approximately 250m[1].
- Incorporation of a new Dry Separation Plant to process coal with rock or other impurities. This coal is likely to be recovered initially from those seams previously mined by the Werris Creek Colliery.
- Provision for the supply of surplus void water for beneficial agricultural activities on and surrounding the Mine Site. This has no implication on the noise impacts of the Mine and hence irrigation areas are not identified.
- Increase the hours of road transportation for coal products.

The Applicant notes that no changes to the approved Mine Site boundary would be required, merely a modification of the internal infrastructure and addition of an off-site irrigation system located adjacent to the Mine. It is noted that a change in the sequence of mining within the approved open cut footprint is planned and will be presented to the Division of Resources & Energy (DRE) of the Department of Trade & Investment, Regional Infrastructure & Services as part of an amended Mining Operations Plan.

1.3 Assessed Receivers

Property ownership and receiver numbers for residences in the study area are illustrated in **Figure 2** (RWC, 2015).

[1] Both components of the overburden emplacement extension would remain within areas previously identified as part of the Mine disturbance footprint.

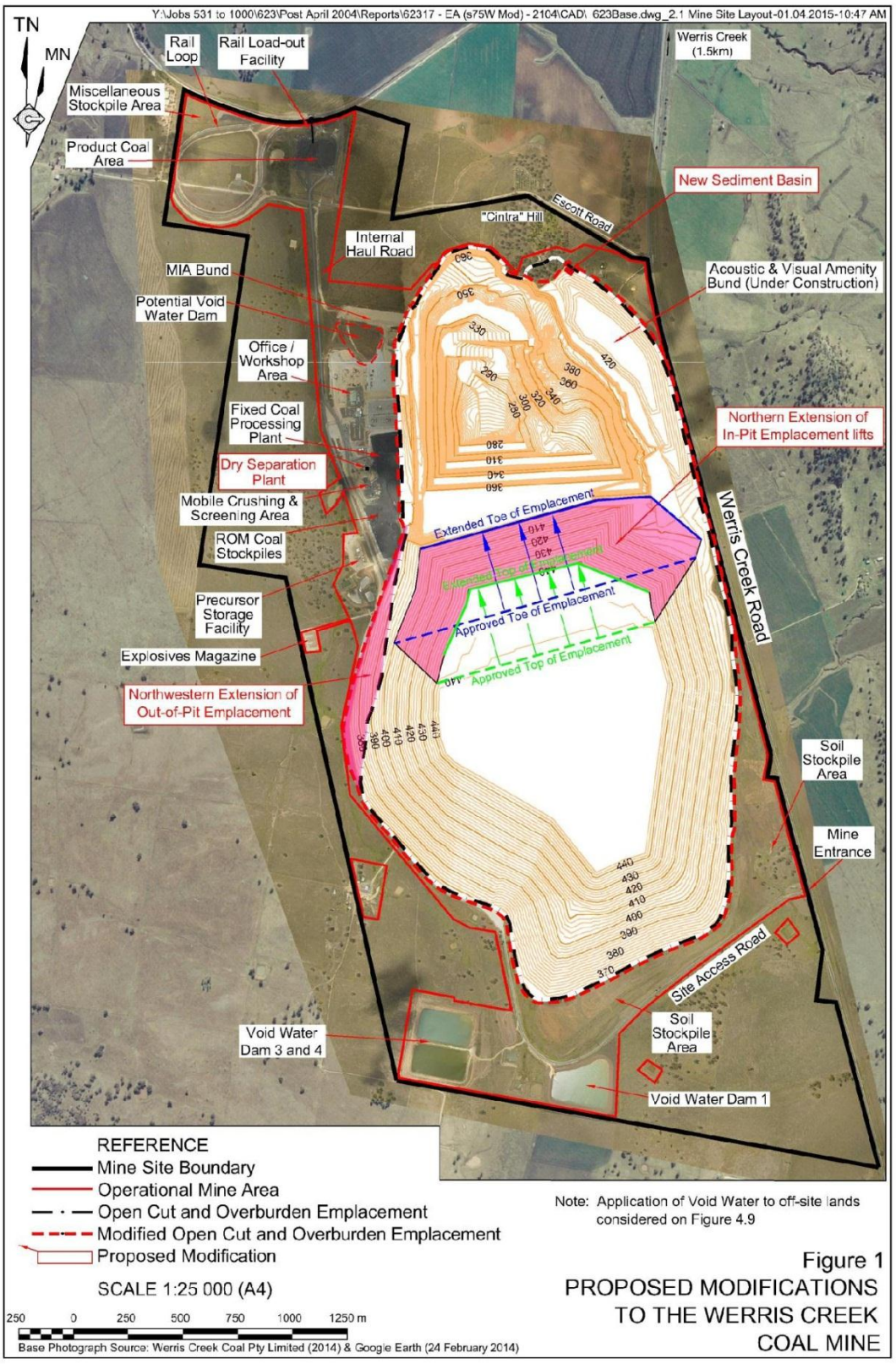

Figure 1
PROPOSED MODIFICATIONS TO THE WERRIS CREEK COAL MINE

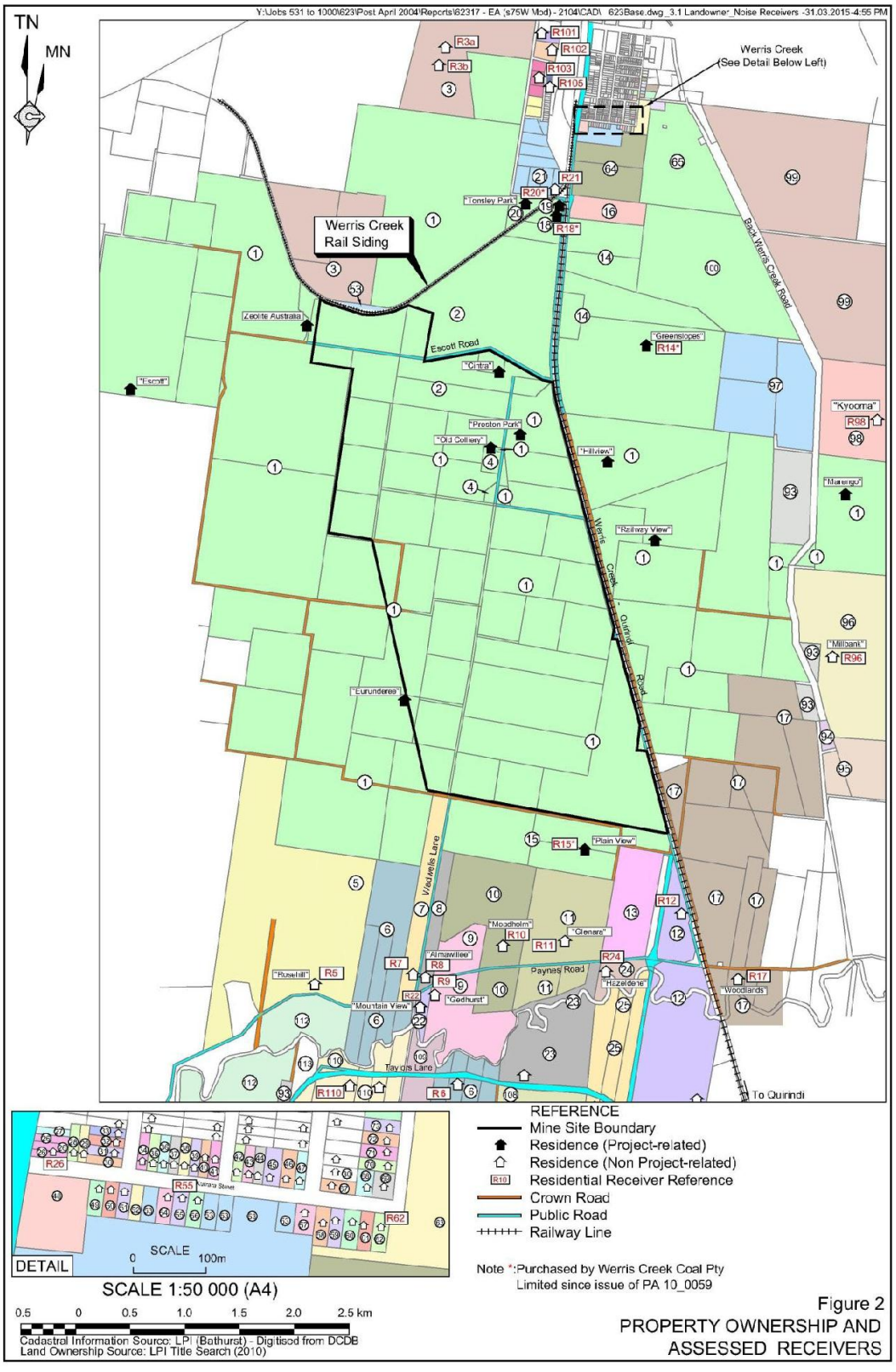

Figure 2
PROPERTY OWNERSHIP AND ASSESSED RECEIVERS

2.0 MODELLING PARAMETERS

Meteorological parameters and operational noise controls incorporated in the noise modelling are described below.

2.1 Meteorology

2.1.1 Wind

Wind roses for the local setting of the Mine Site have consistently revealed seasonal north-westerly and south south-easterly winds. As with all previous noise modelling for the Mine, a wind speed of 3m/s has been adopted in accordance with the NSW *Industrial Noise Policy* (INP).

2.1.2 Temperature Inversions

In order to better understand local inversion conditions of the local setting, Spectrum Acoustics conducted a temperature inversion study at the Mine during June 2010 as part of the WCC Life of Mine (LOM) Project assessment (RWC, 2010). The measured 90th percentile inversion strength of 12°C/100m was adopted as the worst case meteorological condition for noise models of the Werris Creek Coal Mine.

The worst case inversion strength of 12°C/100m has been adopted for modelling in the current assessment.

2.2 Noise controls

The following provides a summary of the key design features, operational controls and management measures implemented at the Mine.

- MIA Bund. The MIA Bund has been constructed to a height greater than 5m to attenuate noise emissions from the Mine Infrastructure Area.
- Haul Truck Replacement. More than half the CAT 785 haul trucks have been replaced by CAT 793XQ (eXtra Quiet) trucks which Spectrum (2015) note perform 1 to 2dB better than the CAT 785's.
- Attenuation of Haul Trucks. Noise assessment undertaken in accordance with ISO 6395 by Spectrum Acoustics confirms the revised target noise level of 117.7dB(A) is achieved for the CAT 785 haul trucks due to the additional noise reduction achieved by the CAT 793XQ fleet.
- Real time noise monitoring. Monitoring of noise levels in real time is undertaken at the locations to the north and south of the Mine Site. A dedicated 'Noise Control Operator' is employed to continually monitor real time noise levels and inform the Open Cut Examiner (OCE) if the dominant noise source is mining. Under these circumstances, the OCE would modify or partially suspend mining operations to achieve the nominated noise criteria. As an illustration of the application of the real time noise monitoring and

management, a total of 976.3 hours of production time was lost during the 2013/2014 AEMR period as a result of modified operations to accommodate noise issues.

- Real time meteorological monitoring. This is used to identify adverse weather conditions such wind direction/speed and temperature inversions with operations to be modified accordingly.
- Noise reduction planning. Noise reduction measures are discussed at the daily meeting based on the current location of mining activities and forecast weather conditions.
- Equipment Testing and Maintenance. Routine testing to confirm that the sound power levels of plant achieves the nominated targets is undertaken. Regular maintenance is undertaken to ensure noise attenuation on plant operates in accordance with manufacturer specifications.
- Bunding. Natural mine features or constructed bunds are utilised close to noise sources to create barriers to the propagation of noise towards receivers.
- Rail spur noise mitigation. Measures including restricting train speeds to 15kph, minimising coal drop heights into wagons and maintaining coal within the loading bin at all times are enforced.

3.0 NOISE CRITERIA AND ASSESSMENT PROCEDURE

3.1 Existing Noise Criteria

Existing noise impact criteria are contained in PA 10_0059, Schedule 3, Condition 1 reproduced below.

Noise Criteria

1. The Proponent shall ensure that the noise generated by the project (including noise generated on the Werris Creek Rail Spur) does not exceed the criteria in Table 1 at any residence on privately-owned land or on more than 25 percent of any privately-owned land.

Table 1: Noise criteria

Location	Day dB(A) $L_{Aeq(15\ min)}$	Evening & Night dB(A) $L_{Aeq(15\ min)}$	Night dB(A) $L_{A1\ (1\ min)}$
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R12	38	38	45
R96	38	37	45
R7, R8, R9, R24	37	37	45
R22, R98	36	36	45
All other privately-owned land	35	35	45

Notes:
- *To interpret the locations referred to in Table 1, see the applicable figure in Appendix 3; and*
- *Noise generated by the project is to be measured in accordance with the relevant requirements and exemptions (including certain meteorological conditions) of the NSW Industrial Noise Policy.*

However, these criteria do not apply if the Proponent has an agreement with the relevant owner/s of these residences/land to generate higher noise levels, and the Proponent has advised the Department in writing of the terms of this agreement.

It is noted that Locations R14, R15, R18 and R20 are now owned by Werris Creek Coal Pty Limited and therefore noise criteria no longer apply.

3.2 Traffic Noise Criteria

Off-site traffic noise criteria were established in the 2010 Noise and Vibration Assessment for the Werris Creek Life of Mine (LOM) Project EA, as reproduced in Table 1, based on the *NSW Environmental Criteria for Road Traffic Noise* (ECRTN). Traffic noise emissions were found to comply with these criteria at all receivers.

Table 1

Road Traffic Noise Criteria in 2010 LOM Project EA (from ECRTN)

Type of Development	Recommended Criteria – dB(A)	
	Day (7am to 10pm)	Night (10pm to 7am)
11. Land use developments with potential to create additional traffic on existing local roads.	$L_{Aeq(1hr)}$55	$L_{Aeq(1hr)}$50

The DECCW (now EPA) *NSW Road Noise Policy* was introduced in March 2011 and supersedes the ECRTN although the Development Type and noise criteria are identical to those contained in **Table 1**.

3.3 Noise Impact Assessment Procedure

3.3.1 Introduction

The assessment of noise emissions was conducted using RTA Technology's Environmental Noise Model (ENM v3.06). Major noise producing items were modelled as point sources and noise contours were generated for the surrounding area. Point calculations were performed for the receivers in Section 3.1.

3.3.2 Noise Sources

Sound power levels of operational noise sources used in the modelling are shown below in **Table 2**. Spectrum Acoustics has measured all major noise producing plant on site over the past three years, so the listed sound power levels are specific to the nominated plant items as opposed to being from a library of typical measured noise data.

Table 2

Mining Equipment Numbers, Function and Sound Power Levels

Item	No. on Site	Function	Sound power level, LW dB(A)
Excavator (540t)	1	Overburden Excavation/Loading	116
Excavator (360t)	1		115
Excavator (190t)	3	Overburden/Coal Excavation/Loading	115
Haul trucks (Cat 785)[1]	9[2]	Overburden/Coal Haulage	116 / 117
Haul trucks (Cat 793XQ)[3]	10		115
Bulldozer (D11)	2	Overburden Prime Push, Overburden/Coal Rip/Push, Final Landform Development Clearing, Overburden/Coal Rip/Push Up, Overburden Emplacement/Road Maintenance, Coal Stockpile Maintenance	116
Bulldozer (D10)	2		116
Bulldozer (D9)	1		116
Bulldozer (D6)	1	Campaign Rehabilitation	109
Bulldozer (D5)	1		109
Grader	1	Road/Overburden Emplacement Maintenance	110
Fuel/Service Truck	1	Equipment Refuelling/Servicing	107
Scraper	4	Campaign Topsoil/Subsoil Removal and Replacement	113
Drill Rig	3	Blast hole Drilling	107/108
Front-end Loader (FEL)	3	Screening Plant/Product Coal Loading	112
Water Cart	4	Dust Suppression	114-118
Crushing plant	1	Coal crushing	118
Dry separation plant[4]	1		112

Note 1: Incorporates noise attenuation.
Note 2: Refer to Section 4.2.
Note 3: XQ refers to Extra Quiet.
Note 4: Sound power level estimated from measurement of similar plant.

Source: Werris Creek Coal Pty Limited

3.3.3 Modelled Scenario

Noise modelling was conducted for the following adverse atmospheric conditions:

- *Adverse winds* – Air temperature 10°C, 70% RH, 3m/s wind from north west and south south-east; and
- *Inversion* – Air temperature 5°C, 85% RH, +12°C/100m vertical temperature gradient.

Noise models were generated for the following (worst-case) scenario illustrated in **Figure 3** using the Environmental Noise Model (ENM v3.06).

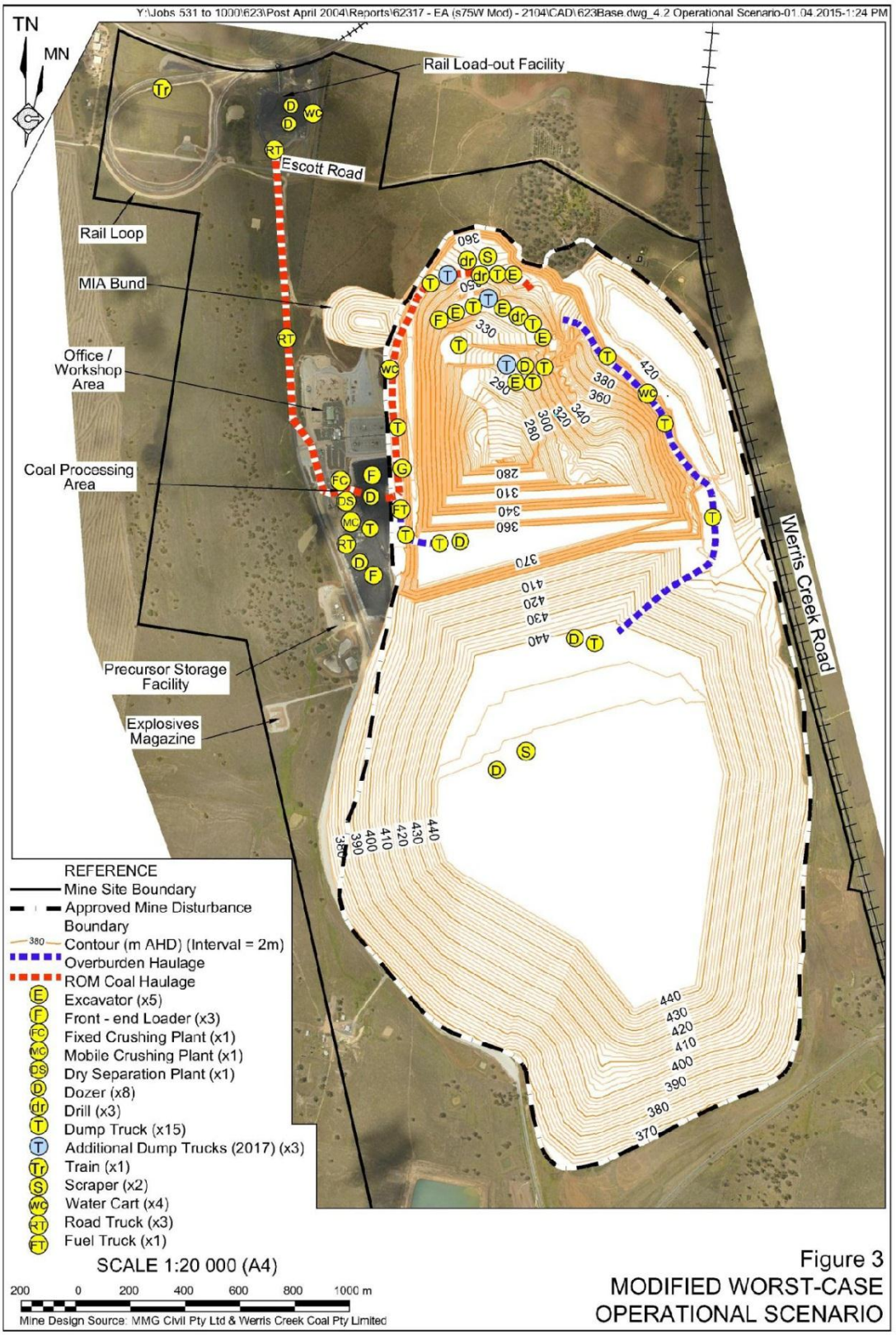

Figure 3
MODIFIED WORST-CASE OPERATIONAL SCENARIO

4.0 PREDICTED NOISE LEVELS

4.1 Operational Noise

Predicted noise levels using the ENM point calculation mode are presented in **Table 3** for the modelled operational and meteorological scenarios. Compliance is assessed against the worst case night time criterion. Noise contours for the worst case (12°C/100m temperature inversion) are shown in **Figure 4**.

Table 3
Predicted operational noise levels dB(A), $L_{eq(15minute)}$

Receiver Reference	Meteorological Condition			Criteria (night)	Maximum Differential
	Inversion 12°C/100m	Wind (3m/s)			
		NW	SSE		
R21	37	23	27	37	0
R3a	34	<20	29	35[2]	-1
R3b	35	<20	30	35[2]	0
R101	33	<20	27	35[2]	-2
R102	33	<20	27	35[2]	-2
R103	34	<20	27	35[2]	-1
R105	34	20	27	35[2]	-1
R26	35	<20	28	35[2]	0
R55	35	22	27	35[2]	0
R62	35	23	27	35[2]	0
R98	38	30	20	36	**+2**
R96	38	34	<20	37	**+1**
R17	35	35	<20	35[2]	0
R12	38	38	<20	38	0
R24	37	35	<20	37	0
R11	38	36	<20	39	-1
R10	38	34	<20	39	-1
R9	37	32	<20	37	0
R8	37	32	<20	37	0
R7	37	32	<20	37	0
R22	37	31	<20	36	**+1**
R5	32	25	<20	35[2]	-3

Note 1: No residential receiver (therefore no R prefix), noise level exceeded on 25% of the property
Note 2: Default criterion of PA 10_0059 applies

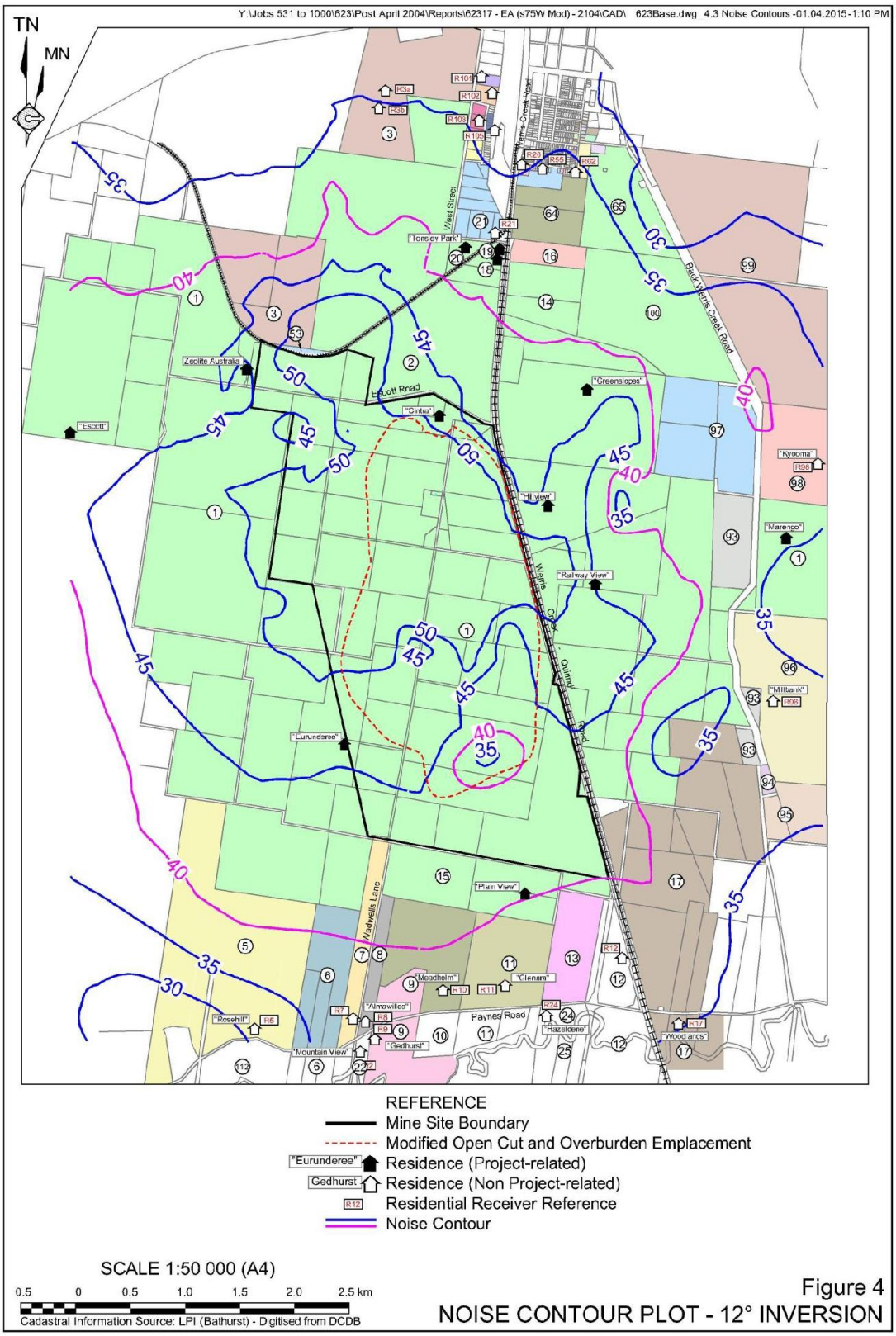

Figure 4
NOISE CONTOUR PLOT - 12° INVERSION

The results presented in **Table 3** indicate that with the exception of R22, R96 and R98, compliance with the noise criteria of PA 10_0059 could be achieved at non-project related residential receivers for the modified operations. The modelling results support the evidence provided by recent monitoring which has identified exceedances of the current noise criteria at R22 (July 2014) and R98 (September 2014). Notably, the noise model used for the NIA has been reviewed and adjusted following consideration of the noise monitoring results and now provides for a more accurate representation of the size and alignment of the Acoustic and Visual Amenity Bund (and subsequently the noise attenuation provided by this). The noise model also accurately reflects the noise mitigation measures nominated in the Noise Management Plan and implemented on the Mine Site (refer to Section 2.2). It is important to note that the predicted noise levels increases are a result of the refinement to the noise model as opposed to the changes to operations.

Additional to the residential receivers, the expected noise levels received on vacant land with building entitlement, namely Properties 16, 64 and 97 (see **Figure 2**) have been assessed through review of the noise contours generated by the noise model. For these properties, the predicted noise level, under worst case inversion conditions, exceeded on greater than 25% of the property is 38 dB(A).

On the basis of the accuracy of the noise model and implementation of all reasonable and feasible noise control works arising from the LOM Project assessment (see Section 2.2), it is recommended that this be established as the noise criteria for Property 97.

4.2 Additional trucks

The proponent has requested noise assessment of a possible future scenario in which three additional trucks may be added to the existing fleet to enable efficient removal of material from the deepest part of the pit in approximately 2017. Point calculation under the worst case inversion conditions for three scenarios of (1) existing fleet (results from **Table 3**), (2) existing fleet plus three additional attenuated trucks and (3) existing fleet plus three additional unattenuated trucks are shown in **Table 4**. The three additional trucks were distributed throughout the site noise model at different levels in the pit (see **Figure 3**).

The results in **Table 3** show that there would be no increase over the predicted worst case levels in **Table 2** if the three additional trucks are attenuated to a sound power level of 116-117 dB(A) as indicated in **Table 1** for existing attenuated trucks on site. An additional 1 dB(A) increase is predicted at R17, R62, R96, R97 and R98 if three additional unattenuated trucks are introduced. Since the mine is currently operating under the reasonable and feasible practice of attenuated trucks, it is recommended that this practice be implemented for the three additional trucks to maintain predicted noise impacts at current levels.

Table 4

Predicted operational noise levels with additional trucks dB(A), $L_{eq(15minute)}$

Residence Reference	12°C/100m Inversion			Criteria (night)	Maximum Differential
	Current 15 trucks	Current +3 unatten.	Current +3 atten.		
R21	37	37	37	37	0
R3a	34	34	34	35	-1
R3b	35	35	35	35	0
R101	33	33	33	35	-2
R102	33	33	33	35	-2
R103	34	34	34	35	-1
R105	34	34	34	35	-1
R26	35	35	35	35	0
R55	35	35	35	35	0
R62	34	35	35	35	0
R98	38	39	38	36	**+3**
97	38	39	38	35	**+4**
R96	38	39	38	37	**+2**
R17	35	36	35	35	**+1**
R12	38	38	38	38	0
R24	37	37	37	37	0
R11	38	38	38	39	-1
R10	38	38	38	39	-1
R9	37	37	37	37	0
R8	37	37	37	37	0
R7	37	37	37	37	0
R22	37	37	37	36	**+1**
R5	32	33	32	35	-2

4.3 Modifying Factor Corrections

A number of 'modifying factor' adjustments to predicted/modelled noise levels are defined in *Table 4.1* in Chapter 4 of the INP.

A review of the spectral noise data for the various sources has revealed that there are no appreciable tonal, impulsive or intermittent components of the site noise emissions requiring numerical assessment.

Low-frequency noise emissions must be assessed to determine whether the low-frequency modifying factor adjustment of + 5dB is applicable. In addition to the INP assessment of low-frequency noise associated with the activities presented on **Figure 3**, the Department of Planning and Environment have advised that the low-frequency modifying factor is not applicable if the C-weighted noise level is less than approximately 55 dB(C).

A review of point calculation results at all assessed receivers over all modelled scenarios has found C-A weighted noise level differences of 7-13 dB. This is below the trigger level of 15 dB for low frequency emissions and complies with the INP low frequency requirement.

4.4 Sleep Disturbance

Assessment of potential sleep disturbance during night time hours usually begins by considering the EPA recommendation that further assessment is required if maximum noise levels[2] (L_{Amax}) exceed the background level (L_{A90}) by more than 15 dB at a bedroom window. If this level is exceeded then further consideration of potential disturbance to sleep includes the nature and level of ambient noise in the area, with some guidance also offered in Appendix B of the OEH *Environmental Criteria for Road Traffic Noise* (ECRTN, 1999).

Review of historical noise monitoring data reveals that mine noise at the monitoring locations is typical "mine hum" with identifiable sources rarely producing levels more than 5 dB above the LAeq. Since implementation of the noise reduction works that are incorporated into the Statement of Commitments for the LOM Project, there has not been a recorded exceedance of the sleep disturbance criterion.

Since there would be no appreciable change to mining machinery or operations, there is minimal probability for sleep disturbance criteria to be exceeded and a full quantitative assessment is considered unnecessary.

4.5 Off-site Traffic

The traffic noise impact assessment from the 2010 LOM Project EA is reproduced below:

> The closest residence to the transport route is R6 (Kapcejevs) at 42m from the centre of Taylors Lane. Based on Equation 2 and using a maximum pass-by sound power level of 108 dB(A), the predicted traffic noise level of this receiver from 10 truck movements in a 1-hour period is 48.4 dB(A). This is approximately 6.5dB below the daytime criterion and 1.5 dB below the night time criterion, although it is unlikely that coal transportation would occur at night.
> (Spectrum Acoustics, 2010)

It is noted that the daytime period for road traffic noise assessment is from 7am – 10pm. This period covers the day and evening periods defined in the INP.

The following information relating to the proposed traffic movements for the current project is reproduced from the MOD 2 EA prepared by RW Corkery & Co Pty Limited.

[2] The sleep disturbance criterion is technically the $L_{A1(1minute)}$ level. As this is the loudest 0.6s during a 15-minute period, the L_{Amax} level is usually adopted.

Traffic Types and Levels

The delivery of coal to the Gunnedah CHPP and domestic markets would be by a range of truck configurations carrying an average of 30t. Based on the despatch of 50 000t of coal per year and an average truck capacity of 30t, this equates to approximately 1 700 truck loads (3 400 movements) per year.

Table 2.5 provides an analysis of weekday coal haulage from the Mine to the Gunnedah CHPP between 3 February and 7 April 2014 which would be indicative of future campaigns.

Table 2.5

Campaign Based Haulage Truck Movement

Traffic Period (2014)		Operating Days	Deliveries						
			Total	Min	Max	Av.	85th %ile	95th %ile	Coal (t)
3 Feb	28 Feb	16	414	18	35	26	33	-	12 397
3 Mar	31 Mar	21	638	11	47	30	39	47	19 668
1 Apr	7 April	5	134	7	34	27	-	-	3 959
Total		**41**	**1 186**	**7**	**47**	**28**	**34**	**43**	**36 024**

On the basis of the 2014 data, between 10 and 50 deliveries are expected per week day (4 to 10 on Saturdays), with an average of 28 (56 movements). Greater than 43 deliveries (86 movements) would only exit the Mine on 5% of days during the haulage campaign.
(RW Corkery & Co Pty Limited, WCC MOD 2 EA)

The worst case number of total heavy vehicles movements in the MOD 2 proposal is 94 per day. Whether these movements are distributed across 11 hours (7am – 6pm) or 15 hours (7am – 10pm) the hourly average is less than the 10 movements/hour considered in the 2010 assessment.

For completeness, the calculated hourly traffic noise levels at the worst affected receiver are:

Scenario	Hours	Movements/hr	$L_{Aeq(1hour)}$
LOM EA 2010	7am – 6pm	10	48.4
MOD 2 EA	7am – 6pm	8.5	47.7
MOD 2 EA	7am – 10pm	6.3	46.4

Under all scenarios, calculated truck noise levels remain under both the daytime and night time noise impact criteria at the worst affected receiver, implying compliance with the criteria at all receivers.

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APPENDIX A

DESCRIPTION OF ACOUSTICAL TERMS

Table A1 contains a glossary of commonly used acoustic terms and is presented as an aid in understanding this report.

The descriptions in this section are not formal definitions of the terms. Formal definitions may be found in AS1633-1985 "Acoustics – Glossary of terms and related symbols".

Table A1. Acoustical Terms

Term	Description
dB(A)	The quantitative measure of sound heard by the human ear, measured by the A-Scale Weighting Network of a sound level meter expressed in decibels (dB).
SPL	Sound Pressure Level. The incremental variation of sound pressure above and below atmospheric pressure and expressed in decibels. The human ear responds to pressure fluctuations, resulting in sound being heard.
STL	Sound Transmission Loss. The ability of a partition to attenuate sound, in dB.
Lw	Sound Power Level radiated by a noise source per unit time re 1pW.
Leq	Equivalent Continuous Noise Level - taking into account the fluctuations of noise over time. The time-varying level is computed to give an equivalent dB(A) level that is equal to the energy content and time period.
L1	Average Peak Noise Level - the level exceeded for 1% of the monitoring period.
L10	Average Maximum Noise Level - the level exceeded for 10% of the monitoring period.
L90	Average Minimum Noise Level - the level exceeded for 90% of the monitoring period and recognised as the Background Noise Level. In this instance, the L90 percentile level is representative of the noise level generated by the surrounds of the residential area.