

Noise Impact Assessment

Chichester Deviation Construction & Operation Noise Assessment

Prepared For

Calibre Engenium

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1 INTRODUCTION

This report provides an assessment of the noise impacts associated with the construction and operation of the BHP Billiton Iron Ore railway Chichester deviation. The noise levels are predicted to noise sensitive premises and compared against relevant criteria.

Appendix B contains a description of some of the terminology used throughout this report.

2 CRITERIA

2.1 Railway Construction

Noise associated with construction activities is not required to satisfy the assigned levels prescribed in the Environmental Protection (Noise) Regulations 1997, but rather management practices as defined in *regulation 13*. These management practices must show that:

- a) *the construction work was carried out in accordance with control of environmental noise practices set out in section 6 of AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites;*
- b) *the equipment used on the premises was the quietest reasonably available; and*
- c) *if the occupier was required to prepare a noise management plan under subregulation (4) in respect of the construction site –*
 - i. *the noise management plan was prepared and given in accordance with the requirement, and approved by the Chief Executive Officer; and*
 - ii. *the construction work was carried out in accordance with the management plan.”*

Regulation 13 requires that where a noise management plan is to be prepared, the plan is to include:

- ❑ details of, and reasons for, construction work on the construction site that is likely to be carried out other than between 0700 hours and 1900 hours on any day which is not a Sunday or public holiday;
- ❑ details of, and the duration of, activities on the construction site likely to result in noise emissions that fail to comply with the standard prescribed under Regulation 7;
- ❑ predictions of noise emissions from the construction site;
- ❑ details of measures to be implemented to control noise (including vibration) emissions;
- ❑ procedures to be adopted for monitoring noise (including vibration) emissions; and
- ❑ complaint response procedures to be adopted.

2.2 Blasting Noise Criteria

Blasting levels are covered by regulation 11, which provides the following criteria:

No airblast level resulting from blasting on any premises or public place, when received at any other premises, may exceed –

- (a) 125dB $L_{Linear\ peak}$ between 0700 hours and 1800 hours on Monday to Saturday inclusive; or
- (b) 120dB $L_{Linear\ peak}$ between 0700 hours and 1800 hours on a Sunday or public holiday.

Notwithstanding subregulation (3), airblast levels for 9 in any 10 consecutive blasts (regardless of the interval between each blast), when received at any other premises, must not exceed –

- (c) 120dB $L_{Linear\ peak}$ between 0700 hours and 1800 hours on Monday to Saturday inclusive; or
- (a) 115dB $L_{Linear\ peak}$ between 0700 hours and 1800 hours on a Sunday or public holiday.

2.3 Operation of the Railway

Noise from the operation of railways is exempt from the Environmental Protection (Noise) Regulations 1997. For noise sensitive premises, the draft *Statement of Planning Policy: Road and Rail Transportation Noise* and the draft *EPA Statements for EIA No. 14 (Version 3) - Road and Rail Transportation Noise* are the most relevant criteria, both of which have been reproduced below.

Although it is proposed by government to only have one policy for transportation noise, both policies are currently being used on different project types and assessments. Generally the EPA would use the draft *Statement of Planning Policy* to assess new projects and to assess the overall noise levels from modified transportation corridors; and would use the draft *EPA Statements for EIA No. 14*, to assess the acceptability of a noise impact from increases in traffic or train volumes resulting from a specific project, such as an upgrade or product increase.

Draft Statement of Planning Policy: Road and Rail Transportation Noise

Table 2.1 sets out the outdoor noise exposure criteria under the draft *Statement of Planning Policy: Road and Rail Transportation Noise*.

Table 2.1 - External Noise Exposure Criteria for Noise Sensitive Land Uses

Time Period	External Noise Exposure Level Criteria (dB)	
	Noise "Target"	Noise "Limit"
Day Time 6.00am – 10.00pm	$L_{Aeq,16hour} = 55dB$	$L_{Aeq,16hour} = 60dB$
Night Time 10.00pm – 6.00am	$L_{Aeq,8hour} = 50dB$	$L_{Aeq,8hour} = 55dB$

The 5 dB difference between the outdoor noise “target” and the outdoor noise “limit”, as prescribed by *Table 2.1*, represents an acceptable “margin” for compliance. Normally, it is practicable to achieve outdoor noise levels within this acceptable margin.

EPA Statements for EIA No. 14 (Version 3) - Road and Rail Transportation Noise

Under the draft *EPA Statements for EIA No. 14 (Version 3) - Road and Rail Transportation Noise* a noise rating is applied depending on existing noise levels at the residence. The noise ratings are reproduced below in *Table 2.2*.

Table 2.2 – EPA Noise Amenity Ratings

Rating	L _{Aeq,T} (Day)	L _{Aeq,T} (Night)
N0	≤ 50	≤ 40
N1	51 - 55	41 - 45
N2	56 - 60	46 - 50
N3	61 - 65	51 - 55
N4	66 - 70	56 - 60
N5	≥ 70	≥ 60

The acceptable transportation noise level to existing residences is as follows.

Table 2.3 Acceptable Transportation Noise Levels

Rating	Acceptable	Conditionally Acceptable	Unacceptable
N0	Rural Residential		
N1	Urban/Unit Red	Rural Residential	
N2	Open space	Rural/Urban res	
N3		Residential units	Rural/Urban res
N4			Residential units
N5			

The noise emissions should be reduced as far as is practicable by means of corridor alignment, use of cuttings and noise barriers to achieve the "acceptable" levels in *Table 2.3*. Where these levels cannot be practicably achieved, the equivalent internal level to N1 in the "conditionally acceptable" cases should be achieved by means of acoustic treatment to the building envelope and provision of mechanical ventilation/airconditioning. In the "unacceptable" cases, provision should be made for the purchase of the noise-sensitive premises.

3 METHODOLOGY

3.1 Noise Modelling Overview

Computer modelling has been used to predict the noise from construction and operation of the railway. The software used was *SoundPLAN 6.5* with the CONCAWE algorithms selected for the construction noise and the Nordic Rail Prediction Method (Kilde Rep. 130) algorithm for the operational noise. The Kilde Rep. 130 algorithm was modified to align with measured noise levels of locomotives and wagons. In addition, to accurately predict the effect of barriers (hills or buildings), the noise source height of the locomotive was raised from the standard 0.5 metres above the railhead to 4.0 metres.

The input data required in the model are:

- ❑ Meteorological Information;
- ❑ Topographical data;
- ❑ Ground Absorption; and
- ❑ Source sound power levels.

Meteorological Information

Meteorological information utilised is based on that specified in EPA *Guidance for the Assessment of Environmental Factors No.8 Environmental Noise draft*, and are shown below in *Table 3.1*.

Table 3.1 –Modelling Meteorological Conditions

Parameter	Night (1900-0700)	Day (0700-1900)
Temperature (°C)	15	20
Humidity (%)	50	50
Wind Speed (m/s)	3	4
Wind Direction*	All & Prevailing	All & Prevailing
Pasquil Stability Factor	F	E

* Note that the modelling package used allows for all wind directions to be modelled simultaneously.

Note that the above conditions approximate the typical worst-case for enhancement of sound propagation. The EPA policy is that compliance with the assigned noise levels needs to be demonstrated for 98% of the time, during the day and night periods, for the month of the year in which the worst-case weather conditions prevail. In most cases, the above conditions occur for more than 2% of the time and therefore must be satisfied.

At wind speeds greater than those shown above, sound propagation may be further enhanced, however background noise from the wind itself and from local vegetation is likely to be elevated and dominate the ambient noise levels.

Topographical Data

Topographical data was based on that provided by Calibre Engenium. The contours are in 5 metre intervals and cover the noise sensitive premises of concern.

Ground Absorption

Ground absorption varies from a value of 0 to 1, with 0 being for an acoustically reflective ground (e.g. water or bitumen) and 1 for acoustically absorbent ground (e.g. grass). In this instance, a value of 0.8 has been used as an average for the study area.

3.2 Construction Noise from Mobile Plant

The equipment assumed in the assessment of construction noise and the associated sound power levels are provided below in *Table 3.2*.

Table 3.2 – Mobile Source Sound Power Levels, dB

Plant Item	Frequency (Hz)									
	31.5	63	125	250	500	1k	2k	4k	8k	Overall
Dozer	94	99	105	105	105	104	104	95	87	112 dB(A)
	103	101	107	104	106	102	98	92	83	
	97	103	107	102	102	101	96	91	81	
Water Cart	106	108	110	110	114	109	107	101	94	118 dB(A)
	113	111	110	110	112	107	105	100	91	
	108	108	105	107	106	106	105	97	88	
CAT 992 Front-End Loader	100	105	110	99	108	102	101	94	87	113 dB(A)
	100	107	116	108	107	103	102	93	84	
	100	106	104	104	103	102	96	91	79	
Drill Rig	113	121	122	124	122	118	115	109	105	124 dB(A)
Grader	105	115	110	107	109	108	106	101	95	113 dB(A)

Note; A single line for a source represents centre octave data. Three lines per source represents one-third octave data.

With regards to the above, please note the following:

- ❑ Source of the above data is from similar machinery measured in the Pilbara region;
- ❑ It is assumed that all plant is operating simultaneously;
- ❑ The sound level of a source represents its L₁₀ noise level;

- Noise sources have been positioned at the closest point to a noise sensitive premises; and
- The height of each noise source is assumed to be 3.0m above ground level.

3.3 Blasting Noise Predictions

The predicted levels from the blasting have been calculated using the Orica blasting calcs below: These calculations assume that the blasts are confined.

$$\text{Airblast Level dB } L_{\text{Linear peak}} = 20 \log \left(\frac{P_B}{P_0} \right)$$

where:

$$P_B = 3.3 \left(\frac{R}{W^{\frac{1}{3}}} \right)^{-1.2}$$

$$P_0 = 2 \times 10^{-8}$$

R = distance from blast

W = maximum charge mass per delay

For the assessment, it was assumed that the charges are sequential and that the charge mass per delay is 80 kg.

3.4 Railway Operation Predictions

The predicted noise levels from the operation of the railway have been undertaken assuming the following variables:

Table 3.3 Input Data for Assessment of Railway Noise

Parameter	Value
Locomotive maximum noise level at 15m	92 dB(A)
Wagons maximum noise level at 15m	86 dB(A)
Train Speed	70 km/h
Height of Locomotive	4 metres above rail head
Train Length	3465 metres
Number of Train Movements per 24 hours	24

Note: Trains assumed to be evenly distributed throughout a 24-hour period.

4 RESULTS

The predicted noise associated with the construction of the railway is provided in *Figures 4.1 and 4.2*. *Figure 4.1* represents all the mobile plant operating simultaneously at the closest location to the Mulga Downs Outcamp. *Figure 4.2* shows the areas of airblast levels that would exceed $115\text{dB } L_{\text{Linear peak}}$, which must be achieved for 9 out of 10 blasts during the daytime on Sundays and Public Holidays, as prescribed in regulation 11.

The predicted noise levels from the operation of the railway are provided in *Figure 4.3*. The contours represent the $L_{\text{Aeq(night-time)}}$ noise level, which would be the most stringent of the criteria.

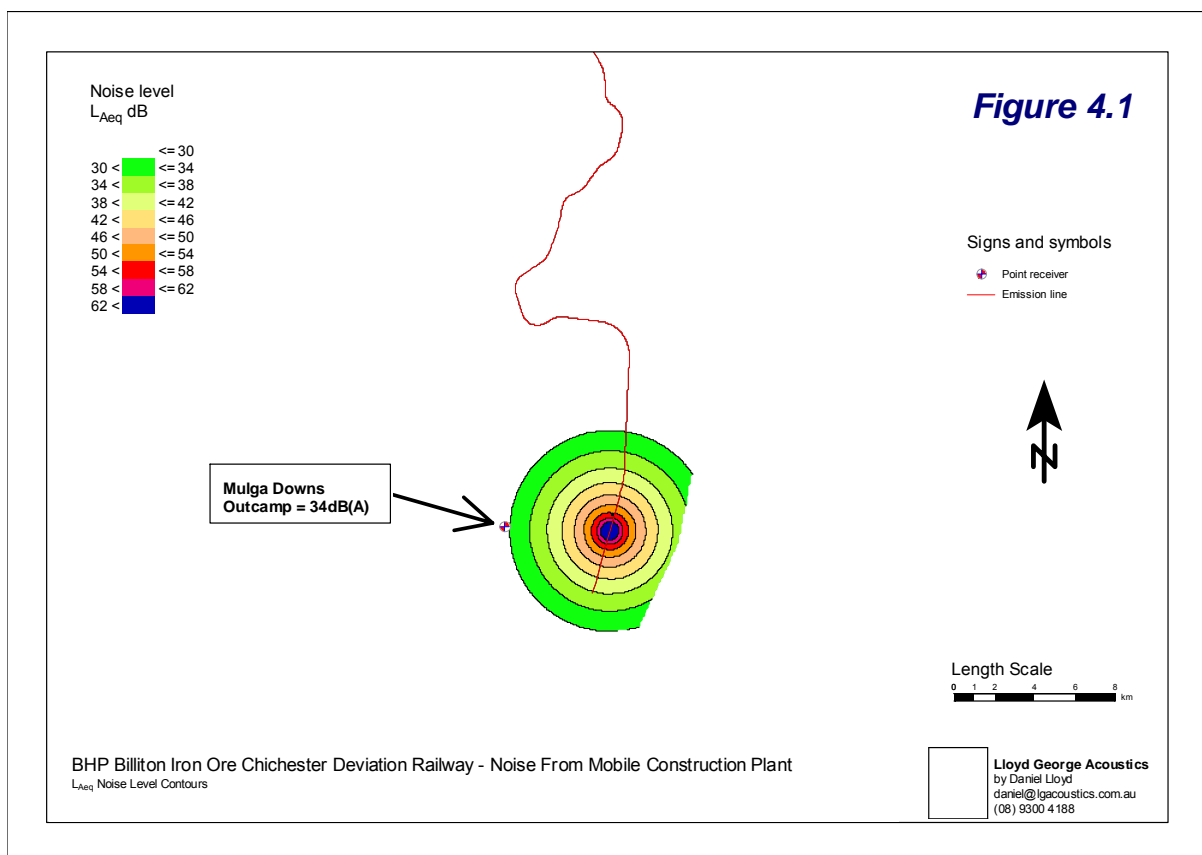


Figure 4.1 Construction Noise Predictions from Mobile Plant

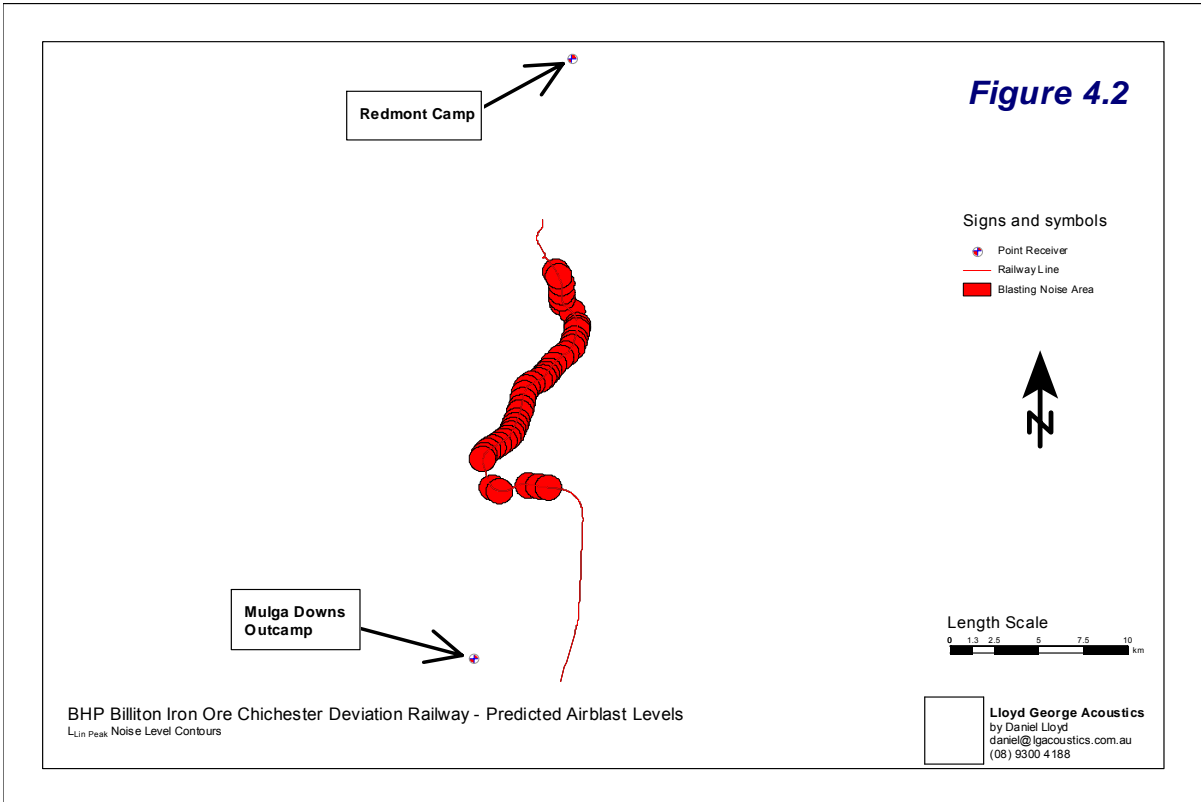


Figure 4.2 Extent of Blasting Conformance

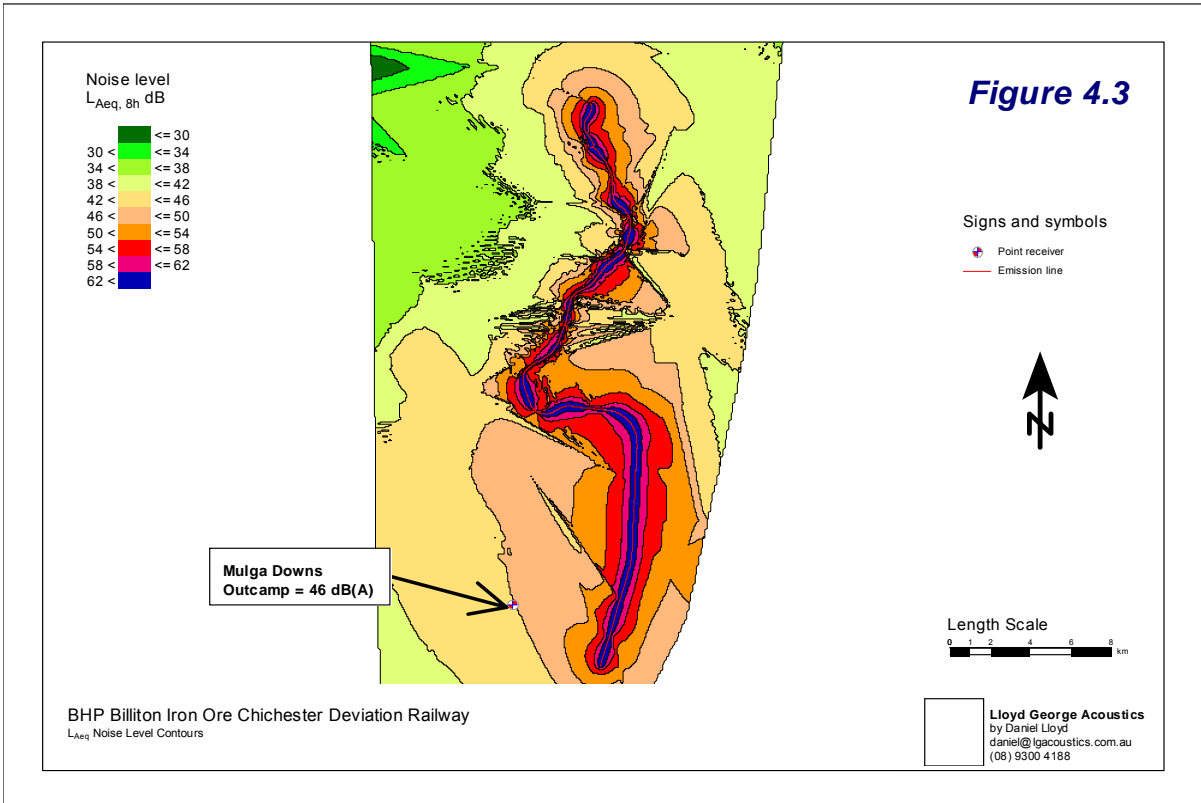


Figure 4.3 Operational Noise Predictions

Appendix A provides noise level contour plots in A4 size.

5 ASSESSMENT

The results show that the noise from the construction and blasting are unlikely to impact on any noise sensitive premises. The only affected premises is the Mulga Downs Outcamp. At this location, the noise from the construction activities is predicted to be L_{A10} 34 dB, under worst-case meteorological conditions, and blasting levels are well below $115 \text{ dB } L_{\text{Linear peak}}$. As this premises is not a residential property and just used on occasions as a temporary shelter, the noise is not expected to be an issue.

The results from the operation of the railway show that the Mulga Downs Outcamp would receive a noise level of $L_{\text{Aeq (8 hour)}}$ 46 dB. This noise level would be acceptable under the draft *Statement of Planning Policy: Road and Rail Transportation Noise* and would be conditional (N2 Rating) under the *EPA Statements for EIA No. 14 (Version 3) - Road and Rail Transportation Noise*. However, as this premises is not a residential property and is just used on occasions as a temporary shelter, the noise is not expected to be an issue.

It should be noted that the noise from construction and operation of the Chichester deviation was also assessed to the Redmont Accommodation Village. The noise level to this location was significantly below the level predicted to the Mulga Downs Outcamp and therefore is unlikely to be audible.

APPENDIX A



A4 Noise Level Contour Plots

Figure 4.1

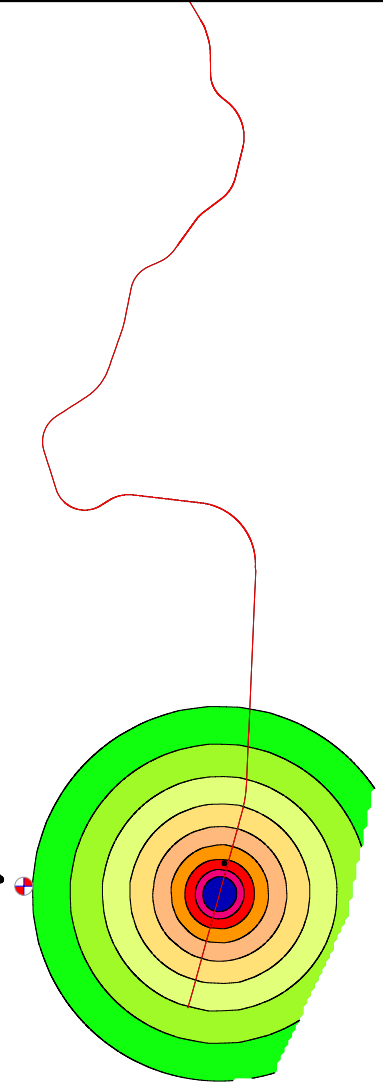
Noise level
 L_{Aeq} dB

≤ 30	≤ 30
$30 <$	≤ 34
$34 <$	≤ 38
$38 <$	≤ 42
$42 <$	≤ 46
$46 <$	≤ 50
$50 <$	≤ 54
$54 <$	≤ 58
$58 <$	≤ 62
$62 <$	

Signs and symbols

-  Point receiver
-  Emission line

Mulga Downs
Outcamp = 34dB(A)



Length Scale

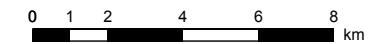
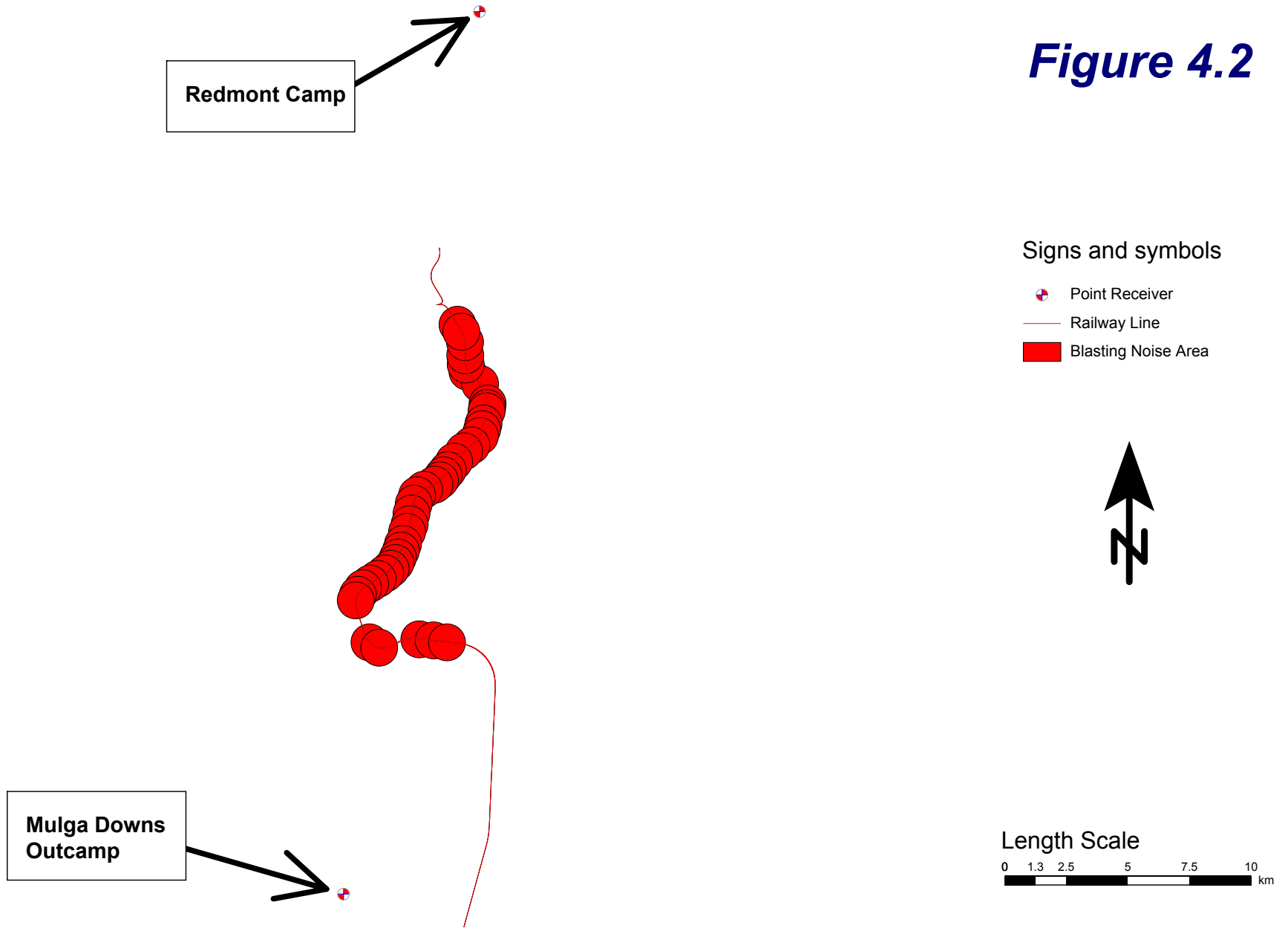


Figure 4.2













BHP Billiton Iron Ore Chichester Deviation Railway - Predicted Airblast Levels
 $L_{Lin Peak}$ Noise Level Contours





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Figure 4.3

Noise level
 $L_{Aeq, 8h}$ dB

	≤ 30
	$30 < \leq 34$
	$34 < \leq 38$
	$38 < \leq 42$
	$42 < \leq 46$
	$46 < \leq 50$
	$50 < \leq 54$
	$54 < \leq 58$
	$58 < \leq 62$
	$62 <$

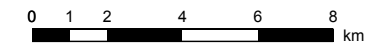
Signs and symbols

-  Point receiver
-  Emission line



Mulga Downs
Outcamp = 46 dB(A)

Length Scale



BHP Billiton Iron Ore Chichester Deviation Railway
 L_{Aeq} Noise Level Contours



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APPENDIX B

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)

The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting

An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

Sound Power Level (L_w)

Under normal conditions, a given sound source will radiate the same amount of energy, irrespective of its surroundings, being the sound power level. This is similar to a 1kW electric heater always radiating 1kW of heat. The sound power level of a noise source cannot be directly measured using a sound level meter but is calculated based on measured sound pressure levels at known distances. Noise modelling incorporates source sound power levels as part of the input data.

Sound Pressure Level (L_p)

The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

L_{ASlow}

This is the noise level in decibels, obtained using the A frequency weighting and the S time weighting as specified in AS1259.1-1990. Unless assessing modulation, all measurements use the slow time weighting characteristic.

L_{AFast}

This is the noise level in decibels, obtained using the A frequency weighting and the F time weighting as specified in AS1259.1-1990. This is used when assessing the presence of modulation only.

L_{APeak}

This is the maximum reading in decibels using the A frequency weighting and P time weighting AS1259.1-1990.

L_{Amax}

An L_{Amax} level is the maximum A-weighted noise level during a particular measurement.

L_{A1}

An L_{A1} level is the A-weighted noise level which is exceeded for one percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{A10}

An L_{A10} level is the A-weighted noise level which is exceeded for 10 percent of the measurement period and is considered to represent the “intrusive” noise level.

L_{Aeq}

The equivalent steady state A-weighted sound level (“equal energy”) in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the “average” noise level.

L_{A90}

An L_{A90} level is the A-weighted noise level which is exceeded for 90 percent of the measurement period and is considered to represent the “background” noise level.

One-Third-Octave Band

Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20 000 Hz inclusive.

L_{Amax} assigned level

Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded at any time.

L_{A1} assigned level

Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 1% of the representative assessment period.

L_{A10} assigned level

Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 10% of the representative assessment period.

Tonal Noise

A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

the presence in the noise emission of tonal characteristics where the difference between —

- (a) the A-weighted sound pressure level in any one-third octave band; and
- (b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

This is relatively common in most noise sources.

Modulating Noise

A modulating source is regular, cyclic and audible and is present for at least 10% of the measurement period. The quantitative definition of tonality is:

a variation in the emission of noise that —

- (a) is more than 3 dB $L_{A \text{ Fast}}$ or is more than 3 dB $L_{A \text{ Fast}}$ in any one-third octave band;
- (b) is present for at least 10% of the representative

Impulsive Noise

An impulsive noise source has a short-term banging, clunking or explosive sound. The quantitative definition of tonality is:

a variation in the emission of a noise where the difference between $L_{A \text{ peak}}$ and $L_{A \text{ Max slow}}$ is more than 15 dB when determined for a single representative event;

Major Road

Is a road with an estimated average daily traffic count of more than 15,000 vehicles.

Secondary / Minor Road

Is a road with an estimated average daily traffic count of between 6,000 and 15,000 vehicles.

Influencing factor

$$= \frac{1}{10} (\% \text{ Type A}_{100} + \% \text{ Type A}_{450}) + \frac{1}{20} (\% \text{ Type B}_{100} + \% \text{ Type B}_{450})$$

where:

% Type A_{100} = the percentage of industrial land within
a 100m radius of the premises receiving the noise

% Type A_{450} = the percentage of industrial land within
a 450m radius of the premises receiving the noise

% Type B_{100} = the percentage of commercial land within
a 100m radius of the premises receiving the noise

% Type B_{450} = the percentage of commercial land within
a 450m radius of the premises receiving the noise

+ Traffic Factor (maximum of 6 dB)

= 2 for each secondary road within 100m

= 2 for each major road within 450m

= 6 for each major road within 100m

Representative Assessment Period

Means a period of time not less than 15 minutes, and not exceeding four hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

Background Noise

Background noise or residual noise is the noise level from sources other than the source of concern. When measuring environmental noise, residual sound is often a problem. One reason is that regulations often require that the noise from different types of sources be dealt with separately. This separation, e.g. of traffic noise from industrial noise, is often difficult to accomplish in practice. Another reason is that the measurements are normally carried out outdoors. Wind-induced noise, directly on the microphone and indirectly on trees, buildings, etc., may also affect the result. The character of these noise sources can make it difficult or even impossible to carry out any corrections.

Ambient Noise

Means the level of noise from all sources, including background noise from near and far and the source of interest.

Specific Noise

Relates to the component of the ambient noise that is of interest. This can be referred to as the noise of concern or the noise of interest.

Satisfactory Design Sound Level

The level of noise that has been found to be acceptable by most people for the environment in question and also to be not intrusive.

Maximum Design Sound Level

The level of noise above which most people occupying the space start to become dissatisfied with the level of noise.

Reverberation Time

Of an enclosure, for a sound of a given frequency or frequency band, the time that would be required for the reverberantly decaying sound pressure level in the enclosure to decrease by 60 decibels.

RMS

The root mean square level. This is used to represent the average level of a wave form such as vibration.

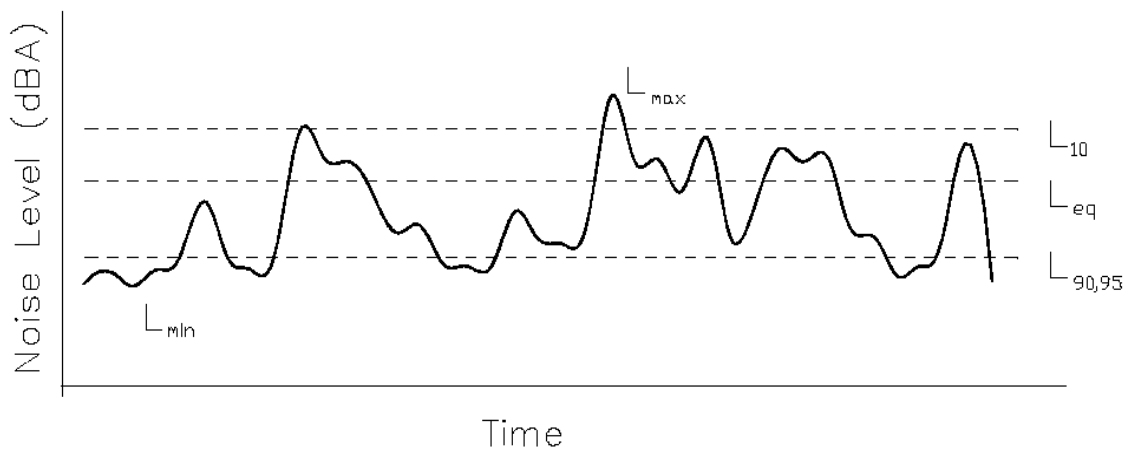
Vibration Velocity Level

The RMS velocity of a vibration source over a specified time period. Units are mm/s.

Peak Velocity

Level of vibration velocity measured as a non root mean square (r.m.s.) quantity in millimetres per second (mm/s).

Chart of Noise Level Descriptors



Typical Noise Levels

