CHAPTER 7 NOISE AND VIBRATION

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7 NOISE AND VIBRATION

This chapter provides a summary of the noise and vibration impact assessment including the potential impacts of the Project on the surrounding community. Measures to manage these impacts are also provided.

7.1 INTRODUCTION

A noise and vibration impact assessment has been undertaken for the Project covering general site operations (mining, blasting and haulage, minerals processing activities, internal traffic and rail shunting movements), potential noise impacts associated with off-site rail movements and mine-related traffic on the roads surrounding the site. This chapter sets out the key findings of the assessment. Further details are provided in the *Rasp Mine Noise and Vibration Assessment Report (2007a)* and an associated Addendum Report (2009) presented as *Annexure G(A) and G(B).*

The Addendum Report re-assesses the predicted noise emissions from construction activities in isolation from open-cut mining, as open-cut mining is no longer a part of the application. The Addendum provides additional details in accordance with the Department of Environment Climate Change and Water (DECCW) *NSW Construction Noise Guideline – Draft August 2008,* as required under the updated Director General Requirements (DGRs) March 2009. This draft guideline is now gazetted as the *Interim Construction Noise Guideline.* Other areas addressed by the Addendum, as a consequence of the updated DGRs, include the DECCW and the Department of Planning (DoP) *Interim Guideline for Assessment of Noise from Rail Infrastructure Projects April 2007* and DECCW *Assessing Vibration: A Technical Guideline February 2006*, both in respect of rail noise and vibration associated with the proposal.

Since the completion of the Addendum BHOP have elected to fully enclose the crushing and screening equipment within a purpose built building. Noise modelling does not address this additional noise abatement measure and therefore the results provided have a higher level of conservatism.

7.2 METHODOLOGY

The 2007 noise impact assessment was undertaken by ERM and the associated 2009 addendum was undertaken by Environmental Management Group Australia Pty Limited (EMGA) in accordance with the following:

- DECCW (2000) Industrial Noise Policy (INP);
- Australian and New Zealand Environment and Conservation Council (ANZECC) (1990) Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration;
- Australian Standard (AS) 1055 Acoustics, Description and Measurement of Environmental Noise;
- DECCW (1994) Environmental Noise Control Manual (ENCM) and Interim Construction Noise Guideline (July 2009);
- DECCW (1999a) Environmental Criteria for Road Traffic Noise (ECRTN); and
- DECCW and DoP Interim Guideline for Assessment of Noise from Rail Infrastructure Projects (April 2007); and

- Assessing Vibration a Technical Guideline (February 2006)

This assessment included impacts associated with Project activities in relation to:

- construction of the processing plant and haul roads;
- underground mining;
- ore haulage;
- operation of the processing plant; and
- ore loading and transport by rail.

To characterise the existing noise environment, monitoring of noise levels was conducted at selected residences surrounding the site. Unattended noise monitoring was conducted for three weeks at the residences at locations M1 to M5. In addition attended short term 15 minute measurements were taken at several locations, including Locations M1 and M5 and Sp1 to Sp10. Monitoring locations are shown on *Figure 7-1*. Noise measurements obtained from monitoring were analysed in accordance with the INP.

The assessment included modelling of noise from all major operational plant and equipment using Environmental Noise Model noise prediction software and addressing the DECCW INP with regard to weather effects.

7.3 EXISTING ENVIRONMENT

Background noise surveys to characterise and quantify the acoustic environment in the area surrounding the Project were undertaken at monitoring locations as indicated in *Figure 7-1,* 'M' indicates locations where long term monitoring was undertaken (3 weeks) and 'Sp' indicates locations where spot noise monitoring occurred. The noise environment in surrounding residential areas is characterised by noise from road traffic, commercial and industrial activities, general urban hum and natural sounds (eg wind in trees etc). *Table 7-1* summarises the amended rating background levels of these monitoring locations.

The locations of representative noise-sensitive receivers assessed are shown as A1 to A10 on *Figures 7-2* to *7-5* and listed in *Table 7-2*. Receivers selected are generally those closest to the Project Area to capture the potential worst case impacts.

The results of noise monitoring are included in *Annexure G(A) and Annexure G(B)*. Monitoring data indicates that background noise levels at residences in the vicinity of the Project are generally typical of rural or relatively quiet suburban residential localities, though are higher during the day at Eyre Street and Argent Street, where noise levels from road traffic and commercial activity are higher. These roads are designated as trucking routes through Broken Hill.

During the day-time, average ambient noise levels ranged from 38 decibels (A-weighted or dB(A)) at Location M4 to 58dB(A) at Location M1. During the night-time they ranged from 34dB(A) at Location M4 to 49dB(A) at Locations M1 and M2. In accordance with the NSW INP the Rating Background Level (RBL) is the median that represents background noise levels at a particular location taken over a particular period. These RBLs for adopted assessment locations are derived from the monitoring data and are shown in *Table 7-2.* These range from 30dB(A) to 43dB(A) during the day and 30dB(A) to 34dB(A) at night.

Figure 7-1 Monitoring locations

Table 7-1 Summary of amended rating background levels

Monitoring location		Rating Background Level (RBL) dB(A)			Ambient Leq Noise Level, dB(A)		
		Day	Evening	Night	Day	Evening	Night
M1	139 Eyre Street	39	36	34	58	57	49
M2	148 Piper Street	33	32	30	49	40	49
M3	237 Hebbard Street	33	33	32	48	53	46
M4	208 Carbon Street	30	30	30	38	40	34
M5	10 Argent Street (2001 data)	37	36	30	54	54	39

1. INP Daytime is defined as 7am to 6pm; Evening is defined as 6pm to 10pm; Night is defined as 10pm to 7am.

2. Day time levels derived on the basis of 7 m/s wind speed threshold at 10 m above ground at Broken Hill Airport. This is considered to represent less than 5 m/s at the microphone according to AS1170.2.

3. 2001 data was used for Argent Street as mechanical noise interference contaminated the 2007 data.

Table 7-2 Rating background (noise) levels at assessment locations

Assessment location		Rating background level, dB(A)		
		Day	**Evening**	**Night**
A1	Piper Street (North)	33	32	30
A2	Piper Street (Central)	33	32	30
A3	Eyre Street (North)	39	36	34
A4	Eyre Street (Central)	39	36	34
A5	Eyre Street (South)	39	36	34
A6	Bonanza & Gypsum Streets	43	36	34
A7	Carbon Street	30	30	30
A8	South Road	43	34	34
A9	Crystal Street	41	34	34
A10	Garnet & Blende Streets	37	36	30

INP Daytime is defined as 7am to 6pm; Evening is defined as 6pm to 10pm; Night is defined as 10pm to 7am.

7.3.1 Project specific operational noise criteria

Assessment criteria for receivers potentially affected by industrial noise are outlined in the INP which includes the following objectives:

- protection of the community from excessive intrusive noise; and
- preservation of the amenity for specific land uses.

Both criteria need to be met.

The residential intrusiveness criterion is met if the $L_{Aeq,15min}$ noise levels from the newly-introduced source does not exceed the existing RBL by more than 5dB.

The criterion for the preservation of residential amenity requires ambient noise levels from all industries to be within the acceptable levels for the particular locality and land uses.

The fundamental difference between the intrusiveness and amenity criteria is that the former is based on a 15-minute period, whilst the latter is averaged over the entire assessment period.

Table 7-3 shows the derived project specific intrusiveness noise criteria. These are the stricter of the intrusiveness and amenity criteria, and have been adopted for this assessment.

Table 7-3 Project specific operational noise criteria

Receiver No	Location	Criterion, $L_{eq,15minute}$ dB(A)			Comments
		Day	Evening	Night	
A1	Piper St North	38	37	35	This also applies to the southern urban area of Broken Hill.
A2	Piper St Central	38	37	35	-
A3	Eyre St North	44	41	39	-
A4	Eyre St Central	44	41	39	-
A5	Eyre St South	44	41	39	-
A6	Bonanza & Gypsum Sts	48	41	39	-
A7	Carbon St	35	35	35	This also applies to the north west urban area of Broken Hill.
A8	South Rd	48	39	39	-
A9	Crystal St	46	39	39	-
A10	Garnet & Blende Sts	42	41	35	This also applies to the northern urban area of Broken Hill.

1. Criteria are based on the existing background noise levels presented in *Table 7-2*.

2. INP Daytime is defined as 7am to 6pm; Evening is defined as 6pm to 10pm; Night is defined as 10pm to 7am.

7.3.2 Modelling approach

A detailed outline of the approach used to conduct noise modelling can be found in *Annexure G(A) and Annexure G(B)* and includes details on calculation procedures, modelling scenarios, plant noise levels and noise mitigation measures that have been incorporated into the Project design.

In summary the approach utilised three-dimensional noise modelling methods (Environmental Noise Model (ENM) software) and takes into account distance, ground effect, atmosphere absorption and topographical detail.

The model incorporates equipment emission data and has been completed for each stage of the Project. Equipment was placed at various locations and heights, representing potential operating conditions that could result in the greatest noise impacts for the life of the Project.

7.4 IMPACT ASSESSMENT

7.4.1 Construction Noise Levels

The construction of the surface processing facility will typically entail two broad stages of construction.

The first stage will be the establishment of the ROM pad area and includes civil works. The expected duration of this stage of construction is 26 weeks.

The second stage will be the structural phase, including mechanical works, piping and electrical works. The expected duration of this stage of construction is 18 weeks.

Based on typical plant emission data, noise levels at representative receiver locations were predicted using the ENM software (a DECCW accepted modelling package).

The results of construction noise predictions are summarised in *Table 7-4* for representative residential locations, as identified in the ERM Report. They are also presented graphically as noise contours in *Figure 7-2*. The results demonstrate that typical construction activities are expected to satisfy the adopted ICNG criteria at all representative residential locations. To that end, predicted noise levels in *Table 7-4* are generally below background noise levels at corresponding residential locations (refer to *Table 7-2*) Therefore on-site construction noise is not expected to be audible at most residential locations for most of the time. The extension of construction hours, by one hour to meet shift arrangements, to between 7am and 7pm seven days per week is therefore not considered unreasonable.

Table 7-4 Predicted construction noise levels

	Location	Predicted Leq,15min Construction Noise Level, dB(A)		ICNG Daytime Criteria (background +10dB)
		Civil Works	Structural Works	
A1	Piper St North	34	27	43
A2	Piper St Central	37	32	43
A3	Eyre St North	37	34	49
A4	Eyre St Central	40	35	49
A5	Eyre St South	36	32	49
A6	Bonanza & Gypsum Sts	32	27	53
A7	Carbon St	38	29	40
A8	South Rd	33	27	53
A9	Crystal St	36	28	51
A10	Garnet & Blende Sts	32	24	47

Figure 7-2 Civil construction noise levels, dB(A)

Broken Hill Operations Pty Ltd

Date: 11/12/09

Source: EMGA

Scale: Not to scale

7.4.2 Operational noise levels

Daytime

The noise modelling results for day-time operations under calm weather conditions are presented as noise contours in *Figure 7-3*. They assume:

- Underground mining operations concurrent with processing (with and without rail spur activities).

Table 7-5 summarises these results against the Project Specific Operational Noise Criteria (*Table 7-3*) and concludes that:

- For underground mining and surface processing activities without the operation of the rail spur, all but one of the representative receivers meet the criteria. The predicted noise level at receiver A2 is marginally above the daytime criteria by 1 dB(A).

- For underground mining and surface processing activities with the operation of the rail spur, all but two of the representative receivers meet the daytime criteria. The predicted noise level at receiver A2 is marginally above the criteria by 1 dB(A), and at A7 a similar marginal breach of 2 dB(A) is predicted for the daytime. It should be noted that the rail spur is unlikely to be used during the one hour evening shoulder period. Hence discussions of impacts during the shoulder period with the rail spur are not relevant.

These exceedances are not considered to be significant as they are below or within 2 dB of the relevant DECCW criteria, after application of reasonable and feasible mitigation. In addition, the rail spur will only operate twice per day over a 15 minute period.

Table 7-5 Predicted daytime noise levels (7am to 7pm)

Assessment location	Predicted $L_{eq,15minute}$ Noise Level, dB(A)		Criteria, dB(A)	
	Underground operations + processing		Day	Day / evening shoulder (6pm – 7pm)
	With rail spur not in use	With rail spur in use		
A1	34	34	38	37
A2	**39**	**39**	38	37
A3	40	40	44	43
A4	41	42	44	43
A5	41	42	44	43
A6	43	46	48	45
A7	34	**37**	35	35
A8	34	37	48	44
A9	36	37	46	43
A10	33	33	42	41

1. Predicted noise levels above criteria are in bold.

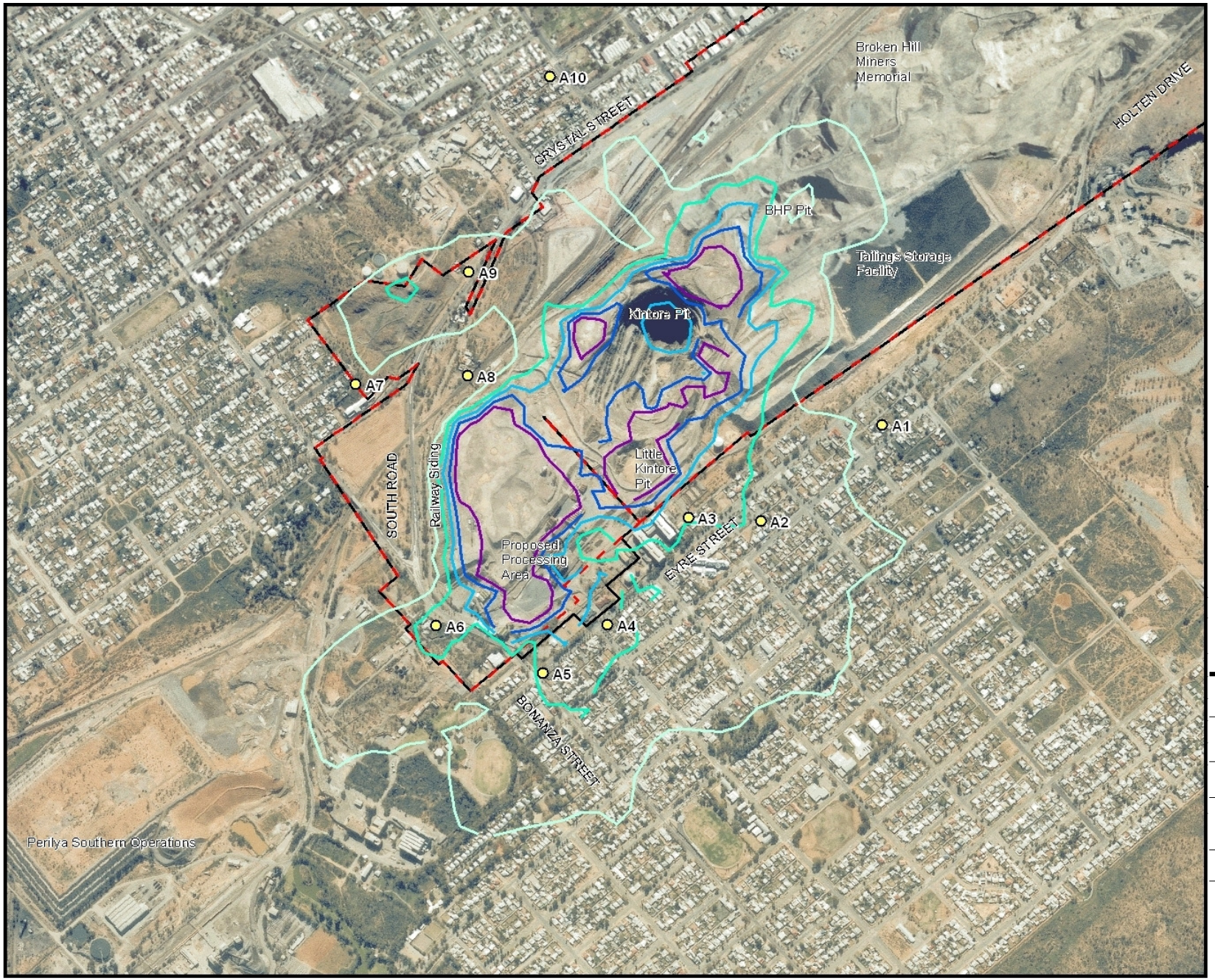
2. Criteria are INP intrusiveness criteria for residential receivers.

3. Rail Spur to be used for two 15 minute periods per day.

4. The Day / Evening shoulder criteria are derived according to the INP.

5. INP Daytime is defined as 7am to 6pm; Evening is defined as 6pm to 10pm; Night is defined as 10pm to 7am.

Figure 7-3 $L_{eq,\ 15minute}$ daytime operational noise levels (underground mining), dB(A)



Legend

- Assessment Location
- 35dB(A)
- 40dB(A)
- 45dB(A)
- 50dB(A)
- 50dB(A)
- Rasp Mine/CML 7 Boundary
- Project Area

Broken Hill Operations Pty Ltd

Date: 24/09/07

Source: Aerial Dept of Lands by ERM

Scale: Not to scale

Evening and Night-time

The noise modelling results for evening and night-time operations under calm weather conditions are presented and summarised against Project Specific Noise Criteria in *Figure 7-4*. The rail spur will not be operating at night therefore; this activity has not been included in the assessment.

In the case of underground mining with surface processing plant the results indicate that for calm weather conditions the criteria is met for all representative receivers during the evening and is exceeded at one location during the night-time. At location A4, noise criteria is exceeded by 1dB, which is considered negligible.

Under various weather conditions, noise levels experienced at a particular location may increase or decrease from those experienced during calm weather conditions. To assess the worst case scenario, noise levels from the Project were assessed under moderate inversion (3°C/100m) conditions during the night. The results presented in *Table 7-6* and *Figure 7-4* indicate, that evening and night time noise impact is not likely at most receivers.

At times of adverse weather, criteria exceedances of 1 dB may occur at one location, A6 in the evening. At night, exceedances due to adverse weather are predicted at five locations A3, A4 and A10 by 1 dB(A), A2 by 2 dB(A) and A6 by 3 dB(A). These exceedance levels are within 5 dB of the criteria and therefore not considered significant, consistent with the INP definition.

Table 7-6 Predicted evening and night time noise levels (7pm to 7am)

Assessment location	Predicted $L_{eq,15minute}$ Noise level, dB(A)		Criteria, dB(A)	
	Calm weather	3ºC/100 m temperature inversion	Evening	Night
A1	27	30	37	35
A2	34	**37**	37	35
A3	39	**40**	41	39
A4	38	**40**	41	39
A5	34	37	41	39
A6	**40**	**42**	41	39
A7	31	33	35	35
A8	32	33	39	39
A9	34	36	39	39
A10	30	**36**	41	35

1. Predicted noise levels above criteria are in bold.

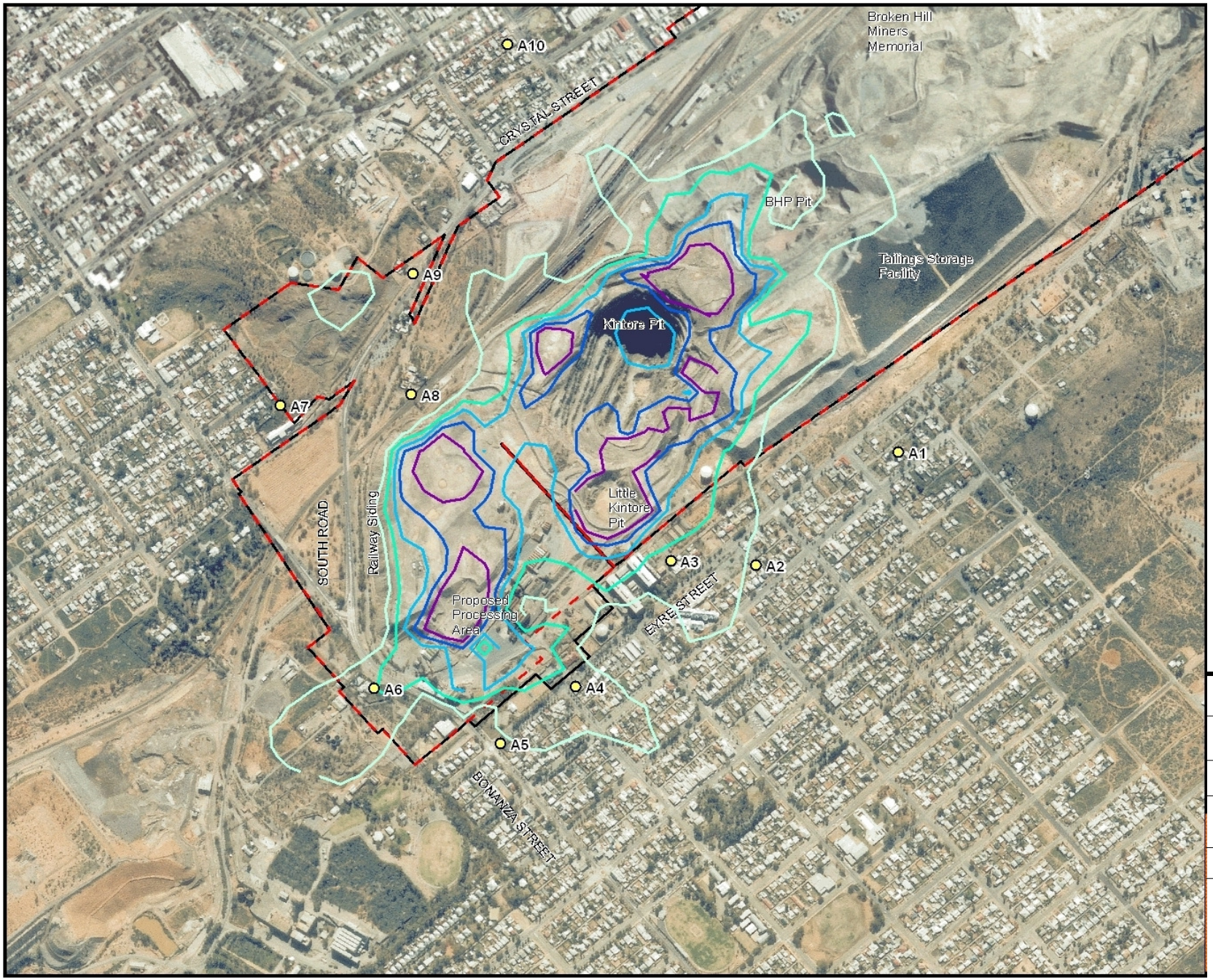
2. INP Daytime is defined as 7am to 6pm; Evening is defined as 6pm to 10pm; Night is defined as 10pm to 7am.

7.4.3 Sleep disturbance

Sleep disturbance can occur by transient noise such as that emanating from bulldozer track plates, truck engine at fast revving and vehicle reversing alarms.

Night-time maximum noise levels (L_{max}) under calm and adverse weather conditions were calculated at each of the receiver locations for the equipment identified as having the most potential to cause sleep disturbance. Project equipment that has the potential to generate transient noise levels included a waste truck, ore truck or a dozer, which given their mobility have the greatest potential to come into closer proximity to the residences.

Figure 7-4 $L_{eq,\ 15minute}$ night time operational noise levels (calm weather), dB(A)



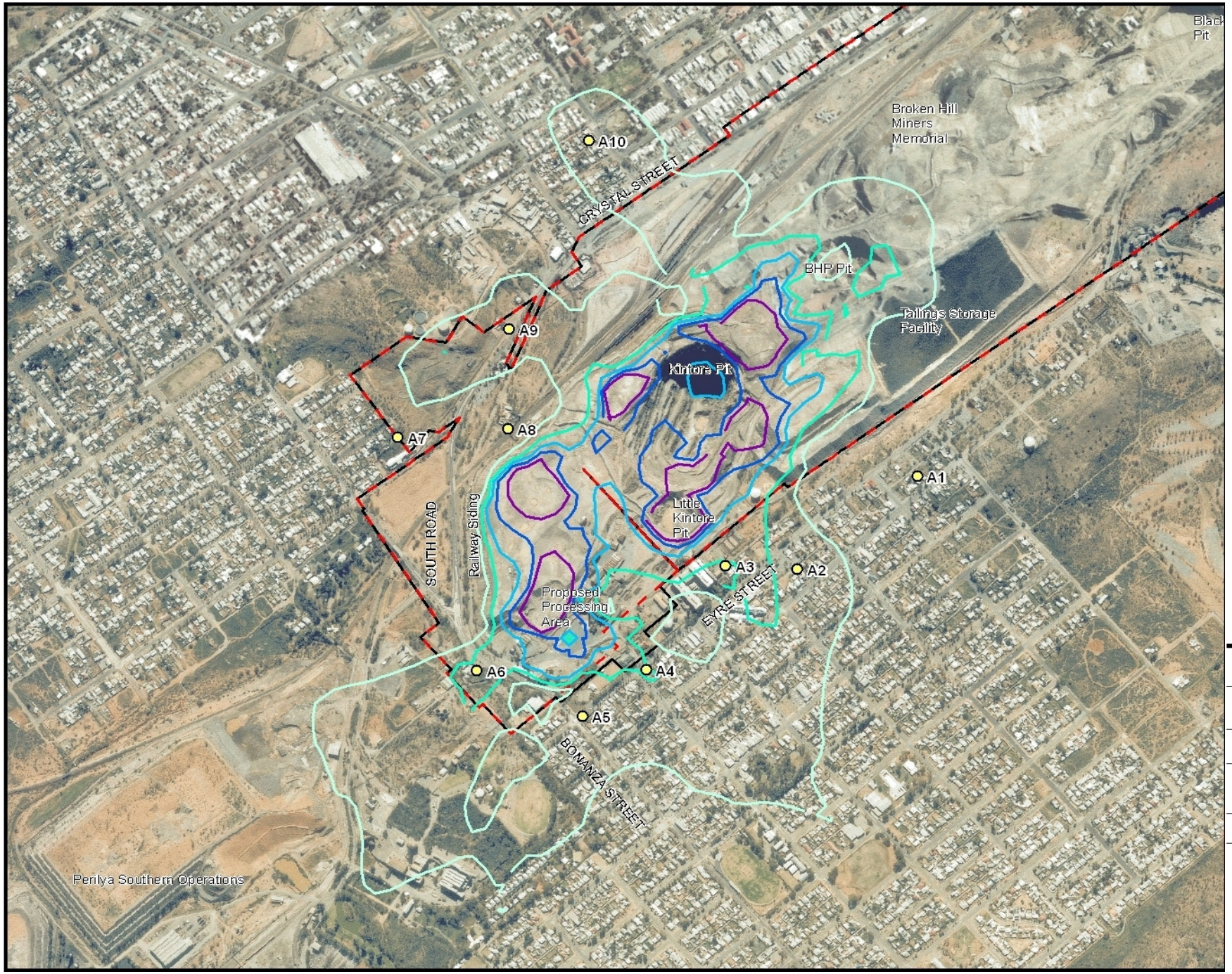
Broken Hill Operations Pty Ltd

Date: 24/09/07

Source: Aerial Dept of Lands by ERM

Scale: Not to scale

Figure 7-5 $L_{eq,\ 15minute}$ night time operational noise levels (3°C/100m inversion), dB(A)



Legend

- Assessment location
- 35dB(A)
- 40dB(A)
- 45dB(A)
- 50dB(A)
- 50dB(A)
- Rasp Mine/CML
- Project Area

Broken Hill Operations Pty Ltd

Date: 24/09/07

Source: Aerial Dept of Lands by ERM

Scale: Not to scale

The calculated maximum noise levels for each assessment location are presented in *Table 7-7*, along with the sleep disturbance criteria. The criteria are consistent with the DECCW's current position which is that to prevent sleep disturbance, the L_{max} noise level from an intrusive source should not exceed the background noise level (*Table 7-2*) by more than 15 dB.

Table 7-7 Predicted L_{max} noise levels from night-time operations

Assessment location	External L_{max} noise level from on-site plant, dB(A)		L_{max} Criteria, dB(A)
	Calm	Moderate inversion	
A1	40	42	45
A2	45	**51**	45
A3	50	**52**	49
A4	39	45	49
A5	40	46	49
A6	36	39	49
A7	47	**49**	45
A8	45	46	49
A9	47	50	49
A10	46	**53**	45

1. Criteria exceedences of greater than 2dB(A) (threshold of perception) are in bold.

Table 7-7 demonstrates that calculated L_{max} noise levels under calm weather conditions are within the stipulated criteria at all assessed receivers. During adverse weather (approximately 30% of winter nights), predicted maximum noise levels are above sleep disturbance criteria at four of the assessed representative receivers (Locations A2, A3, A7 and A10). However not all night-time truck movements would result in the worst case L_{max} noise levels presented in *Table 7-7*, a conservative approach has been adopted. Current night time L_{max} noise levels from ambient (non-site related) sources, as determined by noise monitoring conducted for this assessment, are variable, and typically range from 50dB(A) to 60dB(A), peaking at 77dB(A) on Piper Street. Hence, the L_{max} noise levels predicted to result from the Project are of the same order as the typical average ambient L_{max} already experienced at receptors.

7.4.4 Road traffic noise

Based on expected traffic volumes and distribution, the residences most likely to be affected by road traffic noise from the Project are those on Eyre Street to the east of Comstock Street, this is the designated trucking route.

Expected traffic noise levels were calculated for a representative residence of Eyre Street (i.e. façade 20 m from the road) and are presented in *Table 7-8*. The results indicate that during the busiest hour of the day or night, the environmental criteria for road traffic noise will be met at the potentially most affected residence and therefore no significant road traffic noise impacts are anticipated.

Table 7-8 Predicted traffic noise – Eyre Street (20m from road)

Modeled scenario	Peak 1hr traffic volumes			Leq,1hr dB(A)	Criteria, dB(A)
	Light	Heavy	Total		
Existing (day)	132	21	153	65	NA
Project only (day)	57	12	69	62	NA
Cumulative (existing & project) (day)	189	33	222	67	67
Project only (night i.e. 6.30am – 7.30am for 7am shift change)	67	0	57	51	55

1. Modelled speed is 50 km/hr as per street sign post.
2. Criteria are ERCTN criteria for land use developments with potential to create additional traffic on collector roads.
3. The night time shift change 55dB(A) criteria assumes existing traffic noise levels are relatively low at below 45dB(A).

7.4.5 Main rail line noise

Section 14.4.5 discusses the impacts from rail movements. There will be no additional trains, during normal operations on the main rail line. Hence, no net change in noise impact or exposure is generally anticipated from operations along the main line.

The closest existing residential property to the main rail line is approximately 30 m north of the track (location A8 in the ERM Report). However, the general residential population of Broken Hill to the north is at least 75 m away.

The former Rail Access Corporation (RAC) publishes measured noise levels for various train sets and these are used here for demonstrating likely noise levels. *Table 7-9* provides calculated train pass-by noise levels for two distances from the rail track, one representing the closest, but isolated, residential location and the other representing the closest general residential area of Broken Hill. The data indicates that freight type trains (including locomotives, coal, ore and other freight) generally produce a noise level of 80 dB(A) as a median value (with a 6 dB(A) standard deviation) at 30 m. This satisfies the non-mandatory Guideline value of 85 dB(A) L_{max}. At 75 m away, where the general residential area of Broken Hill begins to the north of the site, noise levels are well below adopted criteria.

Table 7-9 Train pass-by levels at 30m and 75m

Location	Existing Noise levels				RASP Freight		DECCW/DoP Criteria
	Passenger		Freight				
	L_{max} dB(A)	Frequency	L_{max} dB(A)	Frequency	L_{max} dB(A)	Frequency	L_{max} dB(A)
30m	71-80	1/day	63-93 80median	3-7/day	63-93 80median	2/day	85
75m	63-72	1/day	55-85 72 median	3-7/day	55-85 72 median	2/day	85

Notes: 1.The median value noise level has a standard deviation of 6dB.

Further details are provided in *Annexure GA*.

7.4.6 Rail vibration

The *Environmental Noise Management – Assessing Vibration: A Technical Guideline (DECC, 2006),* shows how to calculate the estimated VDV (eVDV) as a screening method. For intermittent vibration Appendix B of the Guideline provides the following equation:

$$eVDV = 0.07 \times v_{rms} \times t^{0.25} \text{ m/s}^{1.75}$$

where v_{rms} is the vibration velocity (root mean square) in mm/s and

t is the total period of the day (in seconds) during which the vibration may occur (ie summation of all train pass-bys).

The vibration caused by a freight train pass-by will vary, depending on site conditions such as track bed type, track condition (continuous welded rail or other), presence of crossovers, train speed and load. Whilst site specific rail vibration data was not collected on this occasion, typical vibration levels are used to estimate emissions. *Table 7-10* provides typical vibration levels from freight train pass-bys at several distances. It is clear that at even 15 m, the eVDV value will satisfy the adopted criteria. The 30 m vibration level representing the closest residence to the track was determined through interpolation of eVDV values at other distances.

Table 7-10 Train pass-by vibration levels

Distance, m	Vibration, mm/s	Passbys	Time, s	eVDV, $m/s^{1.75}$	Day Residential Criteria, $m/s^{1.75}$
15	0.25	1	90	0.05	0.2 - 0.4
22	0.25	1	90	0.05	
30				*0.04*	
44	0.1	1	90	0.02	
48	0.1	1	90	0.02	

Source: Assessment of Proposed Rail Sidings, IPMG Printing Facility, Warwick Farm (Noise and Vibration Assessment from the NSW DoP Major Projects Register, July 2009 (www.planning.nsw.gov.au))

7.4.7 Blasting

The Project requires the use of blasting to recover ore from the underground production areas (stopes).

The minimum separation distance between the proposed blast locations and assessment or receptor locations are summarised in *Table 7-11*.

To assess for blast noise overpressure impacts, the distance taken was from the portal for underground blasts.

To assess for blast ground vibration, the distance to the ore body blast location was used for underground. Due to the position of the Western Mineralisation (the Centenary Mineralisation lies below the Western Mineralisation) ore body and therefore blasting areas an additional location was included for assessment. This location is representative of the closest receivers on Crystal Street. This ensures that potential worst case impacts to residences have been assessed.

Table 7-11 Receptor locations

Assessment location	Minimum blast separation distance, m	
	Underground	
	From portal	Ore body
A1	758	997
A2	680	1158
A3	607	1119
A4	898	1436
A5	1070	1607
A6	1091	1578
A7	919	1165
A8	627	924
A9	658	739
A10	910	517
Other (Crystal St)	-	289

In accordance with ANZECC (1990) guidelines, time and frequency restrictions do not apply to major underground metalliferous mining operations.

Underground blasts

Site specific MICs required to satisfy night-time and daytime ANZECC (1990) limits for overpressure are presented in *Table 7-12* for a range of blast-receptor distances upward of the identified minimum separation distance to residences from the portal i.e. 607 m. These were calculated using the results of 2007 monitoring of underground blasts for decline development, conducted at 209 m, 433 m and 491 m from the decline portal (i.e. source of noise overpressure). It should be noted that decline depth and orientation will change in future which would reduce overpressure noise escaping through the portal to residential areas from their current levels.

The results demonstrate that strict control of MIC values is needed to achieve the 95 dBL night time noise overpressure criteria at receptors. These MIC values should be used as a guide for proposed blasts.

Table 7-12 Recommended blast charge mass

Blast to receptor distance, m	MIC_{8ms} to satisfy ANZECC 95% overpressure	MIC_{8ms} to satisfy ANZECC 95% overpressure
	Day limit of 115 dB(Lin), kg	Night limit of 95 dB(Lin), kg
600	293	11
650	373	14
700	465	18
750	572	22
800	695	27
850	833	32
900	989	38
950	1,163	45
1,000	1,357	53
1,050	1,571	61
1,100	1,806	70

In the absence of more recent site specific ground blast vibration data, the data in *Table 7-12* can be used as a guide for blast limits to avoid impacts from ground vibration at sensitive receptors.

7.5 MANAGEMENT AND MONITORING MEASURES

Given the location of the Project, in the centre of Broken Hill, due consideration was given from the outset to address potential noise impacts to the surrounding neighbours. Consultation was ongoing with the local community, Project engineers and noise consultants to design the Project so that unacceptable levels of noise were mitigated and managed. The following provides an outline of the major measures undertaken in this design together with the necessary management requirements for successful implementation.

7.5.1 Summary of the major noise sources

The major noise sources generated by the Project will be:

- construction activities with earthworks, establishment of site roads, landform reprofiling, construction of the plant buildings, sub-stations, TSF and various ponds;
- underground mining with blasting, and ore and waste truck haulage;
- processing plant with crushing, grinding and milling, concentrate loading and transport, and materials handling; and
- suppliers, contractors and employees traffic movements.

7.5.2 Management of operational noise

The following outlines the design elements resulting from the consultation process:

- limiting selected operational activities to dayshift (7:00am to 7:00pm), for example crushing and rail shunting;
- noise suppression kit on front-end-loaders that operate at the ROM pad;
- crushing and grinding activities located within a depression, being 10m below site surface to the north west;
- cladding on the primary, secondary, tertiary crushers and screen (crushers and screen now enclosed and within a purpose built building);
- re-design mine truck haulage on-site from southern to northern alignment, leading to greater separation distances to south residences;
- re-locating surface ventilation fans from the preferred location near to Crystal Street north of the main railway tracks to an existing pit (Little Kintore Pit) at the southern area of the site. In addition, provision for manufacturer supplied noise suppression on the two ventilation fan arrangements;
- four metre high earth bunding along the northern haul road alignment;
- four metre high earth bunding along the southern haul road alignment, including the area south of Little Kintore Pit, further shielding the ventilation fans; and
- four metre high solid wall running east-west along the southern edge of the proposed Reagent Handling structure.

7.5.3 Management of blasting noise and vibration

The management of noise and vibration associated with blasting activities is an area of much focus for the Project given its proximity to noise and vibration receptors.

As part of the feasibility process alternate methods of mining were considered (e.g. mobile miners, etc), however the properties of the rock mass are such that drill and blast methods are superior in economic, environmental and safety terms.

The key to the management of blasting noise and vibration is a robust quality assurance and quality control process used in concert with the following controls:

- limiting the amount of explosive charge which is fired on any particular delay (MIC) – refer to *Table 7-12*;
- blast holes are accurately drilled in accordance with a predetermined design which has been prepared by personnel with experience in blasting;
- stemming holes and ensuring that the length of the uncharged hole is sufficient to control flyrock as well as blast overpressure and noise;
- ensuring that hole spacings and burdens are not excessive – thus the shot is not excessively confined which leads to vibration;
- firing blasts at times where the local community are engaged in activities which are less sensitive to the issues of noise and vibration;
- monitoring all blasts to confirm stipulated limits are met and also allow for refinement of blast designs (design validation);
- utilising structures which assist in absorbing noise resulting from blasts;
- procedures detailing the manner in which blasts are to be managed at all stages of operations including drilling, charging, firing and record keeping;
- incident investigation processes will be used to evaluate any blast which exceeds stipulated thresholds.

7.5.4 Management Procedures and Monitoring

The current Noise, Vibration and Overpressure Management Plan will be updated to take into account the changes from Project activities. This includes amendments to the procedures for blasting, noise monitoring and compliance assessment. This plan will be updated regularly to reflect any further changes to the operations.

Monitoring will include attended as well as unattended noise recordings in specified locations and under various operating conditions. Similarly, all blasts, vibration and overpressure, will be monitored.

The procedure for monitoring will include a noise and blasting component which includes requirements for:

- monitoring of noise quarterly in the first twelve months and annually thereafter, or at other times when circumstances require additional monitoring at locations where there is a sensitivity to noise and vibration arising from mining operations;
- overpressure and vibration monitoring at sites approved by the DECCW;

- an on-site weather station (including capability for capturing sigma-theta); and
- keeping the local community and regulators informed and responding quickly and effectively to issues raised.

7.6 CONCLUSIONS

Noise levels generated by the Project are not expected to significantly exceed relevant DECCW and DoP criteria at sensitive receivers and can be managed by implementation of management and monitoring measures outlined in *Section 7.5*. Night time operations are not expected to cause impacts and no significant noise impacts from road or main rail line traffic generated by the Project are predicted. Blast design will incorporate control on the charge masses and implementation of management procedures, including monitoring of all blasts, to enable acceptable limits to be maintained with respect to airblast noise overpressure and ground vibration at nearby sensitive receptors.