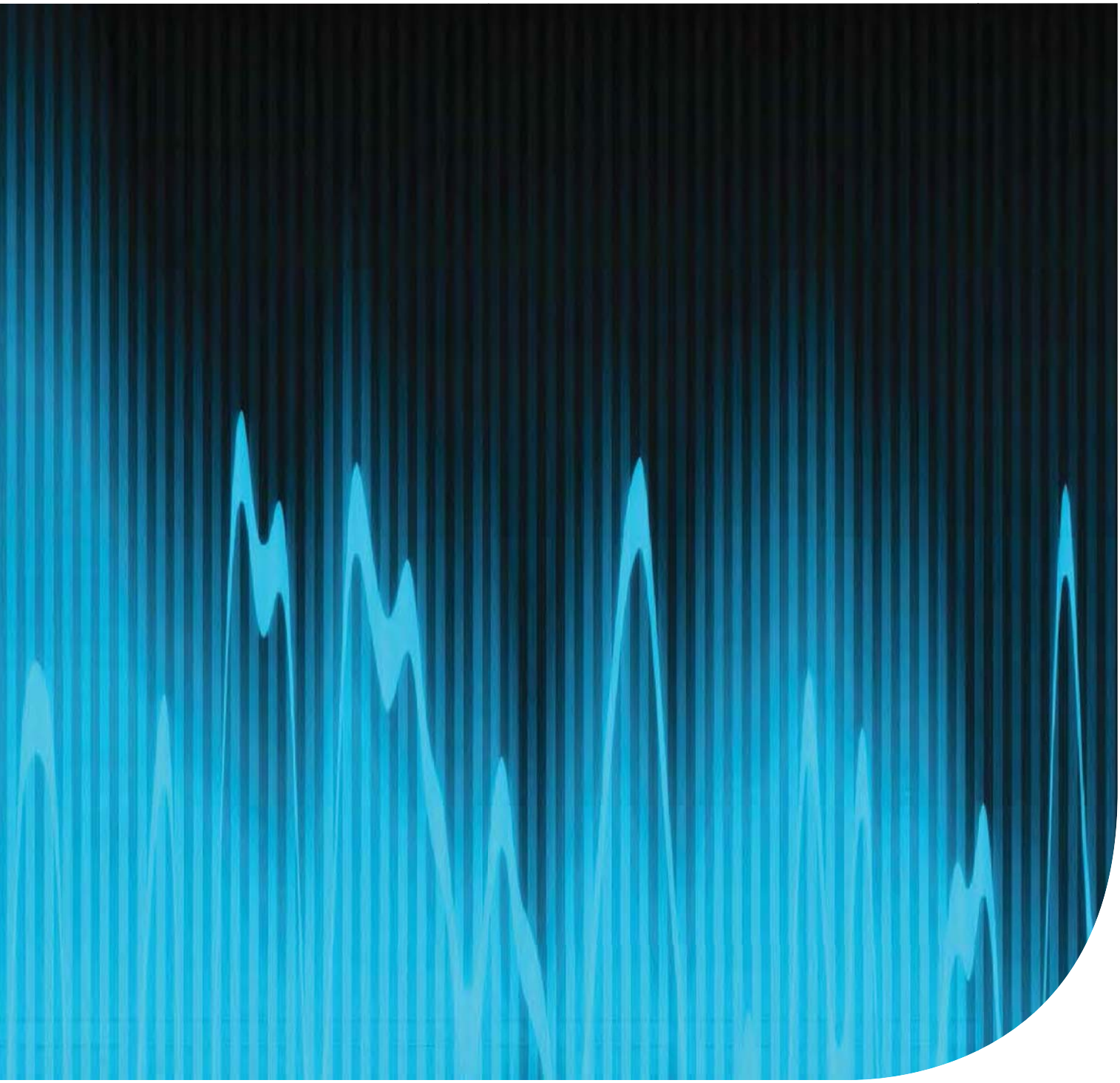
Rasp Mine Modification 5

Construction noise and vibration assessment

Prepared for Broken Hill Operations Pty Ltd | 17 August 2018



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Rasp Mine Modification 5

Final

Report J180306RP1 | Prepared for Broken Hill Operations Pty Ltd | 17 August 2018

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1 Introduction

EMM Consulting Pty Limited (EMM) has been engaged by Broken Hill Operations Pty Ltd (BHOP) to complete a construction noise and vibration assessment for the proposed Modification 5 (MOD5) of Project Approval PA 07_0018 (PA) for the Rasp Mine in Broken Hill, NSW.

BHOP is seeking to modify its PA to extend the current Stores Warehouse and install a cement silo at the Backfill Plant. No formal Environmental Assessment Requirements have been issued by the Department of Planning and Environment (DPE) for the proposed modification, however, the department has provided the following consideration for the assessment of the modification in regards to noise and vibration matters:

> Noise and vibration: construction of the stores extension and cement silo are classified as construction activities. The SEE should include an assessment of the likely construction noise impacts of these activities under the Interim Construction Noise Guideline and be developed in consultation with the NSW EPA;

This report presents an assessment of noise and vibration for the proposed construction works in accordance with the NSW Department of Environment and Climate Change (DECC) Interim Construction Noise Guideline (ICNG). This report also provides recommended construction noise and vibration management measures where relevant in accordance with the ICNG.

This report references the PA and noise and vibration guidelines as follows:

- NSW Department of Planning and Environment (DPE), *Project Approval (PA 07_0018)*), March 2015;
- NSW Environment Protection Authority (EPA), *Noise Policy for Industry*, 2017;
- NSW Department of Environment and Climate Change (DECC), *Interim Construction Noise Guideline*, 2009; and
- NSW Department of Environment and Conservation (DEC), *Assessing Vibration: a technical guideline*, 2006.

2 Existing environment and proposed modification

2.1 Existing mining operations

The Rasp Mine is located in the centre of the City of Broken Hill and mining has been occurring at the site for over 130 years. Existing approved mining operations at Rasp Mine consist mainly of underground operations, surface hauling of material to the processing plant and dispatch of concentrate products.

Construction and operation of the site Concrete Batching Plant (CBP) and the extension of Blackwood Pit Tailings Storage Facility (TSF2) were approved in September 2017 as part of the previous PA modification (MOD4) for the site. The CBP is currently under construction and will be operational before the start of the proposed construction works. The proposed construction activities (MOD5) have the potential to occur concurrently with construction activities associated with the extension of the TSF2, however they are not expected to increase noise from the TSF2 activities to above the relevant limits at surrounding receivers, in accordance with the PA. Therefore, the TSF2 construction activities are not considered part of this modification (MOD5) and have not been included in this assessment.

2.2 Proposed construction (MOD5)

BHOP is proposing to extend their current Stores Warehouse and install a cement silo at their on-site Backfill Plant.

The Stores Warehouse would be located centrally and to the south of the site for storage purposes. The extension would be positioned along a section at the western side of the Stores Warehouse on an area currently used for delivery vehicle access. Site preparation for the proposed extension would consist of levelling the area using an excavator and front-end loader (FEL) to provide a base for the installation of footings and a concrete slab. Approximately 22 tonnes (t) of material would be back-loaded into an ore haul truck (50 t capacity) and transported to the waste rock stockpile in Kintore Pit. Approximately 45 m^3 of concrete would be sourced from the new CBP. The structure would be fabricated off-site and arrive on site as a kit to be assembled on the concrete base. Site assembly would be undertaken using a crane, an elevated work platform and/or scissor lift and battery operated rattle gun and screw guns.

The cement silo would be located adjacent to the Backfill Plant situated central and to the north of the site, on an area currently used for vehicle parking. Site preparation for the proposed extension would consist of levelling the area using an excavator and front-end loader (FEL) to provide a base for the installation of footings and a concrete slab. Approximately 25 t of material would be back-loaded into an ore haul truck (50 t capacity) and transported to the waste rock stockpile in Kintore Pit. Approximately 40 m^3 of concrete would be sourced from the CBP. The cement silo would be fabricated off-site and would be transported to site and placed in position using a crane.

The proposed construction works will be restricted to daytime hours between 7 am and 6 pm Monday to Friday, 8 am to 1 pm on Saturdays, and no work on Sundays or public holidays. The proposed construction activities may occur concurrently and span approximately four weeks. The construction activities will be completed in separate stages as outlined in Table 2.1.

Table 2.1 Proposed construction activities and duration

Construction works	Activity	Expected duration
Stores Warehouse extension	Site preparation	3-4 days
	Installation of concrete slab and footings	4-5 days[2]
	Assembly of building	18-20 days
Cement silo installation	Site preparation	3-4 days
	Installation of concrete slab and footings	4-5 days[2]
	Assembly of building and infrastructure	5 days

Notes: 1. Includes concrete curing time.

2.3 Assessment locations

Construction noise has been assessed at the nearest sensitive receivers to the proposed activities, which are referenced herein as assessment locations. Assessment locations nearest to the proposed Stores Warehouse extension and Cement Silo installation, which include both residences and commercial places, are located to the south on Eyre Street and to the north of Crystal Street, respectively. Assessment locations on Eyre Street and north of Crystal Street are considered potentially worst affected from the proposed construction works and hence were adopted for the purpose of this assessment. It is anticipated that if construction noise levels satisfy the criteria at these assessment locations then predicted construction noise levels will satisfy the criteria at all other receivers.

Assessment locations and indicative construction areas are shown on Figure 2.1.

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Source: EMM (2018); DFSI (2017);

Assessment locations and proposed construction

Rasp Mine Modification 5
Construction noise and vibration impact assessment
Figure 2.1

EMM

3 Criteria

3.1 Construction noise criteria

3.1.1 Interim construction noise guideline

The assessment of noise from construction works has been completed using the ICNG, which provides two methods for the assessment of construction noise emissions:

- quantitative: suited to major construction projects with typical durations of more than three weeks; and
- qualitative: suited to short term infrastructure maintenance (less than 3 weeks).

The method for a quantitative assessment requires a more complex approach, involving noise emission predictions from construction activities to the nearest sensitive receivers, whilst the qualitative assessment methodology is a more simplified approach that relies more on noise management strategies. Due to the type of the proposed construction works and anticipated duration, this assessment has adopted a quantitative assessment approach.

The ICNG recommends standard hours for normal construction work which are Monday to Friday from 7 am to 6 pm, Saturdays from 8 am to 1 pm, and no work on Sundays or public holidays. The proposed construction works will only occur during the ICNG standard hours.

Where noise levels from construction works during standard hours are above the noise affected level, all feasible and reasonable mitigation should be adopted.

3.1.2 Noise management levels

Table 2 of the ICNG provides guidance on establishing noise management levels for residential receivers during standard hours and is reproduced in Table 3.1.

Table 3.1 ICNG residential noise management levels

Time of day	Management level $L_{Aeq,15min}$	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq,15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

Table 3.1 ICNG residential noise management levels

Time of day	Management level $L_{Aeq,15min}$	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Highly noise affected 75 dB	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: i) times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. ii) if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Source: ICNG (DECC 2009).

Further, the ICNG provides noise management levels for other sensitive land uses (non-residential receivers) for standard hours and these are shown in Table 3.2.

Table 3.2 ICNG noise management levels at other sensitive land uses

Land use	Management level, $L_{Aeq,15min}$ (applies when properties are being used)
Classrooms at schools and other educational institutions	Internal noise level 45 dB
Hospital wards and operating theatres	Internal noise level 45 dB
Places of worship	Internal noise level 45 dB
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dB
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dB
Community centres	Depends on the intended use of the centre Refer to the recommended 'maximum' internal levels in AS 2107 for specific uses

Source: ICNG (DECC 2009).

The ICNG also provides noise management levels for commercial and industrial land uses for standard hours and these are shown in Table 3.3.

Table 3.3 ICNG noise management levels at commercial and industrial land uses

Land use	Management level, $L_{Aeq,15min}$
Industrial premises	External noise level 75 dB (when in use)
Offices, retail outlets	External noise level 70 dB (when in use)

Source: ICNG (DECC 2009).

3.1.3 Project construction noise management levels

The construction noise management levels (NMLs) for residential assessment locations have been based on background noise levels (RBLs) determined during previous noise assessments for the Rasp Mine which are considered to be relevant to the assessment of the proposed construction works. The NMLs for construction standard hours adopted for this assessment were derived in accordance with the ICNG for all assessment locations and are presented in Table 3.4.

Table 3.4 Construction noise management levels for standard hours

Assessment location	Representative logging location[1]	RBL, dB(A)	NML, $L_{Aeq(15\text{-}min)}$, dB
Residences on Eyre St	A3, A4	39	49
Residences north of Crystal St	A9, A11	41	51
Commercial places on Eyre St and north of Crystal St	N/A[2]	N/A[2]	70

Notes: *1. Referenced from EMM report Rasp Mine Modification 4 – Concrete batching plant and TSF2 (Blackwood Pit) extension – Noise impact assessment (2017).*

2. Determination of the NML for commercial receivers is not dependent on existing background noise levels.

3.2 Construction vibration

3.2.1 Human comfort

i General discussion on human perception of vibration

Vibration levels which are well below those causing any risk of damage to a building or its contents can be felt by humans. The actual perception of motion or vibration may not, in itself, be disturbing or annoying. An individual's response to that perception, and whether the vibration is "normal" or "abnormal", depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

Human tactile perception of random motion, as distinct from human comfort considerations, was investigated by Diekmann and subsequently updated in German Standard DIN 4150 Part 2-1975. On this basis, the resulting degrees of perception for humans are suggested by the vibration level categories given in Table 3.5.

Table 3.5 Peak vibration levels and human perception of motion

Approximate vibration level	Degree of perception
0.10 mm/s	Not felt
0.15 mm/s	Threshold of perception
0.35 mm/s	Barely noticeable
1.0 mm/s	Noticeable
2.2 mm/s	Easily noticeable
6.0 mm/s	Strongly noticeable

Table 3.5 Peak vibration levels and human perception of motion

Approximate vibration level	Degree of perception
14.0 mm/s	Very strongly noticeable

Notes: These approximate vibration levels (in floors of building) are for vibration having a frequency content in the range of 8 Hz to 80 Hz.

Table 3.5 suggests that people can barely start to feel floor vibration at levels as low as 0.15 mm/s and that the motion becomes "noticeable" at a level of approximately 1.0 mm/s.

ii Assessing vibration a technical guideline

The guideline *Environmental Noise Management – Assessing Vibration: a technical guideline* (DEC 2006) is based on guidelines contained in BS 6472-2008 'Evaluation of human exposure to vibration in buildings (1-80Hz)'.

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended the operator negotiate directly with the affected community.

The guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria. Table 2.1 of the guideline provides examples of the three vibration types and has been reproduced in Table 3.6.

Table 3.6 Types of vibration

Continuous vibration	Impulsive vibration	Intermittent vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, eg occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990).	Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria.

The type of vibration of relevance to the proposed development is intermittent vibration hence, continuous and impulsive vibration have not been discussed further.

iii Intermittent vibration

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time. Intermittent vibration is representative of activities such as impact hammering, rolling or general excavation work (such as an excavator tracking).

Section 2.4 of the guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted root mean square (rms) acceleration levels over the frequency range 1 Hz to 80 Hz. To calculate the VDV, the following formula is used (refer Section 2.4.1 of the guideline):

$$VDV = \left[\int_0^T a^4(t)dt \right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, *a (t)* is the frequency-weighted rms of acceleration in m/s^2 and *T* is the total period of the day (in seconds) during which vibration may occur.

The acceptable VDV for intermittent vibration are reproduced in Table 3.7. There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The guideline states that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

Table 3.7 Acceptable vibration dose values for intermittent vibration

Location	Daytime		Night-time	
	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$
Critical Areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes: *1. Daytime is 7 am to 10 pm and night-time is 10 pm to 7 am.*

2. These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

3.2.2 Structural vibration criteria

Most commonly specified 'safe' structural vibration limits are designed to minimise the risk of threshold or cosmetic surface cracks, and are set well below the levels that have potential to cause damage to the main structure.

In terms of the most recent relevant vibration damage criteria, Australian Standard AS 2187.2-2006 – 'Explosives - Storage and Use - Use of Explosives' recommends the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 'Evaluation and measurement for vibration in buildings Part 2' be used as they are "applicable to Australian conditions".

The standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (eg compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and commercial/industrial buildings are presented numerically in Table 3.8 and graphically in Figure 3.1.

Table 3.8 Transient vibration guide values - minimal risk of cosmetic damage

Line	Type of building	Peak component particle velocity in frequency Range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

The standard states that the guide values in Table 3.8 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings.

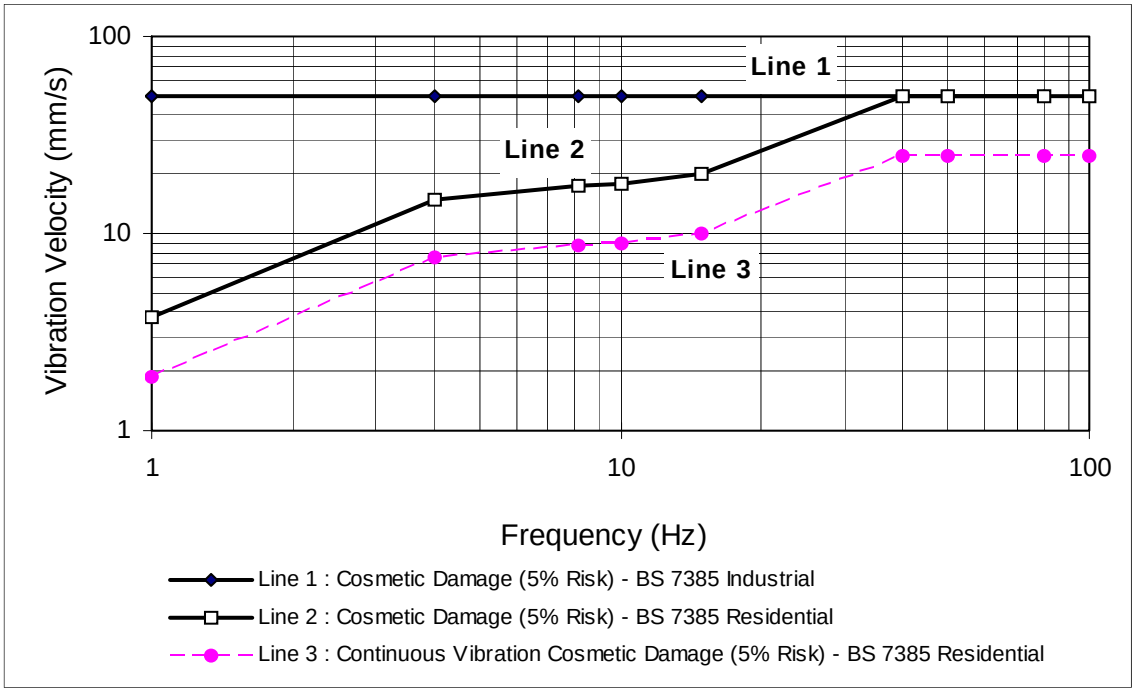

Figure 3.1 Graph of transient vibration guide values for cosmetic damage

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for building types corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard goes on to state that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 3.8, and major damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the guide values in Table 3.8 should not be reduced for fatigue considerations.

In order to assess the likelihood of cosmetic damage due to vibration, AS 2187 specifies that vibration should be measured at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the criteria curves presented in Table 3.8.

It is noteworthy that extra to the guide values nominated in Table 3.8, the standard states that:

> Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK.

Also that:

> A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.

4 Noise assessment

4.1 Noise modelling methodology

Quantitative modelling of construction noise was completed using Brüel & Kjær Predictor Version 11 noise prediction software. This software calculates total noise levels at assessment locations from the concurrent operation of multiple noise sources. The model incorporated factors such as:

- the lateral and vertical location of plant and equipment;
- source-to-receiver distances;
- ground effects;
- atmospheric absorption;
- topography; and
- meteorological conditions.

Three-dimensional digitised ground contours of the site and surrounding land were incorporated to model topographic effects. Equipment was modelled at locations and heights representative of proposed construction activities.

4.2 Meteorological conditions

Meteorological conditions used for the noise modelling were based on the meteorological data used for the previous noise assessment (MOD4), recorded between January 2014 and September 2016 by the Bureau of Meteorology Automatic Weather Station located at the Broken Hill Airport. The weather data analysis was completed in accordance with the methods outlined in the NPfI (EPA 2017). The analysis showed that no wind conditions were identified as 'significant' during the day period (consistent with the ICNG standard hours). Therefore calm meteorological conditions were adopted for the noise modelling of construction noise; relevant parameters are presented in Table 4.1.

Table 4.1 Modelled meteorological conditions

Period	Condition	Temperature	Humidity	Wind speed	Wind direction	Temperature gradient
Day[1]	Calm	20°C	70%	Nil	n/a	D class

Notes: 1. Consistent with ICNG standard hours.

4.3 Acoustically significant plant and equipment

Modelled construction plant and equipment items and associated sound power levels are summarised in Table 4.2. These levels are based on data provided by BHOP or otherwise have been supplemented using EMM's database of equipment used for similar projects. Single octave sound power levels are provided in Appendix A.

Table 4.2 Modelled sound power levels for acoustically significant noise sources

Plant or equipment item	Sound power level (L_{Aeq}), dB	Stores Warehouse	Cement silo
Excavator	104	✓	✓
Front-end loader (FEL)	105	✓	✓
Haul truck (transporting material)	112	✓	✓
Concrete agitator truck (pouring)	109	✓	✓
Concrete agitator truck (driving)	103	✓	✓
Crane	106	✓	✓
Elevated work platform	105	✓	
Power tools	97	✓	

4.4 Construction scenarios and modelling assumptions

The construction noise modelling was based on information received from BHOP. The Stores Warehouse extension and Cement Silo installation may occur concurrently. Hence acoustically significant plant and equipment items for worst case activities from each construction site were modelled as operating concurrently. The construction noise modelling is therefore considered to represent an acoustically worst case scenario. The construction works are proposed to only occur during the ICNG standard hours of 7 am to 6 pm Monday to Friday and 8 am to 1 pm on Saturdays. No construction work will occur on Sundays or public holidays.

As part of the approved PA modification (MOD4), the construction of the site CBP included the construction of a building enclosure and a 6 m high noise bund to mitigate noise associated with CBP operations. The noise bund has been completed and the construction of the CBP is currently underway and will be completed before the start of the proposed construction works (MOD5). The CBP building and noise bund are expected to provide a reduction in noise emissions from the proposed Cement Silo installation at assessment locations to the north of the site (eg north of Crystal Street) and hence have been included in the noise model for the purpose of this assessment.

4.5 Modelling results

Noise levels for worst case construction activities from the proposed, concurrent construction works predicted at the nearest assessment locations (residential or commercial) on Eyre Street and north of Crystal Street are provided in Table 4.3. Predicted noise levels were assessed against the most stringent NML (residential) for assessment locations on Eyre Street and north of Crystal Street.

Table 4.3 Construction noise results

Assessment location	Standard hours NML[1] $L_{Aeq,15min}$, dB	Predicted (worst case) construction $L_{Aeq,15min}$ noise levels , dB	Exceedance of NML, dB
Most affected on Eyre St	49	46[2]	Nil
Most affected north of Crystal St	51	31[2]	Nil

Notes: 1. Most stringent NML (residential).

2. Level predicted at residential and commercial locations.

Modelling results show that site noise from the proposed construction works is predicted to satisfy the ICNG residential NMLs at all assessment locations. A source ranking analysis of the modelled noise activities identified concrete pouring (concrete agitator truck) and transport of material (haul truck) as the

main contributors to predicted noise levels. It is noted that modelled construction noise levels shown in Table 4.3 represent potentially worst case levels from both the Stores Warehouse extension and Cement Silo installation combined. Construction noise emissions levels are expected to be lower for the majority of the construction duration since modelling assumes all equipment operating concurrently. The proposed construction works are expected to be completed in approximately four weeks.

Construction noise impact is expected to be negligible from the proposed construction works, nonetheless management and mitigation measures currently in place or employed at the site are provided in Section 6.

5 Construction vibration

As a guide, safe working distances for typical items of vibration intensive plant are listed in Table 5.1. The safe working distances are quoted for both "Cosmetic Damage" (refer British Standard BS 7385) and "Human Comfort" (refer British Standard BS 6472-1).

Table 5.1 Recommended safe working distances for vibration intensive plant

Plant item	Rating/Description	Safe working distance	
		Cosmetic damage (BS 7385)	Human response (BS 6472)
Vibratory Roller	<50kN (Typically 1-2 tonnes)	5 m	15 to 20 m
	<100kN (Typically 2-4 tonnes)	6 m	20 m
	<200kN (Typically 4-6 tonnes)	12 m	40 m
	<300kN (Typically 7-13 tonnes)	15 m	100 m
	>300kN (Typically 13-18 tonnes)	20 m	100 m
	>300kN (>18 tonnes)	25 m	100 m
Small hydraulic hammer	(300 kg - 5 to 12t excavator)	2 m	7 m
Medium hydraulic hammer	(900 kg - 12 to 18t excavator)	7 m	23 m
Large hydraulic hammer	(1600 kg - 18 to 34t excavator)	22 m	73 m
Vibratory pile driver	Sheet piles	2 m to 20 m	20 m
Pile boring	≤ 800 mm	2 m (nominal)	N/A
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

Source: Transport Infrastructure Development Corporation Construction's Construction Noise Strategy (Rail Projects), November 2007.

The safe working distances presented in Table 5.1 are indicative and will vary depending on the particular item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions. In relation to human comfort (response), the safe working distances in Table 5.1 relate to continuous vibration and apply to residential receivers. For most construction activities, vibration emissions are intermittent in nature and hence higher vibration levels occurring over shorter periods are allowed, as specified in British Standard 6472-2008 – 'Evaluation of human exposure to vibration in buildings (1-80Hz)'.

The proposed construction activities are not expected to include any vibration intensive plant. Therefore, given the nature of the proposed construction activities and the distances to the nearest residences (ie >100 m) and other building structures, intermittent vibration levels are unlikely to cause adverse human response or cosmetic damage.

Vibration impact is not expected from the proposed construction works, nonetheless management and mitigation measures currently in place or employed at the site are provided in Section 6.

6 Management and mitigation

Noise modelling results have shown that levels likely to be generated by the proposed construction works are predicted to satisfy the ICNG NMLs at all assessment locations. Vibration levels likely to be generated by the proposed construction works are also unlikely to cause adverse human response or cosmetic damage. Notwithstanding, the following management and mitigation measures currently in place or employed at the site will benefit noise and vibration emissions generated during the proposed construction activities:

- construction activities are undertaken during standard construction hours only;
- noise abatement bund (6 m high) north of the CBP and proposed Cement Silo;
- regular reinforcement (such as at toolbox talks) of the need to minimise noise;
- regular identification of noisy activities and adoption of improvement techniques;
- use of broadband audible reverse alarms (ie 'squawkers') on vehicles used on site;
- machinery shall not be permitted to 'warm-up' before the nominated working hours;
- where possible, queuing of vehicles shall not to occur adjacent to residential receivers; and
- planning deliveries and access to the site to occur quietly and efficiently.

7 Conclusion

EMM has completed a construction noise and vibration assessment for the proposed MOD5 construction activities at Rasp Mine.

The proposed construction works are expected to be completed in approximately four weeks. Modelling has shown that construction noise levels from proposed construction works are predicted to satisfy the ICNG noise management levels during standard hours at all assessment locations.

Vibration levels from the proposed construction works are unlikely to cause adverse human response or cosmetic damage at the nearest residences and commercial premises.

Further, management and mitigation measures currently in place or employed at the site will benefit noise and vibration emissions generated during the proposed construction works.

Appendix A

Single octave sound power levels

Table A.1 Plant and equipment sound power levels

Item	Single octave sound power level spectrum, dB(A)									Total, dB(A)
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
Excavator	58	69	90	93	95	100	98	89	79	104
Front-end loader	60	88	94	95	97	100	99	93	84	105
Haul truck (transporting material)	72	95	100	103	107	105	105	100	93	112
Agitator truck (driving)	67	85	89	90	96	99	97	92	84	103
Agitator truck (pouring)	-	51	50	76	88	102	104	104	103	109
Crane	-	86	87	94	96	100	102	94	86	106
Elevated work platform	-	67	88	98	100	99	96	90	79	105
Electric tools	-	57	57	61	71	83	84	88	96	97

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