12 Noise and Vibration

12.1 Introduction

This Chapter identifies the noise and vibration values present for the McArthur River Mine Phase 3 Development Project (the Project) and is based on detailed noise and vibration assessments of the Project including the existing McArthur River Mine (MRM), Bing Bong concentrate storage and ship loading facility (Bing Bong) and the MRM to Bing Bong haulage route (refer to Appendix D-6). Potential impacts on the acoustic values associated with the Project are outlined and where appropriate, mitigation measures proposed.

The Project seeks to maintain the existing environmental noise values, such that noise levels at nearby sensitive receptors are conducive to human health and well-being. The Project also seeks to maintain a suitable acoustic environment for individuals to sleep, study or learn, and to be involved in recreation including relaxation and conversation.

12.1.1 Legislation and Guidelines

The Northern Territory Government does not currently have noise limits prescribed by legislation. Typically, projects are assessed on a case by case basis and may reference noise limits from other states such as Western Australia and Queensland. The following guidelines and standards have been used in reference to noise limits for the Project:

- World Health Organisation (WHO) Guidelines for Community Noise, 1999

Acoustic quality objectives as defined by the WHO seek to protect the amenity of an acoustic environment. The indoor night-time goals effectively address sleep disturbance whilst during the day it protects the ability to have a conversation and avoid annoyance. The acoustic quality guideline values are defined within Table 12-1.

Table 12-1 Guideline values for community noise in specific environments

Specific Environment	Critical Health Effect (s)	LAeq (dB)	Time Base (hours)	LA max (fast)
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	30	8	45

Source - WHO, 1999.

- Australian Standard AS1055.1:1997 and AS1055.2:1997 *Acoustics - Description and Measurement of Environment Noise*
- Australian Standard AS2187.2:2006 – *Explosives Storage, Transport and Use.*

The recommended maximum peak particle velocity and sound pressure noise levels from blasting are given by Australian Standard AS 2187.2:2006 are summarised in Table 12-2.

Table 12-2 Ground vibration and peak noise limits for human comfort

Type of building or structure	Peak component particle velocity (mm/s)	Peak sound pressure level [dB(L)]
Sensitive site (residential buildings, theatres, schools, and other similar buildings occupied by people)	5 mm/s for 95% blasts per year 10 mm/s maximum	115 dB(L) for 95% blasts per year 120 dB(L) maximum
Occupied non-sensitive sites, such as factories and commercial premises	25 mm/s maximum	125 dB(L) maximum

12.2 Existing Environment

The Project is located approximately 70 kilometres (km) south-west of the township of Borroloola and 120 km south of Bing Bong on the Gulf of Carpentaria. The McArthur River Mine accommodation village, the nearest residential facility is located approximately 1.6 km away from operational areas.

Borroloola, the nearest town in the Project area, is approximately 2 km from the Carpentaria Highway, approximately half way between MRM and Bing Bong. The Carpentaria Highway is the existing road and will continue to be the Project's haulage route for the transport of bulk concentrate to Bing Bong.

The area surrounding the Project, the haulage route and Bing Bong is sparsely populated and predominantly used for cattle grazing by large pastoral properties. The area has an undulating topography consisting of open farmlands and scrublands.

Potential sources of noise and/or vibration from the surrounding environment include:

- farming and grazing activities
- environmental noise (e.g. birds, insects, wind etc.)
- road traffic.

12.2.1 Climate

The region experiences a warm environment with two distinct seasons - a wet season from December to March and a dry season for the balance of the year (winter drought). Average winter temperatures range between 12–29°C, whilst average summer temperatures range between 25–38°C. The region averages approximately 800 mm of rainfall annually. Climate data is discussed comprehensively in Chapter 6-Climate.

The warm wet season encourages the proliferation of crickets, cicadas and other wildlife which usually generate higher ambient noise levels than during the dry winter season. The greatest noise impact from the Project will usually occur during the cool dry season, since these cooler conditions are more favourable to the propagation of noise at large distances, particularly at night, while the cooler conditions also result in lower ambient noise levels.

12.2.2 Noise Sensitive Receptors

Predominant use of this sparse and remote area for cattle and pastoral purposes means there is minimal potential for noise impact. MRM's accommodation village, the pastoral station and residences in and around Borroloola are the only sensitive receptors within the Project area.

The only Project related sensitive receptor (the accommodation village) is located approximately 1.5 km from the existing power station and 2 km from the current open pit operations. MRM has received no complaints from residents at the accommodation village in regards to mine generated noise. The Project's proposed open pit mining plan will continue to the east, away from the accommodation village.

The closest township to the Project, Borroloola, is located approximately 70 km north of the mining site. The Carpentaria Highway, which is the haulage route to Bing Bong, runs approximately 1.6 km from the nearest sensitive receptor near Borroloola. MRM have received no complaints from residents in Borroloola in regards to haulage traffic noise from MRM to Bing Bong.

12.3 Noise Modelling

Noise contours generated through a SoundPlan model for the area surrounding MRM and Bing Bong were utilised to provide an estimate of noise levels for the Project.

The SoundPlan 7.0 noise modelling program facilitated production of the detailed technical report in Appendix D-6. Sound pressure levels were calculated at nominated locations around MRM and Bing Bong to formulate noise contours. Inputs of ground topographical data, meteorological data, noise source data and receiver locations were employed to generate contours specific to areas of sensitivity. Algorithms to generate predictions appearing in the SoundPlan program (SVT Engineering Consultants, 2011) were derived from the Conservation of Clean Air and Water in Europe (CONCAWE) report (*The propagation of noise from petroleum and petrochemical complexes to neighbouring communities*, CONCAWE Report 4/81, 1981).

The predictive model of noise for the Project has been developed based on actual noise at time of measurement. Background noise levels and model calibration have been developed from measurements taken within the field at MRM and Bing Bong on the 17th to 19th May 2011. Actual noise levels and frequency spectra were measured in close proximity to major noise emitters, as well as in the mid field (50 – 100 metres), to balance the sound power between sources in the model and in the far field (>200 metres).

The models inputs, assumptions, limitations, sensitivities and accuracy are discussed in further detail in Appendix D-6.

The Project's construction works, as described in Chapter 4 – Project Description, will be undertaken over a two year period, with a majority of the works being completed in the dry seasons of each year. Project construction is expected to commence in 2012 and be completed in the dry season of 2013. As noise levels associated with the Project's construction phase are expected to be relatively low, when compared to the noise levels of MRM's ongoing mining activities, the assessment and modelling of noise levels have focused on operational noise, post construction.

12.3.1 Modelling Parameters

Many factors were taken into account in generating the SoundPlan model. Ground surface factors were assumed to be concrete with spilled product and water puddles in the immediate area around the processing plant and hard packed mud and rock in all other areas around the site. Barrier effects of large buildings were also incorporated into the model, as they can either shield, or otherwise attenuate, noise.

SoundPlan calculates noise levels for defined meteorological conditions. In particular, temperature, relative humidity, wind speed and direction data are required as input parameters to the model.

Worst-case, night time meteorological conditions were used for the noise modelling at both MRM and Bing Bong to assess potential Project noise impacts. Table 12-3 presents the worst-case meteorological conditions for noise propagation.

12.3.2 Noise Modelling Results

Noise models have been developed for the Project's operational activities at both MRM and Bing Bong. The modelling involved using actual noise data collected from the existing noise environment and then incorporating predicted noise from different noise sources. The actual noise data modelled for the Project under current operating conditions is shown in Figure 12-1.

Table 12-3 Worst-case meteorological conditions for noise propagation

Time of day	Temperature °C	Relative humidity	Wind speed	Pasquill stability category
Night time	15°C	50%	3 m/s	F

Predicted noise for the mobile mining equipment (refer to Table 12-4) and fixed plant sources (refer to Table 12-5) was incorporated to calculate the Project's future noise contours.

The modelling also generated noise contours for both of the Project's proposed power station sites. The noise contours for the proposed power station site 2 are contained in Figure 12-2 and the noise contours for the proposed power station site 4 are contained in Figure 12-3. Noise contours for Bing Bong are illustrated in Figure 12-4.

Table 12-4 Summary of maximum noise levels from mining equipment

Mobile equipment type (typical machine)	Quantity of vehicles		Sound power (per vehicle) [dB(A)]
	Current situation	Proposed Project	
Water Cart	2	3	105.1
Haul Truck 100T	3		105.1
Haul Truck 150-175T	12	14	106.7
Haul Truck 220T		14	118.7
Excavator	3	4	109.9
Track Dozer	3	3	125.5
Wheel Loader	3	3	110.6
Grader	2	3	105.3
Drill Rig	3	5	115.3
Total Sound Power [dB(A)]	131.1	133.9	

Table 12-5 Sound power levels of sources used in noise models

Source		Current situation		Proposed project		Comments
		Quantity	Sound power [dB(A)]	Quantity	Sound power [dB(A)]	
Crushing	Primary crusher	1	114.5	1	117.9	Production increase of 120%
	Secondary crusher	1	111.4	1	114.8	
	Tertiary crusher	1	104.6	1	108.0	
	Screen 1	1	112.6	1	116.0	
	Screen 2	1	106.2	1	109.7	
Heavy media plant (Whole building)		N/A		1	115.7	New (under construction)
Processing Plant	Processing Plant	1	117.8	1	122.2	Increase from 4 MW to 11 MW
	Float floor (whole building)	1	120.8	No change		
	Roughers (whole building)	1	117.1	No change		
	Regrinders	6	112.6	No change		
	M10,000 Regrinders	1	108.5	4	108.5	Increase in quantity
Power generation, gas turbine (inc. stack)		6	114.2	16	114.8	New
Total Sound Power			127.6		130.6	

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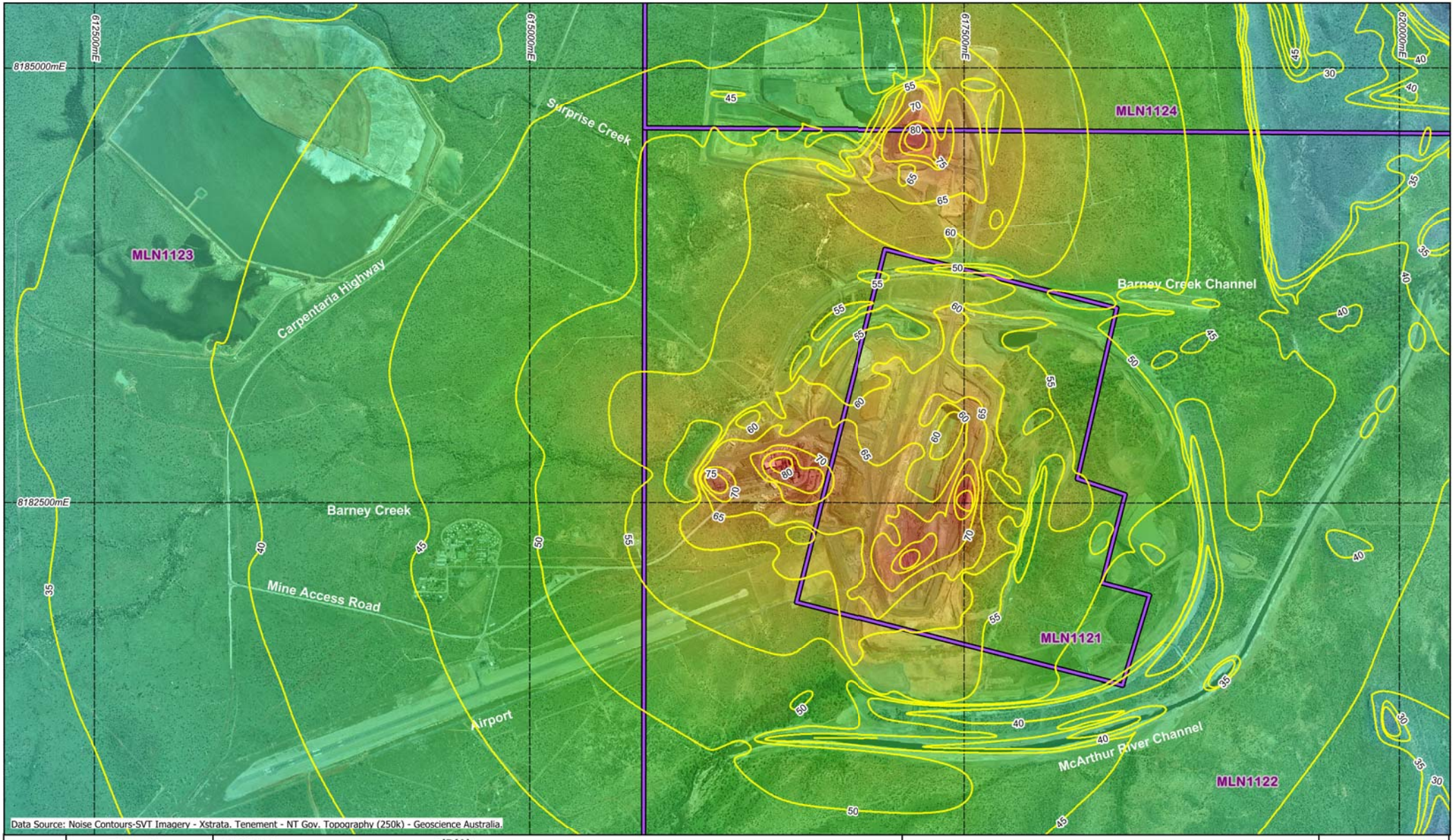

METSERVE

xstrata zinc

0 0.5
Kilometres
Scale: 1:30,000 (A4)

LEGEND
- Project tenement
- Noise contours dB(A)

dB(A)
- 80
- 50
- 40
- 30
- 10

McArthur River Mine
Phase 3 Development Project

Current Situation Noise Contours

12/01/2012

Datum: AGD84
Projection: AMG53

FIGURE 12 - 1

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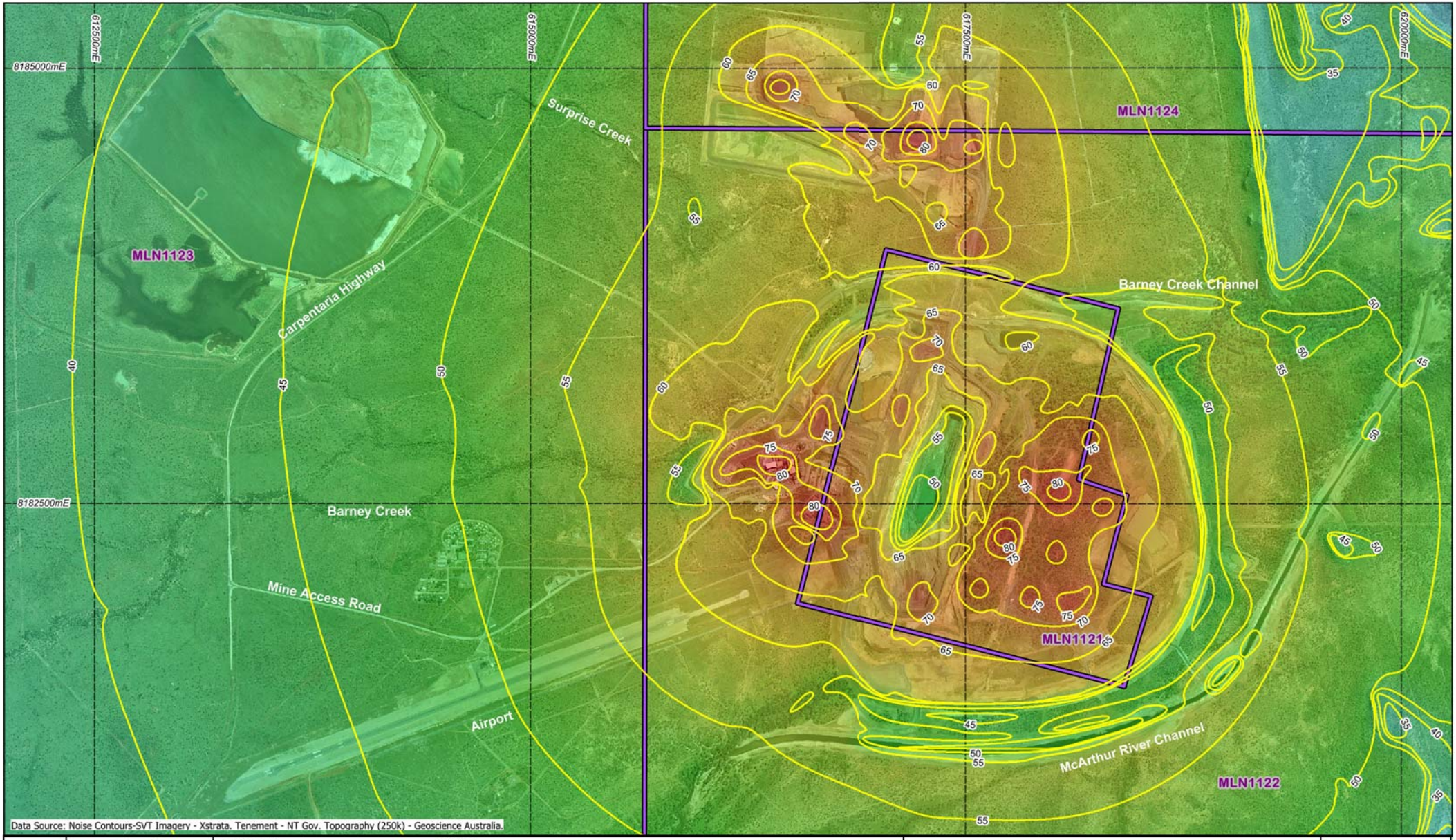

METSERVE

xstrata zinc

0 0.5
Kilometres
Scale: 1:30,000 (A4)

LEGEND
- Project tenement
- Noise contours dB(A)

dB(A)
- 80
- 50
- 40
- 30
- 10

McArthur River Mine
Phase 3 Development Project

Proposed Expansion Noise Contours
Power Station Site 2

12/01/2012

Datum: AGD84
Projection: AMG53

FIGURE 12-2

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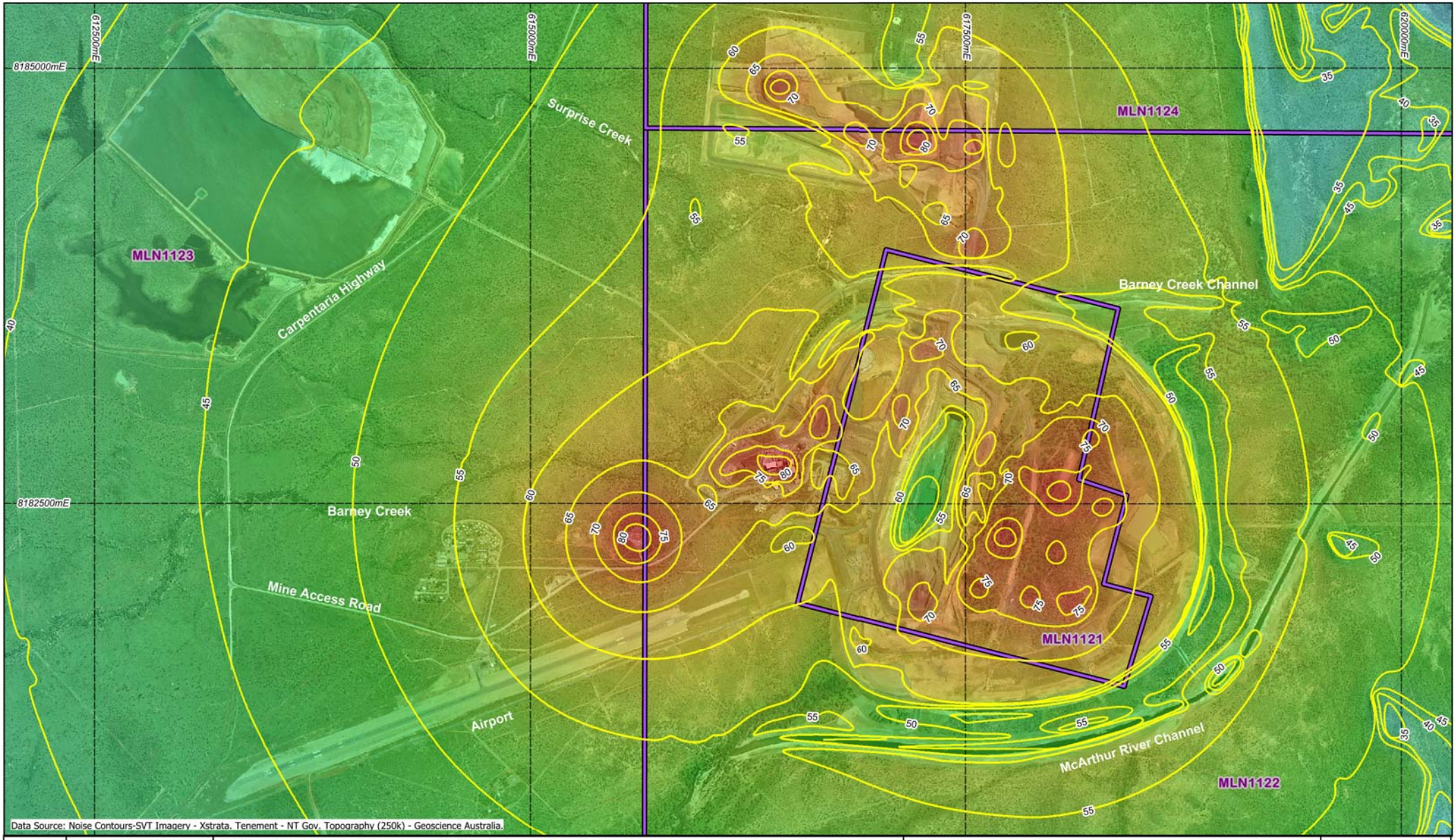


METSERVE

xstrata zinc

0 0.5
Kilometres
Scale: 1:30,000 (A4)

LEGEND
Project tenement
Noise contours dB(A)

dB(A)
80
50
40
30
10

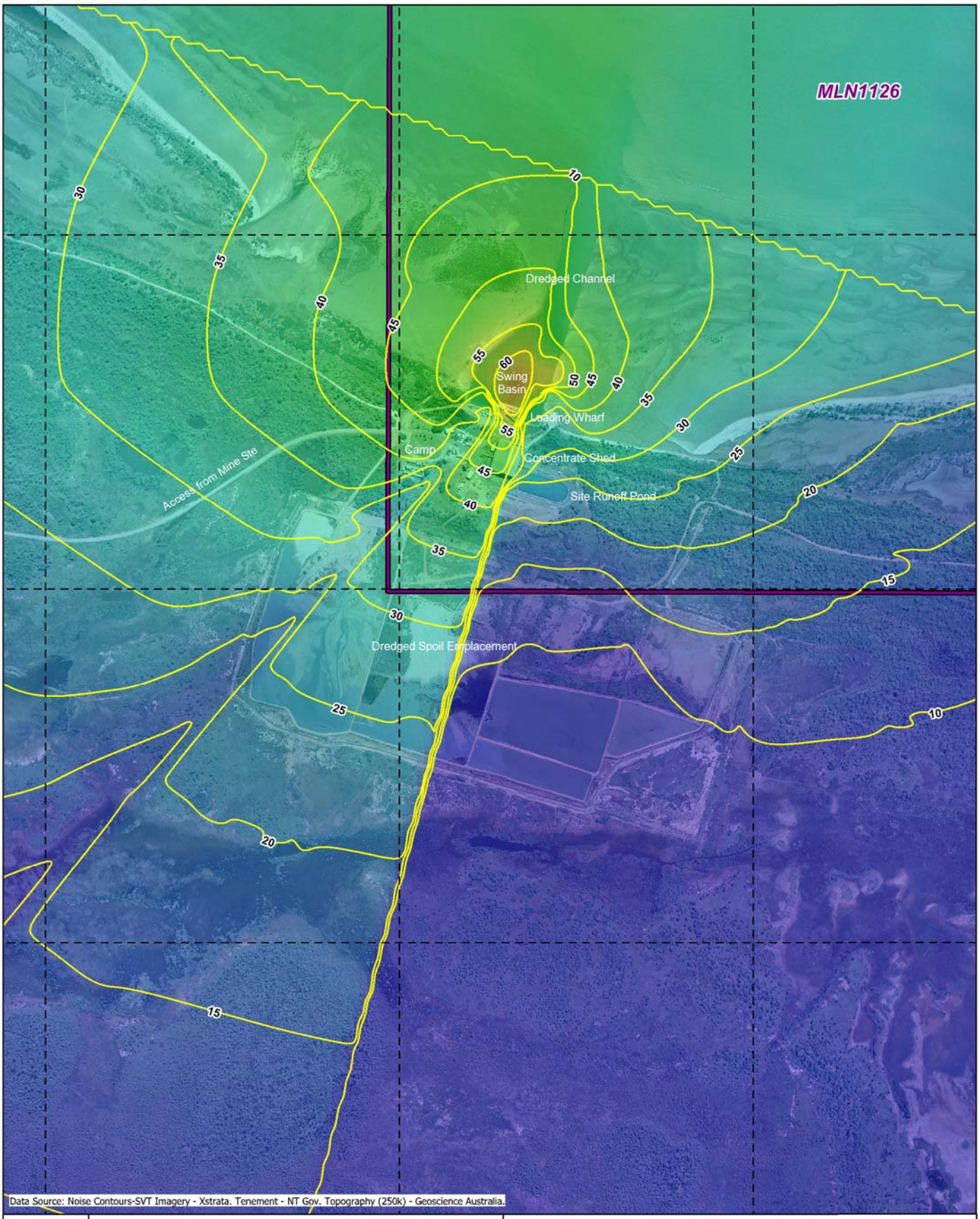
McArthur River Mine
Phase 3 Development Project

Proposed Expansion Noise Contours
Power Station Site 4

12/01/2012

Datum: AGD84
Projection: AMG53

FIGURE 12-3



LEGEND

- Project tenement
- Noise contours dB(A)

dB(A)

- 80
- 50
- 40
- 30
- 10

McArthur River Mine
Phase 3 Development Project

Bing Bong Concentrate Storage and Ship Loading Facility
Current Situation Noise Contours

0.2 0 0.2 0.4

Kilometres

Scale: 1:15,000 (A4)

09/01/2012

Datum: AGD84
Projection: AMG53

FIGURE 12 - 4

METSERVE Mining & Energy Technical Services Pty Ltd

xstrata zinc

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12.4 Potential Impacts and Mitigation Measures

12.4.1 Mining

Noise levels in the environment immediately surrounding the Project site are likely to increase by 3 dB (decibel) to 10 dB, depending on the receptor location. However modelled noise levels readily comply with acoustic quality objectives because of the geographical isolation of the Project from surrounding sensitive receptors. As a result, the health, acoustic amenity and well-being of all residents living near the Project, including those in the accommodation village, are unlikely to be adversely affected by noise.

Noise levels modelled for the Project are predicted to maintain an acoustic environment suitable to allow individuals to sleep, study or learn, be involved in recreation, including relaxation and conversation at all sensitive receptors. Qualities of the acoustic environment that are conducive to protecting the amenity of the community will be preserved. Negligible noise impacts are predicted on terrestrial animals and avifauna, including migratory species.

12.4.2 Haulage Route

With the proposed Project, haulage of concentrate from the Project site to Bing Bong will increase in frequency from nine trips per day to 18. However, noise levels are expected to remain the same because minimal change in the haulage fleet is proposed. Noise measurements taken on the Carpentaria Highway just outside Borroloola on the 17th and 19th May 2011, indicate haulage noise does not have any impact on the closest sensitive receptor 1.6 km from the highway. Modelling indicates haulage noise levels from the trucks drops to below 35 dB (A) beyond 1.25 km from the highway in a worst-case scenario. As there are no known sensitive receptors within close proximity (1.25 km) of the haulage route, noise from Project haulage traffic is not expected to impact adversely on amenity as noise levels are within WHO guidelines.

12.4.3 Bing Bong Concentrate Storage and Ship Loading Facility

Off-shore loading operations for the Project will increase in intensity without a noticeable increase in noise levels. The load-out and bulk carrier (Aburri), which operates from Bing Bong to the export vessel off-shore, will continue for the Project. Frequency of loading to off-shore vessels will increase from 110 to approximately 250 trips per year, however, no increase in noise levels at Bing Bong is expected.

Noise levels taken around Bing Bong were found to fall to 30 dB (A) within 1.3 kilometres from the loading facility. These noise levels at Bing Bong are well within compliance levels to the guidelines stipulated in WHO. As there are no known sensitive receptors within 1.3 kilometres, noise from Bing Bong is not expected to impact adversely on any sensitive receptor.

12.4.4 Power Station

Noise contour models have been generated to help determine siting of the Project's expanded and upgraded power station. Of the two proposed sites (site 2 and site 4) identified for the power plant, noise contours show that predicted noise from a power station located at site 4 may have a negative impact on the accommodation village. Ambient external noise levels at the accommodation village may exceed 55 dB (A). However, if the power plant were to be located at the proposed site 2, external noise levels would decrease to 50 dB (A), thus decreasing noise nuisance within the accommodation village to within the guidelines set out within WHO.

12.4.5 Blasting Impacts

Project blasting will be more frequent and the size of the shot may increase. However, vibration and sound pressure levels will not necessarily increase, as each blast will be staged in bursts. Blasts are expected to be fired every two to three days with multiple shots potentially blasted at the same time.

Empirical formulae generated from the AS 2187.2:2006 were used to estimate the distances from the blast where vibration and sound pressure limits for a 500 kilograms (kg) (regular blast) and a 1,050 kg (void blast) were exceeded. These results are shown in Table 12-6 and Table 12-7, for blast vibration and blast sound pressure levels respectively. These results indicate that blasting vibration and sound pressure guidelines are

unlikely to be exceeded given the large distance between the Project's mining activities and the nearest sensitive receptor.

Predicted results (shown in Table 12-6) indicate that peak vibration levels will not exceed the recommended limits, set by AS 2187.2:2006, for human comfort 1 km beyond the blasting location.

Predicted results (see Table 12-7) indicate that peak sound pressure levels will not exceed the recommended limits, set by AS 2187.2:2006, for human comfort 1.4 km beyond the blasting location.

Table 12-6 Blast distances that exceed vibration limits

Blast type	Maximum instantaneous charge [kg/0.008s] *	Distance from the blast that exceeds vibration limit [m]	
		5 mm/s	25 mm/s
Regular Blast	500	666	243
Void Blast	1,050	965	353

* The quantity of explosive set off within an 8 millisecond (ms) time slot is assumed as the maximum instantaneous charge, and is based on information provided by mining engineers at MRM.

Table 12-7 Blast distances that exceed peak noise limits

Blast type	Maximum instantaneous charge [kg/0.008s]	Distance from the blast that exceeds peak noise limit [m]	
		115 dB/L	125 dB/L
Regular Blast	500	1,072	251
Void Blast	1,050	1,373	322

12.4.6 Mitigation Measures

As described in Chapter 19 – Environmental Management Plan, the environmental values to be enhanced or protected are the acoustic qualities suitable for the well-being of a community, including its social and economic amenity; and for the well-being of the individual, including the individual's opportunities to sleep, relax and converse without unreasonable interference from intrusive noise or vibration.

Noise modelling demonstrated that the acoustic quality objectives would be achieved at all sensitive receptors, and that noise levels at all sensitive receptors are below the relevant recommended guideline limits. Vibration from Project blasting will also be below recommended guideline.

Measures proposed in order to avoid or minimise potential adverse noise and vibration impacts associated with the Project are described below.

- by locating the power plant at site 2, noise levels for the Project's accommodation village are expected to remain below guideline specifications. If an alternative site is selected, then ameliorative measures will be undertaken to ensure noise levels remain below guidelines
- proper equipment maintenance and operational procedures will continue to be implemented to minimise nuisance noise emissions from equipment

- additional shipping and road haulage traffic associated with the Project is expected to register levels below noise guidelines at the nearest sensitive receptor, eliminating the need for specific mitigation measures
- in order to comply with the blasting goals, the maximum instantaneous charge will be below 500 kg for a regular blast and below 1,050 kg for a void blast, where practicable, for blasting only during daylight hours
- the Project will continue to maintain a complaints register. Any legitimate noise or vibration complaint will be investigated and have the appropriate mitigation measures instigated, as required. No complaints regarding noise and vibration have been received at MRM during the life of the current operations
- noise monitoring will continue to be undertaken during the Project's operation phase to confirm compliance with noise level goals. In the event that monitoring identifies an instance of non-compliance with applicable noise limits, additional corrective mitigation measures will be investigated and implemented.