9.0 Noise

9.1 Introduction

This noise assessment has been prepared by sub-consultants SVT. A copy of their report is given in Appendix B. The major activities undertaken as part of the noise assessment are as follows:

- Measurement of existing ambient noise levels at the accommodation village and at the port of Bing Bong.
- Determination of noise emission levels (sound power levels) for existing high noise equipment items and estimation of sound power levels for equipment associated with the proposed expansion.
- Development of an acoustic model for the mine and surrounding area.
- Plotting of noise contours for a range of meteorological conditions for the current mining operations and for the proposed expansion.
- Calculation of noise levels at the accommodation village for a range of meteorological conditions.
- Review of noise limit criteria for the accommodation village.
- Review of the noise impacts of the proposed mine expansion and assessment of noise emissions for compliance with noise limits.
- Identification of high noise equipment items that significantly contribute to increased noise impacts at the accommodation village.
- Review of noise impacts associated with construction activities, blasting and road transport.

9.2 Existing Noise Levels

In order to assess existing ambient noise levels, continuous noise logging systems were deployed at the eastern boundary of the accommodation village and at the manager's house at the port of Bing Bong. The monitoring was conducted for a period of one week, commencing on 9 April 2003. The monitors were set to collect L_{A1}, L_{A10} and L_{A90} noise levels every 15 minutes, where:

- L_{A1} represents the noise level exceeded for 1% of the measurement period;
- L_{A10} represents the noise level exceeded for 10% of the measurement period; and
- L_{A90} represents the noise level exceeded for 90% of the measurement period.

9.2.1 Ambient Noise at McArthur River Accommodation Village

The recorded noise levels are presented in Appendix B. Table 9.1 summarises the range of noise levels recorded at the accommodation village.

Table 9.1

Existing Noise Levels – Accommodation Village

Location	Range of Recorded Noise Levels dB(A)		
	L_{A1}	L_{A10}	L_{A90}
Accommodation Village	35 to 75	34 to 59	29 to 49

Recorded noise levels at this location were influenced by background noise from insects, birds, wind-generated noise, occasional traffic and activities at the accommodation village. Therefore, the L_{A1} and L_{A10} noise levels are not likely to be representative of noise emissions from the mine and processing operations. However, the mine was clearly audible at the monitoring site when background noise levels were low and therefore the L_{A90} noise levels can be considered to be representative of noise emission from the mine and processing operations. The large variation in the L_{A90} noise levels is caused by changes in meteorological conditions, which affect sound propagation, and also by changes in the operating conditions at the mine.

9.2.2 Ambient Noise at Bing Bong

The recorded noise levels are presented in Appendix B. Table 9.2 summarises the range of noise levels recorded at Bing Bong.

Table 9.2

Existing Noise Levels – Bing Bong

Location	Range of Recorded Noise Levels dB(A)		
	L_{A1}	L_{A10}	L_{A90}
Bing Bong	51 to 81	50 to 73	47 to 54

Recorded noise levels at Bing Bong were strongly influenced by activities at the port. In particular, the L_{A90} noise levels are representative of the noise from the generator building. L_{A1} and L_{A10} noise levels are representative of noise from road trains entering and leaving the port facility.

9.3 Noise Modelling

9.3.1 Methodology

An acoustic model has been developed using the ENM noise modelling program developed by RTA Technology. The ENM program calculates sound pressure levels at nominated receiver locations and produces noise contours over a defined area of interest around the noise sources. The inputs required are noise source data, ground topographical data, meteorological data and receiver locations.

The model has been used to generate noise contours for the area surrounding the mine site and also to predict noise levels at the accommodation village. The model does not include noise emissions from any sources other than the mining operations. Therefore, noise emissions from road traffic, aircraft, domestic sources, etc are not accounted for.

The model produces noise contours for specific meteorological conditions over the surrounding area and noise levels at specified receiving locations.

9.3.2 Input Data

Existing Noise Sources

For the existing operations at MRM, sound power levels were developed for the major plant areas that contribute to the noise received at the accommodation village. The sound power levels were calculated from sound pressure level measurements recorded on a closed contour around each plant area, taking into account the distance from the sound source and the area enclosed by the measurement contour. Table 9.3 presents the sound power levels for major plant areas.

Table 9.3

Existing Noise Sources

Item	Octave Band Sound Power Levels - dB(lin)								Overall Levels	
	63	125	250	500	1000	2000	4000	8000	Lin	A
Regrind Circuit	113	113	115	119	111	106	98	93	124	118
Vertimill	108	106	107	103	99	94	86	78	114	105
SAG Mill	118	117	118	114	111	108	100	95	128	116
Flotation Blower	110	108	107	108	103	97	91	85	117	108
Crushing Circuit	117	117	119	111	110	109	104	98	124	116
Power Station	127	124	123	114	112	106	113	112	132	120

Note: Other items of plant such as the flotation circuit, thickeners and the concentrate storage and loading operations produce insignificant noise emissions compared to the items in the table above and have, therefore, been excluded from the noise model.

The simultaneous operation of all the above plant items represents the worst-case noise emission conditions.

Future Noise Sources – Mobile Equipment

Following the change of mining method to open cut, the number of items of mobile equipment operating at any given time and their locations will vary considerably. For the purposes of the noise assessment, it has been assumed that the following equipment will be operational:

- 11 haul trucks, 8 in the pit and 3 on the haul road to the overburden emplacement facility.
- 2 drills.
- 2 excavators.

- 2 dozers.
- 1 front-end loader.
- 1 grader.
- 2 water carts.

The mobile equipment listed above represents approximately 70% of the total mobile fleet anticipated for the open cut project. This is considered to be a realistic scenario for modelling purposes, as not all mobile equipment is likely to be operating simultaneously at any one time.

The sound power levels for these items of mobile equipment are presented in Table 9.4. The mobile equipment items have been distributed throughout the pit for the purposes of the noise model.

Table 9.4

Proposed New Mobile Noise Sources

Item	Octave Band Sound Power Levels - dB(lin)								Overall Levels	
	63	125	250	500	1000	2000	4000	8000	Lin	A
Haul Truck	108	118	115	114	110	106	102	94	122	116
Drill	109	118	113	113	113	112	110	104	122	118
Shovel / Excavator	113	117	107	108	106	101	95	89	119	110
Dozer	110	122	113	114	110	108	104	94	123	116
Loader	108	116	107	108	105	99	95	88	118	110
Grader	109	107	108	106	107	102	97	90	115	110
Water Cart	104	114	111	110	106	102	98	90	118	112

Note: The sound power levels in the table above are estimates. Sound power levels can vary significantly, even for similar items of equipment, depending on the condition of the vehicles.

Future Noise Source – Stationary Equipment

The major additional item of stationary equipment to be introduced as a result of the open cut project that will constitute a significant noise source is the new primary crusher. The new crusher has been assumed to have a similar overall sound power level to the existing secondary crushing circuit but with proportionally more noise being emitted in the lower frequency bands. The sound power levels used in modelling the new primary crusher are given in Table 9.5.

Table 9.5

Proposed New Primary Crusher Noise Source

Item	Octave Band Sound Power Levels - dB(lin)								Overall Levels	
	63	125	250	500	1000	2000	4000	8000	Lin	A
Primary Crusher	123	123	121	111	106	105	100	94	127	116

Topography Ground Types and Barriers

Topographical information for the surrounding area was included in the noise model. The ground contours for the open cut project include the pit and the bund wall around the pit and processing areas. The modelling has assumed a pit level at RL 28 m representing the worst case situation for sound propagation at the start of the pit life. As the pit develops, the equipment in the pit will be located progressively at lower levels and will receive greater noise shielding from the pit walls.

The ground type assumed for the model is "sandy silt, hard packed by vehicles". This is the most appropriate ground type available in ENM for the majority of the area covered by the model. The barrier effects of large buildings at the mine site have also been incorporated into the noise model.

9.3.3 Receiving Locations

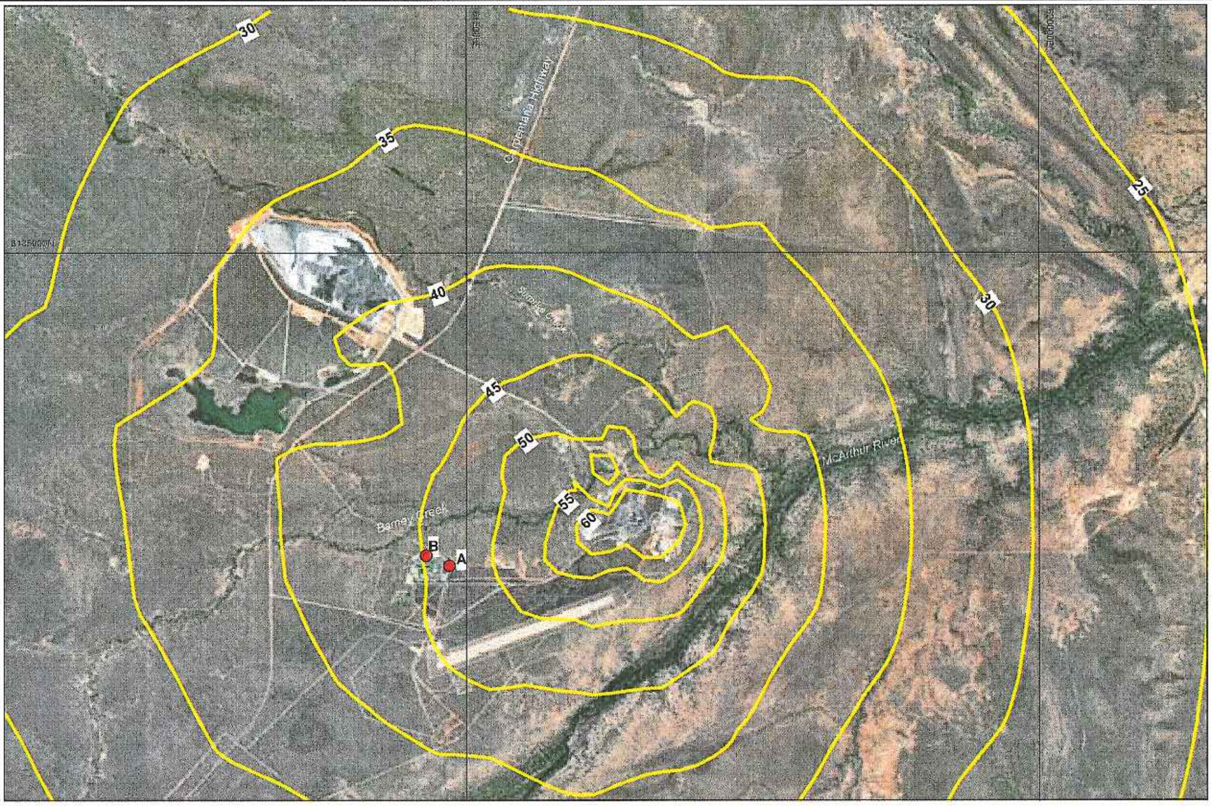
The noise model has been used to predict noise levels at two locations (A and B) at the accommodation village. These locations are shown in Figure 9.1 and are located at the eastern and northern boundaries of the village.

9.3.4 Meteorology

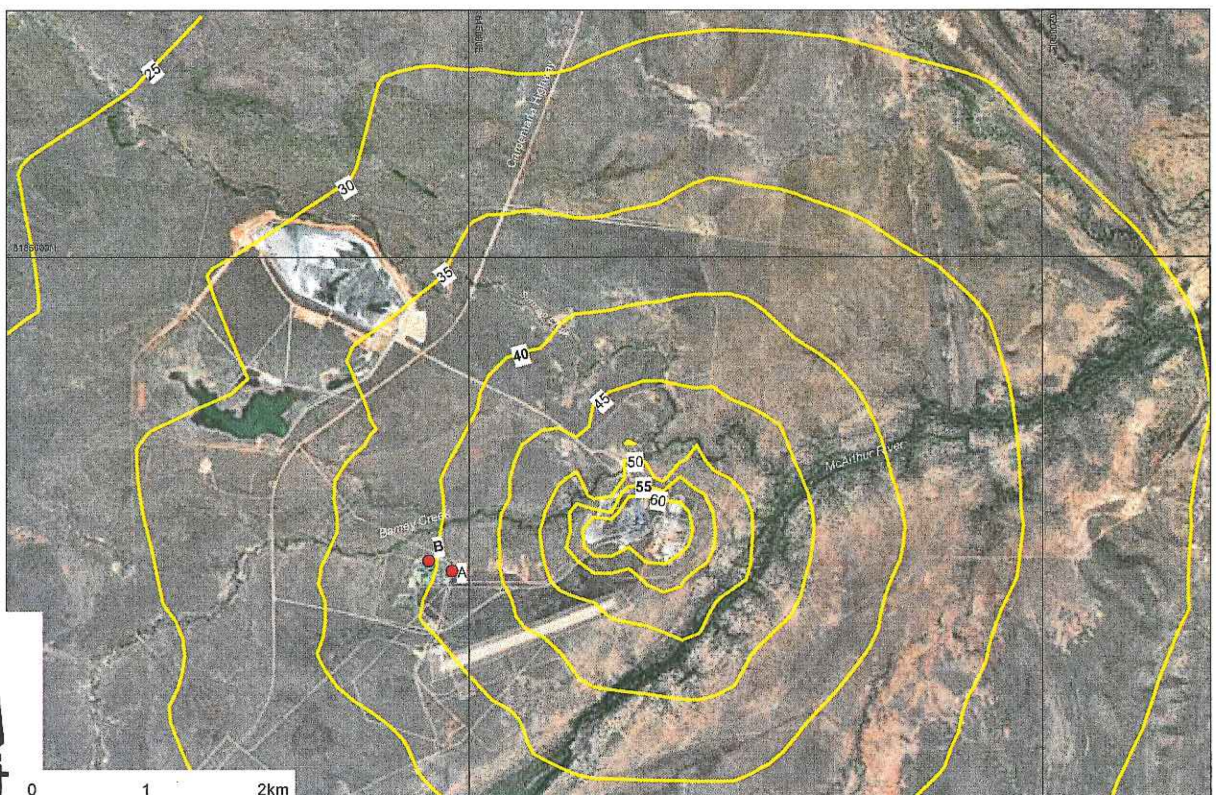
Certain meteorological conditions can increase noise levels at a receiving location by a process known as refraction. When refraction occurs, sound waves that would normally propagate directly outwards from a source can be bent downwards causing an increase in noise levels. Such refraction occurs during temperature inversions and where there is a wind gradient. These meteorological effects can increase noise levels by as much as 5 to 10 dB depending on the source/receiver geometry and intervening topography.

The ENM noise model calculates noise levels for user defined meteorological conditions. In particular, temperature, relative humidity, wind speed and direction data, and temperature inversion rates are required as input to the ENM model.

The noise model has been used to predict noise levels and produce noise contours for a range of meteorological conditions. In all cases the temperature and relative humidity values used were 30°C and 70% respectively. Calm conditions have been investigated as well as 3 m/s winds from each of eight cardinal directions combined with a 2°C/100 m thermal inversion (wind speeds of 3m/s combined with a thermal inversion rate of 2°C/100 m are representative of worst-case conditions for sound propagation).



EASTERLY WIND



Scale 1:60 000 (A3)

Horizontal Datum: AGD84, Zone 53

NORTHERLY WIND

A — Noise Prediction Location

25 — Noise contour (dB(A))

xstrata

URS

McARTHUR RIVER MINE
OPEN CUT PROJECT
ENVIRONMENTAL IMPACT STATEMENT

NOISE CONTOURS
CURRENT OPERATIONS

Drawn: VH	Approved: CMP	Date: 14-12-04	Figure: **9.1**	Rev: A
Job No: **42625552**	File No: 42625552-g-022.wor			A4

9.4 Predicted Noise Levels

9.4.1 Results for Existing Operations

Predicted noise contours for the existing operations are given in Figure 9.1 for conditions with 3 m/s winds from the east and the north combined with a 2°C/100 m temperature inversion. Table 9.6 below presents the noise levels predicted at locations A and B for a range of meteorological conditions.

Table 9.6

Predicted Noise Levels at Accommodation Village – Existing Operations

Wind Direction	Wind Speed (m/s)	Inversion Rate (°C/100 m)	Noise Level at Position A (dB(A))	Noise Level at Position B (dB(A))
Calm	0	0	37	36
N	3	2	43	41
NE	3	2	47	45
E	3	2	48	46
SE	3	2	45	44
S	3	2	39	38
SW	3	2	35	34
W	3	2	35	33
NW	3	2	36	35

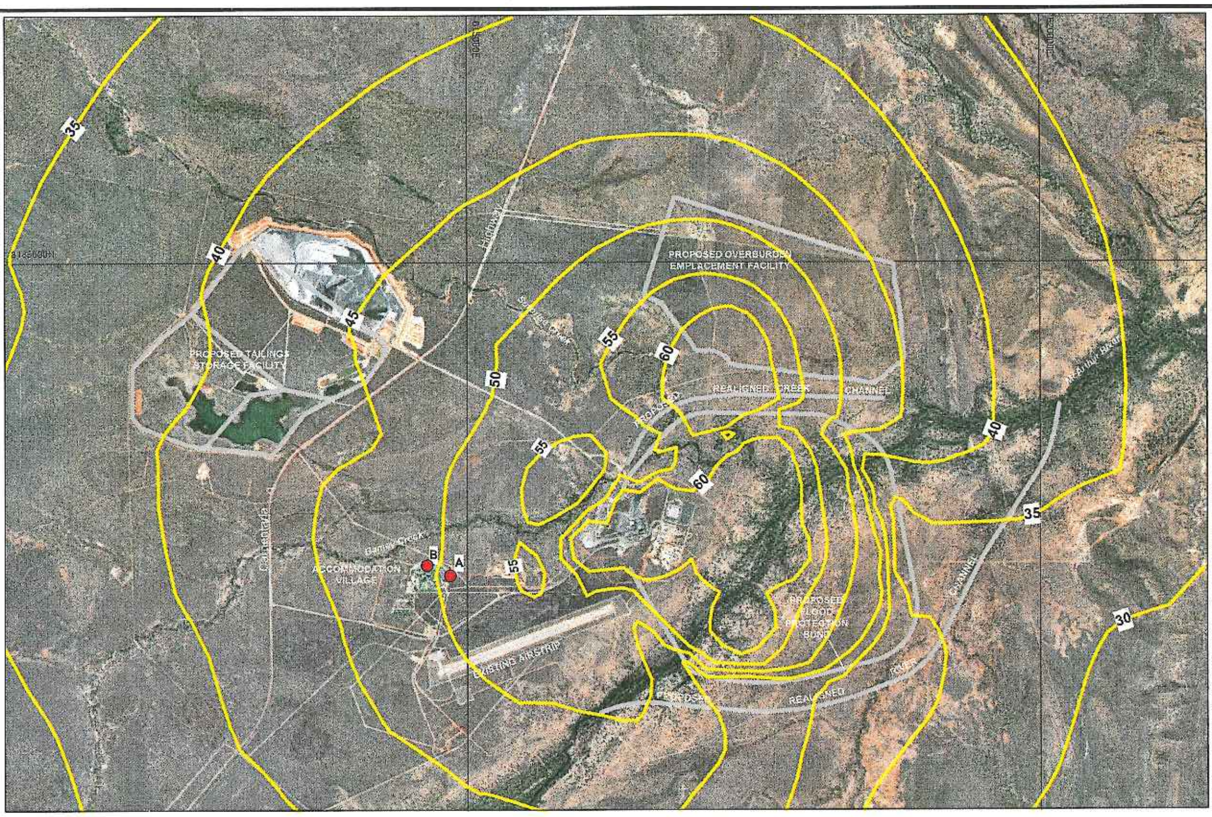
From the table above, it can be seen that noise levels vary between 35 dB(A) and 48 dB(A) at position A when there is a 3 m/s wind combined with a thermal inversion. The worst-case wind direction for sound propagation is from the east. For the same meteorological conditions, noise levels vary between 33 dB(A) and 46 dB(A) at position B.

9.4.2 Verification of Model

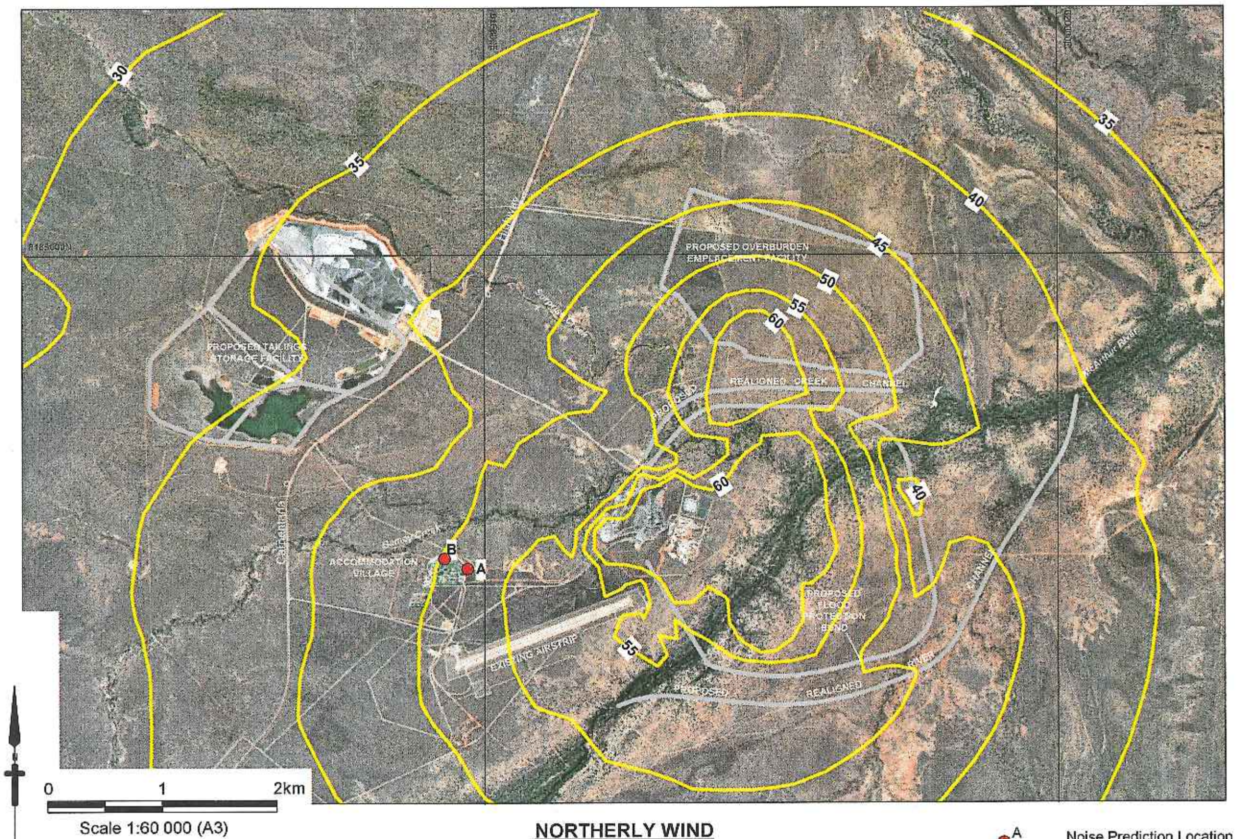
The noise model for the existing mining operations was verified by recording noise levels at various locations and comparing these recordings with noise levels predicted by the noise model for the same operating and meteorological conditions. Noise levels were recorded when background noise was low and when the mining operations were clearly audible. Three locations were investigated, one at the eastern accommodation village boundary, one near the airstrip, and one on the road approximately half-way between the mine site and the accommodation village. An acceptable agreement to within +2/-3 dB(A) was reached at all locations.

9.4.3 Results for Open cut Operations

Predicted noise contours for the open cut operations are given in Figure 9.2 for conditions with 3 m/s winds from the east and the north combined with a 2°C/100 m temperature inversion.



EASTERLY WIND



Scale 1:60 000 (A3)
Horizontal Datum: AGD84, Zone 53
Date of Aerial Photography, 2001

NORTHERLY WIND

A — Noise Prediction Location
50 — Noise contour (dB(A))

xstrata

URS

McARTHUR RIVER MINE
OPEN CUT PROJECT
ENVIRONMENTAL IMPACT STATEMENT

NOISE CONTOURS
OPEN CUT OPERATIONS

Drawn: VH	Approved: CMP	Date: 18-07-05	Figure: **9.2**
Job No: **42625552**	File No: 42625552-g-023c.wor		Rev: C A4

Table 9.7 below presents the noise levels predicted at locations A and B for a range of meteorological conditions.

Table 9.7

Predicted Noise Levels at Accommodation Village – Open cut Operations

Wind Direction	Wind Speed (m/s)	Inversion Rate (°C/100 m)	Noise Level at Position A (dB(A))	Noise Level at Position B (dB(A))
Calm	0	0	40	39
N	3	2	47	46
NE	3	2	50	49
E	3	2	51	50
SE	3	2	49	48
S	3	2	43	43
SW	3	2	38	38
W	3	2	38	37
NW	3	2	40	39

From the table above, it can be seen that noise levels vary between 38 dB(A) and 51 dB(A) at position A when there is a 3 m/s wind combined with a thermal inversion. The worst-case wind direction for sound propagation is from the east. For the same meteorological conditions noise levels vary between 37 dB(A) and 50 dB(A) at position B.

9.5 Noise Increases from Open cut Operations

Table 9.8 below presents the increase in noise levels that can be expected as a result of the operation changing to open cut mining.

Table 9.8

Predicted Noise Level Increase at Village

Wind Direction	Wind Speed (m/s)	Inversion Rate (°C/100 m)	Change in Level - Position A (dB(A))	Change in Level Position B (dB(A))
Calm	0	0	3	3
N	3	2	4	5
NE	3	2	3	4
E	3	2	3	4
SE	3	2	4	4
S	3	2	4	5
SW	3	2	3	4
W	3	2	3	4
NW	3	2	4	4

From Table 9.8 it can be seen that the proposed open cut operation is predicted to increase noise levels at the accommodation village by between 3 and 5 dB(A) compared to existing noise levels.

Mobile equipment is the main contributor to the predicted increase in noise levels. However, the impacts of noise from mobile equipment should reduce progressively as the pit develops and becomes deeper.

9.6 Operational Noise Impacts

Currently there are no statutory regulations governing environmental noise emissions in the Northern Territory.

Consideration of noise impacts for the current mining operations was given in the project's original EIS (Hollingsworth Dames & Moore, 1992). That study adopted an indoor night-time sleep criterion of 35 dB(A). It also assumed a noise reduction of 25 dB(A) from outside to inside for air conditioned residences. This effectively sets the outdoor criterion level at 60 dB(A). This has been used as the basis for this assessment and has been adopted as an appropriate performance indicator for the open cut project.

The indoor criterion of 35 dB(A) is consistent with recommended design sound levels for sleeping areas provided in Australian/New Zealand Standard AS/NZS 2107:2000 'Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors'.

On this basis, the outdoor criterion at the accommodation village of 60 dB(A) is considered reasonable. As can be seen from Table 9.7, the predicted noise level at the village for the worst case meteorological conditions is 51 dB(A). Thus no unacceptable noise impacts are expected from the open cut operations.

9.7 Other Noise Impacts

9.7.1 Construction Noise

Table 9.9 contains a list of typical of equipment likely to be operating during the construction phase as well as typical noise levels for each item of assessed equipment. The noisiest items are jackhammers and pile hammers.

Table 9.9 also shows the predicted noise levels from each item of equipment at the accommodation village which is located at a distance of 1.5 km or greater from the main construction areas. None of the predicted construction noise levels exceed the outdoor noise criterion for the accommodation village of 60 dB(A). Hence, no significant noise impacts are expected from the construction activities.

Table 9.9

Typical Construction Equipment and Predicted Noise Levels at Accommodation Village

Item	L_{Amax} at 7m	Predicted L_{Amax} at Village
Bulldozers	85 dB(A)	40dB(A)
Jackhammers	105 dB(A)	60 dB(A)
Compactors	85 dB(A)	40 dB(A)
Excavators	80 dB(A)	35 dB(A)
Trucks	83 dB(A)	38 dB(A)
Compressors	75 dB(A)	30 dB(A)
Pile hammer	105 dB(A)	60 dB(A)
Concrete pumps	84 dB(A)	39 dB(A)
Concrete saws	93 dB(A)	48 dB(A)

9.7.2 Traffic Noise

Traffic noise impacts from trucks hauling concentrate to the port of Bing Bong are limited to the township of Borroloola. Consideration was given to the potential for traffic noise impacts in the Supplement to the original EIS (Hollingsworth Dames & Moore, 1992). This resulted in the establishment of a bypass corridor some 2.5 km from the township. At this distance traffic should neither cause sleep disturbance nor interfere with the amenity of any residences. Furthermore there will be no significant increase in traffic volumes on the haul road to Bing Bong as a result of the open cut project.

9.7.3 Blasting Noise and Vibration

Peak noise levels from blasting are very difficult to predict but are related to the size and location of the blast and the prevailing weather conditions. It is proposed to implement a blast monitoring program to determine if there is any possibility of sleep disturbance as a result of blasting. If blasting noise does cause sleep disturbance, then a maximum allowable blast size will be determined based on the noise levels recorded from the blast monitoring program. Other control measures could include restricting blasting to certain times of day (eg. shift changes) when sleep disturbance is likely to be minimal, or only blasting when winds are from the south-western quadrant or when wind or rain noise is likely to mask the noise from blasting. Given that the village site is approximately 2 km from the mine site, vibration associated with blasting should be insignificant.

9.7.4 Noise Impacts at Bing Bong

At the Bing Pong port operations there will be no new noise sources introduced as a result of the open cut project and no significant increases in truck or barge traffic. Hence there will be no significant change in noise effects at Bing Bong.

9.8 Noise Management

Strategies for the management and monitoring of noise effects for both construction and operations are outlined in the strategic management plan given in Sections 22.3 and 22.4 respectively.