

APPENDIX 02

ANGAS ZINC MINE ENVIRONMENTAL NOISE ASSESSMENT

ANGAS PROCESSING FACILITY

MISCELLANEOUS PURPOSES LICENSE APPLICATION

2019/0826



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Angus Zinc Mine

Environmental Noise Assessment

24th November 2006

Angus Zinc Mine

Prepared for

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1.0 Introduction

This report considers the environmental noise impacts associated with the proposed Angas Zinc Mine. The Angas Zinc Project is situated about 60 kilometres southeast of Adelaide, South Australia, and 2.7 km from the township of Strathalbyn.

The project involves the exploitation of Zinc and Silver-lead ore. The ore will be mined using underground mining methods. The mine ore (from the underground mine) will be delivered by 40 tonne trucks to the mill. The ore will be crushed, ground with a ball mill, and flotation plant will be utilised to produce concentrate which will be transported to other sites.

This environmental noise study has been carried out for the environmental approval phase of Angas Zinc Project. The focus of this environmental noise study is sensitive human receptors located near the boundary of the mining lease.

The following activities are included in this environmental noise assessment:

- Truck and vehicle movements (on and off site)
- Mill
- Mining ventilation systems
- Material handling
- Pumping and process equipment

This assessment is based on information provided by Terramin Australia and from Bassett Acoustics database of noise from similar facilities.

The noise model developed for the Angas Zinc Project is based on the current design of the plant. Equipment noise limits are provided for equipment to ensure that overall noise limits are achieved for the development.

Nomenclature relevant to this project has been included in Appendix A.

2.0 Project Description

The Angas Zinc Project is situated about 60 kilometres southeast of Adelaide, South Australia, and 2.7 km from the township of Strathalbyn. The project takes its name from the Angas River, which flows through Strathalbyn, then through a valley south of the project area. The deposit outcrops under sewage effluent treatment ponds for the town, and plunges south under a limestone quarry.

The proposed site plan, location of significant plant and sensitive receptors is indicated in Appendix B. Assumptions and requirements for noise emission levels related to the anticipated noise sources are summarised in Appendix C.

2.1 Mining

The ore will be mined using underground mining methods due to the ore reserve having a thickness range of 3-12m, averaging approximately 7m, as well as being located near the town of Strathalbyn, under the local grey water ponds and a main arterial road.

The significant noise sources associated with the underground mining are:

- Ore transport trucks
- Ventilation fan

Underground blasting will be controlled such that noise and vibration will not exceed recognised blasting limits.

2.2 Milling

The mine ore (from the underground mine) will be delivered by 40 tonne ore trucks to the crusher plant. The ore will be crushed and then fed into a ball mill. Water is added into the ball mill feed chute to produce a slurry. Ball mill discharge will be pumped into a hydrocyclone to produce a cyclone overflow. The flotation plant consists of four flotation columns, two in series to produce silver-lead concentrate and two in series to produce zinc concentrate.

Concentrate transport trucks will be B Doubles with a 50 tonne payload capacity. Silver-lead concentrate will require 6 trips per week to Port Pirie and Zinc concentrate will require 25 trips per week to Port Adelaide (total of 31 trips per week).

The significant noise sources associated with the milling are:

- Front end loader
- Primary crusher
- Ball Mill
- Material handling conveyors
- Pumps (various)
- Agitators
- Air compressors

2.3 Locality

The locality of the mining lease includes a number of features, the Strathalbyn to Callington Road, the Strathalbyn wastewater lagoons, a prominent ridge trending approximately east west, an extractive minerals quarry and industrial waste dump located on this ridge, several houses are also located on the ridge. Several portions of land to the north and south of the lagoons, ridge and quarry are currently used for cereal cropping and grazing, as well as a model aeroplane club airstrip and clubrooms.

Sensitive receptors are indicated on the site plan in Appendix B.

2.4 Prevailing Weather

The Fleurieu has a temperate climate. In terms of humidity and temperature, there are warm summers and cool winters in the area. Most of the rainfall occurs in winter.

Wind roses indicate that there are prevailing wind directions in each of the seasons. As there is wind from all directions at different times of the year there is no particular predominant weather pattern which applies for the whole year.

Weather Category 5 meteorological conditions have been utilised in the CONCAWE¹ noise prediction methodology to represent typical worst case noise propagation conditions.

¹ CONCAWE – The oil companies' international study group for conservation of clean air and water – Europe (established in 1963) Report 4/81 "The propagation of noise from petroleum and petrochemical complexes to neighbouring communities". This is a noise propagation model for the prediction of industrial noise accepted by the EPA.

3.0 Noise Criteria

The general environmental duty (section 25) which is defined in the South Australia, Environment Protection Act is:

“A person must not undertake an activity that pollutes, or might pollute, the environment unless the person takes all reasonable and practicable measures to prevent or minimise any resulting environmental harm.”

In order to gauge the impact of noise associated with the project on the residents of Strathalbyn, the environmental noise levels have been compared with various noise criteria. Different noise criteria apply to different activities associated with the Angas Zinc Project. Table 1 summarises the noise sources addressed in this assessment and the applicable noise criteria.

Table 1 Schedule of Applicable Noise Criteria

Noise Source	Applicable Noise Criteria	Comments
Mining, Mill and Processing Plant Operation	<ul style="list-style-type: none"> Environment Protection (Industrial Noise) Policy (INP). World Health Organisation (WHO) sleep disturbance noise criteria. Consideration of the EPA Draft Environment Protection (Noise) Policy (Noise EPP). 	New equipment should comply with the INP. Where possible the environmental noise impact should be minimised.
Traffic Movements (off-site)	<ul style="list-style-type: none"> No significant increase over existing noise levels. 	Any increase in noise associated with the project needs to be assessed in addition to existing levels.

The applicable noise criteria are discussed in the following sections.

3.1 Mining, Mill and Processing Operation (including on-site Traffic)

3.1.1 Environment Protection (Industrial Noise) Policy (INP)

The INP is used to assess noise from existing situations. For new developments, the EPA suggests an environmental noise design criterion of 5 dB(A) lower than the noise level set out in the INP be adopted for planning purposes.

Under the Environment Protection (Industrial Noise) Policy, the allowable equivalent noise level (L_{Aeq}) is the maximum of:

- 5 dB(A) greater than the background noise level, and
- The maximum allowable noise level scheduled for the particular area.

The policy defines the maximum allowable noise levels for particular areas as follows:

Table 2 Schedule of Maximum Allowable Noise Levels

Description of area in which the noise source is situated	Maximum permissible noise levels dB(A)	
	7.00 am - 10.00 pm	10.00 pm - 7.00 am
Rural or predominantly rural	47	40
Urban residential	52	45
Urban residential with some commerce, or with a school, hospital or the like	55	45
Urban residential with some manufacturing industry, or with some place of public entertainment or place of public assembly or a licensed premise	58	50
Predominantly commercial		
Predominantly industrial	65	60
	70	70

The proposed project is in the Grazing zoning as defined in the Alexandrina Council, Strathalbyn District, Development Plan. There is no specific mention of mining developments within the grazing zone. Primary production is promoted in this zone.

The residences are located in the Landscape (Strathalbyn District) zoning. It is noted that "... new residential development should not occur" in this zone.

The area adjacent to the existing residences may be classified as "Urban residential with some manufacturing industry, ..." given the existing quarry, main road and waste water ponds. The maximum permissible noise levels for this category is 58 and 50 dB(A) for daytime and night time respectively.

Penalties for the character of the noise may be applicable according to the policy. A 5 dB(A) penalty may be applied for each of the characteristics of tone, fluctuation and impulsiveness. Given the nature of anticipated noise at the plant, a penalty could be warranted.

Taking the planning penalty of 5 dB(A) and noise characteristic of 5 dB(A), the noise criteria is hence 48 dB(A) and 40 dB(A) for daytime and night time respectively. Similar limits have been suggested by PIRSA.

An alternative approach is to classify the area as urban residential. Assuming the noise levels are low enough not to have significant tone or fluctuation, this would result in a noise limit (with the 5 dB(A) planning penalty) of 40 dB(A) at night and 47 dB(A) through the day.

Given that the two possible approaches result in similar limits, the design limit is taken as 48 dB(A) and 40 dB(A) for daytime and night time respectively.

The INP does not address short-term noise intrusion, and in this case reference is made to the World Health Organisation (WHO) sleep disturbance noise criteria.

3.1.2 World Health Organisation (WHO) Sleep Disturbance Criteria

Many studies have been undertaken to give an indication of the noise level inside a bedroom that would result in sleep disturbance. The WHO has developed guidelines² for community noise in specific environments.

The WHO suggests that the equivalent noise level (L_{eq}) inside bedrooms should be limited to 30 dB(A) and the maximum noise level (L_{max}) should be limited to 45 dB(A).

It is normal practice when considering internal noise levels from an external source to assume that windows may be partially open, as could be the case. Based on the windows being partially open, the WHO suggests that to achieve the internal levels described above, the equivalent (L_{eq}) and maximum (L_{max}) noise levels outside a bedroom window should be limited to 45 dB(A) and 60 dB(A) respectively.

3.2 Off Site Traffic Movements

As the proposed traffic movements are not significant, the proposed criteria for traffic noise associated with the development is that there should not be a significant increase over existing traffic noise levels.

² Berglund, Lindvall and Schwela, 1999, "Guidelines for Community Noise"

3.3 Noise Criteria Summary

In summary, various possible assessment criteria are (including all penalties and corrections) summarised in Table 3. The L_{Aeq} is measured over a 15 minute measurement period unless otherwise stated.

Table 3 Summary of Noise Criteria

Noise Source	Day time noise level ^{(1),(2)} (L_{Aeq})	Night time noise level ^{(1),(2)} (L_{Aeq})	Maximum Noise level (L_{Amax})⁽³⁾
Mining, Mill and Processing Plant Operation. On-site traffic movements.	48 dB(A)	40 dB(A)	60 dB(A)

Notes:

- (1) A planning penalty of 5 dB(A) has been incorporated in deriving the noise limits.
- (2) A noise characteristic penalty (5 dB(A)) has been incorporated in deriving the noise limits.
- (3) Noise limit based on WHO sleep disturbance noise criterion applicable to night time operation.

Noise from off-site traffic should not increase significantly over the existing noise levels.

4.0 Existing Ambient Noise Levels

Ambient noise levels have been measured at two locations which are shown in Appendix B. The logged L_{Aeq} and L_{A90} noise levels (15 minute periods) from the environmental noise logger are presented in Appendix D.

Ambient noise levels vary depending on the time of day and prevailing weather conditions. The noise levels are 50 dB(A) through the day and 30 to 40 dB(A) at night.

Traffic is the dominant existing noise source in the area. It is likely that the previous quarry activity was a significant noise source in the area.

5.0 Expected Noise Levels

Noise associated with the Angas Zinc Project has been divided into separate cases for assessment. These cases are listed below:

- On site activity:
 - Mining Operations (including associated on-site traffic movements)
 - Crushing
 - Milling and Processing (including associated on-site traffic movements)

- Off site Road Traffic

Noise levels have been predicted for both day and night time operations using CONCAWE algorithms in the SoundPLAN³ noise propagation software.

The model generated using this software is based on drawings provided by Terramin Australia. Specifically, the plant layout for the Option 1 site location is based on the Abesque site layout dated the 15th of August 2006 (drawing number: AZP 300-L-001). Meteorological conditions have been assumed to be 'typical worst case' or Weather Category 5 defined in the CONCAWE algorithms.

A list of noise sources included in the noise models and the times of operation of these sources is included in Appendix C.

5.1 Mining, Crushing and Process Plant Operations

Predictions indicate that before noise mitigation works, the most affected receivers for Option 1 are those adjacent to the Western site boundary (locations C and B), for day and night time periods respectively. Before any noise mitigation works, noise levels for Option 1 are predicted to comply with the day time L_{Aeq} noise limit, and exceed the night time L_{Aeq} noise limit by approximately 3 dB(A) at location B.

The most noise affected locations and the controlling noise sources at each of these locations are presented on the following page as Table 4.

³ SoundPLAN 6 is a suite of noise propagation software accepted by the EPA.

Table 4 Controlling Noise Sources Before Noise Mitigation Works.

Site	Time period	Most noise affected receiver	Controlling noise sources
Option 1	Day	C	<ul style="list-style-type: none"> • Front end loader • Ball mill • Volvo Haul truck
	Night	B	<ul style="list-style-type: none"> • Ball mill • Volvo Haul truck • Flotation building

The noise control methods required to reduce the noise levels to achieve compliance with all nominated criteria are summarised in the following section.

5.1.1 Noise Control Methods

The table below summarises the sources that require noise control and the proposed noise control methods to be implemented.

Table 4 Engineering Noise Control Methods

Noise Source	Noise Control Method
Crusher plant	<ul style="list-style-type: none"> • Plant to operate during the day time hours only (7am to 10pm) • Sound power from the crusher to be limited to 113 dB(A) re $10^{-12}W$
Ball Mill	<ul style="list-style-type: none"> • Profiled metal deck or Ultra panel barrier to be constructed around the East, North and northern 1/3 of West side.
Mine Ventilation	<ul style="list-style-type: none"> • Vent Fan to be limited to sound power level of 112 re $10^{-12}W$ dB(A)
Trucks and Front End Loaders	<ul style="list-style-type: none"> • B Double trucks and front end loader servicing the crusher to be utilised during the day time only • Reversing beepers not to operate at night time (suitable alternative warning systems in compliance with OH&S requirements are necessary)

5.1.2 Predicted Noise Levels

Noise levels have been predicted based on the Angus Zinc Mine design, with noise attenuation, as described above.

The noise levels are expected to be less than the noise limits for the day and night time periods with engineering noise control as described in the preceding section. These controls have been implemented in the noise model and the predicted future noise contour levels summarised in Appendix E.

The following table summarises the predicted noise levels, following implementation of the controls, at the sensitive receivers. Terramin have purchased one of the nearby residences. The receiver locations are shown on the site map in Appendix B.

Table 5 Predicted Noise Levels at Sensitive Receivers Following Noise Mitigation

Sensitive Receiver	Predicted noise level L_{Aeq} , (dB(A))	
	Day time	Night time
A – Owned by Terramin	42	38
B	42	38
C	42	37
D	41	36
E	40	35
F	38	32
G	40	35
H	40	38
I	34	30
J	32	28
K	42	33

5.2 Construction Phase

The construction phase of the works is not likely to require significant noise producing equipment. All construction equipment should be of a low noise type and used in accordance with guidelines outlined in AS 2436⁴.

The following practices are proposed for the construction works:

- Australian Standard AS 2436-1981 'Guide to Noise Control on Construction, Maintenance and Demolition Sites' provides guidance for noise control at demolition and construction sites. This standard provides a good reference for the control of noise at the construction site. The proposed works should comply with the suggestions for the control of noise listed in the standard.
- Work on Saturday and Sunday and outside of the period 7.00 am to 6.00 pm should only be carried out if it can be demonstrated that noise levels will not cause excessive disturbance to nearby residents.

⁴ Australian Standard 2436-1981 "Guide to noise control on construction, maintenance and demolition sites".

5.3 Off Site Traffic Movements

DTEI have advised that the existing traffic count (2005) for the Strathalbyn to Callington Road is approximately 1,500 (estimated annual average daily traffic count). There are approximately 9 % commercial vehicles (with half of these heavy vehicles having three or more axles). The number of existing heavy commercial vehicles (B Double or similar) is hence around 65 per day (130 commercial vehicles total). The bulk of these vehicle movements occur through the day period (7 am to 10 pm).

This project is anticipated to generate 31 B-Double or equivalent trips per week (62 movements). These movements will be to the east of the site and not to the west where the closest residences are located. This equates to approximately 8 to 10 movements per day. The existing number of movements is 65 per day and hence this is not considered to be a significant increase.

The change in the average traffic noise level is predicted to be less than 1 dB(A) to the east and no change to the west of the site. Individual pass-by maximum noise levels are not expected to change as B-double trucks already use the Strathalbyn to Callington Road.

6.0 Conclusion

An assessment of environmental noise associated with the Angas Zinc Project has been undertaken. The following table (Table 6) summaries the results of the environmental noise assessment.

Table 6 Conclusion Relating to Angas Zinc Project Environmental Noise

Noise Source	Conclusions
On site mining operations	<ul style="list-style-type: none">• The noise limits can be achieved through the design of equipment to limit noise emission, installation of barrier around three partial sides of the ball mill, and the restriction of some equipment to day time use only.
Off site Traffic	<ul style="list-style-type: none">• Noise from off-site traffic is not likely to be significant when compared with the existing traffic particularly as B-Doubles will enter from and exit to the east where there are no nearby residences.• The total number of truck movements on the Strathalbyn-Callington Road will not increase significantly.

The new plant equipment and infrastructure will be attenuated as necessary to achieve noise levels at the nearest residence below the planning noise limit of 48 dB(A) and 40 dB(A) during the day and night time respectively. It is assumed that this will be verified progressively as the construction and commissioning progresses.

7.0 Appendix A: Nomenclature

'A' Weighted	The 'A' weighting scale is designed to adjust the absolute sound pressure levels to correspond to the subjective response of the human ear. The 'A' weighting is not applied to the underwater measurements when assessing the impact on marine animals.
dB(A)	'A' Weighted overall sound pressure level measured in decibels re 20 μ Pa.
EPA	Environment Protection Authority
INP	South Australian, Environment Protection (Industrial Noise) Policy (INP) 1994.
L_{Aeq}	The L_{Aeq} is defined as the 'A' weighted equivalent noise level and is the energy averaged noise level over the measurement period. This measure is commonly used (with corrections to form the effective noise level) when comparing the criterion noise level for equipment and machinery under the Victorian noise regulations (see effective noise level) and for comparison with other relevant standards for noise.
L_{A10}	'A' weighted noise level exceeded 10% of the measurement period. This is commonly used to represent the upper intrusive noise level.
L_{A90}	'A' weighted noise level exceeded 90% of the measurement period. This is often called the background noise level and is used in the calculation of SEP N-1 noise limits.
L_{Amax}	Maximum 'A' weighted noise level measured over a time period. This descriptor is used within the World Health Organisation (WHO) sleep disturbance guidelines.
W.C.	Weather Category description for the weather conditions as described in the internationally recognised Conservation Of Clean Air and Water – Europe (CONCAWE) environmental noise prediction method.
WHO	World Health Organisation

8.0 Appendix B: Noise Logger Location and Site Plan

The noise loggers were located at the “site office” and toward the rear of the property. The location is indicated in the following figure, along with receiver and source locations.

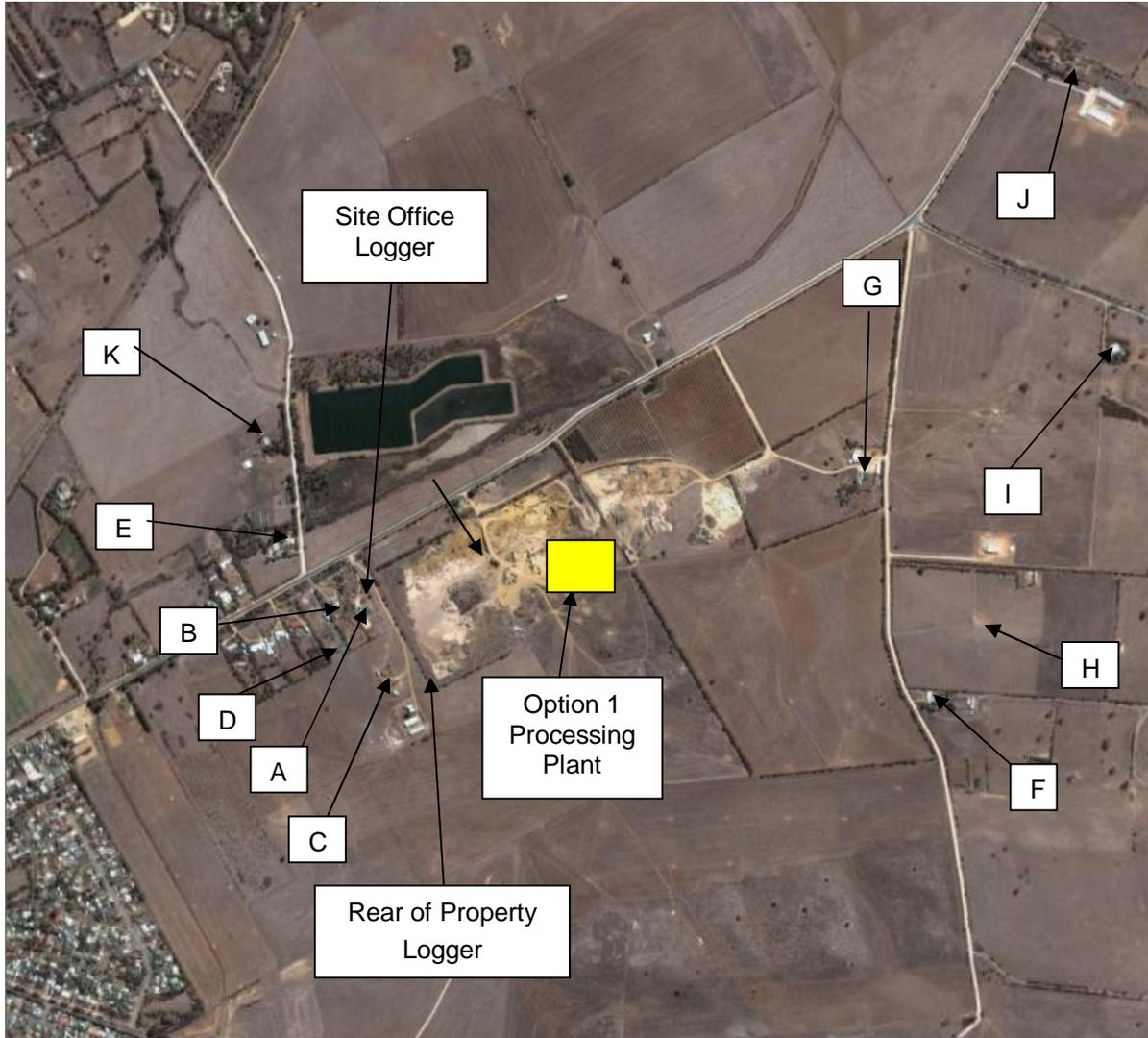


Figure B.1 Site Map, Receiver and Noise Logger Locations

9.0 Appendix C: Noise Source Levels

The maximum allowable noise source emission levels are summarised below.

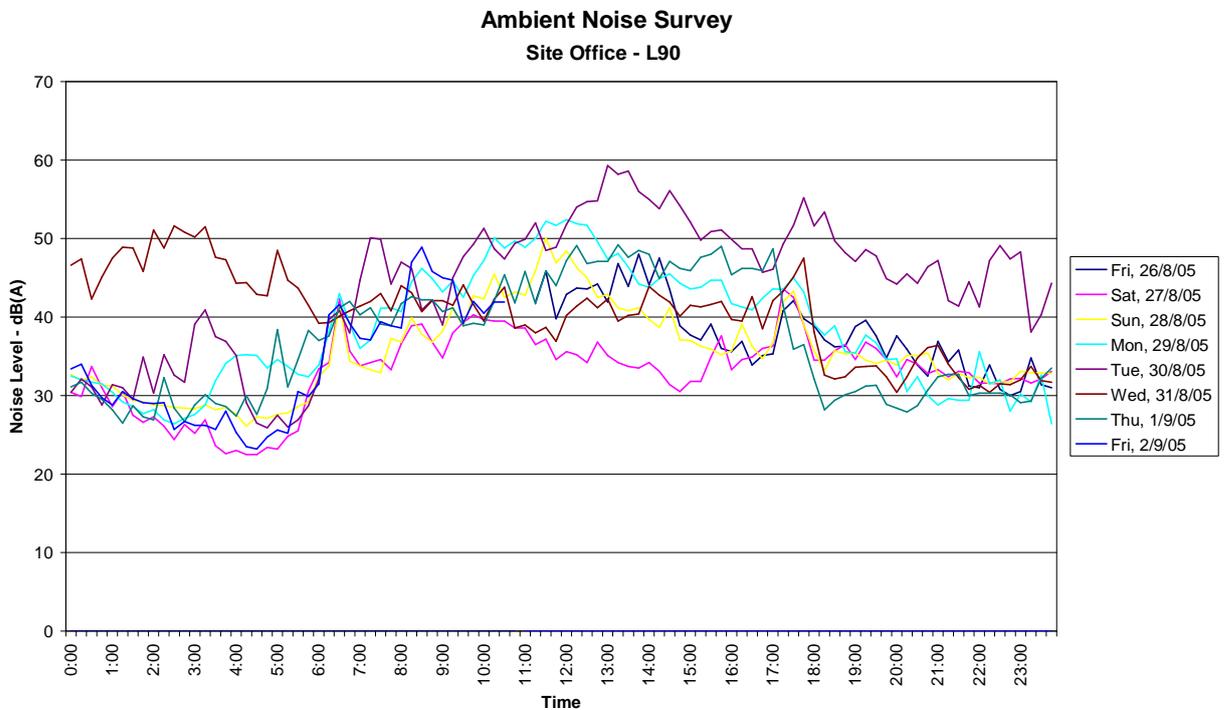
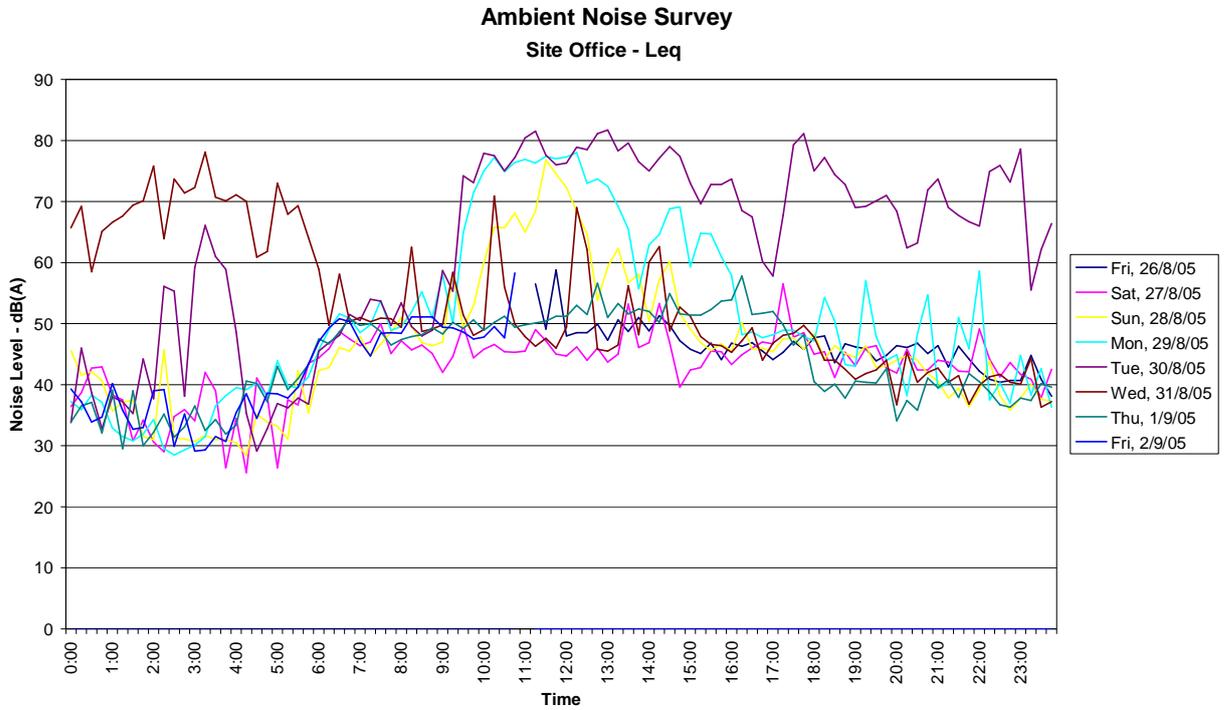
Noise Source	Location	Time of Operation	Emission Level (Sound Power) dB(A) re 10 ⁻¹² W	Notes
Vent fan	In Box Cut	24 hours	109	Included in mine specification
Ore trucks	Between mine/plant – 3 minutes on up track, 1 minute on down track, 1 minute dumping in a 15minute period.	24 hours	112	Volvo A40D
Crusher plant	Refer site plans – AZP 300-L-001	Day Time	113	Crusher measured at existing site in Victoria
Crusher Discharge Conveyor motor	Crushing area	Day Time	75	7.5 kW motor
Discharge Conveyor	Crushing area	Day time	72 dB/m	
Crusher Pumps	Crushing area	Day Time	86	Estimated from motor data
Coarse Ore Bin Feed Conveyor motor	Crusher to coarse ore bin	Day Time	86	18.5 kW motor
Coarse Ore Bin Feed Conveyor	Crushing area	Day time	72 dB(A)/m	
Front end loader	Loading Crusher	Day Time	108	CAT 980C
Mill Conveyor motor	Feeding mill	24 hours	75	7.5 kW motor
Mill Conveyor	Feeding mill	24 hours	69 dB(A)/m	
Ball mill	Refer site plans – AZP 300-L-001	24 hours	109 ⁵	Based on 85 dB(A) @1m.
Mill Motor	Refer site plans – AZP 300-L-001	24 hours	107	Data provided
Mill Pumps	Refer site plans – AZP 300-L-001	24 hours	97	Estimated from motor data
Mill ancillary equipment	Mill	24 hours	93	Data provided
Process air compressor	In Flotation shed	24 hours	83	Data provided
Flotation cells	Flotation tanks	24 hours	93	Data provided

⁵ Figure represents a calculated sound power level based on information that noise level would be no greater than 85 dB(A) @1m, and using dimensions provided in drawing AZP 300-L-003.

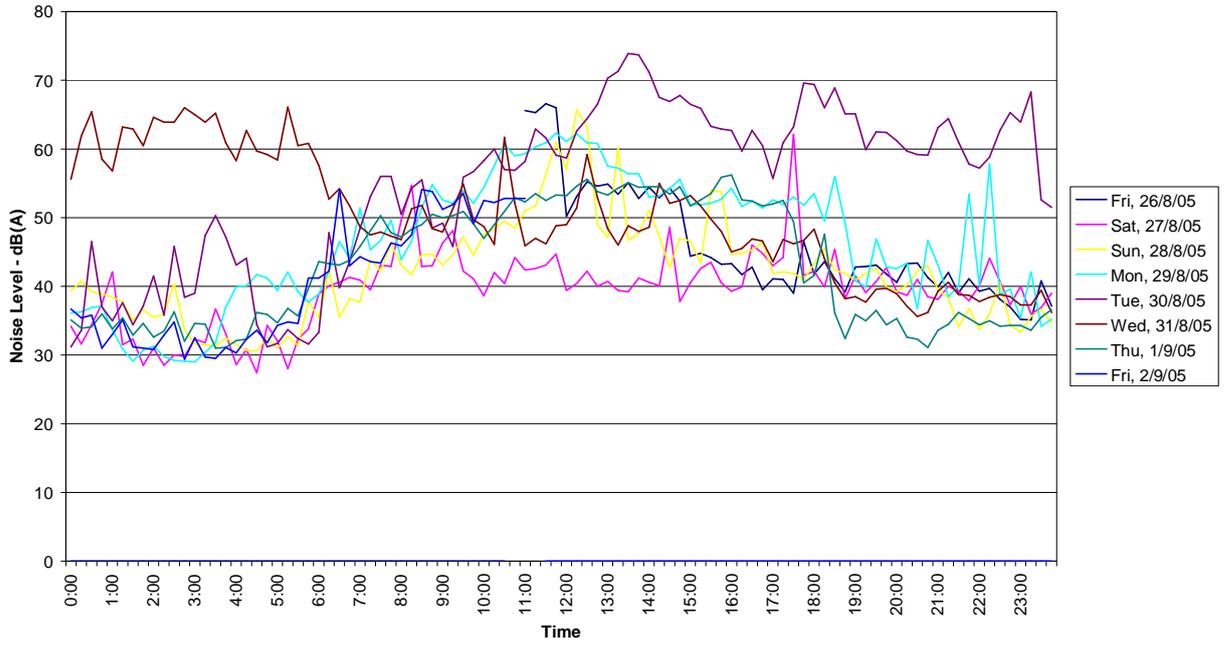
Noise Source	Location	Time of Operation	Emission Level (Sound Power) dB(A) re 10 ⁻¹² W	Notes
Flotation area pumps	Adjacent flotation tanks	24 hours	90	Estimated from motor data
Flotation blowers	Adjacent flotation shed	24 hours	101	Data provided
Thickener filters/agitators	Thickener tanks	24 hours	84	Estimated from motor data
Thickener tank pumps	Refer site plans – AZP 300-L-001	24 hours	90	Estimated from motor data
Lime mixing pumps	Thickener tanks	24 hours	85	Estimated from motor data
Tailing pumps	Adjacent process equipment	24 hours	86	Estimated from motor data
Process water pump	Adjacent pond	24 hours	90	Estimated from motor data
Volvo L120E	Concentrate shed	Daytime	106	Data provided
B-Double	Driving into and out of site	Daytime	112	From previous measurements
Lime mixing pumps	Lime mixing area	24 hours	85	Estimated from motor data
Weighbridge pump	Refer site plans – AZP 300-L-001	Day Time	77	4 kW motor
Concentrate shed pump	Refer site plans – AZP 300-L-001	Day Time	78	5.5 kW motor
Wash down bay pump	Refer site plans – AZP 300-L-001	Day Time	78	5.5 kW motor
Wash down bay water noise	Wash down bay	Day time	99	
Workshop compressor	Adjacent workshop	Day time	85	Data Provided

10.0 Appendix D: Noise Measurement Results

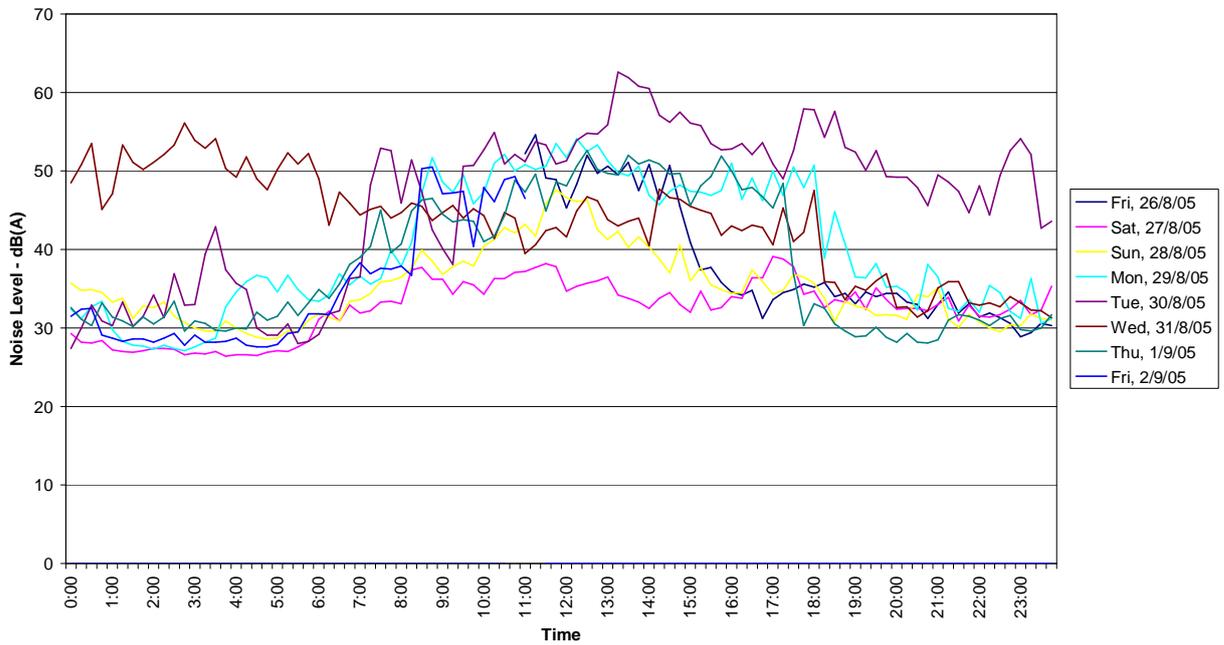
Measured ambient noise levels (L_{eq} and L_{90}) are presented in the following figures.



Ambient Noise Survey
Rear of Property - Leq



Ambient Noise Survey
Rear of Property - L90



11.0 Appendix E: Predicted Noise Contours

Predicted noise levels for the day and night periods are summarised in the following figures.

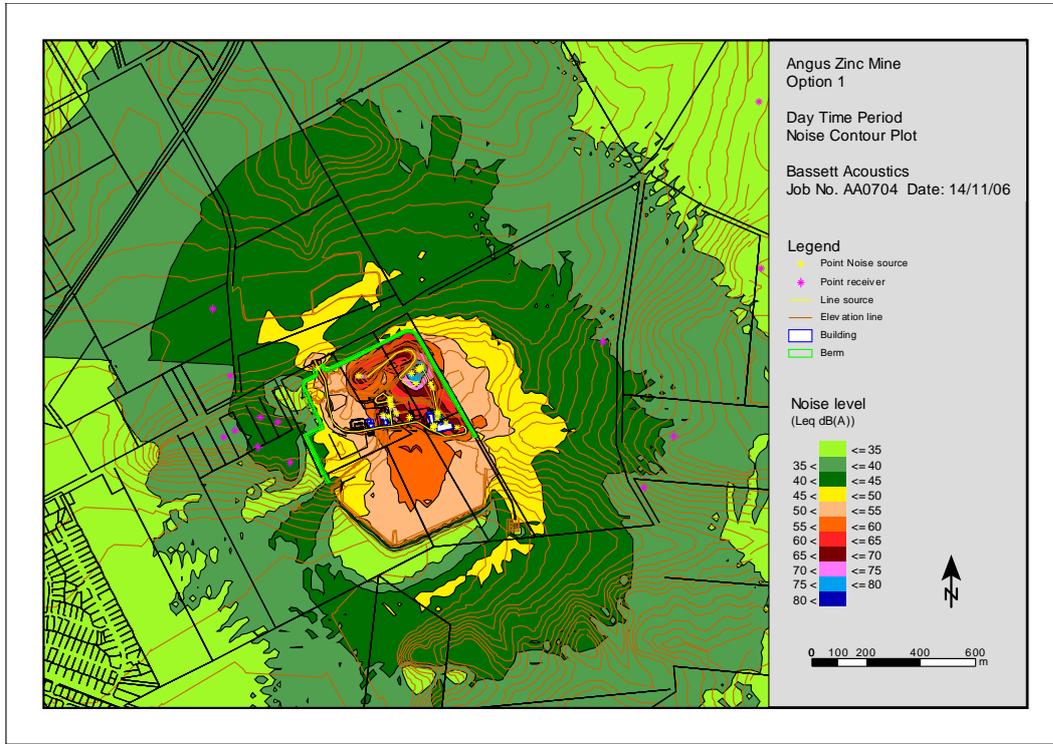


Figure E.1 Option 1 - Predicted day time noise levels

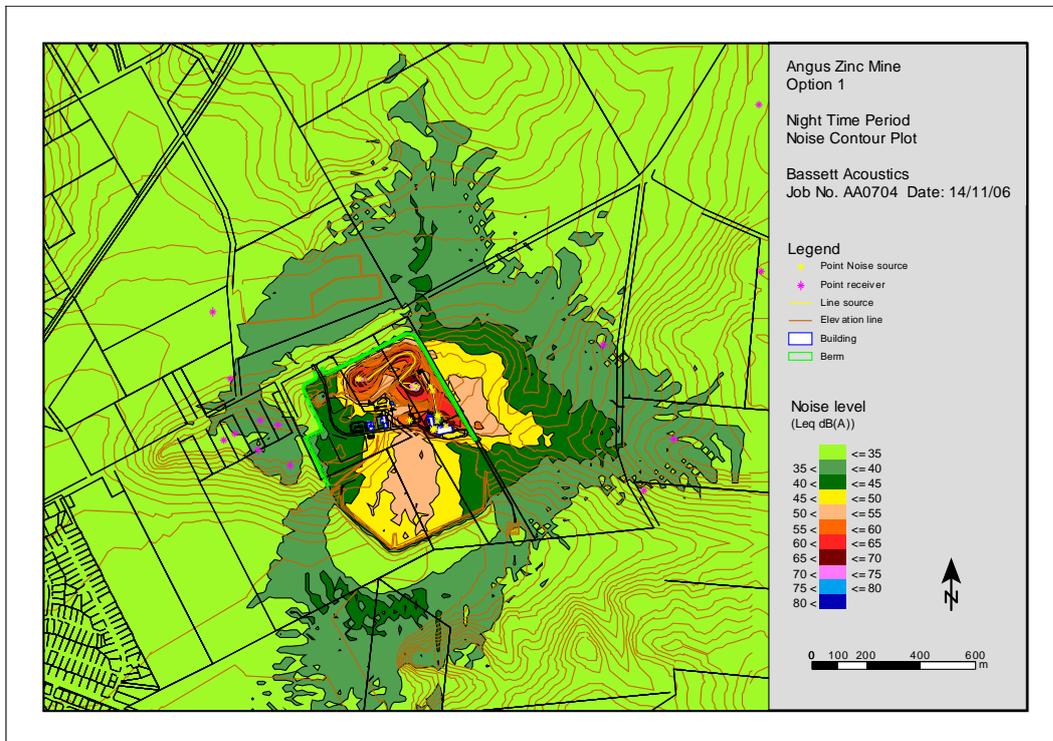


Figure E.2 Option 1 - Predicted night time noise levels