APPENDIX K

ENVIRONMENTAL NOISE ASSESSMENT

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Environmental Noise Assessment

Proposed Cyclone Mineral Sands Deposit

Reference: 14012641-01

Prepared for:
Lost Sands Pty Ltd

Member Firm of Association of Australian Acoustical Consultants

Report: 14012641-01

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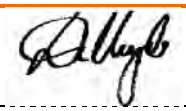
Prepared By:	Daniel Lloyd 
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1 INTRODUCTION

Lost Sands Pty Ltd proposes to develop the Cyclone Sands Deposit (the mine) located within the Eucla Basin in Western Australia, approximately 620 km east of Laverton. The location of the mine, haul road and railway siding is shown in *figure 1.1.*

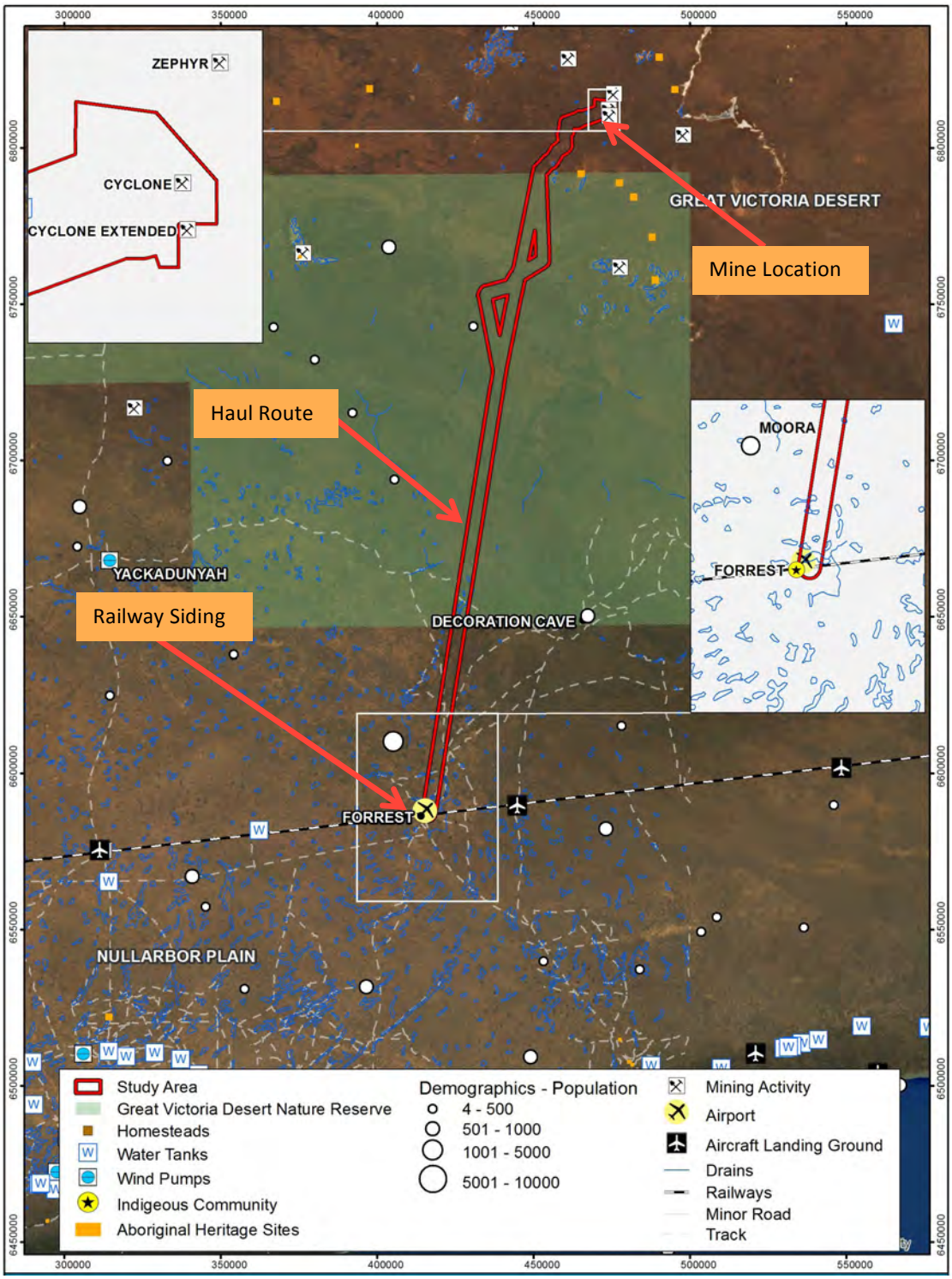


Figure 1-1 Proposed Mine Location

The operations consist of open-cut sand mining using a combination of excavators, trucks and scrapers to haul ore to be screened, slurried and pumped to the process plant. Once processed, the ore will be transported by container truck to the Forrest railway siding. At the Forrest railway siding the containers will be unloaded and stored until sufficient quantity is collected before loading on a train to port.

The supporting infrastructure for mine will incorporate an accommodation camp, small remote power station, airstrip and access roads.

The mining and processing operations will occur 24 hours a day, 7 days a week. The life of mine is expected to be 10 years.

Appendix A contains a description of some of the terminology used throughout this report.

2 CRITERIA

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

Regulation 7 defines the prescribed standard for noise emissions as follows:

- "7. (1) Noise emitted from any premises or public place when received at other premises must not cause or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and
- Must be free of:
  - Tonality;
  - Impulsiveness; and
  - Modulation".

A "…noise emission is taken to *significantly contribute to* a level of noise if the noise emission exceeds a value which is 5dB below the assigned level…"

Tonality, impulsiveness and modulation are defined in Regulation 9. Noise is to be taken to be free of these characteristics if:

a) The characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission; and

b) The noise emission complies with the standard after the adjustments of *Table 2.1* are made to the noise emission as measured at the point of reception.

Table 2-1 Adjustments for Intrusive Characteristics

Tonality	Modulation	Impulsiveness
+ 5dB	+ 5dB	+ 10dB

Note: The above are cumulative to a maximum of 15dB.

The baseline assigned levels (prescribed standards) are specified in Regulation 8 and are shown below in *Table 2.2*.

Table 2-2 Baseline Assigned Noise Levels

Premises Receiving Noise	Time of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise Sensitive[1]	0700 to 1900 hours Monday to Saturday (Day)	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays (Sunday)	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days (Evening)	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35 + influencing factor	45 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise Sensitive[2]	All hours	60	75	80

Notes: 1. Applies within 15 metres of a building associated with a noise sensitive use, as defined in Schedule 1, Part C.

2. Applies at a noise sensitive premise greater than 15 metres from a building associated with a noise sensitive use.

As there are no noise sensitive premises within the vicinity of the mine, the noise will be assessed to the accommodation village.

In regards to impacts to Forrest, noise from the container handling at the railway siding and trucks on a private haul road will require compliance with the Regulations. However, where trucks are operating on public roads, then the noise is exempt. We have assumed an influencing factor of zero for all noise sensitive premises. As such, the baseline levels will be the applicable criteria.

3 METHODOLOGY

Computer modelling has been used to predict the noise levels resulting form the project operations. The software used was *SoundPLAN 7.3* with the CONCAWE algorithms selected. These algorithms have been selected as they include the influence of wind and atmospheric stability. Input data required in the model are:

- Meteorological Information;
- Topographical data;
- Ground Absorption; and

- Source sound power levels.
- Meteorological Information

Meteorological information utilised is based on that specified in EPA *Guidance for the Assessment of Environmental Factors No.8 Environmental Noise draft*, and are shown below in *Table 3-1*.

Table 3-1 Modelling Meteorological Conditions

Parameter	Night (1900-0700)	Day (0700-1900)
Temperature (^{o}C)	15	20
Humidity (%)	50	50
Wind Speed (m/s)	3	4
Wind Direction*	All	All
Pasquil Stability Factor	F	D

Note: The modelling package used allows for all wind directions to be modelled simultaneously.

Note that the above conditions approximate the typical worst-case for enhancement of sound propagation. The EPA policy is that compliance with the assigned noise levels needs to be demonstrated for 98% of the time, during the day and night periods, for the month of the year in which the worst-case weather conditions prevail. In most cases a positive wind (from the source to the receiver) will occur at all sensitive receivers for more than 2% of the time and therefore this meteorological condition must be used.

At wind speeds greater than those shown above, sound propagation may be further enhanced, however background noise from the wind itself and from local vegetation is likely to be elevated and dominate the ambient noise levels.

3.1 Topographical Data

Topographical data was based on that provided by Outback Ecology. The contours are in 20 metre intervals and cover the project area.

3.2 Ground Absorption

Ground absorption varies from a value of 0 to 1, with 0 being for an acoustically reflective ground (e.g. water or bitumen) and 1 for acoustically absorbent ground (e.g. grass). In this instance, a value of 1 has been used.

3.3 Sound Sources

The noise sources assumed in the modelling is provided below:

Mine

- 14 x trucks, 3 x excavators, 3 x dozers, 2 x scrapers, 1 x grader and 1 x water cart.

Processing

- 30+ Processing pumps, 2 x FEL's

Railway Siding

- 1x rubber tyred container handler

3.4 Source Sound Levels

Table 3.2 shows the sound power levels used in the modelling.

Table 3-2 Source Sound Power Levels, dB(A)

Description	Octave Band Centre Frequency (Hz)								Overall
	63	125	250	500	1k	2k	4k	8k	
740 Haul Truck	70	99	97	97	100	98	91	83	106
PC 600 Excavator	79	99	98	96	96	89	81	71	104
850 Digger	79	87	88	93	96	90	84	75	99
D10 Dozer	79	98	103	106	109	107	102	92	113
Water Cart	75	93	96	98	102	101	95	85	106
G16 Grader	77	88	91	90	95	98	94	86	102
D7 Dozer	74	93	92	98	101	100	95	85	106
D6 Dozer	74	91	95	97	101	100	94	85	105
Wheeled Container Loader	84	86	91	95	96	94	87	77	101
Process Pumps	61	74	81	84	91	91	85	76	102
	75	80	83	88	95	90	81	72	
	72	79	81	91	98	87	79	67	
Slow Moving Truck	78	87	93	94	97	95	91	82	107
	79	89	96	97	98	93	89	77	
	83	90	92	98	97	92	87	71	

Data from Lloyd George Acoustics library.

From surveys undertaken at similar processing plant, it is assumed the motors will dominate the overall noise level. As such, the data for processing pumps would include the screens, spirals and trommels.

To predict the noise levels to Forrest from the truck operations, the measured sound pressure level of a truck moving at approximately 40km/h was used to predict the noise level of a single truck passing a receiver location. The noise level assumed for the passing truck at 15 m is shown in *Figure 3-1*.

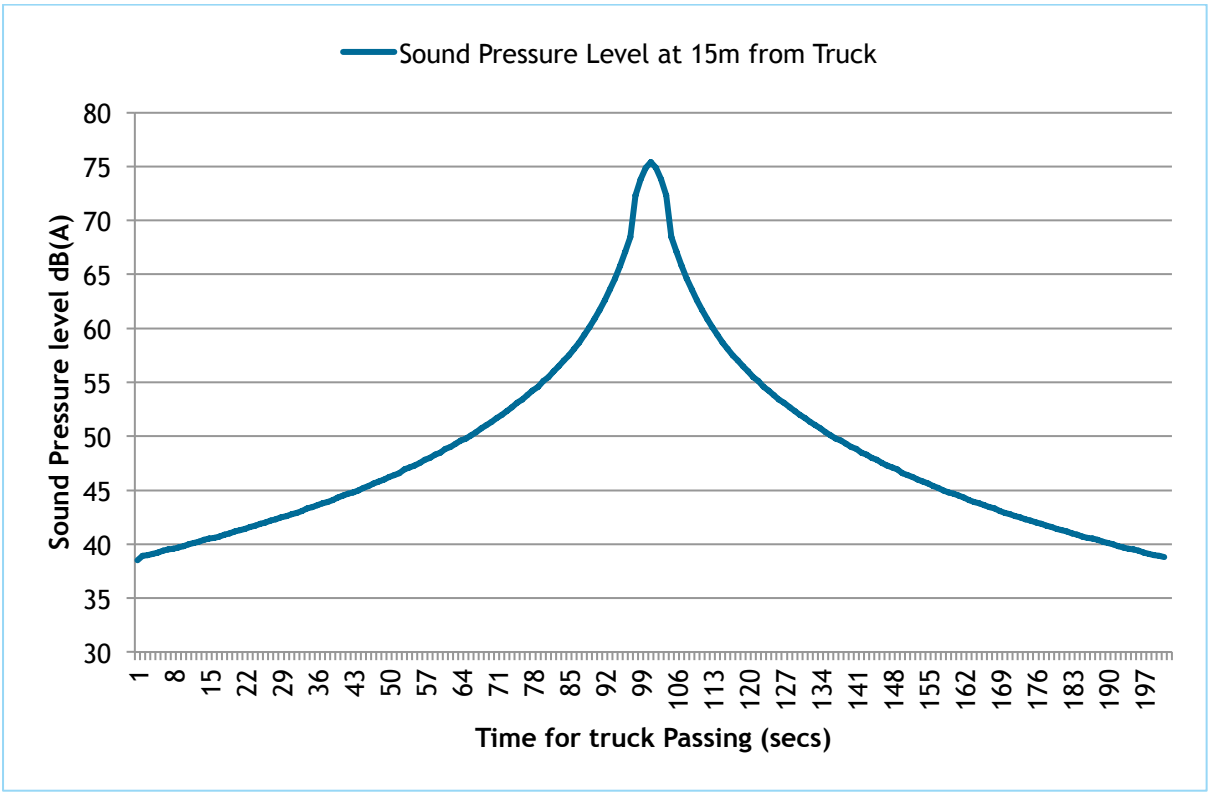


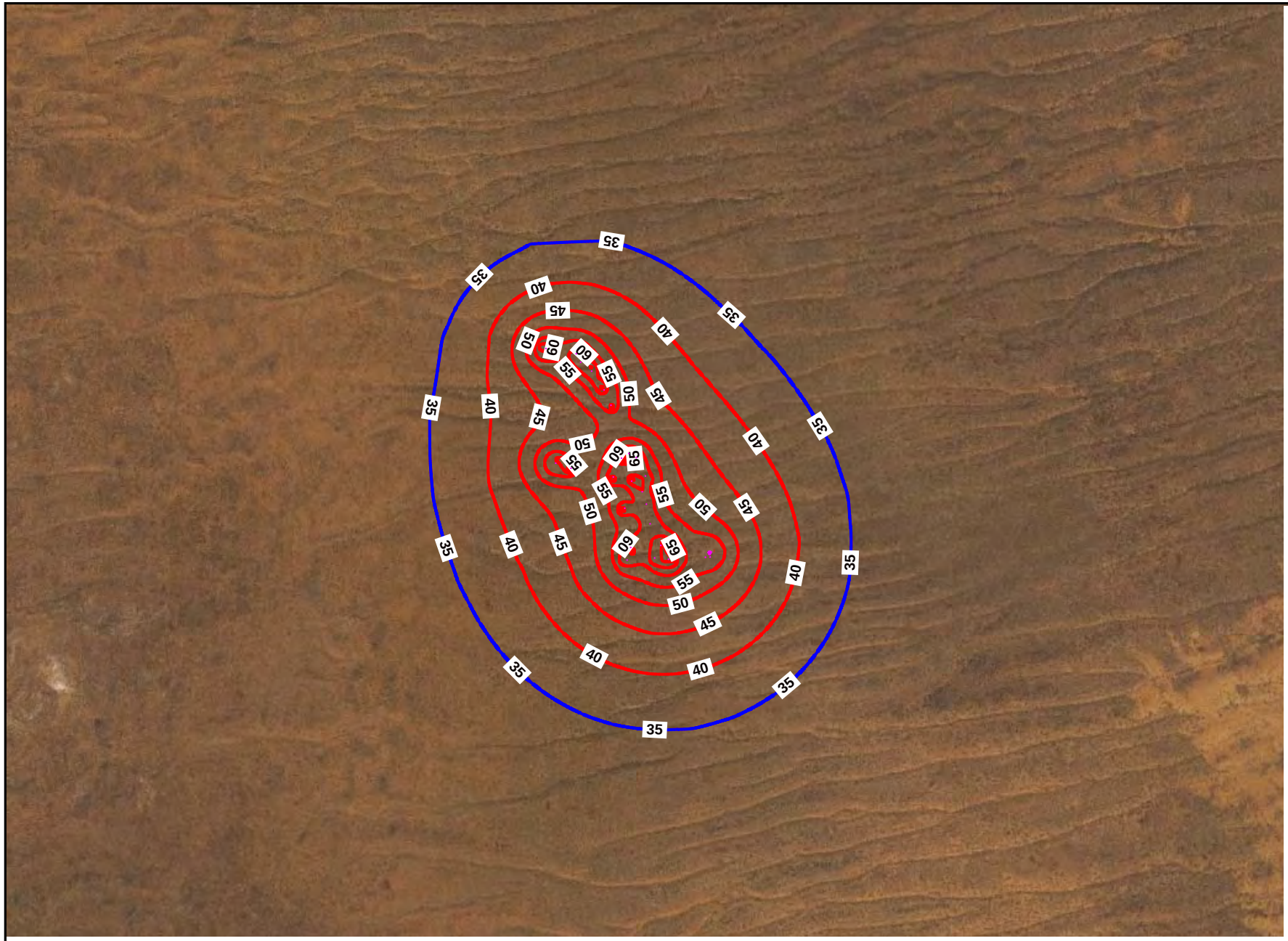
Figure 3-1 Sound Pressure Level of Passing Truck

4 RESULTS

The predicted noise levels associated with the project at both the mine site and the Forrest railway siding is provided in *Figures 4.1 and 4.2* respectively.

For truck noise as it passes Forrest, we have assumed 12 truck movements in any 24 hour period. This equates to two (2) truck movements in any four hour period. Assuming the noise from a truck occurs for 250 seconds, this equates to the noise occurring for approximately 3% of the time. Therefore, under the Regulations the noise from the trucks would need to comply with the night period L_{A1} and L_{Amax} criteria.

Figure 4.1



Cyclone Mineral Sands Project - Mine Operations
Predicted L_{A10} Noise Levels - Assumes All Plant Operating and Wind from All Directions

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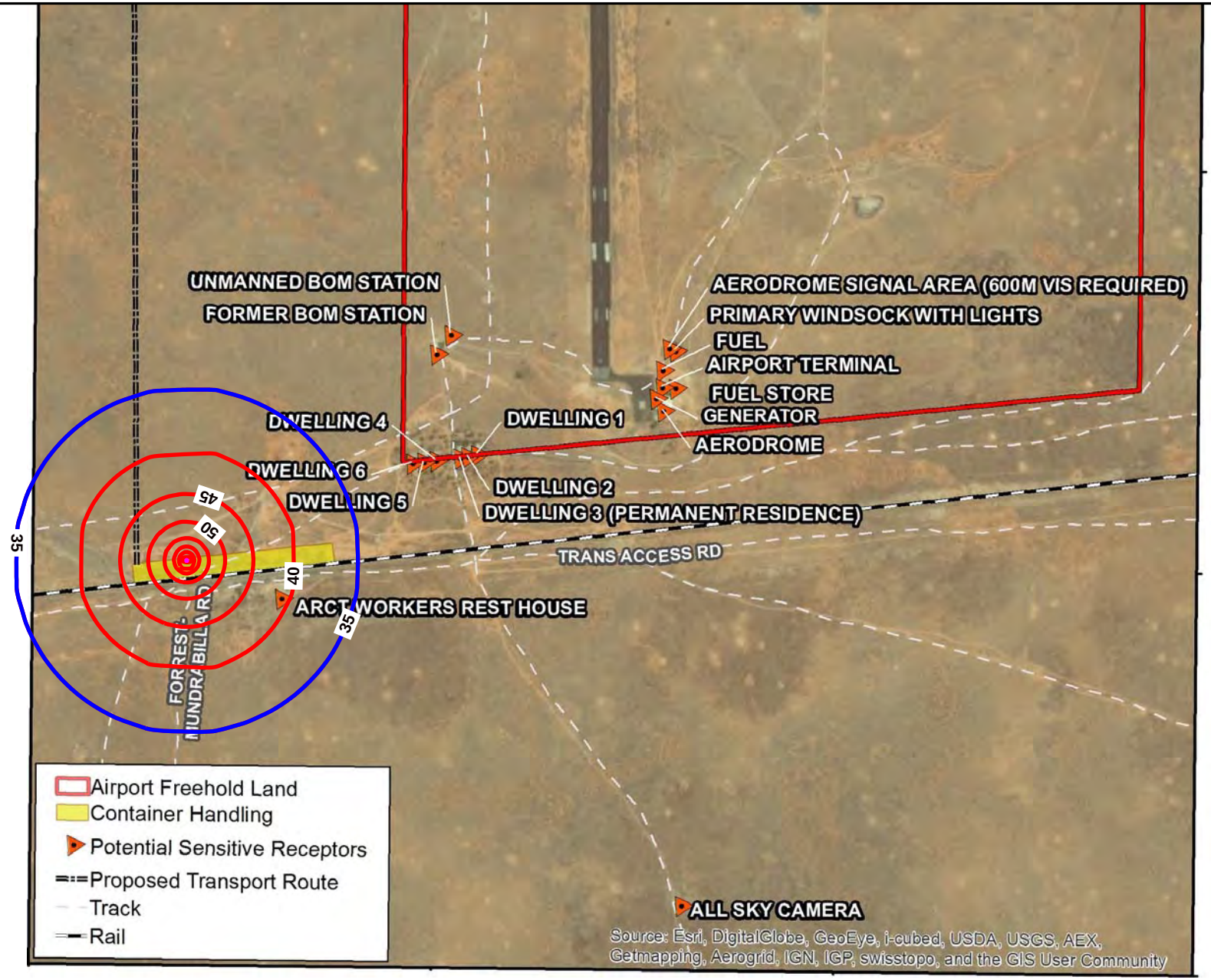
Figure 4.2



Signs and symbols

- Point source

N

Length Scale

0 50 100 200 300 400 m

Cyclone Mineral Sands Project - Container Loading at Forrest
Predicted L_{A10} Noise Levels - Assumes Wind from All Directions

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5 ASSESSMENT

Mine Site

As there are no noise sensitive premises close to the mine site, the mine is compliant with all relevant criteria. However, the Department of Environment and Regulation expects that, where practicable, mine accommodation camps be located such that noise levels are below the L_{A10} night period criterion (35 dB(A)). Therefore we would recommend placing the accommodation camp at least 2 km from the mining operations. In addition, any power generation plant should be placed behind an earth bund to reduce noise to the camp.

Forrest Railway Siding

The noise from the railway siding, during the unloading of trucks and loading of trains, is predicted to comply with the Regulations at all times at permanent residences.

For the ARTC Workers Rest Home, which is temporary accommodation used once a week, the noise is predicted to exceed the Regulations by 5 dB. However, as the accommodation is temporary and only used occasionally, the inside noise level with windows shut, is likely to achieve Australian Standards for noise in sleeping areas during loading activities. Not withstanding this, the noise from the loading will be managed in consultation with any person staying there.

Truck noise

The results of our calculations show that to ensure compliance with the Regulations, any haul road should be located at least 150 metres from any noise sensitive use.

6 DISCUSSION AND RECOMMENDATIONS

The results show that noise associated with the Cyclone Sands Deposit is predicted to comply with the assigned levels under the Regulations at all times.

The location of the mine accommodation village should be at least 2 km from the mining operations and haul roads should not be closer than 150 m from any noise sensitive use.

Appendix A

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)

The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting

An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

Sound Power Level (L_w)

Under normal conditions, a given sound source will radiate the same amount of energy, irrespective of its surroundings, being the sound power level. This is similar to a 1kW electric heater always radiating 1kW of heat. The sound power level of a noise source cannot be directly measured using a sound level meter but is calculated based on measured sound pressure levels at known distances. Noise modelling incorporates source sound power levels as part of the input data.

Sound Pressure Level (L_p)

The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

L_{ASlow}

This is the noise level in decibels, obtained using the A frequency weighting and the S time weighting as specified in AS1259.1-1990. Unless assessing modulation, all measurements use the slow time weighting characteristic.

L_{AFast}

This is the noise level in decibels, obtained using the A frequency weighting and the F time weighting as specified in AS1259.1-1990. This is used when assessing the presence of modulation only.

L_{Amax}

An L_{Amax} level is the maximum A-weighted noise level during a particular measurement.

L_{A1}

An L_{A1} level is the A-weighted noise level which is exceeded for one percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{A10}

An L_{A10} level is the A-weighted noise level which is exceeded for 10 percent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{Aeq}

The equivalent steady state A-weighted sound level ("equal energy") in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the "average" noise level.

L_{A90}

An L_{A90} level is the A-weighted noise level which is exceeded for 90 percent of the measurement period and is considered to represent the "*background*" noise level.

One-Third-Octave Band

Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20 000 Hz inclusive.

L_{Amax} assigned level

Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded at any time.

L_{A1} assigned level

Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 1% of the representative assessment period.

L_{A10} assigned level

Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 10% of the representative assessment period.

Tonal Noise

A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

the presence in the noise emission of tonal characteristics where the difference between -

(a) the A-weighted sound pressure level in any one-third octave band; and

(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

This is relatively common in most noise sources.

Modulating Noise

A modulating source is regular, cyclic and audible and is present for at least 10% of the measurement period. The quantitative definition of tonality is:

a variation in the emission of noise that —

(a) is more than 3 dB $L_{A\ Fast}$ or is more than 3 dB $L_{A\ Fast}$ in any one-third octave band;

(b) is present for at least 10% of the representative.

Impulsive Noise

An impulsive noise source has a short-term banging, clunking or explosive sound. The quantitative definition of tonality is:

a variation in the emission of a noise where the difference between $L_{A\ peak}$ and $L_{A\ Max\ slow}$ is more than 15 dB when determined for a single representative event;

Major Road

Is a road with an estimated average daily traffic count of more than 15,000 vehicles.

Secondary / Minor Road

Is a road with an estimated average daily traffic count of between 6,000 and 15,000 vehicles.

Influencing factor

$$= \frac{1}{10}\left(\%\ \text{Type A}_{100} + \%\ \text{Type A}_{450}\right) + \frac{1}{20}\left(\%\ \text{Type B}_{100} + \%\ \text{Type B}_{450}\right)$$

where:

$\%\ \text{Type A}_{100}$ = the percentage of industrial land within a100m radius of the premises receiving the noise

$\%\ \text{TypeA}_{450}$ = the percentage of industrial land within a 450m radius of the premises receiving the noise

$\%\ \text{Type B}_{100}$ = the percentage of commercial land within a100m radius of the premises receiving the noise

$\%\ \text{TypeB}_{450}$ = the percentage of commercial land within a 450m radius of the premises receiving the noise

+ Traffic Factor (maximum of 6 dB)

= 2 for each secondary road within 100m

= 2 for each major road within 450m

= 6 for each major road within 100m

Representative Assessment Period

Means a period of time not less than 15 minutes, and not exceeding four hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

Background Noise

Background noise or residual noise is the noise level from sources other than the source of concern. When measuring environmental noise, residual sound is often a problem. One reason is that regulations often require that the noise from different types of sources be dealt with separately. This separation, e.g. of traffic noise from industrial noise, is often difficult to accomplish in practice. Another reason is that the measurements are normally carried out outdoors. Wind-induced noise, directly on the microphone and indirectly on trees, buildings, etc., may also affect the result. The character of these noise sources can make it difficult or even impossible to carry out any corrections.

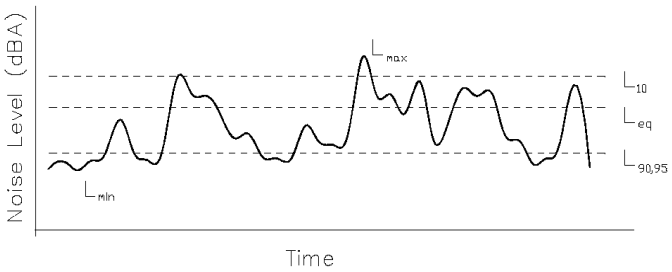
Ambient Noise

Means the level of noise from all sources, including background noise from near and far and the source of interest.

Specific Noise

Relates to the component of the ambient noise that is of interest. This can be referred to as the noise of concern or the noise of interest.

Chart of Noise Level Descriptors



Typical Noise Levels