

SHEFFIELD RESOURCES

Environmental Noise Impact Assessment

THUNDERBIRD MINERAL SANDS PROJECT
DERBY PORT DEVELOPMENT ENVELOPE

NOVEMBER 2016

Environmental Noise Impact Assessment

THUNDERBIRD MINERAL SANDS PROJECT DERBY PORT DEVELOPMENT ENVELOPE

Sheffield Resources

REV	DATE	DETAILS
001	03/11/2016	Environmental Noise Impact Assessment

AUTHOR, REVIEWER AND APPROVER DETAILS

Prepared by:	Andrew Boladz	Date: 03/11/2016	Signature: 
Reviewed by:	Zhang Lai	Date: 03/11/2016	Signature: 
Approved by:	Alex Campbell	Date: 03/11/2016	Signature: 

WSP | Parsons Brinckerhoff

Level 5, 503 Murray Street
Perth WA 6000
PO Box 7181
Cloisters Square WA 6850

Tel: +61 8 9489 9700
Fax: +61 8 9489 9777

www.wsp-pb.com

Filename: 2300650A-ACS-REP-PORT Rev001



This document may contain confidential and legally privileged information, neither of which are intended to be waived, and must be used only for its intended purpose. Any unauthorised copying, dissemination or use in any form or by any means other than by the addressee, is strictly prohibited. If you have received this document in error or by any means other than as authorised addressee, please notify us immediately and we will arrange for its return to us.

TABLE OF CONTENTS

ABBREVIATIONS	II
EXECUTIVE SUMMARY	III
1 INTRODUCTION	1
2 BACKGROUND INFORMATION	2
2.1 Project description	2
2.2 Location of sensitive receivers	3
2.3 Existing noise environment	4
2.3.1 Unattended monitoring.....	4
2.3.2 Operator attended monitoring.....	6
3 ASSESSMENT CRITERIA	8
3.1 Environmental noise	8
3.2 Traffic noise	10
4 METHODOLOGY	11
4.1 Environmental noise assessment	11
4.1.1 Source Sound Power Levels.....	11
4.1.2 Noise modelling scenario and assumptions	12
4.2 Traffic noise assessment	13
5 PREDICTION OF NOISE LEVELS	14
5.1 Environmental noise assessment	14
5.2 Traffic noise assessment	15
6 IMPACT ASSESSMENT	16
6.1 Environmental noise	16
6.2 Traffic noise	16
7 CONCLUSIONS	18

ABBREVIATIONS

Km	Kilometre
Bt	Billion Tonnes
M ²	Metre Squared
M	Metre
dB	Decibel
BOM	Bureau of Metrology
RAP	Representative Assessment Period
WAPC	Western Australian Planning Commission
CoRTN	Calculation of Road Traffic Noise
FHWA	US Federal Highway Administration

EXECUTIVE SUMMARY

Background

This report has been prepared by WSP | Parsons Brinckerhoff for Sheffield Resources Limited (Sheffield Resources) to support its environmental impact assessment of the operations from the Port of Derby and associated road train movements through the township of Derby.

The Port of Derby will have the following infrastructure:

- 5000 metres squared (m²) storage shed.
- Bulk load out facility with conveyor and ship loader.

The identified nearest sensitive receivers are:

- Residential premises located at Elder Street approximately 2 km from the port.
- Café located in the vicinity of the port.

Applicable criteria

The criteria that have been used to assess the noise levels at the sensitive receivers are as follows:

- Environmental Protection (Noise) Regulations 1997.
- Western Australian Planning Commission (WAPC) State Planning Policy 5.4 “Road and Rail Transport Noise and Freight Considerations in Land Use Planning”

Modelling

The acoustic modelling program SoundPLAN has been used to predict the environmental noise levels from port operations at the receivers.

An estimate was made of increased road traffic noise levels from road trains on Derby Highway and Loch Street using the US Federal Highway Administration (FHWA) Model.

Assessment

From the results of the environmental noise measurements and modelling undertaken as part of the assessment, it has been shown that the noise levels from the operations associated with the port are expected to comply with the relevant noise criteria at all the identified receivers.

From the results of the traffic noise measurements and modelling undertaken as part of the assessment, it has been shown that the noise levels from the road trains traveling to and from the port are expected to comply with the relevant traffic noise criteria.

1 INTRODUCTION

The proposed Thunderbird Mineral Sands Project (Thunderbird Project) mine site is located on the Dampier Peninsula about 60 Kilometres (km) west of Derby and 25 km north of the Great Northern Highway joining Derby and Broome.

The Thunderbird Project is one of the largest mineral sands deposits discovered in the last 30 years. It has a total mineral resource of 3.2 Billion Tonnes (Bt) and supports a 47 year mine life.

As part of the project road trains will be used to transport bulk products from the mine to the Port of Derby where it will be loaded onto barges for transshipment to a geared vessel 20 nautical miles offshore in King George Sound.

This report has been prepared by WSP | Parsons Brinckerhoff for Sheffield Resources Limited (Sheffield Resources) to support its environmental impact assessment of the operations from the Port of Derby.

The aims of the study are:

- Provide a description of the proposed port operation based on the project information provided by Sheffield Resources, identifying the main sources of noise associated with the operation of the port.
- Identify all nearby potentially-affected sensitive receivers for the port.
- Provide a description of the environmental noise criteria relevant to the port.
- Assess the potential noise impacts associated with the port on the nearest sensitive receivers.
- Assess the potential noise impact of road trains travelling through Derby to service the port.

2 BACKGROUND INFORMATION

2.1 Project description

The proposed location of the Project and the Port of Derby is shown in Figure 2-1.

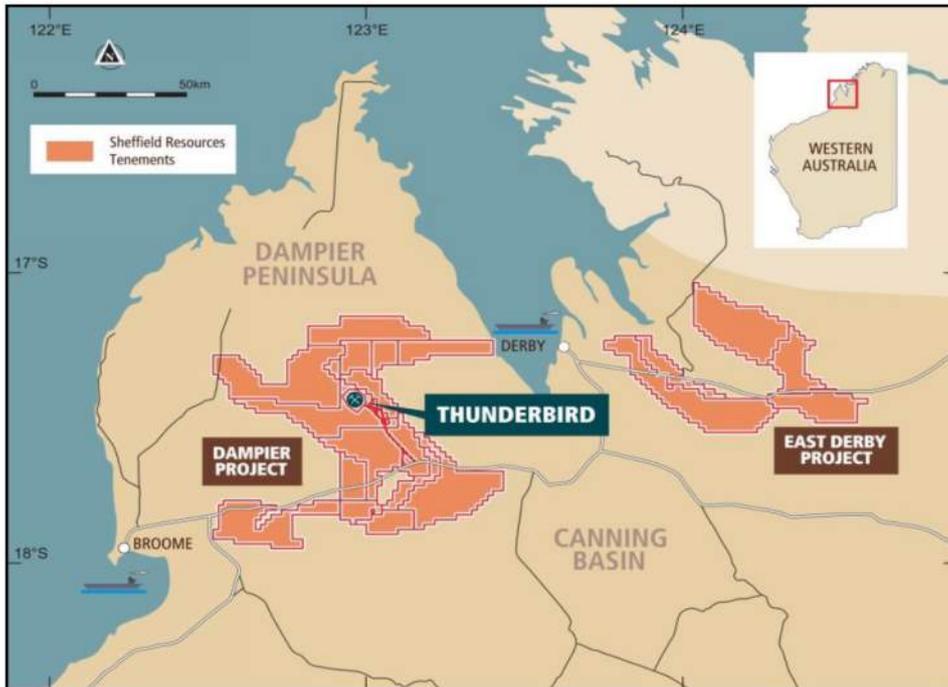


Figure 2-1 Project location

Final product will be transported in bulk by a fleet of five quad road trains from the mine to the Port of Derby for storage and export. The road trains will operate 24 hours a day six days per week and it is anticipated that each road train will complete two runs per 12 hour shift. The road train route will travel through the township of Derby along Derby Highway and Loch Street.

The Port of Derby will have the following infrastructure:

- 5000 metres squared (m²) storage shed.
- Bulk load out facility with conveyor and ship loader previously designed for the Western Metals operations.

The proposed layout of the Port of Derby is shown in Figure 2-2.



Figure 2-3 Location of receivers Port of Derby

2.3 Existing noise environment

2.3.1 Unattended monitoring

Continuous unattended noise monitoring was conducted simultaneously for seven days at two selected free field representative locations between 24 and 31 May 2016. The noise logging was undertaken in order to understand the existing background noise environment.

The noise loggers were located at (as highlighted in Figure 2-4):

- Main Roads Western Australia offices on Woodhouse Street.
- Derby Shire Offices on Loch Street.



Figure 2-4 Noise logging locations

The unattended noise monitoring equipment used during the survey is shown in Table 2-1; the calibration certificates are available on request.

Table 2-1 Unattended noise logging equipment

Location	Equipment Type	Serial No
Main Roads Office	ARL 315 Noise Logger	15-203-504
Shire Office	ARL 316 Noise Logger	16-707-042
N/A	Larson Davis LD200 Calibrator	11584

The loggers were programmed to record various statistical noise levels over consecutive 15 minute intervals. All loggers were checked for calibration before and after the survey and no significant drift (greater than 0.5 decibels (dB)) was detected.

The daily weather conditions at the Bureau of Meteorology (BOM) weather station for Derby during the measurement period can be viewed in Table 2-2. Based on the observations the weather conditions did not have a significant influence on the noise logging.

Table 2-2 Daily weather conditions

Date	Rain mm	0900 Hours					1500 Hours				
		Temp °C	RH %	Wind Direction	Wind Speed Km/h	Pressure hPa	Temp °C	RH %	Wind Direction	Wind Speed Km/h	Pressure hPa
24/05/2016	0	25	65	SSE	11	1015	33	44	NW	13	1011
25/05/2016	0	27	62	SSE	9	1014	33	40	WNW	19	1010
26/05/2016	0	28	51	SSE	13	1016	33	35	WNW	17	1012
27/05/2016	0	28	50	SSE	2	1016	35	31	SSE	19	1011
28/05/2016	0	29	46	ESE	9	1015	34	34	WNW	17	1010
29/05/2016	0	28	55	SSE	11	1014	34	33	NW	13	1010
30/05/2016	0	29	50	ESE	4	1014	34	34	NW	19	1010
31/05/2016	0	28	64	SSW	13	1016	34	36	NW	17	1012

The results of the noise logging are shown in Table 2-3.

Noise loggers continuously measure ambient noise, which includes all noise sources present at the time. The L_{A90} (see Appendix A.1) is a good indicator of background noise as it is relatively insensitive to noises that are short term in duration.

Table 2-3 Noise logging results – Derby

Location	Period	L_{A90} (dB)	L_{A10} (dB)	L_{A1} (dB)
Main Roads Office	Night	28	43	50
	Day	41	54	59
	Evening	40	47	55
Shire Office	Night	31	41	51
	Day	38	56	64
	Evening	38	47	59

2.3.2 Operator attended monitoring

Operator-attended noise measurements were undertaken at locations around the port and township in order to understand the composition of the current noise environment and to supplement the noise logger data.

The instrumentation used during the operator-attended noise monitoring is shown in Table 2-4.

Table 2-4 Attended noise monitoring equipment

Equipment Type	Serial No	Calibration Date
Larson Davis Model 831 Precision Integrating Sound Level Meter	3726	18/09/2015
Larson Davis LD200 Calibrator	11584	18/09/2015

All measurements were conducted using the ‘A-weighting’ filter and ‘slow’ response. All items of acoustic instrumentation employed during the attended noise monitoring surveys were designed to comply with Australian Standard AS IEC 61672 “Electroacoustics - Sound level meters”. Noise measurements were conducted at a height of approximately 1.2 metres (m) above ground level.

All noise measurements were obtained over a sufficient duration to provide a representation of the typical noise emissions.

The sound level meter was calibrated before and after the survey with the calibrator. No significant drift (greater than 0.5 dBA) in calibration was detected.

The attended measurement locations are highlighted in Figure 2-5.



Figure 2-5 Attended measurement locations

The results of the attended noise measurements within Derby are shown in Table 2-5.

Table 2-5 Attended noise measurements Derby 24 May 2016

Location	Time	L _{A90} dB	L _{A10} dB	L _{Amax} dB	Comments
Jetty Café	3.05 PM	38	53	72	Cars visiting café and jetty Bird noise
	7.25 PM	34	45	57	Cars visiting café and jetty
Spinifex Hotel	3.35 PM	34	47	72	Occasional bird and traffic
Shire Offices	4.30 PM	43	60	69	Traffic Loch Street Bird noise Plant noise shire offices
	7.50 PM	37	43	65	Traffic Loch Street
Fishing Club	8.05 PM	37	40	69	Insect noise dominant Domestic condenser unit Traffic
	10.00 PM	40	42	45	Insect noise dominant Domestic condenser unit One vehicle passby

3 ASSESSMENT CRITERIA

3.1 Environmental noise

The applicable statutory requirements for noise emissions are contained within the *Environmental Protection Act 1986* (the Act) and the *Environmental Protection (Noise) Regulations 1997* (the Noise Regulations).

The Noise Regulations require that noise emitted from any premises must comply with assigned noise levels when received at any other premises and be free of the intrusive characteristics of tonality, modulation and impulsiveness. In addition, the noise emissions must not “significantly contribute” to an exceedance of the assigned levels.

The assigned levels are specified according to the type of premises receiving the noise. For noise sensitive receivers, the assigned levels recognise the time of day and the presence of commercial and industrial land zonings and major road within a 450 m radius of the receptor. The Noise Regulations specify requirements relating to tonality, modulation and impulsiveness, as well as to emissions that may “significantly contribute” to an exceedance.

Assigned noise levels

Assigned noise levels are the levels of noise allowed to be received at a premises at a particular time of the day.

There are different assigned levels for noise sensitive, commercial and industrial premises. The assigned levels for noise sensitive premises vary depending on the time of the day. The assigned levels also depend on how close the noise sensitive premises are to industrial and commercial areas and to major roads. The assigned noise levels always apply at the premises receiving the noise.

A noise emission is generally understood to “significantly contribute” if it is higher than a level which is 5 dBA below the assigned level at the point of reception.

The table of assigned levels, shown in Table 3-1 identifies three types of assigned levels: L_{Amax} , L_{A1} and L_{A10} .

Table 3-1 Table of assigned noise levels

Type of premises receiving noise	Time of day	Assigned level (dB)		
		L _{A10}	L _{A1}	L _{Amax}
Noise sensitive premises at locations within 15 m of a building directly associated with a noise sensitive use	0700 to 1900 hours Monday to Saturday	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days	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	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise sensitive premises at locations further than 15 m from a building directly associated with a noise sensitive use	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises	All hours	65	80	90

- 1 The "influencing factor" is calculated for each noise-sensitive premises receiving noise. It takes into account the amount of industrial and commercial land and the presence of major roads within a 450 m radius around the noise receiver.
- 2 The influencing factor will range from zero to about 20 in most cases.

The influencing factor increases with the amount of commercial and industrial premises in the vicinity of the receiver as well as the presence of major or minor roads. This is calculated by considering areas within 100 m and 450 m of the receiver. The calculated influencing factors to be added to the assigned levels are shown in Table 3-2.

Table 3-2 Influencing Factor assumptions

Type	Description	Contribution to IF (dB)
		Elder Street Derby
Industrial Land	within 100 m	13%
	within 450 m	16%
Commercial Land	within 100 m	22%
	within 450 m	12%
Major Roads	within 100 m	0
	within 450 m	0
Secondary Roads	within 100 m	0
Influencing Factor (rounded to nearest dB)		5

Table 3-3 shows the specific noise criteria applicable for the nearest sensitive receivers including the adjustment for the influencing factor.

Table 3-3 Specific criteria

Time of day	Receiver	Assigned level (dB)		
		L _{A10}	L _{A1}	L _{Amax}
Night time Noise Sensitive Premises	Elder Street	40	50	60
Day time Noise Sensitive Premises		50	60	70
Evening Noise Sensitive Premises		45	55	60
Commercial Premises	Jetty Café	60	75	80

If noise emitted from any premises when received at any other premises cannot reasonably be free of intrusive characteristics of tonality (e.g. drone), modulation (e.g. siren) and impulsiveness (e.g. bang), then a series of adjustments must be added to the emitted levels (measured or calculated) and the adjusted level must comply with the assigned level. The adjustments are detailed in Table 3-4.

Table 3-4 Table of adjustments

Adjustment where noise emission is not music these adjustments are cumulative to a maximum of 15 dB		
Where tonality is present	Where modulation is present	Where impulsiveness is present
+5 dB	+5 dB	+10 dB

Based on a comparison of the octave band predicted received noise levels and the existing measured background night time noise levels within the Derby township an audible tone is potentially predicted at 125 Hz. Therefore the predicted received noise levels will be adjusted by 5 dB for potential tonality.

Representative Assessment Period

The assigned levels are statistical noise levels over a Representative Assessment Period (RAP), for this assessment the RAP has been chosen as 60 minutes as an appropriate period for assessing the noise from the project. 60 minutes has been chosen so that at least one full road train movement at the port be included in the assessment.

As the noise from the facility is expected to be generally constant, the L₁₀ criteria will be used for the assessment of the noise levels at the receivers. L_{max} will also be assessed for noise associated with the road trains.

3.2 Traffic noise

The most appropriate criteria to assess the impact of the road trains on the public roads within Derby is contained within the Western Australian Planning Commission (WAPC) State Planning Policy 5.4 "Road and Rail Transport Noise and Freight Considerations in Land Use Planning" (WAPC Criteria). This policy sets out the outdoor noise criteria that apply for noise sensitive developments next to road or rail transport corridors. These criteria are shown in Table 3-5.

Table 3-5 Outdoor traffic noise criteria

Time of Day	Noise Target	Noise Limit
Day (6 am – 10 pm)	L _{Aeq(Day)} = 55 dB	L _{Aeq(Day)} = 60 dB
Night (10 pm – 6 am)	L _{Aeq(Night)} = 50 dB	L _{Aeq(Night)} = 55 dB

4 METHODOLOGY

4.1 Environmental noise assessment

The model was prepared using the SoundPLAN (version 7.4) Industrial Module, a commercial software system developed by Braunstein and Bernt GmbH in Germany.

The software allows the use of various internationally recognised noise prediction algorithms. The CONCAWE method, developed in The Netherlands for assessment of large industrial plants, has been selected for this assessment as it enables meteorological influences to be assessed.

The SoundPLAN model included the climatic parameters outlined in the EPA *Guidance for the Assessment of Environmental Factors Environmental Noise, Draft No.8*; these parameters are highlighted in Table 4-1. The modelling assumed a worst case scenario wind direction of from the source to the receiver.

Table 4-1 Meteorological conditions used in the noise predictions

Time of Day	Temperature	Relative Humidity	Wind Speed*	Pasquil Stability Category
Day (07:00 to 19:00)	20°C	50%	4 m/s	E
Night (22:00 to 07:00)	15°C	50%	3 m/s	F

* - The wind is orientated so that it blows from the source to the receiver

4.1.1 Source sound power levels

The potential for machinery to emit noise is quantified as the sound power level expressed in decibels (dB re 1×10^{-12} W). At the receiver, the noise is quantified as the sound pressure level expressed in decibels (dB re 20 μ Pa).

The Sound Power Levels used in the modelling were obtained from Sheffield Resources and WSP | Parsons Brinckerhoff's database and are shown in Table 4-2.

Table 4-2 Source sound power levels – port operations

Source Item	Octave Band Sound Power Level dBL								Total dBA	Source Height
	63	125	250	500	1k	2k	4k	8k		
Frequency Hz	63	125	250	500	1k	2k	4k	8k		
Road train	122	123	118	118	115	112	111	106	120	2.5
Loader CAT 988	128	126	109	107	102	98	95	90	112	4
Ship loader drive	98	96	94	94	92	90	88	79	97	2
Conveyor (enclosed)	94	87	77	74	71	70	63	58	78/m	2

The placement of the noise sources within the model are outlined in Figure 4-1.

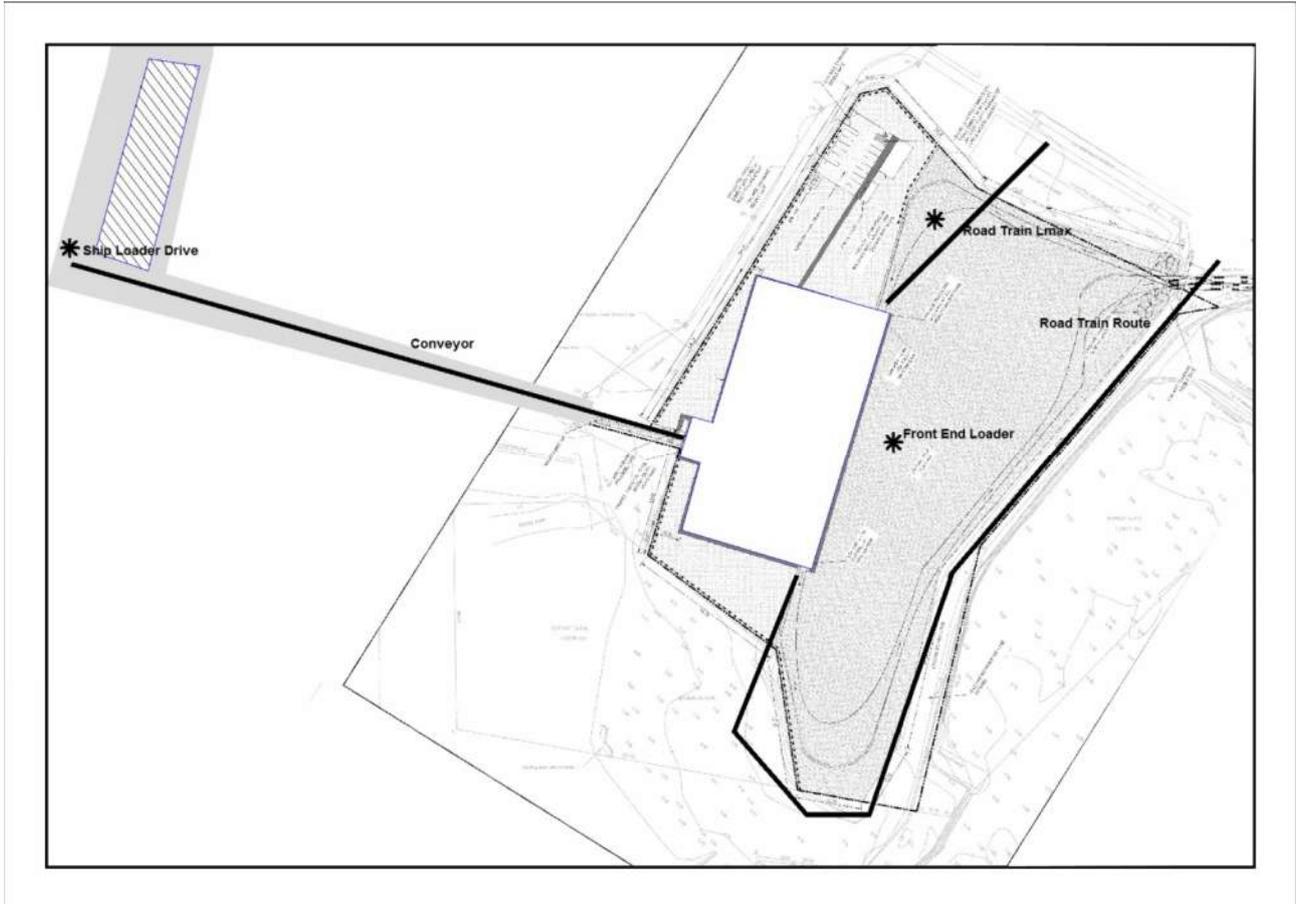


Figure 4-1 Noise source placement

4.1.2 Noise modelling scenario and assumptions

A night time scenario was predicted as the applicable criteria is the most stringent and compliance with the night time criteria will therefore also achieve compliance with the day and evening time criteria.

The following assumptions were used in the modelling after discussions with Sheffield Resources:

- All noise sources are operating simultaneously and at high load.
- The sound levels referred to in this report represent the L_{A10} emission level.
- Topography was provided by Sheffield Resources and incorporated into the SoundPLAN model.
- Ground absorption has been set as 0.7 between the port and the receivers.

4.2 Traffic noise assessment

As part of this acoustic assessment, existing traffic noise levels for Derby Highway and Loch Street were measured by undertaking unattended noise logging.

It is understood that there will likely be up to 40 road train movements (in both directions) per day. In Australia, traffic noise predictions are generally made using the Calculation of Road Traffic Noise (CoRTN) 1988 algorithm. However CoRTN is not generally reliable where less than 200 vehicles per hour travel on the road.

Therefore a calculation of the road trains impact while travelling on public roads was made using the US Federal Highway Administration (FHWA) Model.

The following inputs were used in the modelling of the road trains:

- Average distance to receiver of 20 m along Loch Street and 30 m along Derby Highway.
- Sound Pressure Level of a moving road train is 87 dBA at 7.5 m as per the Vehicle Standard (Australian Design Rule 28/01 – External noise of Motor Vehicles) 2006.
- Passby duration of road train 30 seconds.
- Average of 1.7 road train passbys per hour (40 per day).

The received noise levels associated with the road trains for the day and night time period were logarithmically added to the existing traffic noise conditions. Finally an adjustment of +2.5 dB was made to the traffic noise predictions to account for façade reflection for comparison with the traffic noise criteria.

5 PREDICTION OF NOISE LEVELS

5.1 Environmental noise assessment

The predicted noise levels at the nearest noise sensitive receivers from activities within the Port of Derby under the night time scenario are shown in Table 5-1.

Table 5-1 Predicted noise levels port operations

Noise sensitive receiver	Predicted L _{A10} (dB) port operations	Predicted L _{Amax} (dB) road train
Elder Street Residential	33	38
Jetty Café Commercial	53	71

The noise contour map showing the predicted L_{A10} noise levels from the port operations is shown in Figure 5-1.

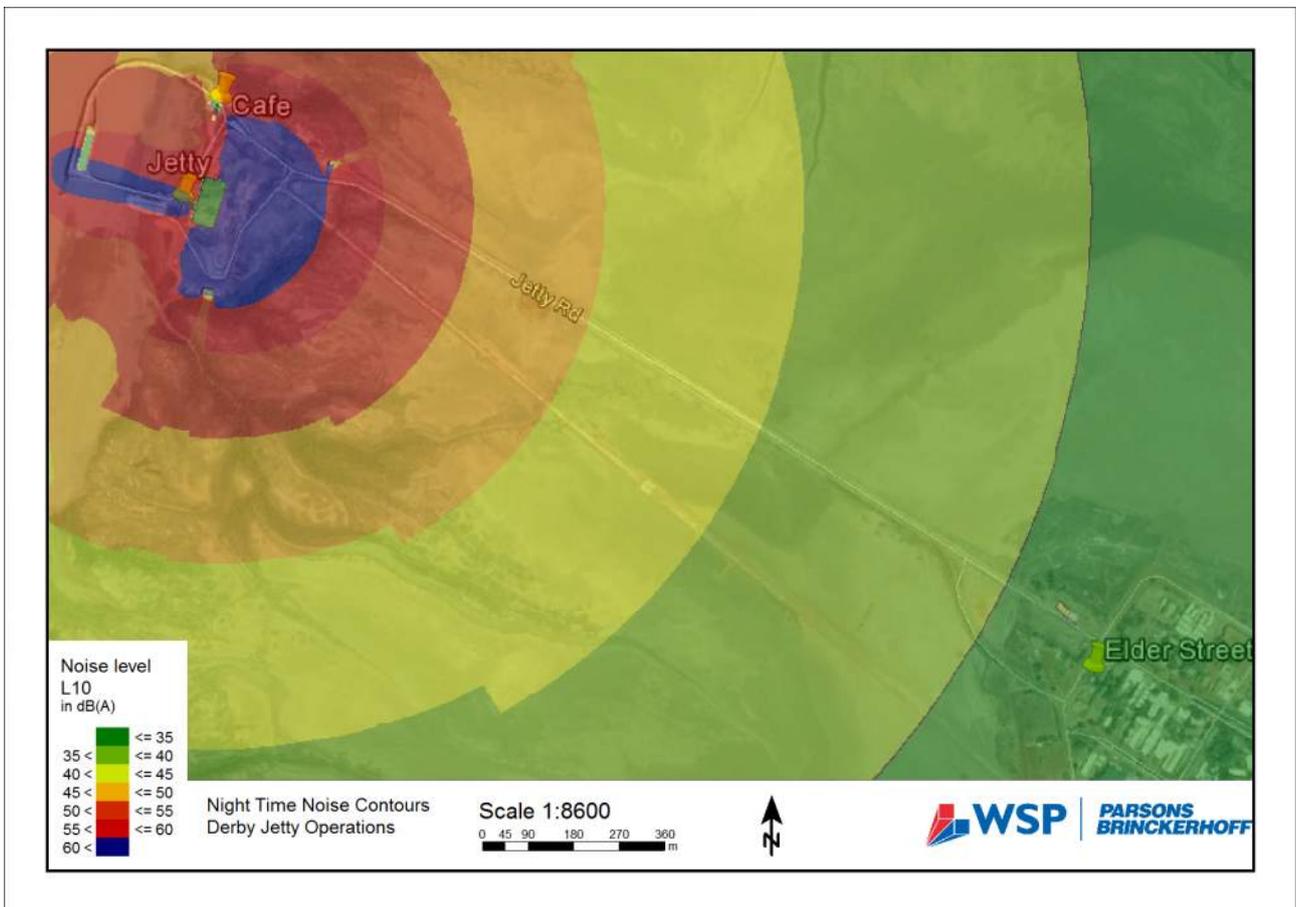


Figure 5-1 Noise contours port operations

5.2 Traffic noise assessment

The existing traffic noise levels recorded at the logger locations are outlined within Table 5-2.

Table 5-2 Measured average daily noise values – existing road traffic

Location	Assessment period	Measured results (dB)
Derby Highway (30 m setback)	L _{Aeq} (Day)	50.7
	L _{Aeq} (Night)	43.4
Loch Street (20 m setback)	L _{Aeq} (Day)	53.2
	L _{Aeq} (Night)	41.2

The predicted noise levels of the road trains in isolation and combined with the existing traffic noise levels are shown in Table 5-3.

Table 5-3 Measured and calculated free field road traffic noise levels

Location	Assessment period	Road train calculated (dB)	Combined existing and road train (dB)
Derby Highway	L _{Aeq} (Day)	38.5	51.0
	L _{Aeq} (Night)	41.5	45.6
Loch Street	L _{Aeq} (Day)	42.5	53.6
	L _{Aeq} (Night)	44.5	46.2

6 IMPACT ASSESSMENT

6.1 Environmental noise

The predicted noise levels at the nearest sensitive receiver compared against the relevant (night time) criteria are shown in Table 6-1 for the L_{A10} and Table 6-2 for the L_{Amax} noise levels.

Table 6-1 Assessment of port L_{A10} noise

Receiver	Specific criteria L_{A10} (dB)	Predicted L_{A10} (dB)*	Compliant with specific criteria
Elder Street Residential	40	38	Yes
Jetty Café Commercial	60	58	Yes

*With +5 dB tonality adjustment

Table 6-2 Assessment of road train L_{Amax} noise

Receiver	Specific criteria L_{Amax} (dB)	Predicted L_{Amax} (dB)*	Compliant with specific criteria
Elder Street Residential	60	38	Yes
Jetty Café Commercial	80	71	Yes

The predicted noise levels are compliant with the criteria contained within the Noise Regulations at the identified nearest residential and commercial receivers.

6.2 Traffic noise

The predicted future traffic noise levels including the additional road train movements as a result of the port operations compared against the WAPC criteria are shown in Table 6-3.

Table 6-3 Assessment of traffic noise levels

Location	Assessment period	Predicted future* (dB)	WAPC target criteria	WAPC limit criteria
Derby Highway	$L_{Aeq(Day)}$	53.5	55	60
	$L_{Aeq(Night)}$	48.1	50	55
Loch Street	$L_{Aeq(Day)}$	56.1	55	60
	$L_{Aeq(Night)}$	48.7	50	55

*With +2.5 dB façade correction

The predicted traffic noise levels for the receivers along Derby Highway are within the WAPC target criteria for the day and night time periods.

The predicted traffic noise levels for the receivers along Loch Street are within the WAPC target criteria for the night time period. The predicted day time traffic noise target is exceeded by 1.1 dB but is compliant with the limit criteria. It should be noted that the existing traffic conditions when façade adjusted already also exceed the target criteria at this location.

The predicted increase in traffic noise as a result of the road train movements on Loch Street and Derby Highway are outlined in Table 6-4.

Table 6-4 Predicted traffic noise increase

Location	Assessment Period	Increase dB
Derby Highway	L _{Aeq} (Day)	0.3
	L _{Aeq} (Night)	2.2
Loch Street	L _{Aeq} (Day)	0.4
	L _{Aeq} (Night)	3.3

The increase in overall traffic noise levels as a result of the road trains is negligible during the daytime period, the more significant increases are during the night time period when overall traffic counts are lower. During the night time an increase of up to 3 dB has been predicted, subjectively the human reaction to an increase in noise of 3 dB or lower is normally unnoticed to tolerable.

7 CONCLUSIONS

7.1 Environmental noise

From the results of the environmental noise measurements and modelling undertaken as part of this assessment, it has been shown that the noise levels from the operations associated with the port are expected to comply with the relevant noise criteria at all the identified receivers.

7.2 Traffic noise

From the results of the traffic noise measurements and modelling undertaken as part of this assessment, it has been shown that the noise levels from the road trains traveling to and from the port are expected to comply with the relevant traffic noise criteria at the receivers along Derby Highway and Loch Street.

A.1 ACOUSTIC TERMINOLOGY

Sound Pressure Level (SPL):

The basic unit of sound measurement is the sound pressure level. The pressures are converted to a logarithmic scale and expressed in decibels (dB).

Sound Power Level (SWL):

The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit $1 \times 10^{-12} \text{W}$.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

A-weighting:

A frequency weighting devised to attempt to take into account the fact that human response to sound is not equally sensitive to all frequencies; it consists of an electronic filter in a sound level meter, which attempts to build in this variability into the indicated noise level reading so that it will correlate, approximately, with human response.

Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} the noise exceeded for 10% of the time, and so on.

Of particular relevance, are:

- L_{A1} The noise level exceeded for 1% of the 15 minute interval.
- L_{A10} The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.
- L_{A90} The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.
- L_{Aeq} The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

Tonality

Tonal noise contains one or more prominent tones (i.e. distinct frequency components), and is normally regarded as more offensive than "broad band" noise.

Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.