Noise Impact Assessment

Fortescue Metals Group Pilbara Iron Ore & Infrastructure Project Stage B

Preliminary Draft for Review Only

Prepared For

Fortescue Metals Group

November 2004

Reference: Job 410264

Lloyd Acoustics
PO Box 717
HILLARYS WA 6923
Phone: 08 9300 4188
Fax: 08 9300 4199

Email: info@lloydacoustics.com.au

Lloyd Acoustics

Report: Job No.-Report No.410264-01 draft

Preliminary Draft Only

Approved for Issue:	
Position:	Project Director
Date:	10 August 2004
Verified	

CONTENTS

APPENDICES

EXECUTIVE SUMMARY

Transportation and operational noise impacts associated with the proposed Fortescue Metals Group Limited, Pilbara Iron Ore and Infrastructure Project Stage B, have been predicted to noise sensitive premises and compared against the relevant noise level criteria.

For operational noise, four scenarios have been considered which includes both short and long-term planning. The assessment incorporates the likely mining and processing plant to be located at each of the four mine sites.

In addition to the above, the likely impacts to birdlife on the nearby Fortescue Marsh are also discussed.

The results show that for the four scenarios considered, the operational noise is significantly below the Environmental Protection (Noise) Regulations 1997, with the most affected residence (Roy Hill), likely to receive a noise level of L_{A10} 17 dB resulting from the Christmas Creek operations.

The predicted noise level to the Christmas Creek mine camp is shown to comply with the assigned noise levels under the Regulations and that an acceptable amenity can be achieved for employees stationed here.

Based on the expected blasting configurations, confined blasts are predicted to comply with the Environmental Protection (Noise) Regulations 1997 at all times, whereas unconfined blasts comply Monday to Saturday only. The most affected residents are Roy Hill and Bonney Downs.

Noise impacts from the proposed railway are predicted to comply with both the *preliminary* draft *EPA Guidance for Road and Rail Transportation Noise (EPA Guidance for the Assessment of Environmental Factors No. 14)* and the noise criterion of $L_{Aeq\ (8\ hour)}$ 55 dB, used for a similar project in the region. The most affected residence resulting from railway noise is Roy Hill, with a predicted $L_{Aeq\ (8\ hour)}$ noise level of 39 dB.

In terms of the effects of the operation on the nearby Fortescue Marsh, the research suggests that there is likely to be some short-term disturbance from blasting, however birds are quick to adapt to a changing environment and should resume normal activities in a short period of time. In terms of transportation and operational noise, the research suggests that an adverse impact to the wildlife from noise is unlikely.

1 INTRODUCTION

This report has been prepared to assess noise impacts associated with the proposed Fortescue Metals Group Limited, Pilbara Iron Ore and Infrastructure Project Stage B, to noise sensitive premises.

The noise assessment includes both the short to medium term mining operations at Christmas Creek and the longer term operations, which include mines at Mt Lewin, Mt Nicholas and Mindy Mindy. In addition to the mining operations, noise impacts associated with the proposed railway are assessed.

The noise levels associated with the mining operations are compared against the assigned noise levels prescribed in the Environmental Protection (Noise) Regulations 1997. The transportation noise levels are compared against criteria used for similar project in the Pilbara region and against the preliminary draft EPA Guidance for Road and Rail Transportation Noise (EPA Guidance for the Assessment of Environmental Factors No. 14).

The results are presented as both predicted noise levels to specific receiver locations and as noise level contours superimposed onto a map of the project area.

In addition to the assessment of noise against the noise criteria, the affect of noise on bird life at the nearby Fortescue Marsh is also examined. This includes the predicted operational and blasting noise levels and a discussion of some recent research into the effect noise has on bird behaviour.

2 DEFINITIONS

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

Decibel

The decibel (dB) describes the sound pressure level 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 pressure level is described by the symbol dB(A).

Linear

A sound pressure level described in the linear scale is a noise level that has not been filtered. A linear sound pressure level is described by the symbol dB(lin).

$L_{A\ slow}$

$L_{A\ slow}$ indicates that the sound level meter is set to slow response rather than fast response.

L_{Amax}

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

L_{A1}

An L_{A1} level is an A-weighted noise level which is exceeded for one percent of the measurement period.

L_{A10}

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

L_{Aeq}

The equivalent steady-state A-weighted sound level ("equal energy") 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.

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.

3 CRITERIA

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations). The relevant sections of these Regulations are discussed below.

3.1 Operational Noise Criteria

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 –

> (a) 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
>
> (b) Must be free of –
>
> i. Tonality;
>
> ii. Impulsiveness; and
>
> iii. Modulation".

A "…noise emission is taken to *significantly contribute to* a level of noise if the noise emission exceeds a value which is 5 dB 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 3.1* are made to the noise emission as measured at the point of reception.

Table 3.1 – Adjustments For Intrusive Characteristics

TONALITY	MODULATION	IMPULSIVENESS
+ 5 dB	+ 5 dB	+ 10 dB

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

The assigned levels (prescribed standards) are specified in Regulation 8 and are shown below in *Table 3.2*.

Table 3.2 – Assigned Noise Levels For Noise Sensitive Premises

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	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[2]	All hours	60	75	80
Industrial and utility premises[3]	All hours	65	80	90

1. Applies within 15 metres of a building associated with a noise sensitive use, as defined in Schedule 1, Part C.
2. Applies at locations further than 15 metres from a building associated with a noise sensitive use, as defined in Schedule 1, Part C.
3. Applies to premises as defined in Schedule 1, Part A, including *Caretaker's and like residences attached to or forming part of premises referred to in [Part A]*.

In the above, the influencing factor, L_{A10}, L_{A1} and L_{Amax} are defined as follows:

Influencing factor — in relation to noise received at noise sensitive premises, means –

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

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

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*.

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_{Amax} assigned level — means an assigned level which, measured as a $L_{A\ slow}$ value, is not to be exceeded at any time.

Where *representative assessment period* means a period of time not less than 15 minutes, and not exceeding 4 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.

For this assessment, the remoteness of the region would generally result in an influencing factor of zero at all noise sensitive premises.

3.2 Construction Noise Criteria

Noise associated with construction activities is not required to satisfy the above prescribed standards but rather management practices as defined in Regulation 13 as follows:

a) *the construction work was carried out in accordance with control of environmental noise practices set out in section 6 of AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites;*

b) *the equipment used on the premises was the quietest reasonably available; and*

c) *if the occupier was required to prepare a noise management plan under subregulation (4) in respect of the construction site –*

   i. *the noise management plan was prepared and given in accordance with the requirement, and approved by the Chief Executive Officer; and*

   ii. *the construction work was carried out in accordance with the management plan."*

3.3 Blasting Noise Criteria

Blasting levels are covered by Regulation 11, which provides the following criteria:

(3) No airblast level resulting from blasting on any premises or public place, when received at any other premises, may exceed –

(a) 125dB $L_{Linear\ peak}$ between 0700 hours and 1800 hours on Monday to Saturday inclusive; or

(b) 120dB $L_{Linear\ peak}$ between 0700 hours and 1800 hours on a Sunday or public holiday.

(4) Notwithstanding subregulation (3), airblast levels for 9 in any 10 consecutive blasts (regardless of the interval between each blast), when received at any other premises, must not exceed –

(c) 120dB $L_{Linear\ peak}$ between 0700 hours and 1800 hours on Monday to Saturday inclusive; or

(a) 115dB $L_{Linear\ peak}$ between 0700 hours and 1800 hours on a Sunday or public holiday.

3.4 Railway Noise Criteria

Road and rail transportation noise impacts are not controlled through Western Australian regulations but through policy or guidance documents developed by various agencies. The Environmental Protection Authority (EPA) may prescribe allowable noise levels from transportation sources, however, this is done on a project-by-project basis.

Historically, the development of railway noise policy has been the sole responsibility of Westrail (now WAGR). However, in January 1998, the Department of Environment (DoE) issued, for limited public sector review, the *preliminary* draft *EPA Guidance for Road and Rail Transportation Noise (EPA Guidance for the Assessment of Environmental Factors No. 14)*. The preliminary draft guidance note was prepared to aid in the assessment of the environmental impact of proposals where noise emissions from road or rail transportation was considered an issue. This guidance note has been under considerable review and has resulted in the Infrastructure Co-ordinating Committee (ICC) of the Western Australian Planning Commission (WAPC) establishing a working group to formulate and investigate a policy to address noise from transportation corridors.

A study was completed through the ICC working group in November 2000, setting out a series of recommendations and issues that need to be further explored. The recommendations for railway noise were as follows:

- External daytime criteria for new transportation infrastructure near existing residential development should be within the range of L_{Aeq} 50 dB(A) to 60 dB(A); and

- External night-time criteria for new transportation infrastructure near existing residential development should be within the range of L_{Aeq} 45 dB(A) to 55 dB(A).

Since the ICC recommendations were put forward, the DoE has used a night-time criterion of L_{Aeq} 55 dB(A) for train noise on a number of projects where night-time railway noise was considered an issue even after the implementation of noise management measures. Although this is not official DoE policy, this criterion was used during the assessment of the proposed Hope Downs port and rail facility in 2001. It is therefore seen as appropriate to use the same criterion for this proposal.

4 NOISE ASSESSMENT METHODOLOGY

4.1 Overview

The computer modelling programme *SoundPlan 6.2* has been utilised to predict the noise propagation from the mines and railway to the surrounding areas. This programme was developed by Braunstein + Berndt, GmbH, a European company and is endorsed by the Department of Environment (DoE).

For the operational scenarios the programme was selected to use the *CONCAWE* algorithms. The CONCAWE methodology was developed from a research paper, publisher in 1981, under the title, “The propagation of noise from petroleum and petrochemical complexes to neighbouring communities”. It has been used as it explicitly deals with the influence of wind and the stability of the atmosphere.

Railway noise levels have been predicted using a modified version of the Nordic Rail Prediction Method (Kilde Rep. 130) algorithm. The Kilde 130 algorithm was used as it provides both L_{Aeq} and L_{Amax} noise level predictions. The L_{Amax} levels were used to verify the model accuracy. The algorithm was modified to align with measured noise levels of locomotives and wagons. In addition, to accurately predict the effect of noise barriers, the noise source height of the locomotive was raised from the standard 0.5 metres above the railhead to 4.0 metres.

Noise from blasting is calculated using equations developed by Orica Explosives Australia (Orica). The Orica equations are shown below:

Unconfined Charge

$$Airblast\ Level\ dB\ L_{Linear\ peak} = 20\log\left(\frac{P_A}{P_0}\right)$$

where:

$$P_A = 185\left(\frac{R}{W^{\frac{1}{3}}}\right)^{-1.2} \qquad \textit{eqn: 4.1}$$

$$P_0 = 2x10^{-8}$$

$R =$ *distance from blast*

$W =$ *maximum charge mass per delay*

Confined Charge

$$Airblast\ Level\ dB\ L_{Linear\ peak} = 20\log\left(\frac{P_B}{P_0}\right)$$

where:

$$P_B = 3.3\left(\frac{R}{W^{\frac{1}{3}}}\right)^{-1.2} \qquad \textit{eqn: 4.2}$$

$$P_0 = 2x10^{-8}$$

$R =$ *distance from blast*

$W =$ *maximum charge mass per delay*

Note that, particularly during the first number of blasts, the airblast levels should be recorded at various distances, so that the constants (185 & 3.3) can be determined for site-specific conditions.

4.2 Meteorological Information

Meteorological information utilised was in accordance with the default conditions nominated in the draft EPA Guidance for the Assessment of Environmental Factors No. 8. As the proposed mine will operate after 10.00 pm the night-time criteria will be the most critical so only these conditions have been considered. The meteorological conditions used in the noise modelling are shown in *Table 4.1*.

Table 4.1 – Modelling Meteorological Conditions

PARAMETER	NIGHT CONDITIONS
Temperature (^{o}C)	15
Humidity (%)	50
Wind Speed (m/s)	3
Temperature Gradient (^{o}C/100m)	2

1. *SoundPlan* does not allow the incorporation of a temperature gradient, but rather a Pasquil Stability Factor (PSF). For Night conditions, a PSF of Type F was chosen.

4.3 Topographical Data

Topographical data was 3-dimensional and supplied electronically by FMG.

4.4 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, all ground has been set to a value of 0.70.

4.5 Operational Noise Sources

The operational noise sources considered in the assessment are provided below in *Table 4.2*.

Table 4.2 – Noise Sources Considered in the Assessment

Plant Description	No
Haul Trucks	24
Loaders	8
FEL	1
Dozers	4
Graders	3
Drill Rigs	3
Water Carts	3
Conveyor Drives	76
Service Trucks	3
Primary Crusher	4
Secondary Crusher	4
Tertiary Crusher	4
Vibrating Screens	36
Conveyors	3

4.6 Operational Sound Power Data

Source sound power level data have been obtained from file data of similar plant measured by Lloyd Acoustics. The number of plant items and the sound power levels are provided in *Table 4.3*.

Table 4.3 – Source Sound Power Levels, dB

SOURCE	OCTAVE BAND CENTRE FREQUENCY (Hz)								OVERALL, dB(A)
	31.5	63	125	250	500	1k	2k	4k	
Mine Area									
Haul Trucks	118	113	109	115	112	111	107	106	116
Loaders	123	130	133	127	123	119	118	110	126
Front-End Loader	113	112	113	110	108	105	100	94	110
Dozers	108	112	117	115	106	107	103	98	112
Graders	105	112	110	107	109	108	106	101	112
Drill Rigs	113	121	122	124	122	118	115	109	124
Water Carts	110	112	121	118	115	109	106	101	116
Conveyor Drives	93	95	97	99	99	99	101	94	105
Service Trucks	115	109	112	109	111	112	109	106	121
	109	108	119	118	115	110	109	102	
	103	105	110	110	115	110	109	100	
Processing Area									
Primary Crusher	117	117	114	122	122	118	116	109	128
	117	117	115	122	124	118	113	109	
	117	115	117	118	121	116	111	105	
Secondary Crusher	107	107	112	110	117	116	113	106	123
	107	111	113	112	116	115	111	103	
	105	111	114	114	115	114	108	100	
Tertiary Crusher	115	106	105	106	108	106	101	95	115
	111	106	108	109	112	108	98	93	
	108	105	106	104	105	101	96	93	
Vibrating Screens	108	112	103	102	104	103	105	108	117
	107	106	104	102	104	104	105	106	
	108	100	103	99	103	104	107	105	

4.7 Operational Scenarios

4.7.1 Operational Scenarios

Four operational scenarios were considered in the noise modelling to represent various stages of the mines. Although the initial phase for each mine includes overburden removal, which is generally considered to be construction noise, we have assumed that for the first 12 months of production, all operational plant will be located on the natural surface of the pit.

The scenario are summarised in *Table 4.4*.

Table 4.4 – Source Sound Power Levels, dB

Scenario	Phase	Description
1	Initial to Medium Phase	This scenario assumes that all plant will be located at the Christmas Creek mine site and all processing will be undertaken here also. All the plant has been located on the natural surface of the pit.
2	Medium to Long Phase Alternative 1	This scenario assumes that all ¾ of the plant will be located at the Christmas Creek mine site and a quarter at the Mt Lewin mine. No other mines will be operational and all processing will be undertaken at Christmas Creek. For this Scenario the plant at Christmas Creek is assumed to be 40 metres below the natural surface, while the plant at Mt Lewin is located on the surface.
3	Medium to Long Phase Alternative 2	This scenario assumes that all ¾ of the plant will be located at the Christmas Creek mine site and a quarter at the Mt Nicholas mine. No other mines will be operational and all processing will be undertaken at Christmas Creek. For this Scenario the plant at Christmas Creek is assumed to be 40 metres below the natural surface, while the plant at Mt Nicholas is located on the surface.
4	Medium to Long Phase Alternative 3	This scenario assumes that all ¾ of the plant will be located at the Christmas Creek mine site and a quarter at the Mindy Mindy mine. No other mines will be operational and all processing will be undertaken at Christmas Creek. For this Scenario the plant at Christmas Creek is assumed to be 40 metres below the natural surface, while the plant at Mindy Mindy is located on the surface.

4.8 Blasting Conditions

Two scenarios have been considered in the assessment of blasting noise to the nearest noise sensitive premises: being unconfined and confined blasts. For unconfined blasts we have assumed a maximum charge mass per delay of 500 kg per hole. For fully confined blasts we have assumed a maximum charge mass per delay of 15000kg. It should be noted that the charge mass assumed for this assessment is based on preliminary information only.

4.9 Transportation Noise Scenario

The transportation noise assessment is based on measured noise levels of BHP Billiton Iron Ore trains and assuming the following input data:

Table 4.5 Input Data for Assessment of Railway Noise

Parameter	Value
Locomotive maximum noise level at 30m	89 dB(A)
Wagons maximum noise level at 30m	78 dB(A)
Train Speed	40 km/h
Height of Locomotive	4 metres above rail head
Train Length	3200 metres
Number of Train Movements/8 hours	3.33

5 RESULTS

The results of the operational noise modelling, blasting calculations and transportation noise modelling are discussed below.

5.1 Operational Noise Modelling

The predicted L_{A10} noise levels at each homestead in the vicinity of the mine as well as the Christmas Creek mine camp is summarised in *Table 5.1.* The predictions include each of the operational noise modelling scenarios for light, downwind conditions. *Figure 5.1* shows the noise level contour plots for scenario 1, which is considered to be the worst-case.

Table 5.1 – Predicted L_{A10} Night-time Noise Levels – Operational Scenarios

Receiver Location	SCENARIO PREDICTED NOISE LEVEL, dB(A)			
	1 Initial to Medium Phase	**2** Medium to Long Phase Alternative 1	**3** Medium to Long Phase Alternative 2	**4** Medium to Long Phase Alternative 3
Roy Hill	17 dB(A)	16 dB(A)	14 dB(A)	14 dB(A)
Bonney Downs	5 dB(A)	0 dB(A)	0 dB(A)	0 dB(A)
Noreena Downs	13 dB(A)	8 dB(A)	8 dB(A)	8 dB(A)
Marillana	8 dB(A)	8 dB(A)	8 dB(A)	15 dB(A)
Ethel Creek	0 dB(A)	5 dB(A)	0 dB(A)	0 dB(A)
Warrie Outcamp (not residential)	20 dB(A)	19 dB(A)	19 dB(A)	19 dB(A)
Fortescue Marsh	40 dB(A)	-	-	-
Christmas Creek Mine Camp	49 dB(A)	-	-	-

Note: Only the night-time scenario was modelled, as this is the most critical.

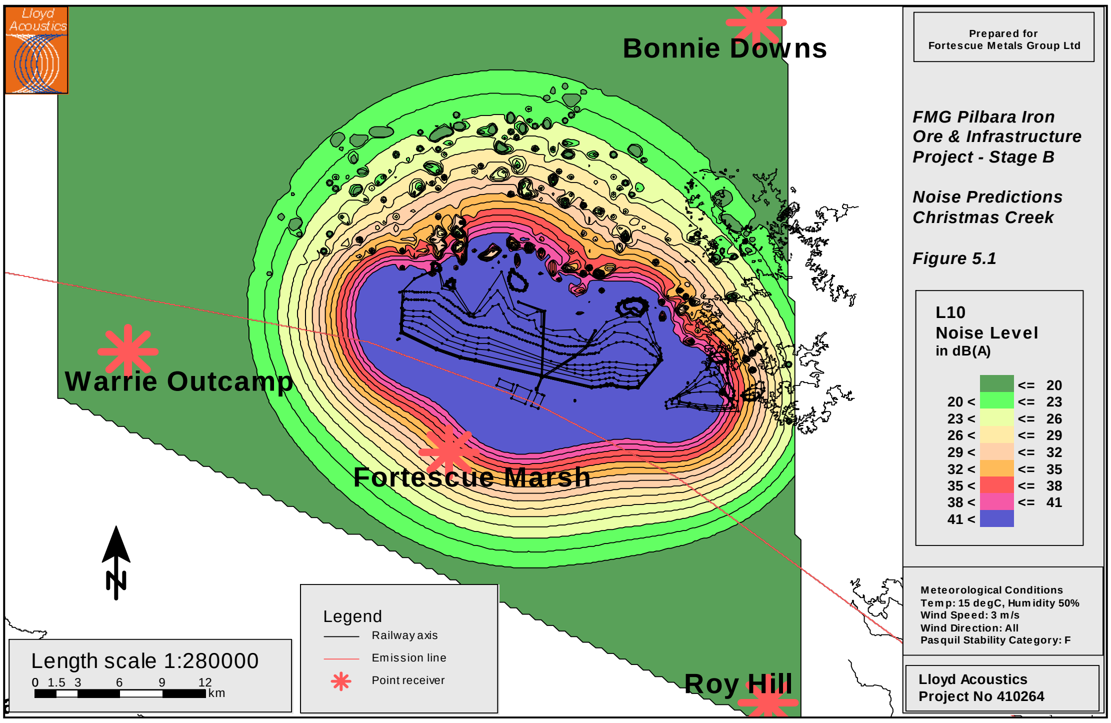

Figure 5.1 – Predicted L_{A10} Night Noise Levels
Operational Scenario 1

Full size (A4) plots for all operational scenarios are contained in *Appendix A*.

5.2 Blasting Noise Calculations

Based on the distance between the mines and the surrounding properties, the predicted noise levels from unconfined and confined blasts are presented in *Tables 5.2 and 5.3.*

Table 5.2 – Predicted Blasting Noise levels Assuming Unconfined Blast

Receiver Location	MINE SITE PREDICTED LINEAR PEAK NOISE LEVEL, dB			
	Christmas Creek	Mt Lewin	Mt Nicholas	Mindy Mindy
Roy Hill	116	119	-	-
Bonney Downs	116	-	-	-
Noreena Downs	114	112	116	-
Marillana	-	-	-	120
Ethel Creek	-	115	111	-
Bamboo Springs	112	-	-	-
Warrie Outcamp (not residential)	122	-	-	-
Poonda Outcamp (not residential)	-	-	-	112
Fortescue Marsh	129			

Table 5.3 – Predicted Blasting Noise levels Assuming Confined Blast

Receiver Location	MINE SITE PREDICTED LINEAR PEAK NOISE LEVEL, dB			
	Christmas Creek	Mt Lewin	Mt Nicholas	Mindy Mindy
Roy Hill	93	96	-	-
Bonney Downs	93	-	-	-
Noreena Downs	91	89	83	-
Marillana	-	-	-	97
Ethel Creek	-	92	88	-
Bamboo Springs	89	-	-	-
Warrie Outcamp (not residential)	99	-	-	-
Poonda Outcamp (not residential)	-	-	-	89
Fortescue Marsh	106			

5.3 Rail Noise Modelling

The results of the rail noise modelling are summarised below in *Table 5.4* and shown graphically in *Figure 5.2.*

Table 5.4 – Predicted $_{LAeq\ (8\ hour)}$ Night-time Noise Levels from Trains

Receiver Location	Night-time Noise Level dB
Roy Hill	39
Bonney Downs	16
Noreena Downs	22
Marillana	(Stage A Railway)
Ethel Creek	33
Warrie Outcamp (not residential)	43
Fortescue Marsh	42

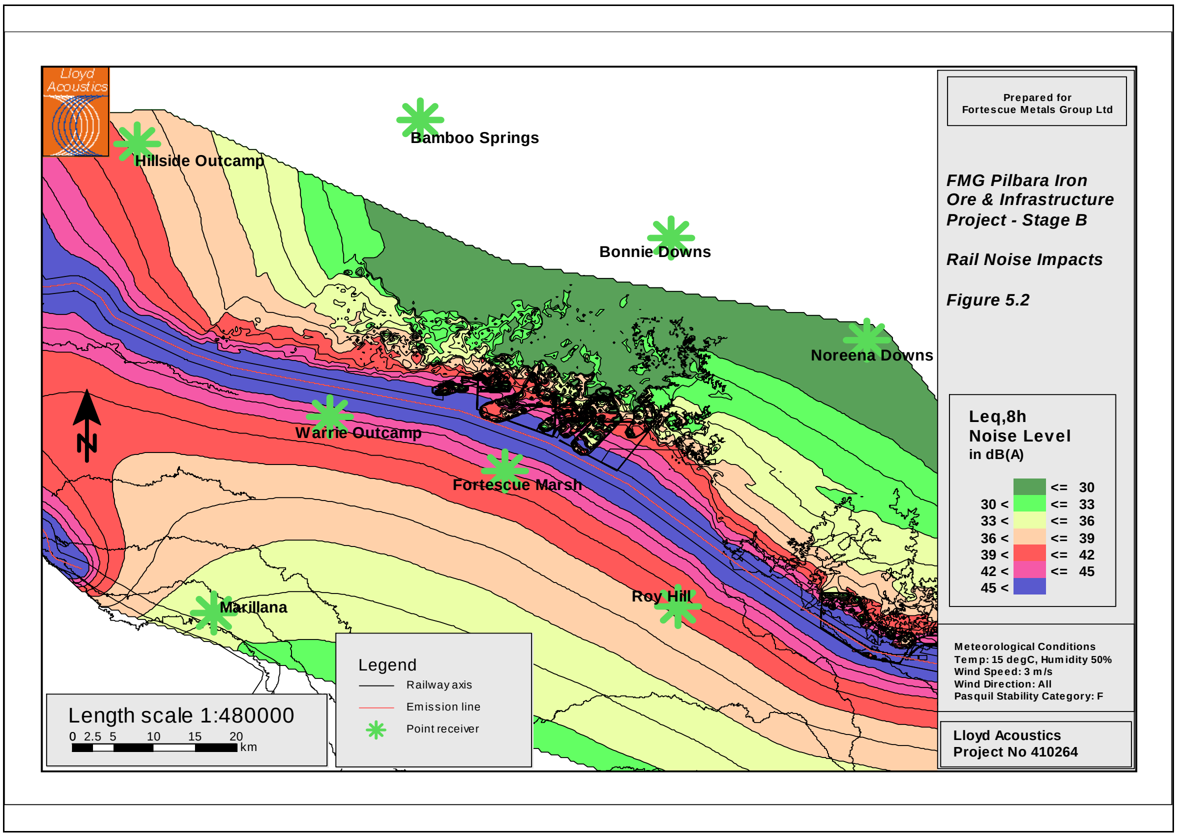

Figure 5.2 – Predicted $L_{Aeq\ (8\ hour)}$ Night Noise Levels From Rail Operations

Full size (A4) plots for all operational scenarios are contained in *Appendix A*.

6 DISCUSSION

6.1 Operational Noise

The results of the operational noise predictions show that under EPA default meteorological conditions, the worst affected premises (Roy Hill) will receive a noise level of L_{A10} 17 dB. This level is L_{A10} 18 dB below the allowable night-time noise levels under the Environmental Protection (Noise) Regulations 1997. Higher noise levels (L_{A10} 20 dB) are predicted at Warrie Outcamp, however, this is a remote camp and is not considered to be a residence.

The predicted noise level to the Christmas Creek mine camp is L_{A10} 49 dB. As the Mine Camp is associated with the proposed mine, it is considered to be an industrial premises under the Regulations and the assigned noise level is therefore L_{A10} 65 dB. Thus, compliance is obtained and it is considered that an acceptable amenity is also achieved.

6.2 Blasting Noise

The predicted blasting noise levels show that the unconfined blasts result in the highest noise levels. For the initial operations at Christmas Creek, the most affected residences are Bonney Downs and Roy Hill, with noise levels of 116 dB $L_{Linear\ peak}$. Higher noise levels (122 dB $L_{Linear\ peak}$) are predicted at Warrie Outcamp, however, this is a remote camp and is not considered to be a residence.

The regulations require airblast noise levels to be under 125 dB $L_{Linear\ peak}$ during the week and 120 dB $L_{Linear\ peak}$ on Sundays, however, 9 in any 10 consecutive blasts (regardless of the interval between each blast), when received at any other premises, are not to exceed:

- 120dB $L_{Linear\ peak}$ between 0700 hours and 1800 hours on Monday to Saturday inclusive; or
- 115dB $L_{Linear\ peak}$ between 0700 hours and 1800 hours on a Sunday or public holiday.

The predictions show that for the assumed charge mass, the blasting levels are slightly over for Sundays at these locations. Blasting noise measurements should be undertaken near Bonney Downs and Roy Hill Homesteads to determine the actual allowable mass to comply with Regulation 11.

6.3 Rail Noise

The night-time noise levels from the proposed railway have been predicted to noise sensitive receivers adjacent to the alignment. As these properties are not currently affected by existing transportation noise, the Noise Amenity Ratings are all N0 (the lowest possible) and the allowable noise level increase is the greater of 4 dB or the highest range of N0, being 40 dB $L_{Aeq,8hour}$. The predicted noise levels range from $L_{Aeq\ (8\ hour)}$ 16 dB to 39 dB, which shows compliance with this criterion.

In addition to this, the predicted noise levels are below the transportation noise criterion of $L_{Aeq\ (8\ hour)}$ 55 dB used by the DoE for similar proposals.

It should be noted that higher noise levels ($_{LAeq\ (8\ hour)}$ 43 dB) are predicted at Warrie Outcamp, however, this is a remote camp and is not considered to be a residence.

6.4 Effect of Noise on Birds

Very little research has been undertaken in Australia regarding the effects of noise on birds. Most studies are undertaken in Europe or America, with particular reference to military operations, and this may hold some relevance to Australia. The Australian Government Department of Environment and heritage reported the following:

Research into the effects of noise on animals is relatively scarce. The results obtained from the studies conducted are frequently contradictory or inconclusive. It does appear reasonably conclusive however, that as with humans, animal reactions to noise vary from species to species. Even species that seem perfectly adapted to human noise can show variation in their reactions. It does appear reasonably conclusive however, that as from human to human, animal reactions to noise vary from species to species. Even species that seem perfectly adapted to human noise can vary in their reactions.

It is known that a large number of animals have adapted to the presence of humans and the noise we generate. In fact, many animals live, apparently quite happily, in extremely noisy environments for example, rodents in factories, ships and subways, fish in waters with constant shipping activity and birds and mammals on and around airfields. Although there have been reports of panic and similar "startle" reactions in animals to both fixed and rotating wing aircraft activity, the difference between these reports and field observations around military and commercial airfields may be explained by the learning process and habituation of many animal populations.

Studies conducted on arctic wildlife suggest that the same animal population should be observed over an extended time period at the same location. Busnel (1978) believes that unusual noise, in combination with close proximity visual stimulation, is enough to disturb any animal, including man, and cause panic. He also points out that any sudden and unexpected intrusion, whether acoustic or another nature, can produce a startle or panic reaction. What is due specifically to noise alone is not always known.

Experimentation with the sonic boom, which is a purely acoustic stimulus (with no associated visual or odour stimuli), shows that the behaviour of domestic and also some traditionally shy wild species was unaffected as the result of repeated sonic booms (see Casaday & Lehmann, 1967, Welch, 1970). Bird scare guns are also an acoustic source producing similar results. Farmers have reported birds actually perching on the guns after a couple of days operation.

The learning ability of many animal species is discussed by Busnel (1971). The animal's initial reaction to a new noise source is fright and avoidance but if other sensory systems are not stimulated (for instance optical or smell), the animal learns quite quickly to ignore the noise source, particularly when it exists in the presence of man.

A recent study "*Noise Effects on Animals 1998 to 2002 Review*" R.C. Kull and C.McGarrity discussed three long-term studies that were reported during this time period regarding the effect of noise on birds. Delaney et al. (2002) investigated the effects of military operations including artillery noise, military vehicle and helicopter noise on Red-cockaded Woodpeckers (RCW). Pruitt et al. (2002) consolidated report describes the effects of military aircraft overflights on Peregrine Falcons. The third long term study also examines the effects of military aircraft noise, but on Mexican Spotted Owls (MSO).

These studies have several commonalities: all three species were on the endangered species list; all developed methods to accurately document the noise stimuli; they examined behavioral responses of the birds to various levels of stimuli to determine proximate effects; they examined demographic and nesting success data to assess populational effects; and they used various forms of technology to actually record responses to noise events. The United States (U.S.) Army addressed concerns of RCWs, since many of their installations have these birds on their restricted access military ranges. Weapon noise from .50 caliber blank machine gun fire and artillery simulators appears not to significantly limit RCW reproductive success (Delaney et al., 2002). Male Peregrine Falcons tended to respond more intensely to jet overflights than females. Pruitt et al. (2002), also reported that peregrines were more sensitive to humans and other raptors than to disturbances by helicopters, jets and boats. Their study indicated that intensity of response is a better indicator of productivity than noise exposure. Male peregrine ledge attendance was somewhat decreased at nests sites exposed to jet overflights, but was compensated for by increased attendance by females. Pruitt et al. (2002) concluded that there was no significant effect of exposure to jet overflight on peregrine nest success or productivity.

In terms of the effects of transportation noise exposure on birds, a recent paper *Disturbance of Meadow Birds by Railway Noise in the Netherlands* E. Waterman1, I. Tulp2, R. Reijnen3, K. Krijgsveld2, C. ter Braak4 examines whether the construction of new railroads and increased usage of existing railroads can lead to disturbance of local animal populations. A comparison between noise level and density of territories was presented and was shown that densities of meadow birds close to railroads are reduced in comparison to undisturbed areas. In the study it was shown that the threshold noise level from which densities were affected varied little between species. The relation between relative density and immission levels for all meadow birds combined, as well as the confidence intervals is shown in *Figure 6.1*

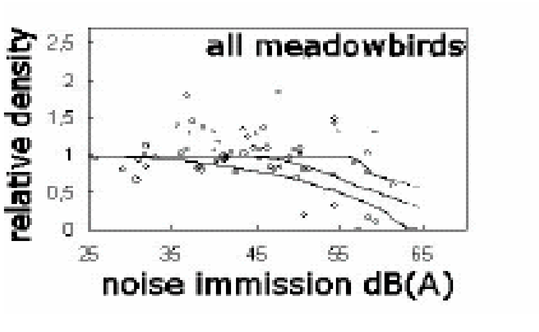

Figure 6.1 Relationship Between Noise Levels and relative Bird Densities

For the predicted blasting noise levels of $L_{Linear\ peak}$ 129 and 106 dB for unconfined and confined blasts respectively, the research suggests that there is likely to be some short-term disturbance, however birds are quick to adapt to a changing environment and should resume normal activities in a short period of time. FMG will, however, be implementing blast management strategies to minimise this impact including: blasting during favourable wind conditions and monitoring blasts during the breeding season. In terms of transportation and operational noise, the research suggests that an adverse impact to the wildlife from these noise sources is unlikely.

7 CONCLUSION

From the results of the noise prediction modelling, it has been shown that operational, blasting and railway noise resulting from Stage B of the Fortescue Metals Group Pilbara Iron Ore and Infrastructure Project is able to comply with the relevant noise level criteria.

For the four mining scenarios considered, the operational noise is significantly below the Environmental Protection (Noise) Regulations 1997, with the most affected residence (Roy Hill), likely to receive a noise level of L_{A10} 17 dB resulting from the Christmas Creek operations.

The predicted noise level to the Christmas Creek mine camp is L_{A10} 49 dB, which complies with the assigned noise levels under the Regulations of L_{A10} 65 dB. It can also be said that a noise level of L_{A10} 49 dB would result in an acceptable amenity being achieved for employees stationed here.

The unconfined blasting noise levels are predicted to comply with the Environmental Protection (Noise) Regulations 1997 Monday to Saturday only, whereby the confined blasts are predicted to comply at all times. The most affected residents from blasting noise are Roy Hill and Bonney Downs. As these predictions are based on preliminary charge mass information, blasting noise measurements should be undertaken near Bonney Downs and Roy Hill Homesteads to determine the actual allowable mass to comply with Regulation 11.

Noise impacts from the proposed railway are predicted to comply with both the *preliminary* draft *EPA Guidance for Road and Rail Transportation Noise (EPA Guidance for the Assessment of Environmental Factors No. 14)* and the noise criterion of $L_{Aeq\ (8\ hour)}$ 55 dB, used for a similar project in the region. The most affected residence resulting from railway noise is Roy Hill, with a predicted $L_{Aeq\ (8\ hour)}$ noise level of 39 dB.

In terms of the effects of the operation on the nearby Fortescue Marsh, the research suggests that there is likely to be some short-term disturbance from the blasting, however birds are quick to adapt to a changing environment and should resume normal activities in a short period of time. To mange this FMG will implement specific blast management procedures including:

- Blasting under favourable meteorological conditions;
- Modified blasting practices to minimise noise;
- Bird monitoring program during breeding times; and
- Noise monitoring in the vicinity of the marsh.

In terms of transportation and operational noise, the research suggests that an adverse impact to the wildlife from noise is unlikely.