Forge Resources – Balla Balla Project

ENVIRONMENTAL NOISE ASSESSMENT

18th February 2013

Forge Resources

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SKM

Forge Resources – Balla Balla Project – Environmental Noise Assessment

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Executive Summary

The proposed Forge Resources Ltd (Forge) Balla Balla Project involves mining and processing of magnetite ore at Balla Balla near Whim Creek in the Pilbara, slurry-pipeline transport to Port Hedland and storage and shipping from Utah Point at Hedland.

The Project was approved by the Minister for the Environment on 28 April 2009 (Implementation Statement No. 0794). Forge then acquired the Project from Atlas Iron Ltd in May 2012, though the acquisition did not include the export option via Utah Point in Port Hedland.

Forge has selected a barge export option with a loading facility approximately 15 km northwest of the approved mine site and is now seeking approval to develop associated infrastructure. The development will produce and export 6.0 Mtpa of magnetite concentrate. The magnetite concentrate will be loaded onto barges for transhipment to larger Ocean Going Vessels (OGV) with a typical shipment size of 165,000 tonnes.

Forge engaged Sinclair Knight Merz (SKM) to conduct environmental noise modelling for the proposed barge export option and assess if any significant change to the project noise impact at identified receptor locations is likely as a result of the proposed export infrastructure development.

SKM has developed a SoundPLAN model to simulate noise emissions from two scenarios:

1) Approved Mine Pit and Processing Plant, and
2) Approved Mine Pit and Processing Plant, plus the Proposed Iron Ore Storage Facility & Ship Loading Facility

The model output has been assessed with reference to the Environmental Protection (Noise) Regulations 1997 at sensitive receptors identified as relevant to the project. The specific project activities assessed in each scenario include:

- Noise relevant to the operational phase of the proposed mine and export project
- Noise relevant to the construction works
- Blasting noise

Model predictions at receptor locations are presented in Table E1 against the assigned noise level as prescribed by the Environmental Protection (Noise) Regulations 1997.

Table E1 Predicted Sound Pressure Levels at the Nearest Identified Noise Sensitive Receivers

Scenario Modelled Weather Conditions / Mine operation Configuration	Predicted SPL dB(A) - Noise Sensitive Receiver Location			
	Mine Site Camp	West Moore Island Fishing Lodge	Coorinjinna Pool	Whims Creek Hotel
Day Time Weather Conditions				
Mine Site Operating Only	41.4	19.8	35.5	22.4
Mine Site , Iron ore Storage / Dewatering Facility / Ship Loading Facility	41.4	50.7	35.8	24
Night Time Weather Conditions				
Mine Site Operating Only	41.9	20.5	36.2	23.1
Mine Site , Iron ore Storage / Dewatering Facility / Ship Loading Facility	42	51	36.5	24.8

From the noise level predictions, based on the presumption that all equipment will be operating on maximum load 24 hours / 7 days, the following conclusion can be drawn:

Operations:

At the mine site camp site, Coorinjinna Pool and the Whim Creek Hotel sites, there is predicted to be a marginal increase of between 0.1 – 1 dB (site dependent) between the operating configurations of the mine site only and mine site / iron ore - dewatering facility / ship loading facility. This does not represent a significant change in impact between modelled scenarios.

The predicted noise level at the mine camp site, resulting from activities at the approved mine site is lower than the day time Assigned Noise Level criterion of 45 dBA for sensitive receptors but is 7 dB(A) higher than the EPA Assigned Noise Level of 35 dBA for the night time. The key contribution to the predicted noise levels is noise from the operation of the production drilling rigs. If drilling rigs are to operate at night time then noise mitigation will be required to reduce the acoustic impact on the noise levels at the camp site.

The prediction modelling shows that the proposed location of the ship loading operation will have a significant impact at the West Moore Island Fishing Lodge. There is a predicted increase of 31 dB compared to the mine site operational levels, for both the day and night-time scenarios. The resultant noise levels would exceed the Assigned Noise Level criterion will be exceeded by 15 – 16 dBA for the night time period and by 5 -6 dBA during the day time.

Construction of Slurry Pipeline, Stockyards, Overland Conveyor and Shiploader:

If the construction works are to be performed between the hours of 0700 – 1900 hours Monday to Saturday, the noise emissions will need to be reduced to be as quiet as practical. No further actions would be required.

Based on the assumptions of number and type of plant, if construction works are to be performed outside the normal day time hours or on a Sunday or public holiday, a buffer zone of 10 kilometres around the construction works site would be required.

Blasting:

With management of charge weight, blasting noise and vibration will not be an issue.

Contents

Acoustic Terminology **6**
1 Introduction **7**
2 Background **8**
2.1 Mine Site 9
2.2 Dewatering Plant / Iron Ore Stock Pile Site (prior to ship loading) 9
2.3 Iron Ore Barge / Ship Loading Operation 10
2.4 Identified Noise Sensitive Receivers 10
3 Noise Criteria **12**
3.1 Operational Phase 12
3.2 Construction Noise Criteria 14
3.3 Blasting Noise Criteria 15
4 Equipment Sound Power Levels **16**
4.1 Mine Equipment 16
4.2 Iron Ore Storage Facility – Balla Balla 16
4.3 Ship Loading Operation 17
4.4 Slurry Pipeline Construction Equipment 17
4.5 Ship loading Jetty Construction Equipment 18
5 Prediction Methodology **19**
5.1 Operational 19
5.2 Construction Noise 19
5.3 Blasting 20
6 Results **22**
6.1 Noise Prediction Modelling 22
6.2 Mine Site, Iron Ore Storage / Dewatering Facility / Ship Loading Facility Operating 23
6.3 Mine Operation and Construction Works 25
6.4 Ground Vibration Prediction0 26
6.5 Construction Noise (Plant Equipment) – 'Slurry' Pipeline. 26
6.6 Construction Noise (Plant Equipment) – Ship Loading Jetty. 26
7 Discussion **28**
7.1 Significant Noise Sources 28
7.2 Construction Noise 29
7.3 Blasting 29
7.4 Ground Vibration Prediction 30
8 Conclusion **31**
8.1 Review of the Two Proposed Mine Site Operation Configurations 31
8.2 Concentrate Slurry Pipeline 31
8.3 Conveyor / Jetty / Ship Loader 32
8.4 Blasting Noise and Vibration 32
Appendix A **33**
Appendix B **36**

Acoustic Terminology

Term	Description
dB	Sound pressure levels are expressed in decibels as a ratio between the measured sound pressure level and the reference pressure. The reference pressure is $2x10^{-6}$ Pascal.
dB(A)	The A-weighted sound pressure level in decibels, denoted dB(A) is the unit generally used for the measurement of environmental, transportation or industrial noise. The A-weighting scale approximates the sensitivity of the human ear when it is exposed to normal levels and correlates well with subjective perception over a number of different types of sounds. An increase or decrease in sound level of approximately 10 dB corresponds to a subjective doubling or halving in loudness. A change in sound level of 3dB is considered to be just noticeable.
dB(C)	A Sound Pressure Level where the sound is filtered in accordance with the C- weighting scale. The C- weighting scale is relatively flat across the frequency spectrum but with reductions at very high and very low frequencies.
L_{A1}	The A weighted sound pressure level that is exceeded for 1% of the measurement period
L_{A10}	The A weighted sound pressure level that is exceeded for 10% of the measurement period (approximately the average maximum noise level)
L_{A90}	The A weighted sound pressure level that is exceeded for 90% of the measurement period (represents the background noise level)
L_{Aeq}	The equivalent continuous sound level. The steady dBA level which would produce the same A weighted sound energy over a stated period of time as the time varying sound.
L_{Amax}	Is the maximum a-weighted noise level measured during the measurement period
NATA	National Association of Testing Authorities

1 Introduction

SKM has been commissioned by Forge Resources Limited to perform an Environmental Noise Assessment on the proposed development of the Balla Balla Project in Western Australia

The Balla Balla mine site is located near the Pilbara coastline, approximately 100km east of Anketell Point and 120km south-west of Port Hedland, on the North West Coastal Highway and adjacent to the Pilbara Energy Gas pipeline and the grid power line between Karratha and Port Hedland.

It is proposed to transfer the iron to a storage facility via a slurry pipeline. The proposed storage / dewatering facility is located approximately 7 kilometres to the west of the mine site and 13 Kilometres South South East of the proposed ship loading facility.

The assessment is based on the prediction of the noise levels at identified noise sensitive receivers due to the operation of proposed fixed and mobile plant at the Balla Balla mine site, iron ore storage area and ship loading facilities.

The predicted noise level due to the normal operation of the mine site, the iron ore storage facility and the iron ore ship loading facility was compared with the 'assigned noise levels' presented in the Environmental Protection (Noise) Regulations 1997 for the identified noise sensitive receivers.

A comparison was also conducted of the predicted noise level due to the operation of the Balla Balla Mine operation only, with the total noise level generated by the Balla Balla Mine operation and taking into account the additional noise emission from the proposed iron ore storage /dewatering facility and the ship loading facility.

The predicted noise levels were determined at four noise sensitive receiver locations.

This report details the results of our findings.

2 Background

Forge Resources Limited is proposing to develop the Balla Balla Project in the Pilbara region of Western Australia.

The mine site is located approximately 10 kilometres (km) north-west of Whim Creek, midway between the regional centres of Karratha and Port Hedland (Figure 1)

The project includes the development of the following components:

- Development of the mine site including mine pit and processing
- The construction of a concentrate 'slurry' pipeline from the mine site and a dewatering plant / iron ore storage facility to be located approximately 7 Km west of the Balla Balla mine site.
- Development of an iron ore storage facility
- The construction of a jetty and ship loading facility at Balla Balla.

Figure 1 below presents the location of the Forges Resources Balla Balla mine site.

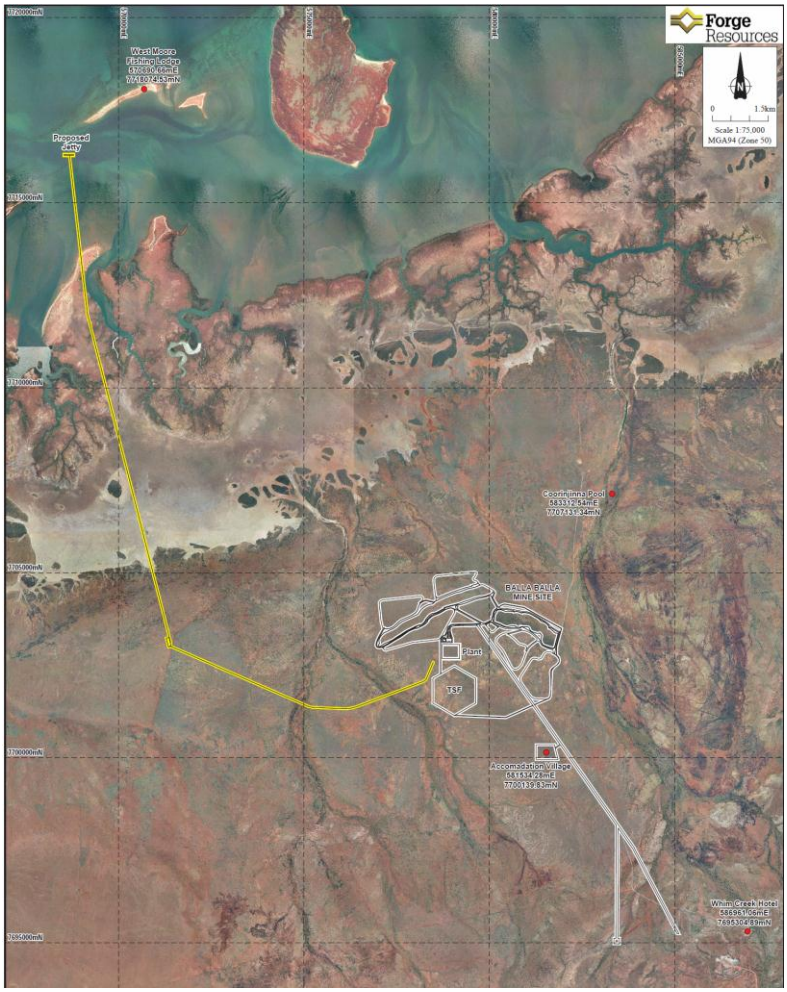

Figure 1 Location of mine site, iron storage facility and proposed ship loading facility

2.1 Mine Site

The operating equipment to be located at the proposed mine site will include the following:

FIXED PLANT (at ground level)

- Ball Mill
- SAG Mill
- Primary Crusher
- Rock Breaker
- Screens
- Conveyors
- Conveyor drives
- Pumps
- Air compressors
- Blowers
- Cyclones
- Dust Collectors
- Magnetic Separators
- Apron Feeders
- Hoist & cranes

MOBILE PLANT (nominally located in the pit)

- Loading Shovel
- Dump Trucks
- Production Drill Rig
- Bulldozer
- Front End Loader
- Grader
- Water Carts
- Light Vehicles

2.2 Dewatering Plant / Iron Ore Stock Pile Site (prior to ship loading)

The operating equipment to be located at the proposed iron ore stock pile site will include the following:

- Rail Mounted Linear Luffing and Slewing Stacker
- Bucket Wheel Reclaimer
- Pumps

- Conveyors
- Conveyor Drives
- Front End Loader

2.3 Iron Ore Barge / Ship Loading Operation

The operating equipment to be located at the proposed jetty will include the following:

- Ship Loader
- Conveyors
- Conveyor Drives

2.4 Identified Noise Sensitive Receivers

Noise level predictions have been performed for four identified noise sensitive receiver locations.

These are:-

- Mine Site Camp site located approximately 3.5 kms south east of mine processing plant site.
- Coorinjinna Pool located approximately 3.7 kms north – east from the mine pit site.
- West Moore Island Fishing Lodge located approximately 2.2kms north – east from the proposed ship loading facility
- Whim Creek Hotel located approximately10.5 kms south – east of the mine processing plant site.

Figure 1 above also shows the location of the noise sensitive receivers in relation to the Balla Balla mine site and associated facilities.

It is proposed to transport the iron ore concentrate from the mine site to the iron ore storage facility, via a slurry pipeline. The iron ore will be then transported to the ship loading facility using a conveyor.

Figure 2 below presents the proposed route of the slurry pipeline to the iron ore storage site and the conveyor to the ship loading facility.

Figure 2 Proposed slurry pipeline to the iron storage area and the conveyor route to the ship loading facility.

3 Noise Criteria

In Western Australia, the Environmental Protection (Noise) Regulations 1997 were gazetted to present a fair and effective set of rules to govern noise emissions.

These regulations have been tailored to the *Environment Protection Act 1986*.

The Regulations are the 'prescribed standard' under sections 51, 62(4), 74 (3) and clause 22 of schedule 4 of the Act.

The Western Australian Environmental Protection (Noise) Regulations 1997 prescribe the following:

- Noise criteria (Assigned Levels) relevant to the operational phase of the proposed mine project
- Noise level conditions relevant to the construction works
- Blasting noise level criteria relevant to blasting during mining operations

3.1 Operational Phase

For the operational phase of the project, Regulation 8 of the Environmental Protection (Noise) Regulations 1997 defines three types of assigned level parameters to be met at noise sensitive receiver locations.

These assigned level parameters are:

- L_{AMax} assigned levels means a noise level which is not to be exceeded at any time.
- L_{A1} assigned level means a noise level which is not to be exceeded for more than 1% of the time
- L_{A10} assigned level means a noise level which is not to be exceeded for more than 10% of the time

Table 1 below presents the Assigned Noise Levels for different types of receiving premises and for different times of the day.

Table 1 Assigned Noise Levels for Noise Sensitive Premises from Environment Protection (Noise) Regulations 1997

Premises Receiving Noise	Time of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{AMAX}
Noise Sensitive premises at locations within 15 metres 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 Sunday and public holidays	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise Sensitive premises at locations further than 15 metres from a building associated with a noise sensitivity use	All hours	60	75	80
Commercial Premises	All Hours	60	75	80
Industrial and utility premises	All hours	65	80	90

The influencing factor referred to in Table 1 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

The influencing factor will range from 0 to approximately 20 in most cases. For instance, an influencing factor of 0 requires that no industry or commerce and no major roads occur in the immediate vicinity of the sensitive receptor. Under these circumstances, the L_{A10} assigned level for the period 7 am to 7 pm Monday to Saturday would be 45 dB(A) at locations within 15 metres of a building directly associated with a noise sensitive use.

Regulation 7of the Regulations also requires that 'noise emitted from any premises 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'.

A noise emission 'significantly contributes to' a level of noise if the noise emission is greater than a level which is 5 dB below the assigned level at the point of reception. In the example above, a noise emission would significantly contribute to the noise level at the sensitive receptor if the noise emitted was greater than 40dB.

Regulation 9 of the Regulations sets out an objective test to assess whether the measured noise has intrusive or dominant characteristics or can be taken to be "free" of these characteristics.

If these characteristics cannot be reasonably or practicably removed, then a series of adjustments to the measured noise levels are set out. The adjustments are set out in Table 2 below.

Table 2 Noise Level Adjustments Presented in the Western Australian Environmental Protection (Noise) Regulations 1997

Adjustments where the 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

Therefore, using both Table 1 and 2, and using the previous scenario, should the noise emitted have tonality, the noise would significantly contribute to the noise level at the sensitive receptor if the noise emitted was greater than 35dB (ie/ >35dB + 5dB tonality = >40dB).

3.2 Construction Noise Criteria

Balla Balla Mine Site – Concentrate Slurry Pipeline – Iron Ore Storage Facility – Jetty / Ship Loading Facility

Noise due to construction activities is not required to achieve the assigned levels prescribed in Regulation 7 provided management practices presented in regulation 13 are adhered to.

Day Time Construction – Normal Working Hours

For construction work carried out between 7am and 7 pm on any day which is not a Sunday or public holiday:

- The construction work must be carried out in accordance with control of noise practices set out in section 6 of Australian Standard 2436 – 1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites".
- The equipment used for the construction must be the quietest reasonably available, and
- The Chief Executive Officer may request that a noise management plan be submitted for the construction work at any time.

Construction Out of Hours

For construction done outside the hours 7 am – 7 pm Monday – Saturday,

The requirements for construction works on a Sunday, or on a public holiday, or construction works performed outside the hours of 7 am – 7 pm are:

- The work must be carried out in accordance with the requirements of section 6 of AS 2436-1981
- The equipment used must the quietest reasonably available
- A noise management plan must be presented and approved by the CEO
- Affected nearby occupiers must be notified at least 24 hours before the work is started and the developer must show why out of hours work is necessary

A noise management plan must be prepared and presented to the Chief Executive Officer no later than 7 days before the construction work is required under Regulation 13. If these criteria cannot be met, then the assigned noise levels under Regulation 7 apply.

3.3 Blasting Noise Criteria

Regulation 11 describes the blast noise criteria and these are presented below.

Daytime Blasting

For blasting carried out between 7 am and 6 pm on any day which is not a Sunday or public holiday, the air blast level received on any premises must not exceed :-

- 125 dB Linear Peak for any blast, and
- 120 dB Linear Peak for nine in any ten consecutive blasts, regardless of the interval between blasts.

Blasting on Sundays and Public Holidays

For blasting carried out between 7 am – 6 pm on a Sunday or public holiday, the air blast levels received on any premises must not exceed –

- 120 dB Linear Peak for any blast, and
- 115 dB Linear Peak for nine in any ten consecutive blasts, regardless of the interval between blasts.

Blasting at Other Times

Air blast levels resulting from blasting on any premises or public place must not exceed 90 dB Linear Peakat any premises outside the periods between 7 am and 6 pm on any day.

4 Equipment Sound Power Levels

The proposed major plant and equipment to be located at the operational areas of the proposed Balla Balla mine site, iron ore storage facility and the jetty and ship loading facilities are described below.

4.1 Mine Equipment

A list of equipment that will be likely employed in the operation of the proposed mine site has been supplied by Forge Resources Ltd.

Sound Power Level data has been sourced from a data bank or from information obtained on the internet on specific noise sources.

The sound power levels of the proposed plant and equipment to be used at the Balla Balla mine site are presented in Table 3 below.

Table 3 Sound Power Level Per Unit of Equipment to be Located at the Mine Site

Equipment Configuration	Sound Power Levels (dBA) (L_{A10})									
	Octave Band Centre Frequency (Hz)									Overall PWL
	31.5	63	125	250	500	1K	2K	4K	8K	
Processing Area										
Ball Mill	92	91	98	104.5	109	112	110	107	102	116
Semi Autogenous Grinding Mill (SAG)	71.5	80	92	100.5	109	108	99	94	90	115
Tertiary Crusher (Gyratory)	77.5	91	99	113	121	118	114	110	108	128
Rock Breaker	85	90	100	105	114	111	112	109	103	118
Vibrating Screens	68.5	86	87	93.5	101	103	106	109	105	117
Pumps	89	88	87	80	79	76	71	62	48	92
Air compressors	47	60	69	76	82	83	86	86	84	91
Blowers	40	53	65	74	83	84	86	81	71	90
Agitators	31	44	56	65	74	75	77	72	62	81
Conveyors	78	82	83.5	82.5	83	82	76.5	71	66	90
Conveyor drives	98	102	104	103	103	106	107	99.5	88.5	113
Cyclones	40	53	65	74	83	84	86	81	71	90
Mine Area										
Haul Trucks (x14)	78.5	87	93	106.5	109	111	108	107	-	***116***
Loaders/ Excavators (x3)	103.5	104.5	111.5	106	103.5	99	95	86.5	80	***114.5***
Front-End Loader (x2)	52	85	95	100	107	107	106	101	92	***112***
Bulldozers (x5)	59	75	96	97	102	103	98	95	85	108
Graders (x3)	63	73	92	92	101	104	103	99.5	93	109
Drill Rig (x3)	73	95	106	117.5	121	120	118	112	-	***126***
Water Carts (x3)	70	86	105	109.5	112	109	107	102	-	***116***
Light Vehicles (LV's) (x23)	55	61.5	74	84.5	91	94.5	91	88	82.5	98

4.2 Iron Ore Storage Facility – Balla Balla

A list of the equipment that will be likely employed in the operation of the proposed iron ore storage facility prior to the ship loading operation is presented in Table 4.

Sound Power Level data has been sourced from a data bank or from information obtained on the internet on specific noise sources.

Table 4 Sound Power Level of Equipment to be Located at the Iron Ore Storage/ Dewatering Facility

Equipment Configuration	Sound Power Levels (dBA) (LA10)									
	Octave Band Centre Frequency (Hz)									Overall PWL
	31.5	63	125	250	500	1K	2K	4K	8K	
Iron Ore Storage Facility										
Stacker	103	108	109.5	110	109	108.5	102.5	96	89.5	116.5
Reclaimer	101	109	109.5	116.5	108.5	108	100.5	95	88.5	119
Pumps	89	88	87	80	79	76	71	62	48	92
Conveyors per metre	84	88	89.5	88.5	89	88	82.5	77	74	96
Conveyor drives	98	102	104	103	103	106	107	99.5	88.5	113
Front-End Loader	52	85	95	100	107	107	106	101	92	***112***

4.3 Ship Loading Operation

A list of the equipment that will be likely employed in the operation of the ship loading operation has been presented in table 5.

Sound Power Level data has been sourced from a data bank or from information obtained on the internet on specific noise sources.

Table 5 Sound Power Levels of Equipment to be Operational during the Ship Loading Operation at the Balla Balla Ship Loading Jetty.

Equipment Configuration	Sound Power Levels (dBA) (LA10)									
	Octave Band Centre Frequency (Hz)									Overall PWL
	31.5	63	125	250	500	1K	2K	4K	8K	
Ship Loading Operation										
Ship Loader	79.5	89	92.5	99	104.5	104	99.5	93	82	109.5
Conveyors per metre	78	82	83.5	82.5	83	82	76.5	71	66	90
Conveyor drives	98	102	104	103	103	106	107	99.5	88.5	113

4.4 Slurry Pipeline Construction Equipment

Table 6 below presents the Sound Power Levels (PWL) for the proposed equipment and for the calculation of the total Sound Power Level (PWL) in accordance with the methodology presented for the screening procedure if the construction equipment is operating outside the hours of 0700 – 1900 hours.

The Sound Power Level assigned to each piece of construction equipment was based on the data presented in AS 2436-1981 Table D2.

Table 6 Sound Power Level for the Proposed Construction Equipment for the Pipeline

Equipment Configuration	Number	Sound Power Level/ Unit (dBA)
Excavators – 300 kW	2	114
Bulldozer – 300 kW	2	117
Crane – 120 kW	1	102
Generator – 250 kVA	1	112
Trucks – 20t	2	103
TOTAL		**122***

Note this is worst case operating conditions – it assumes all equipment operating at maximum load

4.5 Ship loading Jetty Construction Equipment

Table 7 below presents the Sound Power Levels (PWL) for the proposed equipment and for the calculation of the total Sound Power Level (PWL) in accordance with the methodology presented for the screening procedure if the construction equipment is operating outside the hours of 0700 – 1900 hours.

The Sound Power Level assigned to each piece of construction equipment was determined using the data presented in AS 2436-1981 Table D2.

Table 7 Sound Power Level for the Proposed Construction Equipment for the Jetty Construction

Equipment Configuration	Number	Sound Power Level / Unit (dBA)
Pile Driver (diesel impact type – worst case)	1	126
Bulldozer – 300 kW	1	117
Crane – 120 kW	1	102
Generator – 250 kVA	1	112
Trucks – 20t	2	103
TOTAL		**126.5***

Note this is worst case operating conditions – it assumes all equipment operating at maximum load

5 Prediction Methodology

5.1 Operational

The noise level predictions at the nearest identified sensitive receptors were determined using the SoundPLAN 7.1 computer modelling software. This modelling package is accepted and endorsed by numerous agencies nationally and internationally.

The SoundPLAN modelling was performed using the CONCAWE industrial noise prediction method. The CONCAWE method was selected because it is a noise prediction method that includes the influences of wind and atmospheric stability in a way which can be easily quantified with site meteorological data. The CONCAWE Method was originally published as "*The Propagation of Noise from Petroleum and Petrochemical Complexes to Neighbouring Communities*" by CONCAWE in 1981. The Method was tested and validated over distances of 100 – 2000 metres, under a range of meteorological conditions for noise emissions from large petrochemical plants.

The noise model was developed using terrain contours at 10 m intervals and aerial photography to identify the locations of sensitive receivers (confirmed during the site inspection).

Meteorological conditions were modelled as the 'Worst Case (night time {1900 – 0700 hrs}) and day time {0700 – 1900} periods as presented in the EPA 'Guidance for the Assessment Environmental Factors No. 8'.

Table 8 below presents the meteorological parameters used in the prediction modelling.

Table 8 Meteorological Parameters used in the Prediction Mode.

Parameter	Conditions	
	Day (0700 – 1900)	Night (1900 – 0700)
Temperature (^{o}C)	20	15
Humidity (%)	50	50
Wind Speed (m/sec)	4	3
Pasquil Stability Index	E	F

Note that the uncertainty in prediction of the noise level is +/- 3 dBA.

5.2 Construction Noise

5.2.1 Screening Test for the Iron Ore Slurry Pipeline

The following assumptions have been made to determine the total Sound Power Level (PWL) due to operation of the equipment that is to be used to construct the proposed concentrate slurry pipeline from the mine site to the iron ore storage / dewatering facility.

In accordance with the methodology presented in 'Guidance for the Assessment of Environmental Factors – No. 8, the total sound power level of the assumed construction equipment was determined to be 122 dBA.

Using the 'Screening Procedure for Noise - Worksheet' in conjunction with the calculated Sound Power Level for the pipeline construction works, the minimum allowable distance between the construction equipment and the nearest noise sensitive receiver was determined.

5.2.2 Screening Test for the Jetty Construction Phase

The following assumptions have been made to determine the total Sound Power Level (PWL) due to operation of the equipment used to construct the proposed jetty.

In accordance with the methodology presented in 'Guidance for the Assessment of Environmental Factors – No. 8, the total sound power level of the assumed construction equipment was determined to be 126.5 dBA.

Using the 'Screening Procedure for Noise - Worksheet' in conjunction with the calculated Sound Power Level for the jetty construction works, the minimum allowable distance between the construction equipment and the nearest noise sensitive receiver was determined.

5.3 Blasting

5.3.1 Air Blasts Sound Pressure Levels

From Australian Standard AS 2187.2–2006 titled 'Explosives - Storage and Use Part 2 Use of Explosives', Section J5 Air Blast Levels, the predictive formula has been used to determine the air blast levels.

Air blast overpressure has been estimated using the following formula:-

$$P = K_a(R/Q^{1/3})^a$$

Where P= Pressure in Kilopascals

Q = Explosive charge mass in kilograms

R = distance from charge, in meters

K_a = site constant (usually in the range 10 – 100 for a confined blast hole

or 516 for an unconfined blast)

a = site exponent (-1.45)

To convert the Airblast pressure from kilopascal to $dB_{Linear\ Peak}$ the following formula was used:-

Airblast Level ($dB_{Linear\ Peak}$) = $20 \log_{10} (P/P_o)$

Where P = calculated airblast pressure in Pascals.

P_o = reference = 2×10^{-5} Pa

5.3.2 Ground Vibration

Australian Standard AS 2187.2 -2006 presents a formula for the estimation of the ground vibration.

Many site factors will affect the transmission of vibration through the ground. The most accurate prediction for a site would be generated from actual vibration measurements taken at the site of the

blasting operations. However, in the absence of such on site data, an estimation may be determined using the following equation:

$$V= K_g(R/Q^{1/2})^{-B}$$

Where V= Ground Vibration (Vector Peak Particle Velocity [mm/sec])

Q = Maximum instantaneous charge (effective charge mass per delay) in Kg

R = distance from charge to measurement point in meters

K_g & B = constants related to site and rock properties

The following values have been found to relate to 'average' rock under 'worst case'.

K_g = 1140 / B = 1.6

6 Results

SoundPLAN noise level prediction modelling was performed for two mine operating configurations these being:-

1) Approved Mine Pit and Processing Plant only

- **Mine Pit at 10 metres Depth / Process Plant at Ground Level**

  All mine pit equipment was located at a depth of 10 metres below ground level and the processing equipment located at ground level.

2) Approved Mine Pit and Processing Plant, plus the Proposed Iron Ore Storage Facility & Ship Loading Facility

- **Mine Pit at 10 metres Depth / Process Plant at Ground Level & Iron Storage / Dewatering Facility / Ship Loading Facility**

  All mine pit equipment was located at a depth of 10 metres below ground level and the processing equipment located at ground level.

  Iron ore storage / dewatering facility located approximately 7 km to the west of the mine pit site.

A mine pit depth of 10 metres below ground level was selected as it would present a worst scenario with much of the mine pit equipment just shielded and representing the operation of the mine in the early operating stages. It must be noted that as the pit deepens, the acoustic impact of the mine equipment would be reduced due to acoustic shielding of the equipment.

6.1 Noise Prediction Modelling

Appendix A presents the predicted noise level contours generated by the operation of the mine site including mine pit operations and the processing plant only, using the 'Day Time' and 'Night Time meteorological conditions prescribed in the EPA 'Guidance for the Assessment of Environmental Factors' – 'Environmental Noise' No.8 Draft.

Appendix B presents the predicted noise level contours due to the operation of the Mine site including the mine pit and processing plant equipment, the iron ore storage / dewatering facility and the ship loading facility using the 'Day Time' and 'Night Time meteorological conditions prescribed in the EPA 'Guidance for the Assessment of Environmental Factors' – 'Environmental Noise' No.8 Draft.

6.1.1 Mine Site Only Operational – Noise Prediction Modelling

Appendix A presents the predicted Noise level contours for the "Day' and 'Night' time meteorological conditions as presented in EPA 'Guidance for the Assessment Environmental Factors No. 8', Section 5.2.3 titled 'Noise Level Predictions'.

6.1.2 Mine Site Camp Accommodation

It can be seen that the night time predicted noise level at the proposed camp accommodation site due to the operation of the mine equipment and processing plant is 41.9 dBA. This is of the order of 7 dBA over the Assigned Noise Level of L_{A10} 35 dBA criteria (2200 – 0700 hours).

The predicted noise level for the Day time condition is 41.4 dBA. This is below the Assigned Noise Level (0700 – 1900 hours) criterion of L_{A10} 45 dBA.

6.1.3 Coorinjinna Pool

The predicted night time noise level at Coorinjinna Pool due to the operation of the mine equipment and processing plant only is 36.2 dBA. This is of the order of 1 dBA over the Assigned Noise Level (2200 – 0700 hours). The predicted noise level for the Day time condition is 35.5 dBA which is significantly lower than the Assigned Noise Level (0700 – 1900 hours) criterion of L_{A10} 45 dBA.

6.1.4 Whim Creek Hotel

The predicted night time noise level at the Whim Creek Hotel due to the operation of the mine equipment and processing plant is 23.1 dBA. This is below the Assigned Noise Level (2200 – 0700 hours). The predicted noise level for the Day time condition is 22.4 dBA which is also below the Assigned Noise Level (0700 – 1900 hours) criterion of L_{A10} 45 dBA.

6.1.5 West Moore Island Fishing Lodge

The predicted night time noise level at the West Moore Island Fishing Lodge due to the operation of the mine equipment and processing plant only is 20.5 dBA. This is below the Assigned Noise Level (2200 – 0700 hours). The predicted noise level for the Day time conditions is 19.8 dBA. This is below the Assigned Noise Level (0700 – 1900 hours) criterion of L_{A10} 45 dBA.

6.2 Mine Site, Iron Ore Storage / Dewatering Facility / Ship Loading Facility Operating

The predicted noise level at the four identified noise sensitive receiver locations were determined for the operation of the mine site, Iron Ore Storage / Dewatering Facility and the Ship Loading Facility for the Day and Night time meteorological conditions.

6.2.1 Mine Site Camp Accommodation

It can be seen that the night time predicted noise level at the proposed camp accommodation site is 42 dBA. This is 7dBA over the Assigned Noise Level of L_{A10} 35 dBA criterion (2200 – 0700 hours).

The predicted noise level for the Day time condition is 41.4 dBA. This is below the Assigned Noise Level (0700 – 1900 hours) criterion of L_{A10} 45 dBA.

6.2.2 Coorinjinna Pool

The predicted night time noise level at Coorinjinna Pool is 36.5 dBA. This is of the order of 2 dBA over the Assigned Noise Level (2200 – 0700 hours). The predicted noise level for the Day time condition is 35.8 dBA which is significantly lower than the Assigned Noise Level (0700 – 1900 hours) criterion of L_{A10} 45 dBA.

6.2.3 Whim Creek Hotel

The predicted night time noise level at the Whim Creek Hotel is 24.8dBA. This is below the Assigned Noise Level (2200 – 0700 hours). The predicted noise level for the Day time condition is 24 dBA. This is below the Assigned Noise Level (0700 – 1900 hours) criterion of L_{A10} 45 dBA.

6.2.4 West Moore Island Fishing Lodge

The predicted night time noise level at the West Moore Island Fishing Lodge is 20.5 dBA. This is below the Assigned Noise Level (2200 – 0700 hours). The predicted noise level for the Day time condition is 19.8 dBA. This is significantly below the Assigned Noise Level (0700 – 1900 hours) criterion of L_{A10} 45 dBA.

6.2.5 Comparison of the Predicted Noise Levels

A comparison of the predicted noise levels due to operation of the Mine Site only and the Mine Site / Iron Ore Storage / Dewatering facility / Ship loading facility shows minimal noise level increases of the order of 0.1 to 2 dB at the mine site camp accommodation, Whim Creek Hotel and at the Coorinjinna Pool.

The predicted increase in the noise levels at the West Moore Island Fishing Lodge site due to the operation of the ship loading facility is in the order of 30 dBA. This due to the fact that the ship loading facility will be located approximately 2.75 kms from the lodge site.

Table 9 presents the predicted noise levels at the four identified nearest noise sensitive receivers for the two mine operating configurations viz for the mine pit and processing plant only and for the mine pit, processing plant, iron ore storage and dewatering facility and ship loading facility.

Table 9 Predicted Sound Pressure Levels at the Nearest Identified Noise Sensitive Receivers

Scenario Modelled Weather Conditions / Mine operation Configuration	Predicted SPL dB(A) - Noise Sensitive Receiver Location			
	Mine Site Camp	West Moore Island Fishing Lodge	Coorinjinna Pool	Whims Creek Hotel
Day Time Meteorological Conditions				
Mine Site Operating Only	41.4	19.8	35.5	22.4
Mine Site , Iron ore Storage / Dewatering Facility / Ship Loading Facility	41.4	50.7	35.8	24
Night Time Meteorological Conditions				
Mine Site Operating Only	41.9	20.5	36.2	23.1
Mine Site , Iron ore Storage / Dewatering Facility / Ship Loading Facility	42	51	36.5	24.8

Note that the Assigned Noise Level for the night time is 35 dBA.

6.3 Mine Operation and Construction Works

6.3.1 Blasting

The 'ground vibration levels' and 'air blast peak sound pressure levels' have been calculated using two methods blasting for various distances.

6.3.1.1 Confined Blasting

The following has been assumed in calculating the 'confined' blasting prediction:

- Maximum charge mass per delay of 1,000 kg per hole
- K_a (site constant)= 100 (worst case scenario)

Table 10 below presents the predicted air blast peak linear Sound Pressure Levels for a confined blast configuration using a maximum 1,000 kg charge mass at various distances from the blast site.

Table 10 Predicted Air Blast Peak Linear Sound Pressure Levels for a 1,000 Kg charge mass for a Confined Blast

Distance from Blast Site (metres)	Predicted Air Blast Sound Pressure Level (dB Peak Linear)
1,000	136
2,000	127
3,000	122
4,000	118
5,000	115

6.3.1.2 Unconfined Blasting

The following assumptions have been made in calculating the unconfined blasting levels:

- Maximum charge mass per delay of 50 kg per hole
- K_a (site constant) = 516 (As per recommended value in AS 2187.2 -2006)

The predicted air blast sound pressure levels for a 50 kg unconfined blast is presented in Table 11 below.

Table 11 Predicted Air Blast Peak Linear Sound Pressure Levels for a 50 Kg Unconfined Blast

Distance from Blast Site (metres)	Predicted Air Blast Sound Pressure Level (dB Peak Linear)
1,000	138
2,000	132
3,000	125

4,000	121
5,000	118

6.4 Ground Vibration Prediction0

Australian Standard AS 2187.2 -2006 presents a formula for the estimation of the ground vibration.

The following assumption has been made:

- 1,000 kg charge mass
- Confined blast

Table 12 below presents the estimated ground vibration levels for a charge mass 1,000 kg confine blast.

Table 12 Calculated Peak Particle Velocity (PPV) for a Charge Mass 1000 kg Confined Blast at Various Distances from the Blast Site

Distance from Blast Site (metres)	Estimated Ground Vibration Peak Particle Velocity (mm / sec)
1,000	2.1
2,000	0.7
3,000	0.4
4,000	0.2
5,000	0.2

6.5 Construction Noise (Plant Equipment) – 'Slurry' Pipeline.

For construction works performed outside the hours of 0700 – 1900 hours for Monday to Saturday, on a Sunday and on public holidays, the screening procedure methodology presented in the EPA '*Guidance for the Assessment of Environmental Factors – Environmental Noise' No.8,* indicates that if using the equipment detailed in Section 5.2.1, a minimum buffer zone in the order of a 10 km radius between the construction works and the nearest noise sensitive receiver would be required. The calculation of the minimum buffer zone was based on the assumption that all equipment would be operating at maximum engine speed and continuously for long periods.

6.6 Construction Noise (Plant Equipment) – Ship Loading Jetty.

For construction works performed outside the hours of 0700 – 1900 hours for Monday to Saturday, on a Sunday and on public holidays, the screening procedure methodology presented in the EPA '*Guidance for the Assessment of Environmental Factors – Environmental Noise' No.8,* indicates that if using the equipment detailed in Section 5.2.1, a minimum buffer zone in the order of a 12 – 13 km radius between the construction works and the nearest noise sensitive receiver would be required. It can be seen from Figure 1 that the distance from the most extreme end of the jetty (Piling only) to the

West Moore Island Fishing Lodge is approximately 2.75 kms while land based equipment would located more than 4.5 – 5 kms from the Fishing Lodge.

7 Discussion

As described in Section 2.4, there are a number of noise sensitive receivers within a 9 - 10 km radius around the mine site, including the accommodation camp which is located approximately 3.5 km from mine pit site.

The 'Night' and 'Day' time noise level prediction modelling has been presented for the 'worst case' scenario that all mine pit equipment and plant is operating while located at an initial depth of 10 metres below ground level and that the mine processing plant is permanently located at ground level height while assuming the recommended meteorological conditions.

In reality, some of the equipment will not be operating 24 hours, 7 days a week on maximum load and several major noise sources such as the excavators and many haul trucks will be in the mine pit at a greater depth than 10 metres resulting in higher noise attenuation. The acoustic impact of this equipment will be reduced as the mine pit walls will shield these noise sources with respect to the nearest noise sensitive receivers.

It is believed that the mining operation will only be performed after the 'over burden' has been removed from the mine pit site. The initial construction works will be performed at ground level for a relatively short period of time with limited equipment just to remove the burden. To obtain a representative mining scenario, the noise level prediction modelling was conducted assuming all equipment operating 10 metre depth.

7.1 Significant Noise Sources

7.1.1 Mine Site Operating Only

The camp site is the most affected noise sensitive receiver due to the operation of the mine site and is of the order of 7 dBA over the Assigned Noise Level of L_{A10} 35 dBA criteria for the night time period (2200 – 0700 hours).

A review of the ranked noise source noise data shows that the productions drills (3 off) have the greatest acoustic impact at the 3 nearest noise sensitive locations near the mine site.

The noise emissions from the drilling rigs would need to be reduced by 20 – 22 to meet the night time assigned noise level of 35 dBA.

This noise reduction maybe achieved by purchasing quieter units than modelled in this report or, if a quieter is not available, then noise mitigation must be performed or drilling works can only be performed during the day time period.

Reducing the noise level due to the drilling rigs will reduce the night time noise levels due to the operation of the mine equipment and plant to meet the night time criteria not only at the mine site camp but also at the Coorinjinna Pool site.

Note the noise level emissions due to operation of the mine site the at Whim Creek site meet the Assigned Noise levels for the day and Night time periods.

The noise emissions for the daytime period at the mine camp site and Coorinjinna Pool site meet the day time Assigned Noise Level criterion.

The predicted noise levels due to the operation of the Mine site at the Moore Island Fishing Lodge were well below the Assigned Noise Levels for the Night and Day time periods.

7.1.2 Mine Site and Dewatering and Storage Facility & Iron Ore Loading Facility

The operation of the Dewatering and Storage Facility and the Iron Ore Loading Facility had minimal acoustic impact at the mine camp site and at the Coorinjinna Pool site.

The noise emission from the Dewatering and Iron Ore Storage Facility increased the overall noise levels at the Whim Creek site by 1 – 2 dB over the noise level generated by the mine site. However, the overall noise level due to the operation of the mine site and the Dewatering & Iron Storage Facility and the Iron Ore Ship Loading Facility was well below the Assigned Noise Levels for the Night and Day time periods.

The iron loading facility had a significant acoustic impact at the Moore Island Fishing Lodge increasing the noise level from a predicted noise of approximately 20 dBA to a predicted level of 51 dBA.

A review of the noise source ranking at the Moore Island Fishing Lodge showed that the overland conveyors were the dominant noise source (51 dBA). The noise emission from the ship loader was in the order of 20 dB lower than from the overland conveyors at the Lodge.

Investigation into developing a quieter conveyor system will be required and feasible noise mitigation applied such as constructing an acoustic 'tunnel' over the conveyor to reduce the noise emisssion.

7.2 Construction Noise

7.2.1 'Slurry' Pipeline.

If the construction works are to be performed between 0700 – 1900 hours Monday to Saturday, then the equipment should have noise mitigation fitted to make it as quiet as practical. If work is to be performed out of these hours or on a Sunday or public holiday, a buffer zone in the order of a 10 km radius would be required. If a noise sensitive receiver is located within the buffer zone during construction works, then the works must be managed to ensure that the construction works are performed during 'normal' working hours that is 0700 – 1900 hours Monday to Saturday.

7.2.2 Jetty / Ship Loader Construction.

If the construction works are to be performed between 0700 – 1900 hours Monday to Saturday, then the equipment should have noise mitigation fitted to make it as quiet as practical. If work is to be performed out of these hours or on a Sunday or public holiday, a buffer zone in the order of a 12.5 km radius would be required. As a noise sensitive receiver (the West Moore Island Fishing Lodge) will be located within the buffer zone during construction works, the works must be managed to ensure that the construction is only performed during 'normal' working hours that is 0700 – 1900 hours Monday to Saturday

7.3 Blasting

7.3.1 Confined Blasting Air Blast Prediction Levels

The nearest noise sensitive receiver is the Mine Site accommodation camp which is located approximately 3.5 km from the closest edge of the mine pit.

Using the formula presented in AS 2187.2 – 2006, the estimated Air blast sound pressure level at this location will be 120 dB peak linear based on a 1,000 kg confined mass charge.

The blast noise level predicted will likely just comply with the 120 dB linear peak criterion (9 in 10 consecutive blasts) between the hours 0700 and 1800 hours Monday to Saturday and also exceeds the 115 dB Linear Peak criterion between the hours 0700 – 1800 hours on a Sunday or public holiday noise criteria presented in the Environmental Protection (Noise) Regulations 1997 - Regulation 11.

7.3.2 Unconfined Blasting Air Blast Prediction

Using the formula presented in AS 2187.2 – 2006, the estimated Air blast sound pressure level will be 120 dB peak linear based on a 50 kg mass charge at the nearest noise sensitive receiver location.

The predicted air blast level of 120 dB peak linear will likely just comply with the 120 dB linear peak criterion between the hours 0700 and 1800 hours Monday to Saturday, but exceeds the 115 dB Linear Peak between the hours 0700 – 1800 hours on a Sunday or public holiday Air blast criterion presented in the Environmental Protection (Noise) Regulations 1997 - Regulation 11.

7.4 Ground Vibration Prediction

Using the formula presented in AS 2187.2 – 2006, the estimated the Peak Particle Velocity (PPV) ground vibration level will be approximately 0.2 mm/sec based on a 1,000 kg mass charge at this nearest noise sensitive receiver location.

Australian Standard AS 2670.2 – 1990 titled ‘Evaluation of human exposure to whole- body vibration Part 2 : Continuous and shock – induced vibration in buildings (1 to 80 Hz)’ presents recommended vibration levels for residential buildings for the day and night times for transient vibration excitation with several occurrences per day. It states that the satisfactory magnitudes of building vibration with respect to human response range from 1.4 - 2.8 mm/ sec for the night time period.

The predicted vibration level due to blasting at the mine pit site is in the lower range of the recommended level and therefore should result in very little human response, if any at all.

8 Conclusion

The noise level predictions for the proposed Balla Balla mining operation have been based on the weather conditions (day & night time) as presented in EPA 'Guidance for the Assessment Environmental Factors No. 8', Section 5.2.3 titled 'Noise Level Predictions'. It also makes the presumption that all equipment will be operating on maximum load 24 hours / 7 days.

8.1 Review of the Two Proposed Mine Site Operation Configurations

From the noise level predictions, the following conclusion can be drawn:

At the mine site camp site, Coorinjinna Pool and the Whim Creek Hotel sites, there is predicted to be a marginal increase of between 0.1 – 1 dB (site dependent) between the operating configurations of the mine site only and mine site / iron ore - dewatering facility / ship loading facility. This does not represent a significant change in impact between modelled scenarios.

The predicted noise level at the mine camp site, resulting from activities at the approved mine site is lower than the day time Assigned Noise Level criterion of 45 dBA for sensitive receptors but is 7 dB(A) higher than the EPA Assigned Noise Level of 35 dBA for the night time. The key contribution to the predicted noise levels is noise from the operation of the production drilling rigs. If drilling rigs are to operate at night time then noise mitigation will be required to reduce the acoustic impact on the noise levels at the camp site.

The prediction modelling shows that the proposed location of the ship loading operation will have a significant impact at the West Moore Island Fishing Lodge. There is a predicted increase of 31 dB compared to the mine site operational levels, for both the day and night-time scenarios. The resultant noise levels would exceed the Assigned Noise Level criterion will be exceeded by 15 – 16 dBA for the night time period and by 5 -6 dBA during the day time.

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8.2 Concentrate Slurry Pipeline

8.2.1 Concentrate Slurry Pipeline – Construction

If the construction works are to be performed between the hours of 0700 – 1900 hours Monday to Saturday, the plant noise emission will need to be reduced to be as quiet as practical. No further actions would be required.

Based on the assumptions of number and type of plant, if construction works are to be performed outside the normal day time hours or on a Sunday or public holiday, a buffer zone of 10 kilometres around the construction works site would be required.

8.2.2 Concentrate Slurry Pipeline – Operation

The noise level emission due to the operation of the slurry pipe will be insignificant as it is proposed that the pipeline will not have any intermediate pump stations operating between the mine site and the dewatering facility.

8.3 Conveyor / Jetty / Ship Loader

8.3.1 Conveyor / Jetty / Ship Loader – Construction

If the construction works are to be performed between the hours of 0700 – 1900 hours Monday to Saturday, then the plant noise emission will need to be reduced to be as quiet as practical. No further actions would be required.

Based on the assumptions of number and type of plant, if construction works are to be performed outside the normal day time hours or on a Sunday or public holiday, a buffer zone of 10 kilometres around the construction works site would be required.

8.3.2 Conveyor / Jetty / Ship Loader – Construction

The predicted noise level emission due to the operation of the conveyers / ship loading facility will exceed the EPA noise criterion as presented in section 7.3.2 above.

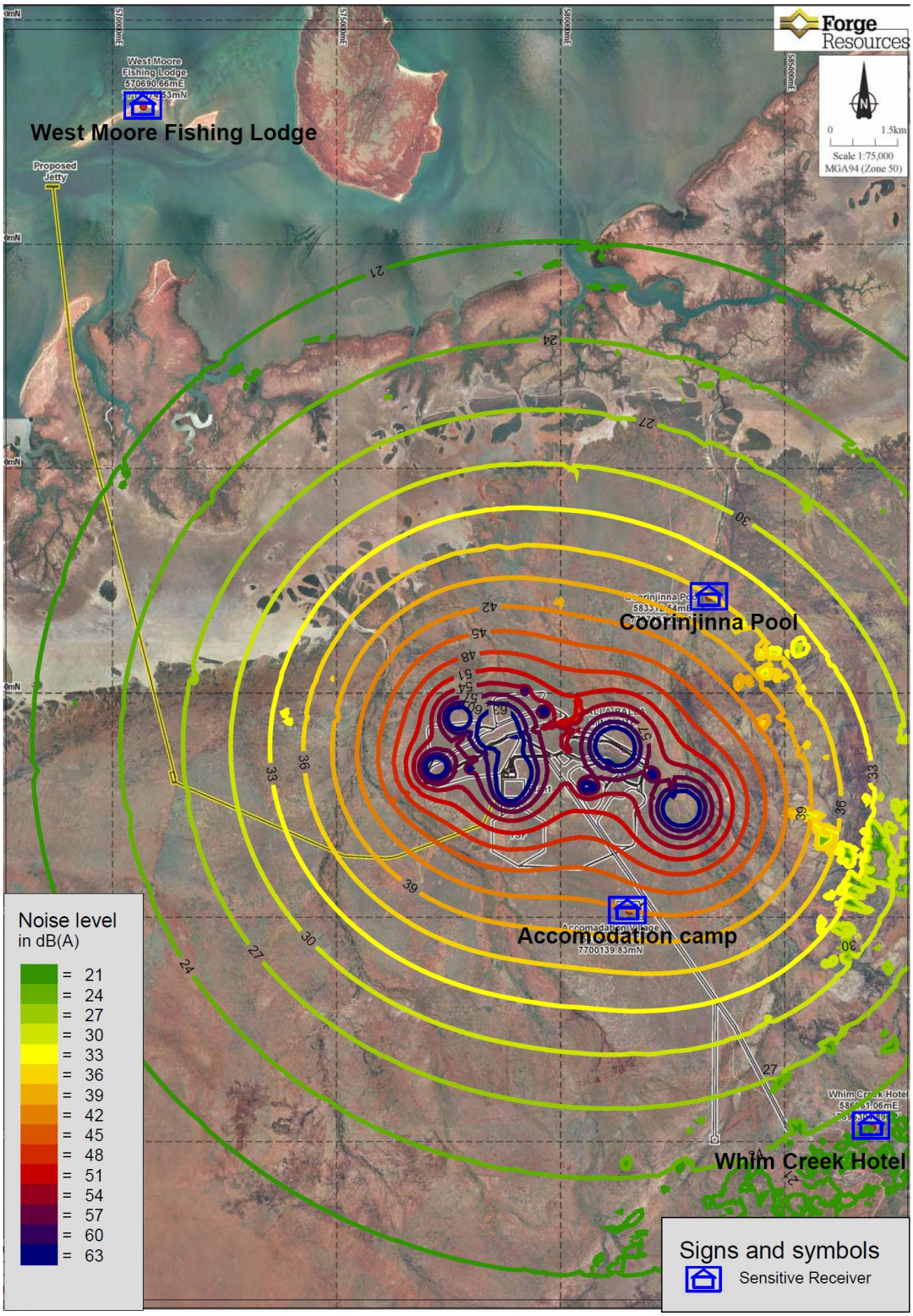
8.4 Blasting Noise and Vibration

With management of charge weight, blasting noise and vibration will not be an issue.

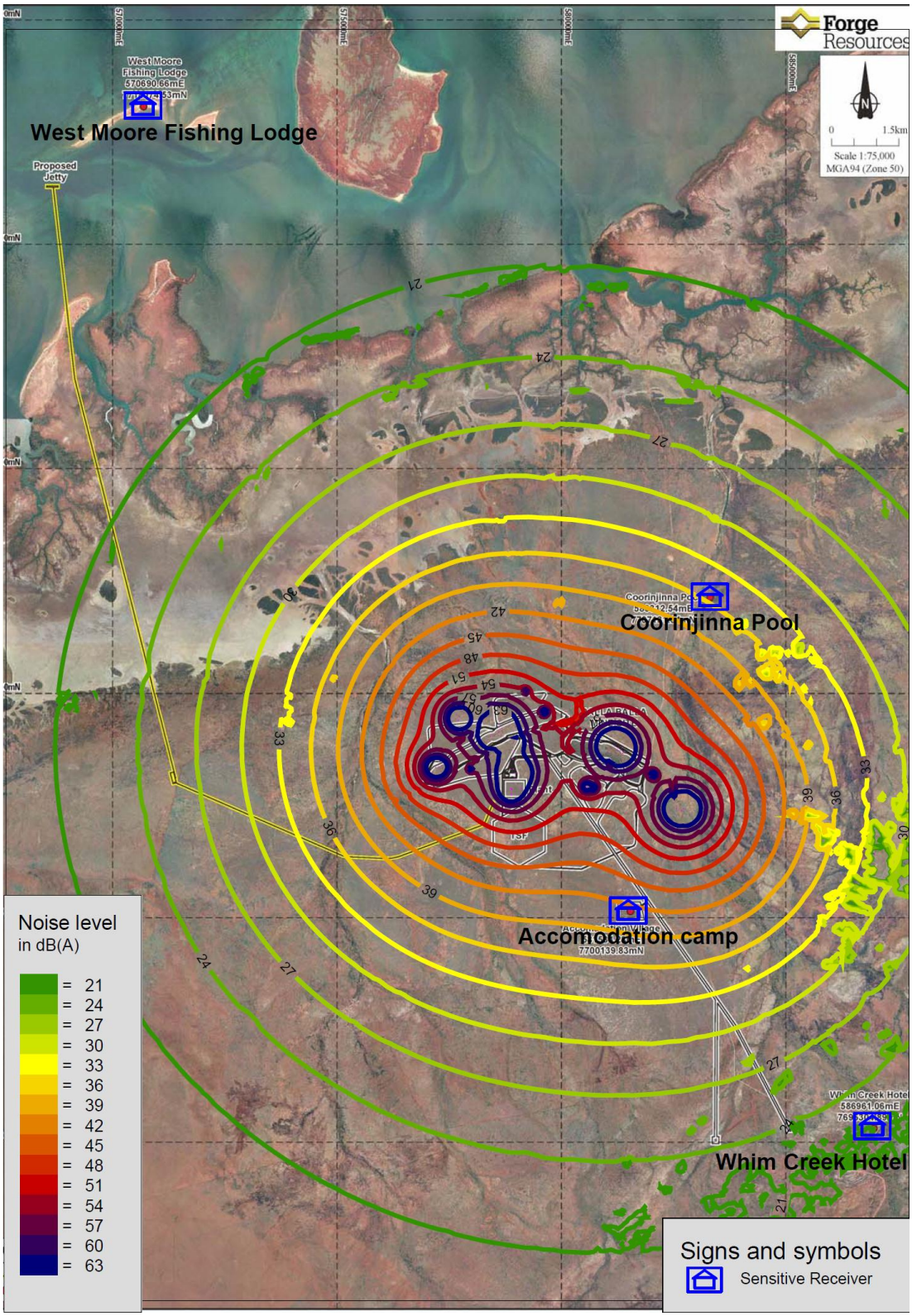
Appendix A

Appendix A1 – Predicted Noise Level Contours for the mine site only – Night time Meteorological Conditions

Appendix A2 – Predicted Noise Level Contours for the mine site only – Day time Meteorological Conditions



Appendix A1 – Predicted Noise Level Contours for the mine site only – Night time Meteorological Conditions

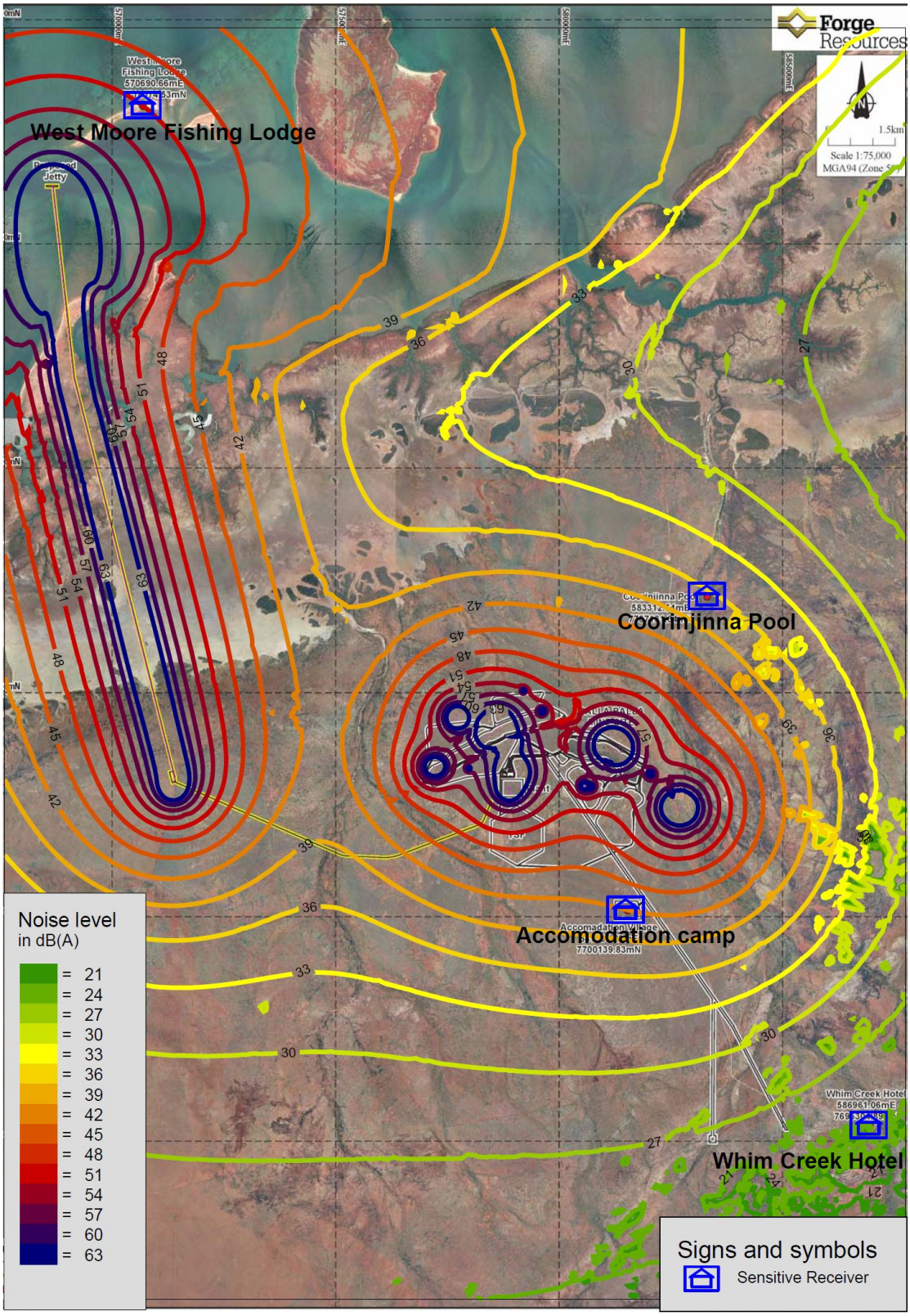


Appendix A2 – Predicted Noise Level Contours for the mine site only – Day time Meteorological Conditions

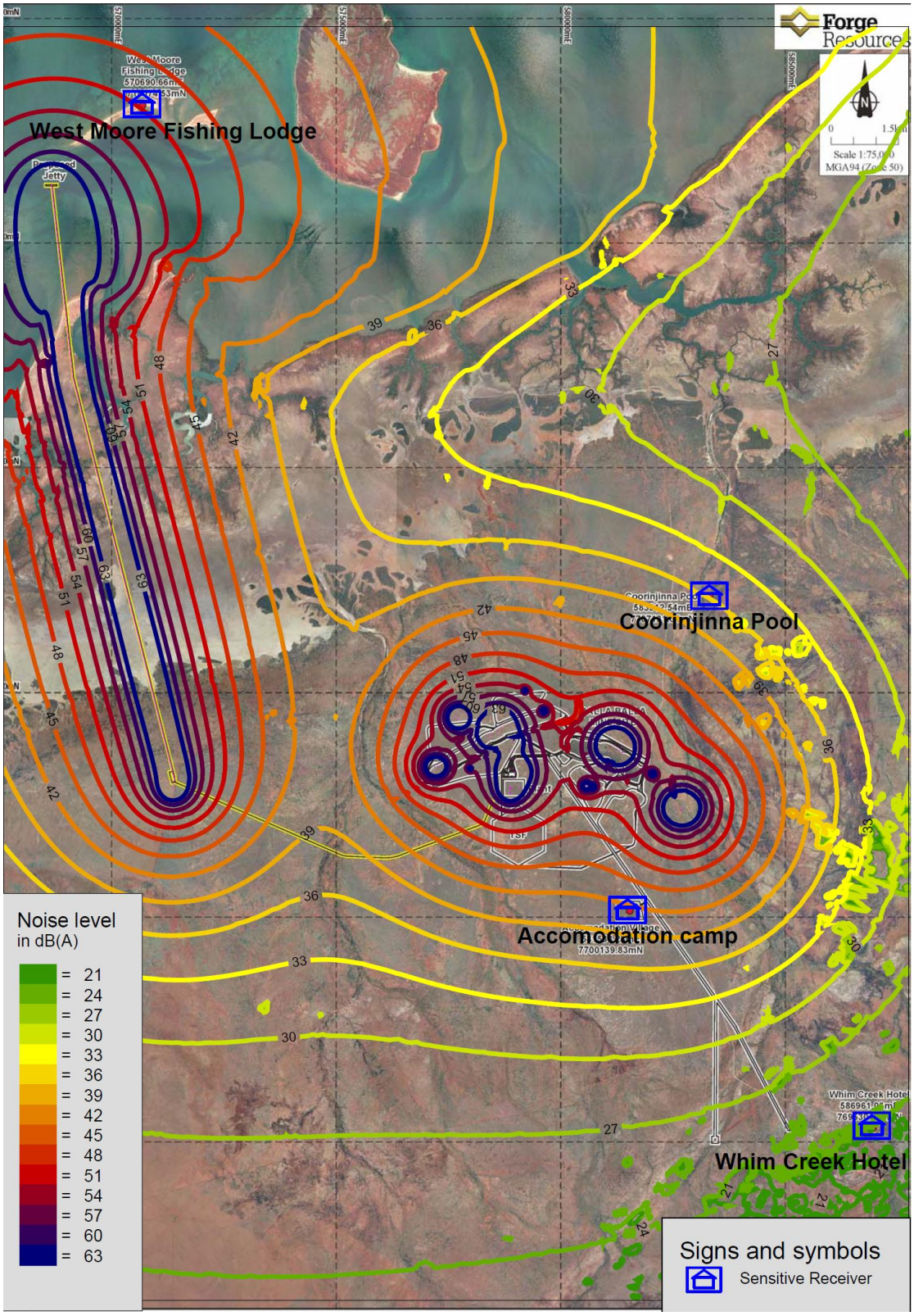
Appendix B

Appendix B1 – Predicted Noise Level Contours for the mine site only – Night time Meteorological Conditions

Appendix B2 – Predicted Noise Level Contours for the mine site only – Day time Meteorological Conditions



Appendix B1 – Predicted Noise Level Contours for the Mine Site, Iron ore Storage, Dewatering Facility and Ship Loading Facility – Night time Meteorological Conditions



Appendix B2 – Predicted Noise Level Contours for the Mine Site, Iron ore Storage, Dewatering Facility and Ship Loading Facility – Day time Meteorological Conditions