APPENDIX R: ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT - B2018 PROJECT (TALIS CONSULTANTS)

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SIGMC Beyond 2018 Environmental Noise and Vibration Assessment

Prepared for St Ives Gold Mining Company Pty Ltd

August 2017

Project Number: TN17015-1

DOCUMENT CONTROL

Version	Description	Date	Author	Reviewer
0	Draft - Internal Review	17/08/17	LA/PL	GB
1	Draft - Issued for Client Review	22/08/17	LA	JM/EV
2	Issued to client	25/08/17	LA	

Approval for Release

Name	Position	File Reference
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Signature

Executive Summary

This report summarises an environmental noise and vibration assessment undertaken for the Beyond 2018 Project (B2018) at the St Ives Gold Mine, Kambalda Western Australia (WA).

B2018 will involve mining of a number of pits within the B2018 Development Envelope including pits at proposed South West (SW) Dome, Rialto and Playa disturbance areas (see Figure 1-1) which are in close proximity (~2km) to noise sensitive receivers at the Townships of East Kambalda and West Kambalda.

Aim

The aim of the assessment was to determine if the proposed B2018 operations are predicted to comply with the *Environmental Protection (Noise) Regulations 1997* (the Regulations) and, if required, determine potential mitigation options for B2018.

Conclusions

Based on the data provided and the outcomes of the modelling and analysis, the following has been concluded:

- Noise levels from the B2018 operations are predicted to comply with the Regulations for all modelled operational cases at all times of day, evening and night.
- Noise from blasting is predicted to comply with the Regulations.
- Vibration from blasting is predicted to comply with Australian Standard AS2187 criteria, and be at a level that would not disturb or be perceivable in the Towns of East and West Kambalda.

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1 Introduction

Talis Consultants Pty Ltd (Talis) has been engaged by St Ives Gold Mining Company Pty Ltd (SIGMC) to undertake an environmental noise and vibration assessment for the Beyond 2018 Project (B2018).

1.1 Overview

B2018 will involve mining operations in various pits including proposed disturbance areas at South West (SW) Dome, Playa and Rialto which are located at approximately 2km from noise sensitive receivers in the Township of East Kambalda and West Kambalda. The proposed B2018 operations are in closer proximity to Kambalda than the existing operations. The proposed operations are shown in Figure 1-1, and the B2018 Development Envelope is shown in Appendix B.

1.2 Aim

The aim of this assessment is to quantify the noise and vibration impacts from the proposed B2018 operations and determine if the operations comply with the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

1.3 Scope

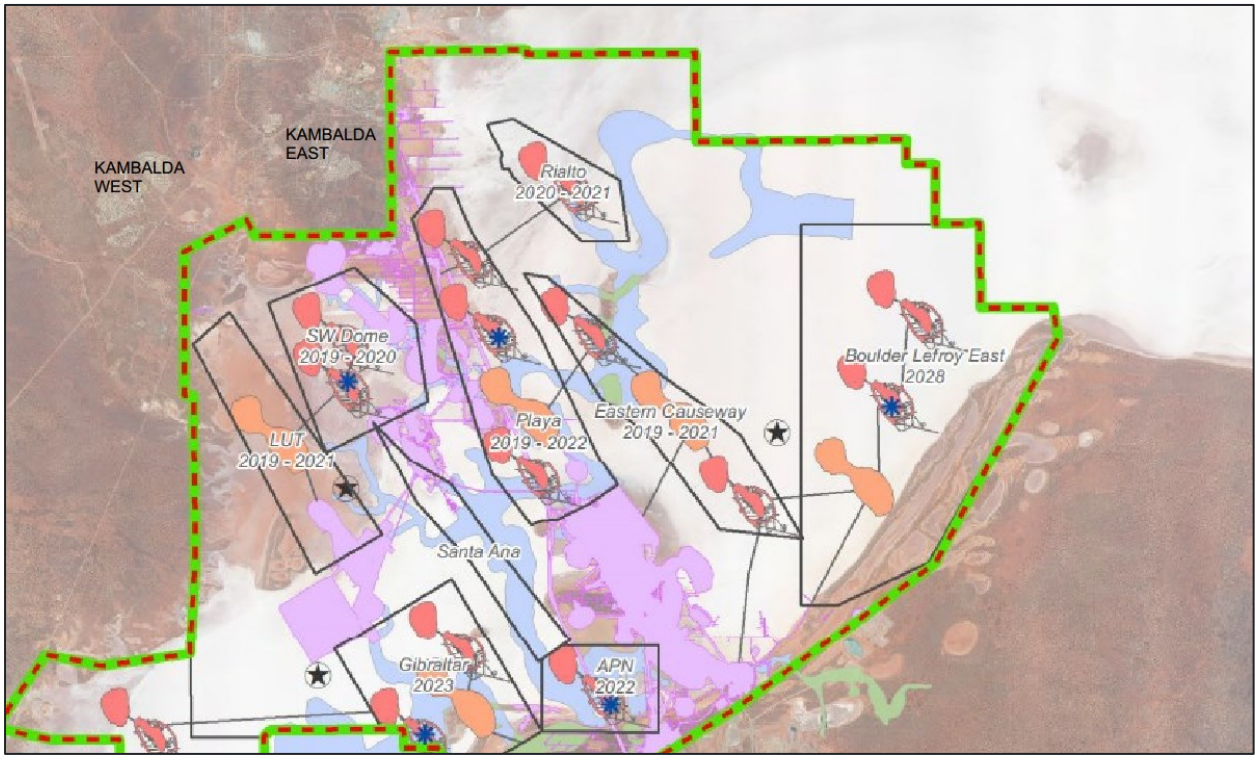
This report summarises the method, modelling results, compliance assessment and (if applicable) noise control options for B2018.

The scope of this document includes;

- Section 2 – Assessment Criteria
- Section 3 – Method
- Section 4 – Results and Compliance Assessment
- Section 5 – Noise Management
- Section 6 – Blasting
- Section 7 - Conclusions

1.4 Applicable Documents

[1] *Environmental Protection Act 1986*.
[2] *Environmental Protection (Noise) Regulations 1997*.
[3] Australian Standard AS2187 “Explosives – Storage, Transport and Use”.
[4] SVT Report Rpt02-1401246-Rev0-17 May 2016 “Environmental Noise Impact Assessment for Proposed Mining Operations of Pistol Club Pit at St Ives Gold Mine”.



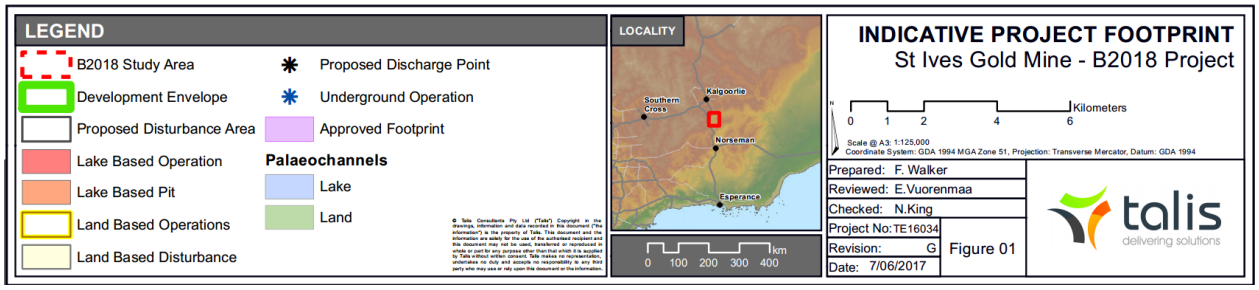


Figure 1-1 Location of Proposed B2018 Operations (SW Dome, Playa, Rialto) and Noise Sensitive Receivers (Kambalda East and Kambalda West)

2 Assessment Criteria

2.1 Noise Assessment Criteria

Received noise has been assessed against the Regulations.

The Regulations define maximum allowable noise levels which apply to noise received at sensitive premises, such as residential areas. The noise maximum level, called an assigned level, is determined by a combination of a base noise level plus an Influencing Factor (IF).

The influencing factor applicable depends on the surrounding land use zonings and the presence of major and minor roads. Based on a review of the receiver locations, no influencing factor is applicable (i.e. IF =0).

The assigned noise levels include L_{A1}, L_{A10} and L_{AMAX} noise parameters, defined as;

- L_{AMAX} means an assigned level that is not to be exceeded at any time;
- L_{A1} means an assigned level that is not to be exceeded for more than 1% of time; and
- L_{A10} means an assigned level that is not to be exceeded for more than 10% of time.

As the B2018 operations are ≥2km from the sensitive receivers, the L_{A10} noise parameter is the most appropriate and stringent assessment criteria because it is highly improbable that the mines L_{A1} and L_{AMax} parameters would be exceeded at distances of 2 km's or more.

Therefore, The L_{A10} noise parameter is the focus of this assessment.

Table 2-1 presents the L_{A10} assigned noise levels for the relevant sensitive receivers for the B2018 expansion. As shown in the table, the Horse Stables (R1) have a higher assigned noise level, as they have previously been classified as commercial premises (SVT, 2016).

Table 2-1 Assigned Noise Levels

Sensitive Receiver	L_{A10} Assigned Noise Level		
	Day (0700-1900)	Evening (1900-2200)	Night (2200-0700)
R1 Horse Stables	60	60	**60**
R2 Kambalda (East)	45	40	**35**
R3 Kambalda (West)	45	40	**35**
R4 Kambalda (West)	45	40	**35**

2.1.1 Adjustments for intrusive or dominant characteristics

Received noise is subject to adjustment if the noise exhibits intrusive or dominant characteristics i.e. if the noise is impulsive, tonal or modulating. These adjustments, shown in Table 2-2, are cumulative up to a maximum of 15 dB.

Section 9 of the Regulations sets out objective tests to assess whether the noise is free of these characteristics. A definition of tonality, impulsiveness and modulation as defined by Regulation 9 is presented in Appendix A1 and a summary of the application of these tests for B2018 is discussed below.

Table 2-2 Adjustments for intrusive or dominant characteristics (cumulative to maximum 15 dB)

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

2.1.1.1 Adjustments Summary

No adjustments have been applied to the received noise levels for intrusive or dominant characteristics for the proposed B2018 operations, for the following reasons.

Tonality

The predicted received levels have not been adjusted for tonality for the following reasons:

- The worst case predicted noise levels from B2018 operations are lower than previously measured background noise levels (SVT, 2016) at R1 and R2 in the community. Assuming these background noise levels are still the same, any received tonal characteristics in the received level is likely to be masked and not protrude[1] above background noise; and
- No tonality adjustment was included for the previous assessment (SVT, 2016) (scenario 1 and scenario 2). As mining operations for the previous assessment (SVT, 2016) at the Pistol Club were closer to the community and similar in nature to the proposed B2018 operations, it is assumed that tonality adjustment is not required for this assessment.

Impulsiveness and Modulation

The predicted received levels have not been adjusted for modulation or impulsiveness for the following reasons:

- None of the mining equipment proposed for B2018 is expected to modulate at the source; and
- The distance between the nearest B2018 operation and receiver is ~2km and therefore any impulsiveness (LA Peak) generated at an equipment source would disperse with distance and is unlikely to meet the Section 9 of the Regulations criteria, i.e. LA Peak higher than the LA Slow max by more than 15 dB.

2.1.2 Adjustments for Significant Contributor

If other industries 'significantly contribute' to the received noise level at the sensitive receivers, adjustment of the assigned level is required.

Section 7 of the Regulations states that noise emitted from any premises when received at another premises must not cause, or significantly contribute to, a level of noise which exceeds the assigned level. Where there are multiple emitting premises, the noise emission is taken to ***significantly contribute*** to the received level if it exceeds a value which is 5 dB below the assigned level.

Therefore, it needs to be determined if there are any other industries which are likely to *significantly contribute* to the received levels other than SIGMC.

During previous measurements on-site (SVT, 2016) it was determined that there are no other industries that significantly contribute to the received noise levels, and as such, no significant contributor penalty is applicable.

[1] Tonality must protrude above background noise to be measured and an adjustment applied.

As the current B2018 scope is desktop based, it will be assumed that this is still valid, and no significant contributor adjustment will be applied.

2.2 Blasting Assessment Criteria

Blasting is an irregular mining activity that creates high instantaneous noise and vibration levels at the source. Due to the nature of blasting, the Regulations define different noise criteria.

The following sections define the noise and vibrations limits applicable to blasting.

2.2.1 Noise Limits

Table 2-3 outlines the blast noise limits defined in the Regulations. As blasting is carried out at SIGMC for single blasts during the day-time, the most applicable limit is 125 dB (Monday – Saturday) and 120 dB (Sundays and Public holidays).

Table 2-3 Blasting Noise Limits

Time Period	Noise Limit dB Peak (Lin)	Applicable to
Day-time (7 am to 6 pm), except Sundays or public holidays	125	Any blast
Day-time (7 am to 6 pm), except Sundays or public holidays	120	9 in 10 consecutive blasts
Sundays & Public Holidays (7 am to 6 pm)	120	Any blast
Sundays & Public Holidays (7 am to 6 pm)	115	9 in 10 consecutive blasts
Night-time (6 pm to 7 am) on any day	90	Any blast

2.2.2 Blast Vibration Limits

Blasting vibration impacts have been assessed against AS2187.2, and can be categorised into criteria for structural damage and criteria for vibration disturbance (i.e. potential for blasting vibration to disturb people sleeping).

Blast Vibration Criteria for Building Damage

EPA Guidance Note 8 states "Predictions of ground vibration levels should be carried out at the nearest adjacent premises for a typical blast of the size proposed, using Appendix J7 of Australian Standard AS 2187.2-2006"[2].

[2] Appendix J of AS 2187.2-2006: Explosives - Storage Transport and Use states that "conventional blasting at normal distances is unlikely to create ground vibrations of a magnitude which causes damage".

The accepted vibration parameter for blasting is ground borne particle velocity at the receiver (in mm/s). Table 2-4 presents the vibration levels defined in Appendix J4 of AS 2187.2.

Table 2-4 Blasting Vibration Limits – Building Structural Integrity

Type of Building Structure	Peak Particle Velocity (mm/s)
Houses and low-rise residential buildings and commercial buildings	15

Blast Vibration Criteria for Human Comfort

Blast vibration has the potential to cause sleep disturbance which can result in fatigue. It is therefore considered a safety concern. Blasting at SIGMC is limited to day-time hours and therefore its impacts are expected to be limited to shift workers sleeping during day-time hours.

The levels available in literature as shown in Table 2-5 were considered when determining acceptable vibration sleep disturbance criteria for this study.

Table 2-5 Blasting Vibration Limits – Human Discomfort

Literature	Description	Peak Particle Velocity (mm/s)
AS2187.2 2006 (Appendix J4)	95th percentile for human comfort	5
German Standard DIN4150	Vibration is Noticeable	1
	Vibration is Easily Noticeable	2.2
	Vibration is Strongly Noticeable	6

3 Noise Modelling Overview

3.1 Noise Model Software

A desktop environmental noise model was created to simulate the B2018 operations using the SoundPlan v7.4 software program (SoundPlan). This software package calculates sound pressure levels at nominated receiver locations and produces noise contours over a defined area of interest. SoundPlan can be used to model different types of noises, such as industrial noise, traffic noise and aircraft noise, and it has been recognised as accepted software by the Department of Water and Environmental Regulation (DWER).

SoundPlan provides a range of prediction algorithms that can be selected by the user. The CONCAWE[3,4] prediction algorithm has been used for the B2018 model, which is consistent with previous studies including (SVT, 2016).

The inputs required by the SoundPlan model software are noise sources, ground topographical data, meteorological data and sensitive receiver point locations. The inputs used for the B2018 model are discussed below.

3.2 Noise Model Inputs

3.2.1 Noise Sensitive Receivers

Table 3-1 and Figure 3-1 present the location of sensitive receivers used in this assessment to predict noise levels within the community.

R1 is a horse stables (i.e. commercial premise) and R2, R3 and R4 are residential premises (i.e. sensitive receivers).

Table 3-1 Noise Receivers

Reference	Name	Assigned Noise Level (L_{A10}, night)	GPS Location
R1	Stables	60	372072(E), 6545966(N)
R2	Kambalda East	35	372992(E), 6546812(N)
R3	Kambalda West (NE)	35	369408(E), 6546575(N)
R4	Kambalda West (SW)	35	368728(E), 6545507(N)

[3] CONCAWE (Conservation of Clean Air and Water in Europe) was established in 1963 by a group of oil companies to carry out research on environmental issues relevant to the oil industry.

[4] The propagation of noise from petroleum and petrochemical complexes to neighbouring communities, CONCAWE Report 4/81, 1981

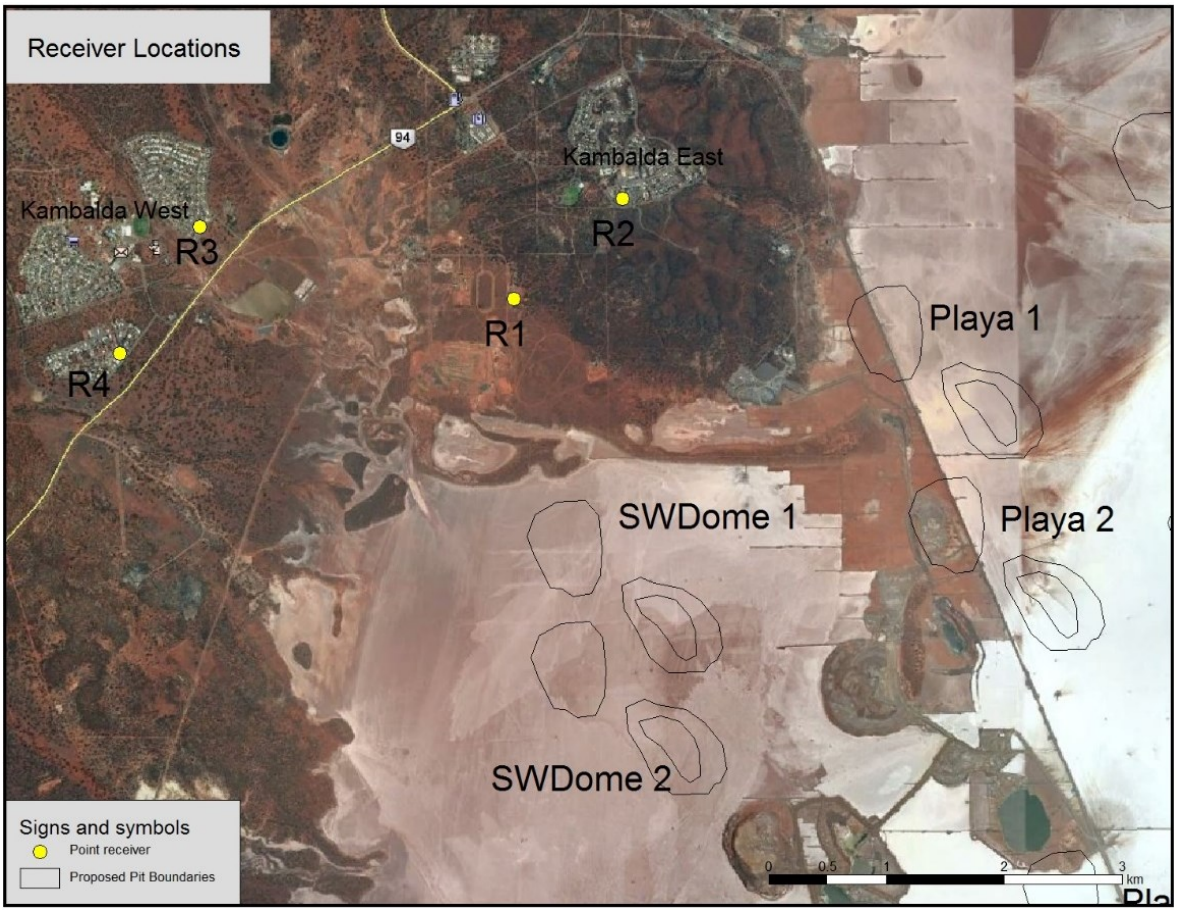


Figure 3-1 Noise Sensitive Receiver Locations

3.2.2 Topography

Topography provided by SIGMC was imported into the model to create a digital ground map for the study area.

The noise model was setup with all mobile equipment placed on the ground surface (i.e. not in a pit). This is considered worst case because if the mobile equipment items were positioned at depth inside a pit, the pit walls would offer some shielding from the noise sources.

3.2.3 Ground Absorption

The acoustic properties of the ground surface can have a considerable effect on the propagation of noise. Flat non-porous surfaces such as concrete, asphalt and calm water are highly reflective whereas soft, porous surfaces such as foliage and grass are highly absorptive.

For CONCAWE, the ground factor (G) varies from 1 (totally reflective) to 0 (totally adsorptive).

In order to represent the hard rock and sparse vegetation of the study area, the ground surface applied to the model was G=0.8.

3.2.4 Meteorological Conditions

Table 3-2 presents the worst case meteorological conditions applied to the model, which are defined in the DWER (formerly Department of Environment Regulation (DER)) "Draft Guideline on Environmental Noise for Prescribed Premises".

Table 3-2 Worst-case Meteorological Conditions for Noise Propagation

Time of day	Temperature	Relative Humidity	Wind Speed	Pasquil Stability Category (PSC)
Night (22:00 - 07:00)	15º Celsius	50%	3 m/s	F

3.2.5 Noise Sources (Mining Equipment List)

Noise sources (i.e. mining equipment) were entered into the model using the proposed B2018 equipment details received from SIGMC including type, make, model and quantity.

Each equipment item is allocated a Sound Power Level (SWL) in the noise model, which is the total acoustic energy emitted by each item. The SWLs applied to each equipment item were a combination of previously measured SIGMC equipment (SVT, 2016), and measurements previously performed by Talis on similar equipment types.

In order to represent worst case mining operations, the noise model scenarios were setup with all of the proposed equipment operating simultaneously. This is considered worst case scenario as it is unlikely that 100% utilisation of equipment would be achievable during operations.

Table 3-3 presents the list of equipment and noise source SWL levels modelled for each B2018 scenario. The layout of noise sources for each scenario is presented graphically in Figure 3-2.

Detailed noise source data included octave bands for each item are shown in Appendix C.

Table 3-3 Equipment Noise Sources Included in Each Model Scenario

Equipment Details	Quantity	Locations	Sound Power Level per item in dB(A)
Dump Truck - Cat 785	2	Pit (2)	119.7
Dump Truck - Cat 789 (operational)	7	Pit (2), Haul Road (5)	118.3
Dump Truck - Cat 789 (idle)	3	Pit (2), Waste (1)	107.1
Grader - Cat 16M	2	Haul Road (2)	107.2
Hitachi EX3600 Excavator	3	Pit (3)	122.7
Lighting Tower	10	Pit (10)	89.5
Service Truck - Isuzu 6x4	1	Haul Road (1)	101.5
Swamp Dozer - Cat D7	1	Pit (1)	116.2
Tool Carrier - CAT 972H	1	Haul Road (1)	101.5
Track Dozer - Cat D10T	5	Pit (3), Waste (2)	119.2
Tyrehandler - Cat 988	1	Haul Road (1)	101.5
Water Cart- Cat 773	1	Haul Road (1)	116.9

3.3 Noise Model Scenarios

The noise model was setup to represent the mining operations closest to the Towns of East and West Kambalda. Each of the modelled operations were setup with an operational pit, waste dump and haul route connecting to the main haul road and processing area.

The layout, configuration and quantities of equipment modelled in each of the proposed B2018 operations were identical. This approach was adopted so that the noise emissions and impacts from each B2018 mining area were directly comparable to each other and to the Regulations. The modelled scenarios were as follows;

- Scenario 1 Mining at proposed SW Dome disturbance area.
- Scenario 2 Mining at proposed Playa disturbance area.
- Scenario 3 Mining at proposed Rialto disturbance area.
- Scenario 4 Mining at proposed SW Dome + Playa disturbance areas simultaneously.

The noise model layout and mobile equipment items in each B2018 model scenario is shown in Figure 3-2. The same configuration was used for each scenario. The equipment lists and quantities were provided by SIGMC and in order to represent conservative worst case model predictions, the following has been assumed:

- 100% utilisation of equipment (i.e. all equipment operating simultaneously); and
- Although there may possibly be waste stockpiles which create shielding, the modelling assumes no stockpiles and therefore no shielding.

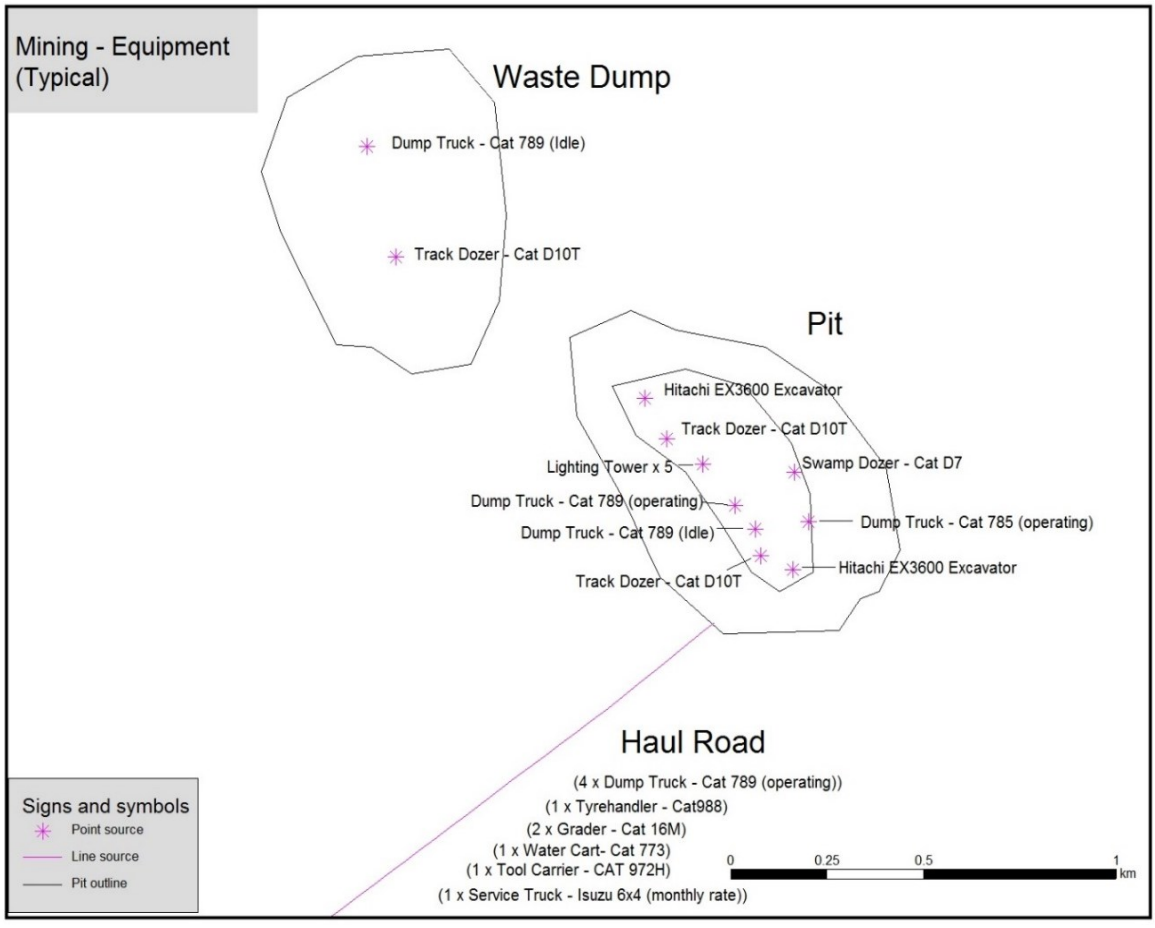


Figure 3-2 Noise Model Layout (the Same for Each B2018 Operation)

3.4 Cumulative Noise Impacts

The modelled scenarios quantify the noise impacts for mining in the B2018 operations. It has been assumed that other operational areas, such as Pistol Club, will not operate simultaneously with the B2018 operations.

4 Noise Model Results and Compliance Assessment

The following sections present the modelling results and compliance assessment against the Regulations (section 4.1), Noise Contour Maps (section 4.2) and top contributing equipment items (Appendix D).

4.1 Model Results

Table 4-1 presents the predicted noise levels for the modelled noise scenarios and a compliance assessment against the Regulations for the night-time assigned levels.

As can be seen from the tabulated results, the model predicts received levels at all sensitive receivers (i.e. R1, R2, R3 and R4) are less that the assigned level and are therefore expected to comply with the requirements of the Regulations. As the received noise levels are predicted to be compliant at night-time the levels will also be compliant for all other times of the day.

Table 4-1 Mining Noise Model Results

Sensitive Receiver	Night-time LA10 Assigned Noise Level	LA10 Noise Model Prediction			
		SW Dome	Playa	Rialto	SW Dome + Playa
R1 Horse Stables	60	41.5	36.2	34.1	41.4
R2 Kambalda East	35	29.6	20.5	28.2	29.3
R3 Kambalda West	35	31.9	26.2	24.9	31.3
R4 Kambalda West	35	30.1	23.9	22.6	29.5

4.2 Noise Contour Maps

Figure 4-1 to Figure 4-4 present noise contour maps of the modelled scenarios:

- Figure 4-1 presents a noise contour map for mining at SW Dome 1 and SW Dome 2. The activities include mining and a waste dump to the north. A haul route is also included from the mining area back to the Lefroy Mill.
- Figure 4-2 presents a noise contour map for mining at Playa 1 and Playa 2. The mining configuration is identical to SW Dome.
- Figure 4-3 presents a noise contour map for mining at Rialto and Playa operating simultaneously.
- Figure 4-4 presents a noise contour map for mining at SW Dome and Playa simultaneously.

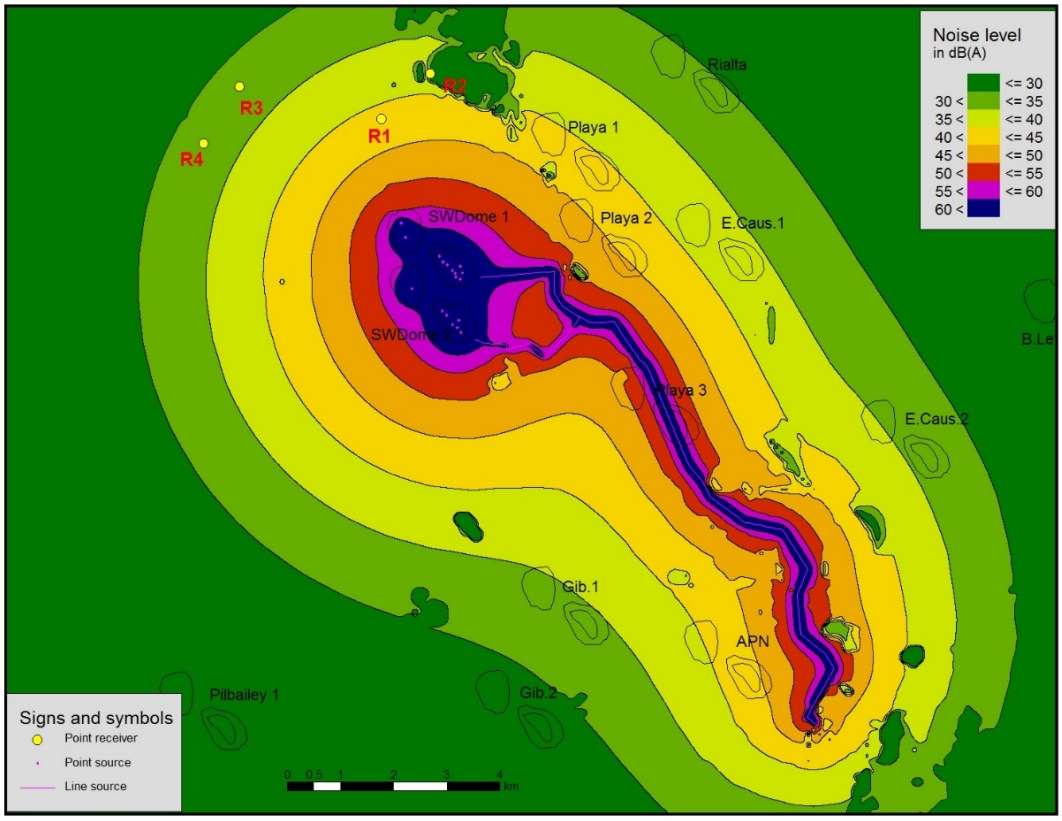


Figure 4-1 Noise Contour Map – Mining at SW Dome

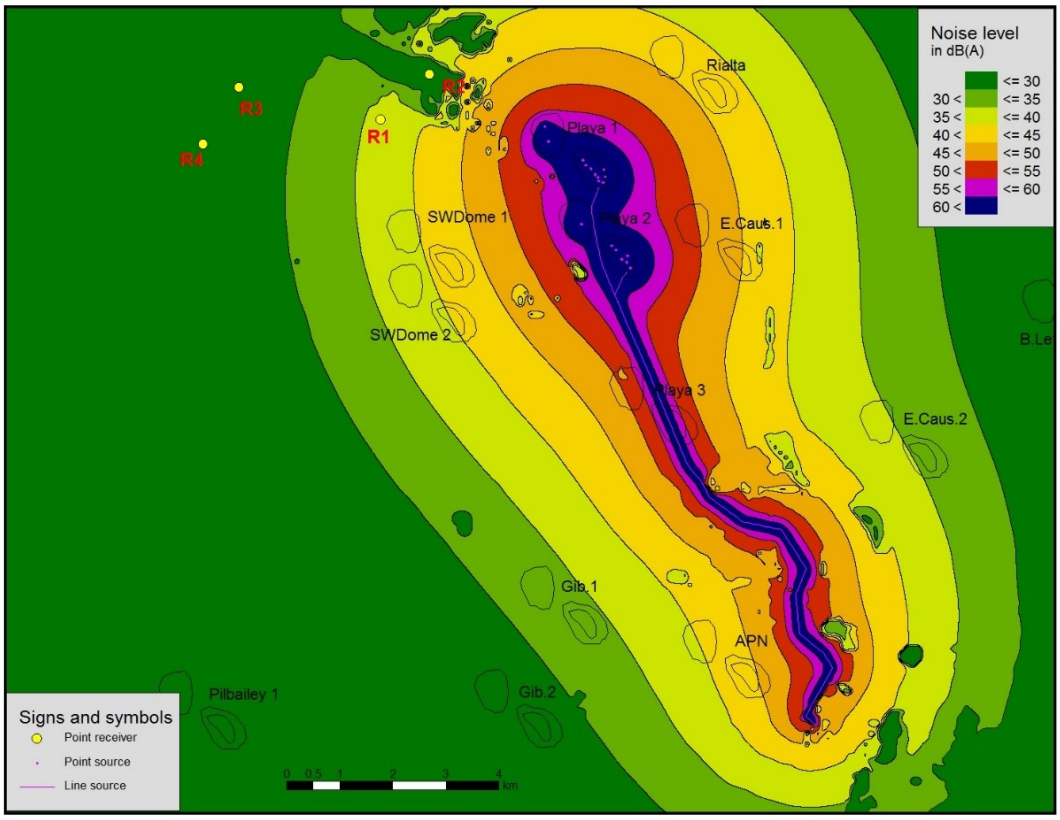


Figure 4-2 Noise Contour Map – Mining at Playa

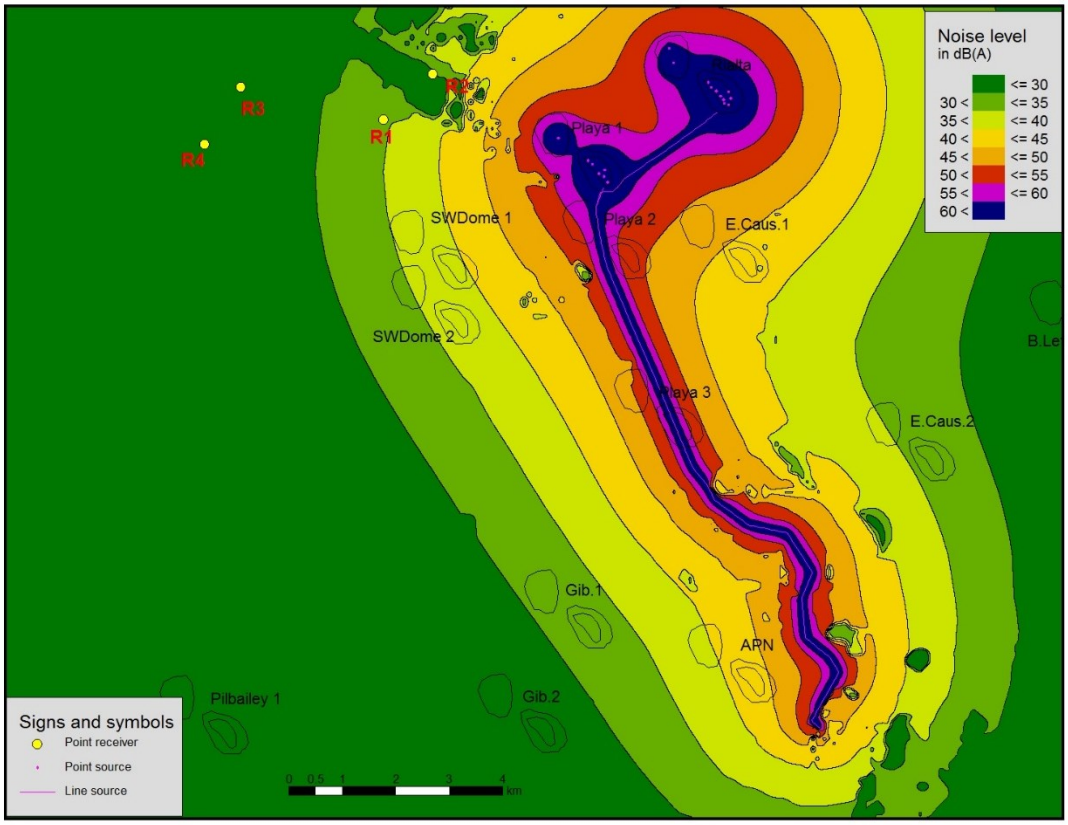


Figure 4-3 Noise Contour Map – Mining at Rialto

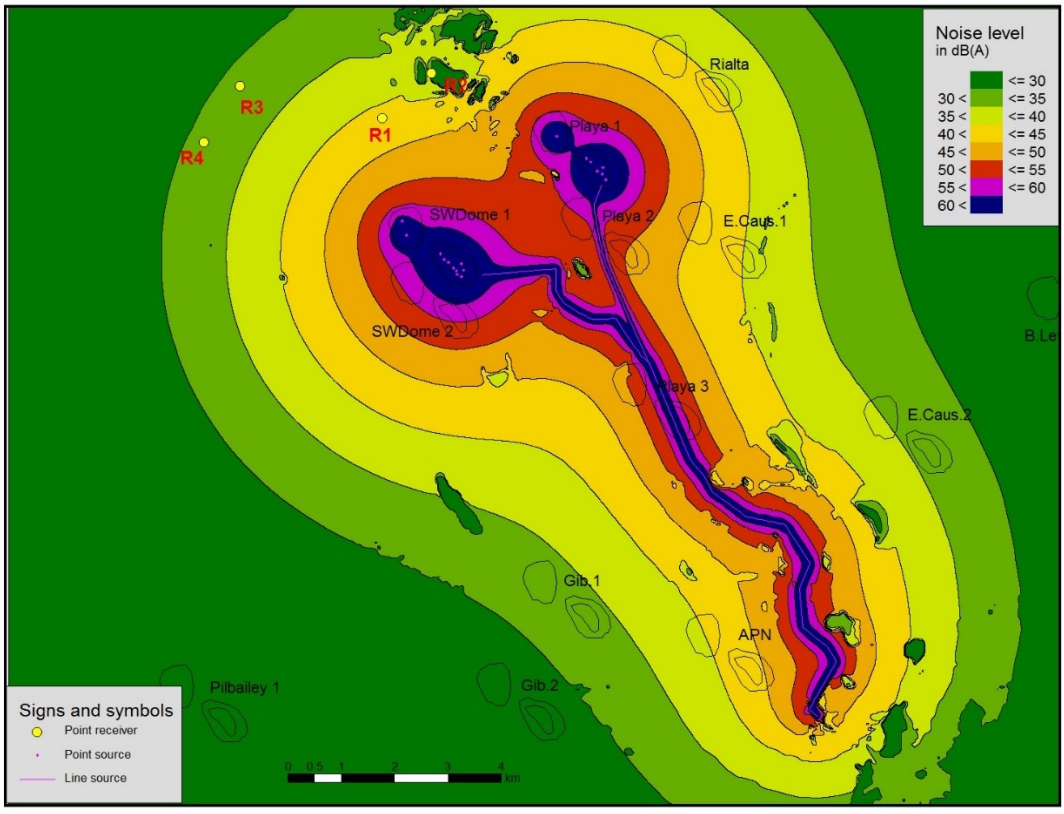


Figure 4-4 Noise Contour Map – Mining at SW Dome + Playa

5 Noise Management

All modelled B2018 operations are predicted to comply with the Regulations under conservative conditions (i.e. worst case operational and weather conditions) at all times of day. Therefore, no noise control actions have been proposed for B2018.

However, considering that the B2018 and Pistol Club (SVT, 2016) pits are in closer proximity to Kambalda than SIGMC's previous operations, it is recommended that SIGMC consider developing a noise management procedure/plan for their operations. The plan should include a community complaint response process.

6 Blasting

Blasting is a common mining activity that has the potential to result in high noise and vibration levels. For the B2018 Project, blasting is expected to occur when the pits are deep (i.e. below the sediment layers and in hard ground).

As this scope was a desktop study, blasting measurements were not undertaken. Therefore, a desktop assessment has been undertaken to predict the potential impacts of blasting at the pit (SW Dome) closest to Kambalda, and undertake a compliance assessment against the criteria defined in section 2.2.2.

6.1 Blasting Parameters

Table 6-1 presents that blast parameters which were used to undertake the B2018 blasting noise and vibration assessment.

The parameter which has the most significant effect on the noise and vibration emissions is the weight of explosives per hole. Therefore, two separate assessments have been undertaken including; average explosives per hole (66 kg) and worst case explosives per hole (149 kg).

Table 6-1 Typical Blasting Parameters

Parameter	Typical Blast Parameters[5] (Average Values from Invincible Pit Stage 5)
Number of holes	181
Total explosives	10,263 kg
Explosives per hole	66 kg (149 kg max)
Depth	7.5m
Hole Diameter	115mm
Emulsion	Fortis Advantage @ 1.2g/cc
Delay	400ms

6.2 Blasting Noise Assessment

Consistent with previous noise assessments (SVT, 2016), the peak noise level from blasting has been predicted using the following empirical formula[6]:

$$\mathbf{SPL = 20Log10\ [0.162(W^{1/3}/R)0.794] + 171}$$

where;

- **SPL** is the unweighted peak instantaneous sound pressure level in dB

[5] The typical blast parameters quoted are the averaged values for blasts carried out during SIGMC Invincible Stage 5 pit, which are higher (i.e. more conservative) than Invincible Stage 6 blast parameters.

[6] Fidell S, Horonjeff R, Schultx T and Teffeteller S Journal of the Acoustical Society of America 74(3): 888-893. Community response to blasting.

- **R** is the distance in feet
- **W** is the maximum weight of explosives per detonation in pounds.

In order to be conservative, the worst case instantaneous charge mass per hole of 149kg (329 pounds) has been assumed.

6.2.1 Blast Noise Results

For the B2018 pits, the following peak instantaneous noise levels ($dB_{Lin, peak}$) from blasting at the SW Dome pit have been calculated;

- R1 (Horse Stables) = 105 dB
- R2 (East Kambalda) = 103 dB
- R3 (West Kambalda) = 101 dB

Based on the calculations undertaken, blasting in the SW Dome area is predicted to comply with the Regulations at all sensitive receivers.

These calculations assume flat ground, and therefore the topographical features such as hills or stockpiles in the area may also provide some shielding which is not accounted for.

6.3 Blasting Vibration Assessment

Ground borne vibration levels have been estimated using blast parameters provided by SIGMC (see Table 6-1) and the vibration prediction formula defined in AS2187.2[7], which is as follows;

$$V = K(\frac{R}{Q^{0.5}})^{-B}$$

Where:

V is the ground vibration peak particle velocity in mm/s

R is the distance between the detonation and the receiver

Q is the maximum instantaneous charge in kg

K and B are empirical constants related to site and rock properties. Where 'K' refers to the site confinement conditions (i.e. free face, quarry, heavily confined blasting) and 'B' refers to expected rock types.

The values used for the calculation include a peak detonation of 149kg/hole and site and rock properties for average free field conditions defined in AS2187 of K=1140 and B=1.6.

[7] Square Root scaling of charge per delay. Nichols et al 1971 (Nichols, H.R., Johnson, C.F., and Dewall, 1971 "Blasting Vibrations and their effects on structures, Bureau of Mines bulletin 656").

6.3.1 Blast Vibration Results

For the B2018 pits, the following vibration levels (mm/s) from blasting at the SW Dome pit have been calculated;

- R1 (Horse Stables) = 0.7 mm/s
- R2 (East Kambalda) = 0.4 mm/s
- R3 (West Kambalda) = 0.3 mm/s

Based on the calculations undertaken, blasting in the SW Dome area is predicted to comply with AS2187.2 vibration criteria for building damage, and is also below the criteria which may disturb or be perceivable by the community.

6.4 Blasting Outcomes

Blasting noise impacts are predicted to comply with the Regulations at all receivers.

Blasting vibration impacts are predicted to comply with AS2187.2 for building integrity, and be at a level that would not be disturb or be perceivable in the Towns of East and West Kambalda.

7 Conclusions

Based on the outcomes of this assessment, the following has been concluded:

- Noise levels from the B2018 operations are predicted to comply with the Regulations for all modelled operational cases at all times of day, evening and night.
- Noise from blasting is predicted to comply with the Regulations.
- Vibration from blasting is predicted to comply with Australian Standard AS2187 criteria and be at a level that would not be disturb or be perceivable in the Towns of East and West Kambalda.

Therefore, no noise mitigation measures are proposed for the B2018 Project.

Appendix A **Noise Legislation**

Noise management in Western Australia is implemented through the *Environmental Protection (Noise) Regulations 1997* (the *Regulations*), which operate under the Environmental Protection Act 1986. The *Regulations* specify maximum noise levels (assigned noise levels) which are the highest noise levels that can be received at noise-sensitive (residential), commercial and industrial premises.

Assigned noise levels are defined differently for noise sensitive premises, commercial premises, and industrial premises. For noise sensitive premises, an Influencing Factor (IF) is included in the assigned noise levels. The IF depends on the presence of major/minor roads and commercial/industrial land use zonings within circles of 100 metres and 450 metres radius from the noise receiver.

For noise sensitive residences, the time of day also affects the assigned levels. The regulations define three types of assigned noise level:

- L_{ASMAX} means an assigned level that is not to be exceeded at any time;
- L_{AS1} means an assigned level that is not to be exceeded for more than 1% of time;
- L_{AS10} means an assigned level that is not to be exceeded for more than 10% of time.

The applicable assigned noise level for continuous noise emissions, such as the SIGMC mining operation, is the L_{A10} parameter. Therefore, the LA10 will be the focus of this assessment.

The assigned noise levels for noise sensitive premises are summarised in Table A1. The influencing factor for all receivers is 0 (as previously calculated). Therefore the assigned levels in Table A 1 are applicable.

Table A 1 Assigned Noise Levels as defined in the Environmental Protection (Noise) Regulations

Type of receiver	Time of Day	LAS10	LAS1	LASMAX
Noise sensitive premises	07:00-19:00	**45** +IF	55 +IF	65 +IF
	19:00-22:00	**40** +IF	50 +IF	55 +IF
	22:00-07:00[8]	**35** +IF	45 +IF	55 +IF

Noise levels at the receiver are subject to penalty corrections (5 dB to 15 dB) if the noise exhibits intrusive or dominant characteristics, i.e. if the noise is impulsive, tonal, or modulating. Regulation 9 sets out objective tests to assess whether the noise is taken to be free of these characteristics.

Noise levels at the receiver are subject to penalty corrections (5 dB to 15 dB) if the noise exhibits intrusive or dominant characteristics, i.e. if the noise is impulsive, tonal, or modulating.

Appendix A1 Intrusive or Dominant Noise Characteristics (Regulation 9)

Noise emitted from any premises (e.g. the mine site), when received at another premises (e.g. the sensitive receiver), must be free of tonality, impulsiveness and modulating characteristics. These are described below.

[8] 22:00-07:00 hours Monday to Saturday and 22:00-09:00 Sundays and Public Holidays.

Tonality

Tonality is the presence of tonal characteristics where the difference between —

a. the A-weighted sound pressure level in any one-third octave band; and
b. the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

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

Impulsiveness

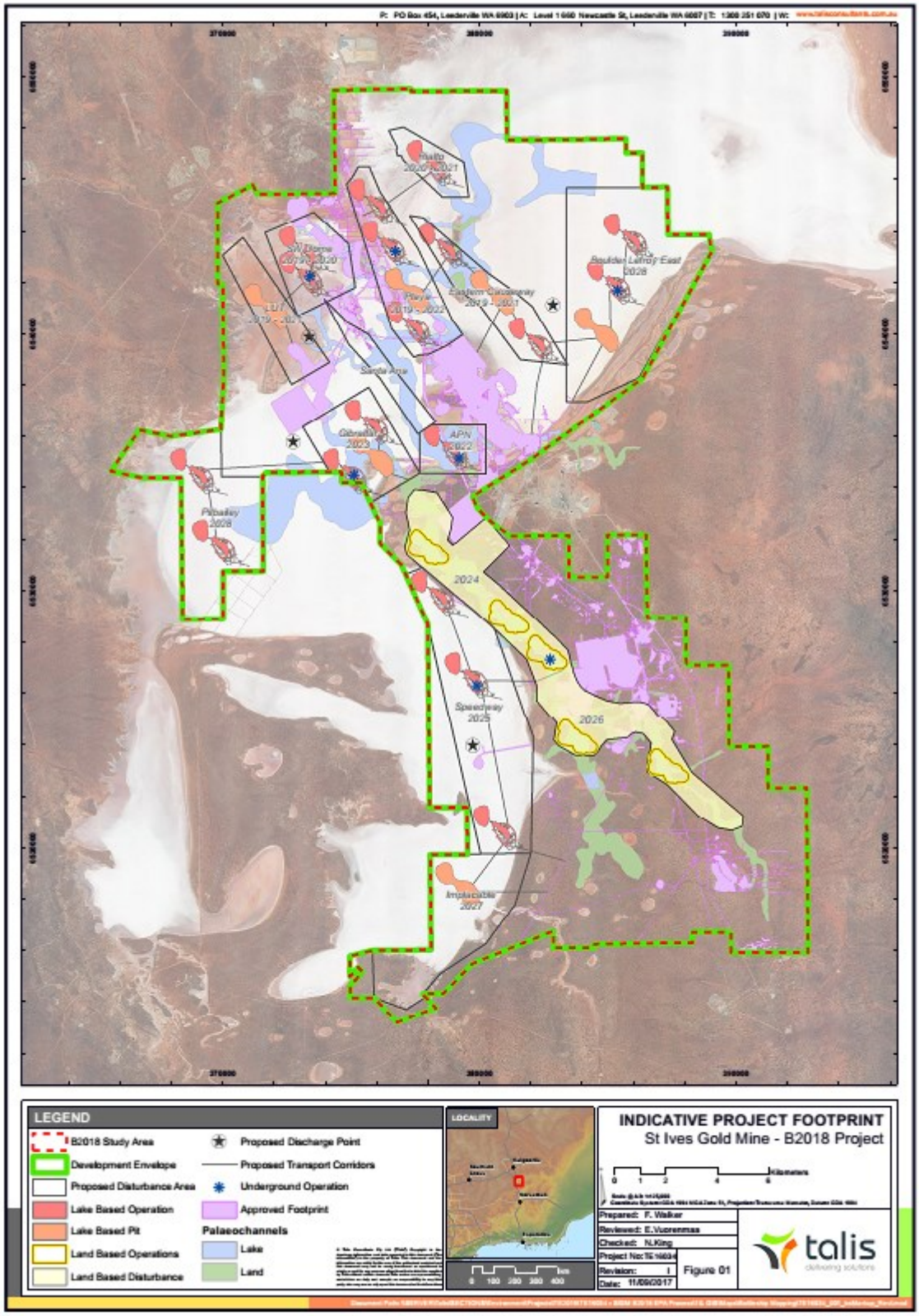
Impulsiveness means a variation in the emission of a noise where the difference between $L_{A\ peak}$ and $L_{A\ Slow\ max}$ is more than 15 dB when determined for a single representative event.

Modulation

Modulation means a variation in the emission of noise that —

c. is more than 3 dB $L_{A\ Fast}$ or is more than 3 dB $L_{A\ Fast}$ in any one-third octave band; and
d. is present for at least 10% of the representative assessment period; and
e. is regular, cyclic and audible.

Appendix B **B2018 Project Area**



Appendix C **Equipment Noise Source Levels (SWL's)**

Item	O/A	31.5hz	63hz	125hz	250hz	500hz	1k	2k	4k	8k
Haul Truck (CAT 785 operational)	**119.7**	68.8	92.6	102.8	110.8	115.2	114.0	112.7	104.0	91.9
Haul Truck (CAT 789 operational)	**118.3**	82.8	97.4	106.9	109.4	115.7	109.7	107.3	97.4	81.3
Haul Truck (CAT 789 idle)	**107.1**	74.5	94.8	91.8	93.3	100.7	103.0	100.2	93.0	79.9
Grader (CAT 16M)	**107.2**	59.3	77.2	94.3	97.6	100.7	101.7	101.3	95.0	83.1
Excavator (Hitachi EX3600)	**122.7**	79.5	92.8	105.8	113.3	117.7	118.0	115.2	108.0	97.9
Water Cart (CAT 773)	**116.9**	75.2	81.6	106.4	106.0	109.4	110.9	112.2	103.9	91.2
Dozer (CAT D10T)	**119.2**	68.0	85.3	95.0	103.2	110.4	115.4	114.2	109.1	100.5
Dozer (CAT D7)	**116.2**	65.0	82.3	92.0	100.2	107.4	112.4	111.2	106.1	97.5
Lighting Tower	**96.5**	62.8	77.4	89.3	87.1	88.1	90.0	90.0	84.7	77.3
Service Truck (Isuzu)	**101.5**	67.8	82.4	94.3	92.1	93.1	95.0	95.0	89.7	82.3
Tool Carrier (CAT 972H)	**101.5**	67.8	82.4	94.3	92.1	93.1	95.0	95.0	89.7	82.3
Tyre Handler (CAT 988)	**101.5**	67.8	82.4	94.3	92.1	93.1	95.0	95.0	89.7	82.3
Water Cart (CAT 773)	**116.9**	75.2	81.6	106.4	106.0	109.4	110.9	112.2	103.9	91.2

Appendix D **Top Contributing Equipment Items**

Table D 1 presents the top noise contributing equipment to received levels at Kambalda East. Although the model predictions comply with the assigned levels, the top contributing items provide an indication of equipment items most likely to impact the community.

As can be seen in the table, equipment that operates in the waste dump (i.e. north of the pit) will have the highest impact on the community.

Table D 1 Equipment Contribution List at Kambalda East

Rank	Equipment	Located	Received Noise Level in dB(A)
1	Track Dozer - Cat D10T	Waste SW Dome 2	27.2
2	Hitachi EX2600 Excavator	Pit SW Dome 1	19.8
3	Dump Truck - Cat 789 (Idle)	Waste SW Dome 1	18.1
4	Hitachi EX2600 Excavator	Pit SW Dome 1	16.4
5	Dump Truck - Cat 789 (operational)	Pit SW Dome 1	15.6
6	Hitachi EX2600 Excavator	Pit SW Dome 2	14.2
7	Dump Truck - Cat 785 (operational)	Pit SW Dome 1	12
8	Dump Truck - Cat 789 (operational)	Pit SW Dome 2	12
9	Track Dozer - Cat D10T	Pit SW Dome 1	11.8
10	Haul Road	Road SW Dome 1	9.5

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