

# NOISE IMPACT ASSESSMENT

## Goschen Rare Earths and Mineral Sands Project

**Prepared for:**

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## DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
640.30299.00200-R02-v1.0	15 September 2023	Benjamin French Gustaf Reutersward Jim Antonopoulos	Adrian White	Adrian White

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## EXECUTIVE SUMMARY

### Overview

This technical report is an attachment to VHM Limited's Goschen Rare Earth and Mineral Sands Project (the Project) Environment Effects Statement (EES). It has been used to inform the EES required for the Project.

### Existing environment

The Project is located in relatively flat farming land that is used predominantly for cropping with several rural residences surrounding the Project area. In the vicinity of the pumping station next to Kangaroo Lake the flat land is used for agriculture as well as recreation and tourism purposes, with residences mainly on the west and northern shores of the lake,

The existing noise environment in the Project area is typical of rural farming area, with background noise levels being generally low and determined by non-anthropogenic sources such as wind and insects. However, at some locations the existing noise environment would feature noise generated by farming activity and equipment (e.g. tractors, harvesters, grain trucks etc.) for periods during the year. On the shores of Kangaroo Lake the noise environment would also feature occasional noise from recreational boating.

A background noise monitoring programme was completed at four locations around the Project area over a period of approximately four weeks in October 2018. No monitoring was completed in the vicinity of Kangaroo Lake.

The ambient vibration environment in the Project site area is anticipated to be very low, below the threshold of perception, with only occasional and very localised vibration being generated by vehicular movement, farming or domestic related activity.

### Impact assessment findings

Evaluation of noise impacts on noise sensitive areas and natural areas was undertaken in accordance with the requirements of the Environment Protection Act 2017 (EP Act) and subordinate legislation. Evaluation of noise impacts first considered General Environmental Duty (GED) requirements, and once all noise sources had been eliminated or reduced so far as reasonably practicable, residual noise impacts were assessed against established criteria.

Noise impacts from sources controlled by the Regulations were assessed against the Noise Protocol and relevant guidelines. Other noise impacts were assessed against the Environment Reference Standard and relevant guidelines.

The assessment of residual noise impacts, once the principles of GED had been applied, found the following key impacts:

- Minimal construction phase impacts
- Operational phase impacts at two current receivers
- Minimal project traffic noise impacts

## EXECUTIVE SUMMARY

### Construction noise

- Construction phase noise emissions have been predicted, assessed and found to comply with the requirements of the *Civil construction, building and demolition guide*, (EPA Publication 1834). Construction activities will be limited to EPA normal working hours, with the exception of unavoidable works and low-noise impact works (if required).
- Predicted construction noise from the main project site is likely to be below ambient background noise levels at most receivers, with only a single receiver anticipated to receive construction noise at an elevated level, however, it is unlikely to result in adverse impact.
- Predicted noise from water pipeline construction activity is likely to be below ambient background noise levels at most receivers, with only a small number of receivers in the town of Mystic Park anticipated to receive construction noise at an elevated level. Two receivers are predicted to be exposed to noise levels exceeding 75 dBA and nine receivers between 60 dBA and 75 dBA. Since the work is short in duration (anticipated to be only a few days in Mystic Park) and occurs during EPA normal working hours, the level of impact is considered reasonable as long as impacts are appropriately controlled through the use of appropriate management measures, e.g. prior community consultation and notification is undertaken.
- Construction Works are to be completed under a Construction Environmental Management Plan (CEMP) incorporating a Noise Management Plan (NMP).

### Operational noise

- Operational phase noise emissions have been predicted and assessed to the requirements of the *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*, (EPA Publication 1826).
- During Area 1 mining operations (Year 1 to Year 8) a moderate exceedance (7-10 dBA) of the day period noise limit was predicted for receiver R14. It is understood that an agreement will be reached with receiver R14 for the duration of works in Area 1; it is unlikely to be considered a sensitive receiver should the Project proceed as the residents will be relocated whilst mine operations impact on the property. All other receivers will comply with day period noise limits.
- During Area 1 mining operations (Year 1 to Year 8) a moderate exceedance (4-5 dBA) of the night period noise limit was predicted at receivers R12 and R13. It is anticipated that compliance can be achieved by a combination of applying:
  - addition of specialist engineered noise suppression kits to haul fleet vehicles (see below),
  - higher levels of noise suppression on the processing plant building,
  - restricting mining activities to below ground pits only during the night.

The viability of these solutions will be evaluated during detailed design.

- During Area 3 mining operations the house denoted as R9 will be used as a project operations office and therefore not considered a sensitive receiver. Mining in the northernmost cells of Area 3 (Year 11) is closest to receiver R7 which is predicted to comply with day period noise limits. Subsequent mining in Area 3 (Year 15) is sequenced for cells further from R7 and it is anticipated to comply with day, evening and night period noise limits once more detailed evaluation is completed.

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## EXECUTIVE SUMMARY

- Noise modelling has considered the presence of low frequency noise levels. Whilst there are limitations associated with modelling low frequency noise impacts, receivers R3, R12 and R14 may be exposed to low frequency noise over the Project's life.
- The haul and mining mobile plant were identified as dominant noise sources for all receivers at some stage of the mine's life. A further contingency mitigation may be considered for the mobile plant (haul trucks, excavators, scrapers, dozers, etc) and includes specialist engineered noise reduction kits, where local screening is not feasible. Typically, noise suppression kits from specialist providers such as Hushpak, Mintek etc. include upgraded exhaust mufflers, acoustic louvred fan packages and acoustic treatment to engine compartments and air inlet plenums. The addition of noise suppression kits typically results in an overall reduction of approximately 5-10 dBA from the standard model. The additional cost of such engineered noise reduction kits is quite significant and hence the need for and type and extent of mitigation is best considered a contingency measure and evaluated in more detail once there is greater clarity of the operations.
- Noise from the pumping station at Kangaroo Lake is predicted to comply with the noise limits at all nearest receivers for all time periods.
- Review of potential cumulative noise impacts from operational and construction stage works (during the early mining stage where construction of the processing plant may occur concurrently) indicated negligible impacts. Cumulative noise from operational noise with existing sources of industry noise in the general project area and surrounds was also considered and is expected to be negligible, however, potential cumulative noise was identified in relation to the Kangaroo Lake pumping station which will be constructed near existing pumps. It is recommended that the enclosure of the new pumping station is designed to ensure cumulative noise from both sources complies with the noise protocol noise limits and achieves the relevant low frequency noise criteria. This will need to be evaluated in more detail during the detailed design phase.

### Road traffic noise

- There are no statutory requirements in Victoria with respect to project related traffic that is travelling on a public road. Notwithstanding the above, the relevant ERS environmental values, indicators and objectives have been referenced for informative purposes to evaluate potential for impacts and it has been determined that they are unlikely to be compromised by project traffic.

### Mitigation and contingency measures

Potential impacts on noise due to the Project would be avoided, minimised or managed to required standards through the recommended mitigation measures.

A number of key mitigations have been assumed in the Project design, including:

- Minimising truck haulage in Area 1 and between Area 3 and the processing plant by piping a slurry between the MUP and the processing plant.
- For mining block operations closer to sensitive receivers, mining will be limited to day period only, reducing the potential noise impact on these receivers during periods that people are more sensitive to noise.

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## EXECUTIVE SUMMARY

- The haul fleet will have upgraded exhaust silencers (e.g. Humex, Mammoth etc.) fitted to all haul fleet vehicles, which will have the benefit of reducing overall haul truck noise emissions by approximately 3 dB compared to standard, and reducing low frequency noise even further.
- The main power plant is anticipated to be operating continuously 24/7 and represents a significant potential source of noise emissions. The Project shall incorporate the highest levels of noise control for the power station including, placing all gensets in acoustic enclosures and containing all gensets within a generator building, use of high-performance exhaust mufflers and low noise cooling radiators. The objective is to reduce power station noise as far as reasonably practicable.
- The pumping station will be specified with an appropriate acoustic enclosure, and allow for consideration of cumulative noise from existing pumps in the Kangaroo Lake area.
- Construction phase impacts will be mitigated by limiting the construction to EPA normal working hours and ensuring prior community consultation and notification occurs.

Operations phase impacts will be mitigated by:

- Employing best practice noise management, and
- Removing receiver R9 by utilising this location as a site administrative office whilst mining Area 3.
- Removing receiver R14 by acquisition of the property, relocating the residents for the duration of mining in Area 1.
- Restricting mining activities to below ground pits only during the night where necessary.
- Consider implementing contingency mitigation for mobile mining plant in the form of engineered noise suppression kits, which typically include upgraded exhaust mufflers, acoustic louvred fan packages and acoustic treatment to engine compartments, to specific items of plant. The addition of noise suppression kits to typical mobile plant such as excavators, scrapers, haul trucks and dozers would typically result in an overall reduction of approximately 5-10 dBA from the standard model.
- The risks of low frequency noise impacts are controlled by elimination (eliminate low frequency noise emissions through regular maintenance), engineering controls (high performance silencers and enclosures to power plant building) and administrative controls (limiting certain activities and mining locations to day periods only).

## CONTENTS

<b>1</b>	<b>INTRODUCTION .....</b>	<b>16</b>
1.1	Requirement for an EES .....	16
<b>2</b>	<b>PROJECT DESCRIPTION .....</b>	<b>17</b>
2.1	Project Overview.....	17
2.2	Project Development .....	18
2.3	Key Project Components .....	19
2.3.1	Shift times .....	23
<b>3</b>	<b>SCOPING .....</b>	<b>24</b>
3.1	EES Evaluation Objectives and Scoping Requirements.....	24
<b>4</b>	<b>EVALUATION FRAMEWORK .....</b>	<b>26</b>
4.1	Legislation, Policy, Guidelines and Standards.....	26
4.2	General Environmental Duty .....	29
4.3	Regulated Noise Criteria .....	29
4.3.1	Environment Protection Act 2017 .....	30
4.3.2	Environment Protection Regulations and Noise Protocol 2021 .....	30
4.3.3	Low Frequency Noise Guidelines.....	32
4.4	Non-Regulated Noise Criteria .....	34
4.4.1	Environment Reference Standard .....	34
4.4.2	Construction Noise Guidelines .....	38
4.4.3	Project Related Traffic Noise .....	39
4.5	Application Hierarchy of Noise Criteria .....	39
<b>5</b>	<b>CONSULTATION AND ENGAGEMENT .....</b>	<b>41</b>
<b>6</b>	<b>METHODOLOGY .....</b>	<b>42</b>
6.1	Overview of Assessment Method.....	42
6.2	Study Area.....	43
6.3	Existing Environment .....	44
6.4	Avoidance and Minimisation .....	44
6.5	Risk Assessment.....	45
6.6	Impact Assessment .....	45
6.6.1	Assessment Methodology .....	46
6.6.2	Construction Noise Modelling .....	47
6.6.2.1	Equipment Noise Levels - Construction.....	47
6.6.3	Operations Noise Modelling.....	48
6.6.3.1	Mining Scenarios .....	48

## CONTENTS

6.6.3.2	Noise Sources - Operations .....	50
6.6.3.3	Power Station .....	51
6.6.3.4	Haul Fleet .....	52
6.6.4	Kangaroo Lake Pumping Station .....	52
6.6.5	Project Related Traffic .....	54
6.7	Limitations, Uncertainties and Assumptions .....	56
6.7.1	Baseline Ambient Noise Levels .....	56
6.7.2	Noise Prediction Model .....	56
6.7.3	Meteorological Conditions .....	56
6.7.4	Equipment Noise Emissions .....	56
<b>7</b>	<b>EXISTING ENVIRONMENT .....</b>	<b>57</b>
7.1	Local Setting .....	57
7.2	Sensitive Receivers .....	57
7.3	Topography .....	62
7.4	Background Noise Levels .....	63
7.4.1	Background Noise Level Assessment .....	65
7.5	Background Vibration .....	65
<b>8</b>	<b>RISK ASSESSMENT .....</b>	<b>66</b>
<b>9</b>	<b>CONSTRUCTION IMPACT ASSESSMENT .....</b>	<b>67</b>
9.1	Construction Scenarios .....	67
9.1.1	Processing Plant .....	67
9.1.2	Water Pipeline .....	67
9.2	Construction Modelling Results .....	69
9.3	Processing Plant .....	69
9.3.1	Regulated Noise Impacts .....	69
9.3.2	Non-regulated Noise Impacts .....	69
9.4	Water Pipeline Construction .....	72
9.4.1	Regulated Noise Impacts .....	72
9.4.2	Non-regulated Noise Impacts .....	72
<b>10</b>	<b>OPERATIONAL IMPACT ASSESSMENT .....</b>	<b>77</b>
10.1	Scenario 1 – Area1 Y1Q1 .....	77
10.1.1	Regulated Noise Impacts .....	77
10.1.2	Non-Regulated Noise Impacts .....	80
10.2	Scenario 2 – Area1 Y6Q2 .....	81
10.2.1	Regulated Noise Impacts .....	81



## CONTENTS

10.2.2	Non-regulated Noise Impacts .....	84
10.3	Scenario 3 – Area3 Y11Q3 .....	86
10.3.1	Regulated Noise Impacts .....	86
10.3.2	Non-Regulated Noise Impacts .....	88
10.4	Scenario 4 – Area3 Y15Q2 .....	88
10.4.1	Regulated Noise Impacts .....	88
10.4.2	Non-regulated Noise Impacts .....	90
10.5	Pumping Station - Kangaroo Lake .....	92
10.5.1	Regulated Noise Impacts .....	92
10.5.2	Non-regulated Noise Impacts .....	94
10.6	Summary of Residual Impacts .....	95
10.7	Project Related Traffic Noise .....	96
<b>11</b>	<b>CLOSURE PHASE IMPACT ASSESSMENT .....</b>	<b>98</b>
<b>12</b>	<b>CUMULATIVE IMPACTS .....</b>	<b>98</b>
12.1	Construction and Operational Stage Cumulative Impacts.....	98
12.2	Cumulative Impacts with existing industry .....	99
<b>13</b>	<b>SUMMARY OF MITIGATION, MONITORING AND CONTINGENCY MEASURES .....</b>	<b>101</b>
13.1	Mitigation Measures.....	101
13.2	Monitoring and Contingency Measures .....	103
<b>14</b>	<b>SUMMARY OF IMPLICATIONS UNDER RELEVANT LEGISLATION .....</b>	<b>106</b>
14.1	Commonwealth .....	106
14.2	Victorian.....	106
<b>15</b>	<b>CONCLUSION.....</b>	<b>108</b>
<b>17</b>	<b>REFERENCES .....</b>	<b>112</b>

## DOCUMENT REFERENCES

### TABLES

Table 1	Scoping Requirements Relevant to Noise .....	24
Table 2	Legislation, Policy, Guidelines and Standards Relevant to the Assessment .....	26
Table 3	Definitions of Day, Evening and Night (Environmental Protection Regulations 2021) .....	31
Table 4	Definition of Noise Limits (Noise Protocol) .....	31
Table 5	Mine, Quarry and Landfill Variations .....	32

## CONTENTS

Table 6	Outdoor one-third octave low frequency noise threshold levels from 10 Hz to 160 Hz.....	33
Table 7	ERS environmental values relating to the ambient sound environment.....	34
Table 8	Land use categories for the ambient sound environment.....	35
Table 9	Indicators and objectives for the ambient sound environment .....	36
Table 10	EPA Publication 1834 construction noise guidelines .....	38
Table 11	Noise evaluation criteria .....	40
Table 12	Stakeholder Engagement Undertaken for Noise .....	41
Table 13	Construction Noise Modelling Scenarios .....	47
Table 14	Scenario 1: Processing Plant: Earthworks Sound Power Levels.....	47
Table 15	Scenario 2: Processing Plant: Building Sound Power Levels .....	48
Table 16	Scenario 3: Pipelaying Sound Power Levels .....	48
Table 17	Noise Modelling Scenarios.....	49
Table 18	Sound Power Level Summary.....	51
Table 19	Kangaroo Lake Pump Station Noise Sources.....	54
Table 20	Daily Vehicle Movements.....	55
Table 21	Identified Nearest Sensitive Receivers Within 5 km of the Facility .....	58
Table 22	Identified Sensitive Receivers Within 800 m of Kangaroo Lake Water Pipeline.....	60
Table 23	Monitoring Locations .....	65
Table 24	Measured Background Noise Levels (based on L90, 1 hr) .....	65
Table 25	Noise Protocol Noise Limits (Leq, 30 min) .....	65
Table 26	Noise Risks.....	66
Table 27	Processing Plant Construction Noise Results .....	69
Table 28	Processing Plant Construction Predicted Noise Levels (non-regulated).....	71
Table 29	Water Pipeline Construction – Predicted Noise Levels (natural areas) .....	74
Table 30	Noise Model Results (dBA) - Scenario 1 - Area 1 Y1Q1.....	78
Table 31	Scenario 1 – Predicted Noise Levels (non-regulated) .....	80
Table 32	Noise Model Results (dBA) - Scenario 2 - Area 1 Y6Q2.....	82
Table 33	Noise Model Results (dBA) - Scenario 2 - Area 1 Y6Q2 incl. Noise Bund .....	83
Table 34	Scenario 2 – Predicted Noise Levels (non-regulated) .....	84
Table 35	Noise Model Results (dBA) - Scenario 3 - Y11Q3 .....	87
Table 36	Scenario 3 – Predicted Noise Levels (non-regulated) .....	88
Table 37	Noise Model Results (dBA) - Scenario 4 - Area 3 Y15Q2.....	89
Table 38	Scenario 3 – Predicted Noise Levels (non-regulated) .....	91
Table 39	Noise Model Results (dBA) - Scenario 5 – Pumping Station .....	92
Table 40	Kangaroo Lake Pump Station – Predicted Noise Levels (non-regulated).....	94
Table 41	Predicted Project Traffic Noise Levels.....	96
Table 42	Cumulative Noise Assessment – Construction of Processing Plant and Y1Q1 of Operations.....	98
Table 43	Mitigation Measures Relevant to Noise.....	101
Table 44	Monitoring and Contingency Measures Relevant to Noise .....	104
Table 45	Key Processing Plant Buildings.....	2
Table 46	Processing Plant Equipment List .....	2
Table 47	Powerplant Equipment List.....	3
Table 48	Powerplant Building element Transmission Losses .....	3
Table 49	MUP Equipment List.....	4

## CONTENTS

Table 50	Mine Fleet Equipment List .....	4
Table 51	Stockpiles Equipment List .....	5
Table 52	Haul Routes Equipment List .....	5

## FIGURES

Figure 1	Project Location.....	17
Figure 2	Mitigation Hierarchy .....	19
Figure 3	Project Area 1.....	20
Figure 4	Project Area 3.....	21
Figure 5	Proposed Water Supply Pipeline Route .....	22
Figure 6	Overview of Assessment Framework.....	42
Figure 7	Cell Map – Area 1 Left, Area 3 Right. ....	48
Figure 8	Day Shift Only Mining Operations.....	50
Figure 9	Render of Proposed Power Station Layout .....	51
Figure 10	Kangaroo Lake Pump Station Proposed Layout .....	53
Figure 11	Kangaroo Lake Pump Station and Closest Sensitive Receivers .....	53
Figure 12	Traffic Routes: Years 1 to 8 (left) and Years 8 to 20 (right).....	54
Figure 13	Identified Nearest Sensitive Receivers to the Facility.....	59
Figure 14	Nearest Sensitive Receivers to the Pipeline.....	61
Figure 15	Regional Topography Surrounding the Project Site .....	62
Figure 16	Project Area, Monitoring Locations and Sensitive Receivers.....	64
Figure 17	Nearest Sensitive Receivers to the Pipeline Options .....	68
Figure 18	Processing Plant: Earthworks Noise Map.....	70
Figure 19	Processing Plant: Building Noise Map.....	71
Figure 20	Proposed Pipeline Noise Map .....	73
Figure 21	Alternative Route Pipeline Noise Map .....	73
Figure 22	Mystic Park Pipeline Noise Map Detail .....	76
Figure 23	Scenario 1: Y1Q1 Noise Map .....	78
Figure 24	Scenario 2 – Y6Q2 Noise Map .....	81
Figure 25	Scenario 2 – Y6Q2 Noise Map – with Noise Bund.....	83
Figure 26	Scenario 3 –Y11Q3 Noise Map.....	86
Figure 27	Scenario 4 Area 3 Y15Q2 Noise Map.....	89
Figure 28	Kangaroo Lake Pump Station Noise Map .....	93
Figure 29	Derivation of typical LFN spectrum.....	7
Figure 30	Example of extrapolated LFN spectra against EPA LFN Guidelines threshold levels.....	8

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## CONTENTS

### APPENDICES

- Appendix A Risk Register
- Appendix B Source Noise Levels
- Appendix C Baseline Noise Monitoring

## Abbreviations

Abbreviation	Full
m	Metre
m/s	Metres per second
MREC	Mixed rare earth carbonate
MSP	Mineral separation plant
Mt	Million tonnes
MUP	Mining unit plant
MVA	Mega volt amps
MW	Megawatt
NEPM	National Environment Protection Measures
NSW	New South Wales
OA	Overall A-weighted sound pressure level
PEM	Protocol for Environmental Management
Rd	Road
RNP	Road Noise Policy
St	Street
t	Tonne
UTM	Universal Transverse Mercator
VOC	Volatile organic compound
WCP	Wet concentrator plant
3d	3 dimensional
BoM	Bureau of Meteorology
DCCEEW	Department for Climate Change, Energy, the Environment and Water
EE Act	Environment Effects Act
EES	Environment Effects Statement
EPA	Environment Protection Authority Victoria
EPBC Act	Environment Protection and Biodiversity Conservation Act
FPP	Feed Preparation Plant
ft	Foot
GED	General environmental duty
GL	Giga litres
GMW	Goulburn Murray Water
HAL	hot acid leach
HMC	Heavy Mineral Concentrate
ISO	International Organization for Standardization

Abbreviation	Full
kg	Kilograms
kg/h	Kilograms per hour
km	Kilometre
kW	Kilowatt
LNG	Liquid Natural Gas
m	Metre
m/s	Metres per second
MREC	Mixed rare earth carbonate
MSP	Mineral separation plant
Mt	Million tonnes
MUP	Mining unit plant
MVA	Mega volt amps
MW	Megawatt
NEPM	National Environment Protection Measures
NSW	New South Wales
OA	Overall A-weighted sound pressure level
PEM	Protocol for Environmental Management
Rd	Road
RNP	Road Noise Policy
St	Street
t	Tonne
UTM	Universal Transverse Mercator
VOC	Volatile organic compound
WCP	Wet concentrator plant

## Glossary

Acoustic Descriptor	Description
L90	The noise level exceeded for 90 % of the measurement period. This is commonly referred to as the background noise level.
Leq	The equivalent continuous sound level. This is commonly referred to as the average noise level.
Leq, 16h	The equivalent continuous sound level over the period of 8 hours of night (6 am to 10 pm)
Leq, 1h	The equivalent continuous sound level over the period of 1 hour
Leq, 8h	The equivalent continuous sound level over the period of 8 hours of night (10 pm to 6 am)
Leq, 15h	The equivalent continuous sound level over the period of 8 hours of night (7 am to 10 pm)
Leq, 9h	The equivalent continuous sound level over the period of 9 hours of night (10 pm to 7 am)
Lmax	The maximum sound level
Lp	Sound Pressure Level
Lw	Sound Power Level
Rw+Ctr	Rw = weighted sound reduction index, Ctr is an (negative) adjustment value to account for low frequency performance
Hz	Hertz
dB	Decibel. The unit of sound level.
dBA	A-weighted decibel

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# 1 Introduction

This technical report is an attachment to VHM Limited's Goschen Rare Earth and Mineral Sands Project (the Project) Environment Effects Statement (EES). It has been used to inform the EES required for the Project.

## 1.1 Requirement for an EES

The Project was referred to the Minister for Planning to seek advice on the need for an EES under the Environment Effects Act 1978 (Vic) (EE Act).

On 10 October 2018, the Minister for Planning decided that an EES was required on the basis that the Project has the potential for a range of significant environmental effects.

On 19 December 2018 under delegated authority from the Minister for the Environment, the Department of the Environment and Energy, now referred to as the Department for Climate Change, Energy, the Environment and Water (DCCEEW), made a decision that the Project is a controlled action under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and would require assessment and a decision about whether approval should be given under the EPBC Act. DCCEEW also confirmed the Victorian Government's advice that the Project will be assessed under a bilateral agreement under the EE Act.

The EES allows stakeholders to understand the likely environmental impacts of the Project and how they are proposed to be managed. The Minister's assessment of the EES will also inform statutory decisions that need to be made on the Project.

The EES was developed in consultation with the community and stakeholders.



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## 2 Project Description

### 2.1 Project Overview

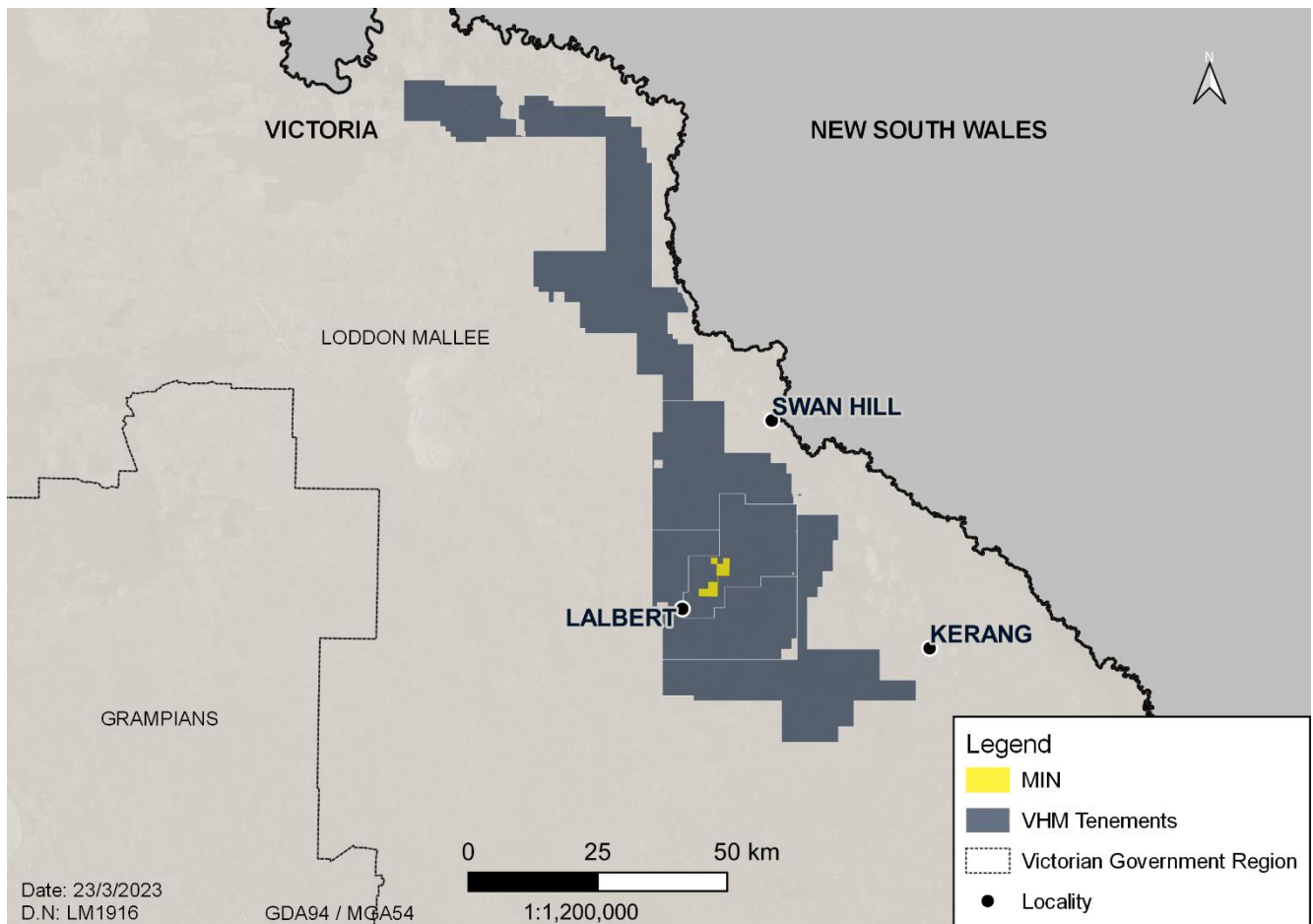
The Project is an approximately 20-25 year rare earth and mineral sands mine and processing facility. VHM has been developing the Project in the context of a rapidly growing global demand for rare earths. One of the world's largest, highest grade zircon, rutile and rare earth mineral deposits is in the Loddon Mallee region of Victoria in Australia. VHM intends to establish the Project to mine these deposits and process to produce and market a range of products to national and international consumers.

The mine footprint has been restricted to avoid intersection with groundwater and significant areas of remnant native vegetation. VHM will implement a staged development approach, initially developing phase 1 consisting of a mining unit plant (MUP), wet concentrator plant (WCP), rare earth mineral concentrate (REMC) flotation plant and a hydrometallurgical plant that will further refine the REMC that is produced at Goschen. The product suite for phase 1 consists of a zircon/titania heavy mineral concentrate (HMC) and mixed rare earth carbonate (MREC).

Phase 2 will commence approximately 2 years post-production and consist of an additional mineral separation plant (MSP) and, subject to prevailing market circumstances at that time, hot acid leach (HAL) and chrome removal circuit, that will produce additional products such as premium zircon, zircon concentrate, HiTi rutile, HiTi leucoxene, LoTi leucoxene, low chromium ilmenite.

The Project is located approximately 4 hours' drive (280 km) northwest of Melbourne and 30 minutes (35 km) south of Swan Hill within Gannawarra Shire, refer to **Figure 1**.

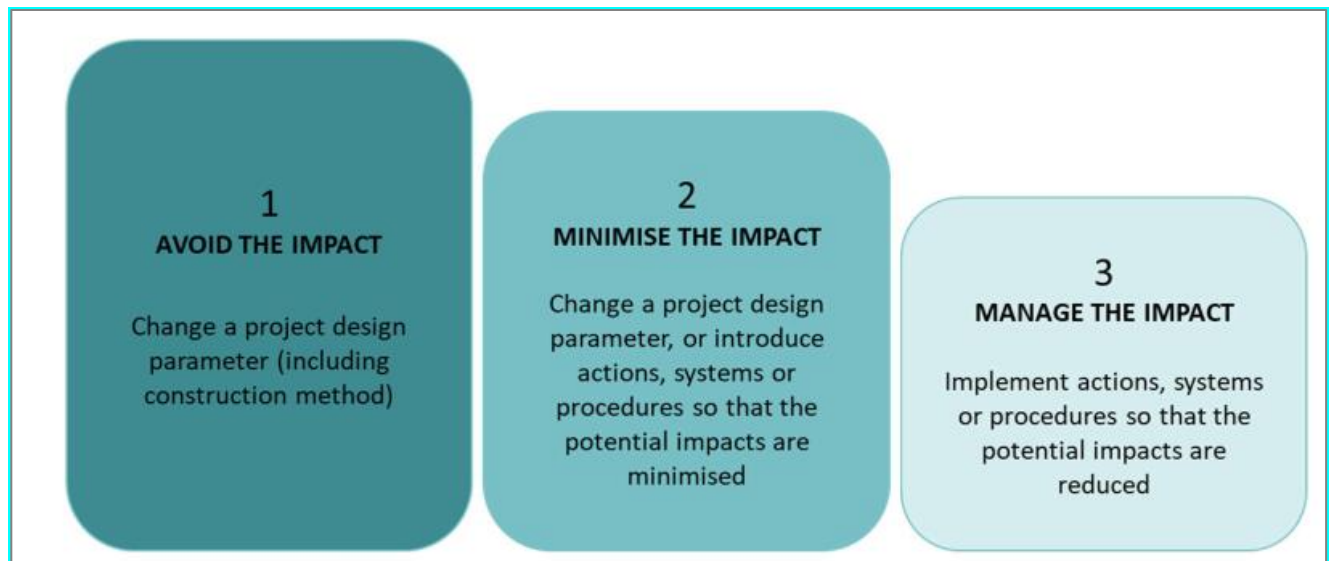
#### Figure 1 Project Location



## 2.2 Project Development

It is recognised that there are opportunities to avoid and minimise environmental impacts during the many stages of project development. During project inception and early design development stages of the Project, decisions on the location of the Project, its design and construction techniques have enabled impacts to be significantly avoided and minimised in accordance with the hierarchy presented in **Figure 2**.

**Figure 2 Mitigation Hierarchy**



Avoidance and minimisation of social and environmental impacts is central to the Project's decision making and as such, the Project will continue to be refined in response to technical requirements and potential environmental and social impacts identified during the development phase.

This process was considered in the preparation of a project description which is found at Chapter 4: Project description. A description of how avoidance of impact has informed the design in relation to noise can be found in **Section 6.4**.

Examples of this process being implemented include the decision to create vegetation protection zones within the Project (mining area), restricting mining operations to day period hours only to avoid noise related impacts to certain receivers, and restricting mining to depths above the water table to avoid impacts to the groundwater table.

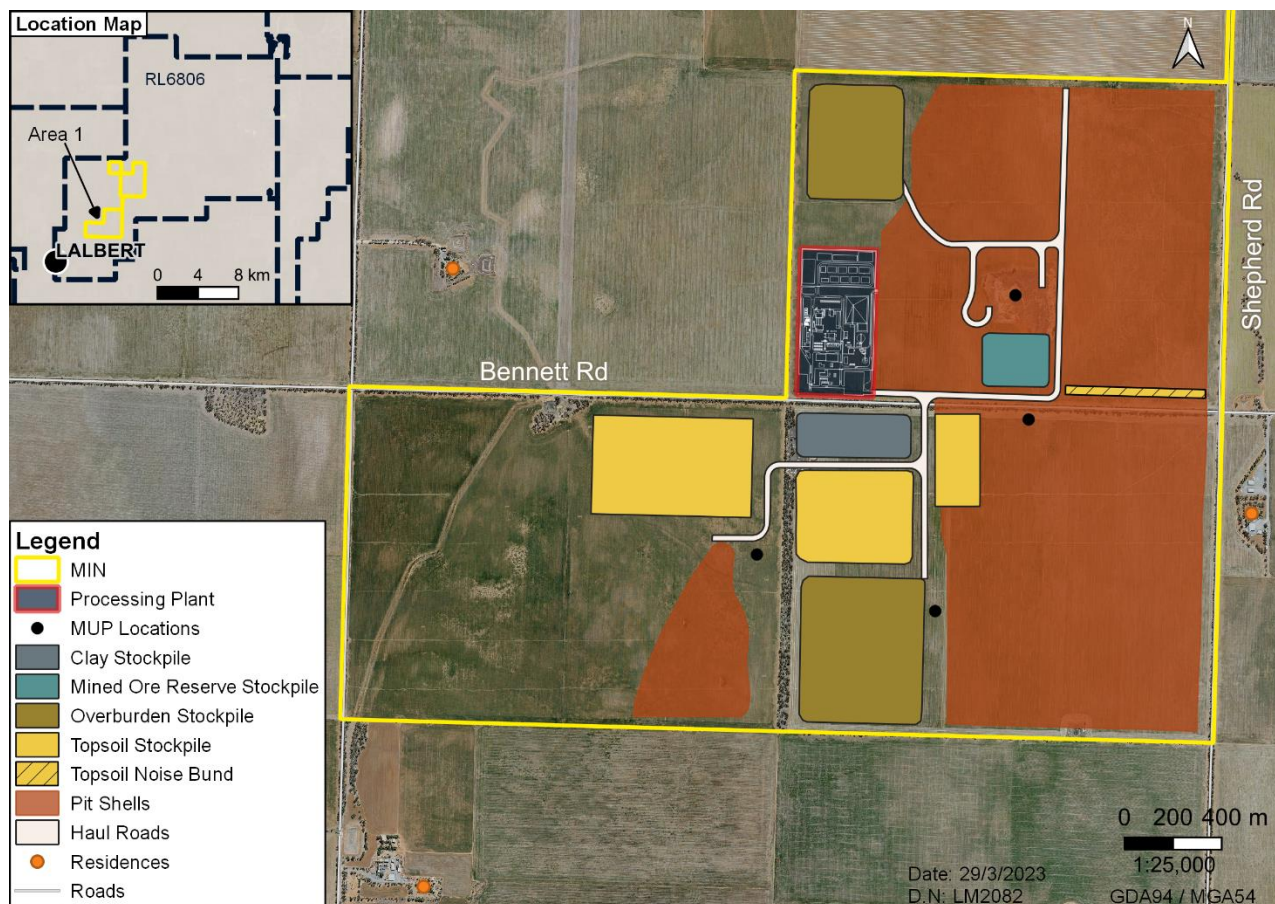
After opportunities to avoid impact were incorporated into the Project, minimisation and rehabilitation measures were developed. These are described in the construction and operation impact assessment sections below.

## 2.3 Key Project Components

The Project site consists of a heavy mineral sand mining and processing operation that will produce several HMCs and a range of critical rare earth minerals across two defined mining areas known as Area 1 and Area 3 (**Figure 3** and **Figure 4**).

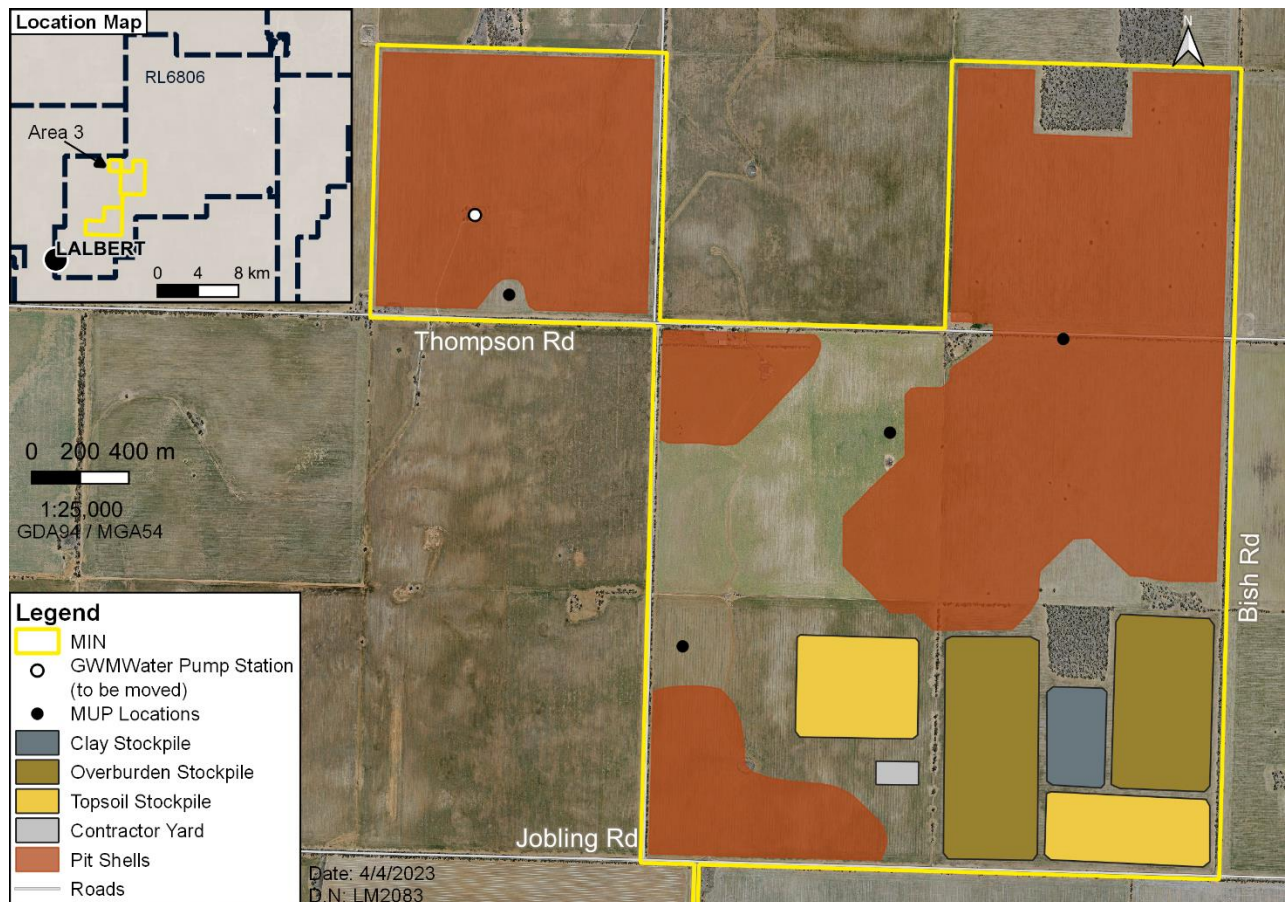
Conventional open pit mining equipment (truck and excavator) will be used for a strip-mining operation in Area 1 and Area 3. Mining will progress by blocks, each with a final floor footprint of approximately 250 m x 200 m. Topsoil and overburden will be stockpiled in waste dumps in the first instance. Ore will be transported by haul truck to the MUP where it will be turned into a slurry and piped to the processing plant. As the mining of the blocks continues, waste material (topsoil, overburden and tailings) from the initial mining voids will backfill the mined voids, reducing haulage and double handling. The stockpiled material on the surface will ultimately be rehandled to the final mine void. The land will then be rehabilitated to its original, or other approved, land use.

**Figure 3 Project Area 1**





**Figure 4 Project Area 3**



The key components that make up the Project are described below.

**Mining** – Mining will take approximately 20-25 years at 5 million tonnes (Mt) of ore produced per year and will occur only above groundwater (no dewatering) across approximately 1,479 hectares of farmland using conventional open cut mining methods of excavation, load, and haul.

**Processing** – Heavy mineral sands and rare earths ore will be separated via an on-site WCP and MSP to generate a MREC. Refining of the MREC on-site is limited to hydrometallurgical extraction to produce a mixed rare earth carbonate. Tailings from the various mineral processes will be homogenised and placed back into the ore zone earlier mined.

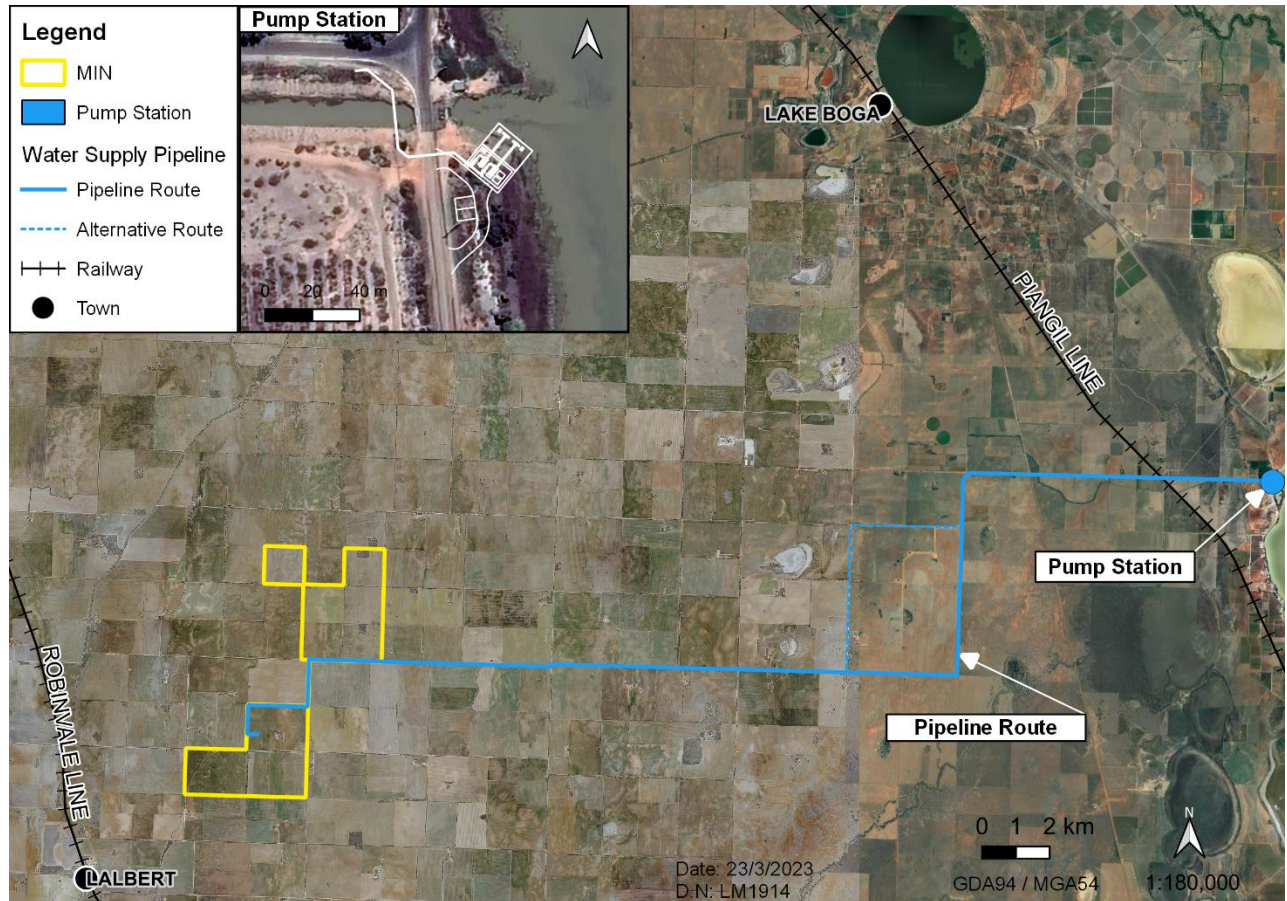
**Rehabilitation** – The mined areas will be progressively backfilled in a staged manner, with tailings dewatered in-pit to allow overburden and topsoil placement in a profile that reinstates the background soil structure. This will process of rehabilitation result in the ability for a return to the current agricultural land uses within 3 – 5 years.

**Power** – Electrical power needed for mining and processing will be produced on-site from dual fuel diesel/LNG fired power generators, with a gradual evolution over the life of mine to renewables, hydrogen and/or battery as technologies and commercial viability increase. Heat energy for the on-site gas fired appliances shall be provided from an extension of the distribution network from the main LNG storage and regasification system.

**Transport** – Final products shall be containerised in 20 ft sealed sea containers on site and exported via Melbourne Port using road and/or rail-based land logistics solutions. Ultima will provide intermodal rail solution, to reach the shipping export ports.

**Water** - Water will be required for construction earthworks, processing, dust suppression and rehabilitation. Up to 4.5 GL a year will be needed for the start-up of the Project. Water will be sourced from Goulburn Murray Water (GMW) from a new pumpstation at Kangaroo Lake via the open water market. A 38 km underground pipeline is proposed beneath existing local road easements as shown in **Figure 5**.

**Figure 5 Proposed Water Supply Pipeline Route**



### 2.3.1 Shift times

The proposed shift times for the Project are as follows:

#### **Construction**

- 7 am to 6 pm, with exceptions for 'unavoidable works' or 'low noise works'

#### **Operation**

- Single shift = Day shift only – 7 am to 6 pm
- Double shifts = Day shift – 6 am to 6 pm, Night shift – 6 pm to 6 am

## 3 Scoping

### 3.1 EES Evaluation Objectives and Scoping Requirements

The scoping requirements for the Goschen Mineral Sands and Rare Earths Project Environment Effects Statement, May 2019 ('scoping requirements') by the Minister for Planning, set out the specific environmental matters the Project must address in order to satisfy the Victorian assessment and approval requirements.

The scoping requirements include a set of evaluation objectives. These objectives identify the desired outcomes to be achieved in managing the potential impacts of constructing and operating the Project in accordance with the *Ministerial guidelines for assessment of environmental effects* under the EE Act.

The following evaluation objective is relevant to the acoustic assessment:

To protect the health and wellbeing of residents and local communities, and minimise effects on air quality, noise and the social amenity of the area, having regard to relevant limits, targets or standards.

A stated requirement of the Minister is for the EES to address the effects of the Project construction and operation on air quality and noise on nearby sensitive receivers (particularly residences).

The aspects from the scoping requirements relevant to the evaluation objective are shown in **Table 1** as well as the location where these items have been addressed in this report.

**Table 1 Scoping Requirements Relevant to Noise**

Aspect	Scoping Requirement	Section Addressed
Key Issues	The potential for risks to public health and safety and diminished social wellbeing at all stages of the Project due to a range of factors including but not limited to exposure to noise.	<b>Section 4.2</b> <b>Section 6.6</b> <b>Appendix A</b>
Existing Environment	Identify dwellings and any other potentially sensitive receivers (e.g. community centres, schools, recreation facilities and agricultural businesses) that could be affected by the Project's potential effects on noise levels.	<b>Section 7.2</b>
	Monitor and characterise background levels of noise in accordance with PEM requirements, including adjacent sensitive receivers and along potential transport routes	<b>Section 7.4</b>
Assessment of Likely Effects	Assess likely noise increases at sensitive receivers in the vicinity of the Project and along the proposed transport route.	<b>Section 8</b> <b>Section 9</b> <b>Section 10</b>



Aspect	Scoping Requirement	Section Addressed
Design and Mitigation Measures	Identify potential and proposed design responses and/or other mitigation measures in accordance with best management practice, to avoid, reduce and/or manage significant effects for sensitive receivers, during the Project construction, operation, decommissioning and post-closure stages, arising from noise.	<b>Section 6.4</b> <b>Section 13.1</b>
Approach to Manage Performance	Describe monitoring programs for potential effects on amenity, environmental quality, health and social wellbeing including a framework for identifying and responding to any emerging issues.	<b>Section 13.2</b>

## 4 Evaluation Framework

The assessment will consider legislation, policy and standards relevant to noise along with specific assessment criteria that have been derived for the purposes of the study.

### 4.1 Legislation, Policy, Guidelines and Standards

The legislation, policy, guidelines and standards relevant to this assessment are summarised in **Table 2**.

**Table 2 Legislation, Policy, Guidelines and Standards Relevant to the Assessment**

Document Title	Summary	Relevance to Project
<b>Commonwealth Government</b>		
<b>Victorian Government</b>		
<i>Environment Protection Act 2017</i> (Vic)	<p>The <i>Environment Protection Act 2017</i> (EP Act) as amended by the <i>Environment Protection Amendment Act 2018</i> (Victoria State Government, 2019), took effect on 1 July 2021.</p> <p>The Act gives EPA enhanced powers and tools to prevent and minimise the risks of harm to human health and the environment from pollution and waste and includes the general environmental duty (GED). The GED requires everyone, including businesses and individuals, conducting activities that pose a risk to human health or the environment from pollution or waste to understand those risks and take reasonably practicable steps to eliminate or minimise them.</p>	<p>Noise emissions from the Project have the potential to impact human health and the environment.</p> <p>The EP Act defines <u>unreasonable noise</u> due to factors such as volume, intensity, character, time or if it is prescribed to be <u>unreasonable noise</u>.</p> <p>GED is relevant to the Project requiring noise emissions that pose a risk to human health or the environment to be minimised as far as reasonably practicable.</p>
<i>Public Health and Wellbeing Act 2008</i> (Vic)	<p>The Public Health and Wellbeing Act (PHWA) aims to achieve the highest attainable standard of public health and wellbeing by:</p> <ul style="list-style-type: none"> <li>protecting public health and preventing disease, illness, injury, disability or premature death</li> <li>promoting conditions in which people can be healthy</li> <li>reducing inequalities in the state of public health and wellbeing.</li> </ul>	<p>The PHWA covers various types of nuisances, including noise, which are, or are liable to be, dangerous to health or offensive.</p> <p>In determining whether a nuisance is likely to be dangerous to health or offensive, regard:</p> <ul style="list-style-type: none"> <li>must not be had to the number of persons affected or that may be affected; and</li> <li>may be had to the degree of offensiveness.</li> </ul>

Document Title	Summary	Relevance to Project
<i>Environment Protection Regulations 2021 (Vic)</i>	<p>The <i>Environment Protection Regulations 2021</i> (Regulations) are to support the implementation of the <i>Environmental Protection Act 2017</i> by imposing obligations in relation to environmental protection, including noise.</p> <p>The Regulations took effect on 1 July 2021</p>	<p>The Regulations set out a noise framework for residential, commercial, industrial and trade premises, as well as entertainment venues and events.</p> <p>The framework defines; operating times (day, evening, night) and sets base noise limits.</p> <p>Noise emitted from commercial, industrial and trade premises is prescribed to be <u>unreasonable noise</u> if the effective noise level of the noise exceeds the noise limit, as determined in accordance with the Noise Protocol or has regard to a <u>prescribed factor</u>.</p> <p>Noise emitted from commercial, industrial and trade premises is prescribed to be <u>aggravated noise</u> if it exceeds:</p> <ul style="list-style-type: none"> <li>the lower of (i) 75 dBA, or (ii) the noise limit plus 15dB in the Day period</li> <li>the lower of (i) 70 dBA, or (ii) the noise limit plus 15dB in the Evening period</li> <li>the lower of (i) 65 dBA, or (ii) the noise limit plus 15dB in the Night period</li> </ul>
<i>Environment Reference Standard 2021 (Vic)</i>	<p>Under the <i>Environment Protection Act 2017</i>, the Environment Reference Standard (ERS) is to be used to assess and report on environmental conditions in the whole or any part of Victoria. It sets out indicators and objectives for the ambient sound environment.</p> <p>The ERS provides typical ambient (outdoor, free field) noise levels expected in different land use zones. It does not define noise limits nor design criteria.</p>	<p>The ERS sets out ambient noise indicators and objectives for land use categories.</p> <p>Indicators and objectives relevant to the land surrounding the Project area are:</p> <ul style="list-style-type: none"> <li><math>L_{eq, 8h}</math> (10 pm to 6 am) = 35 dBA</li> <li><math>L_{eq, 16h}</math> (6 am to 10 pm) = 40 dBA</li> </ul> <p>Indicators and objectives relevant to the natural areas of unique native habitat are qualitative and relate to a sound quality that is conducive to human tranquillity and enjoyment having regard to the ambient natural soundscape.</p>

Document Title	Summary	Relevance to Project
<i>Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues, EPA Publication 1826.4 (EPA Victoria, 2021)</i>	<p>This publication provides a protocol for the purpose of determining noise limits for new and existing commercial, industrial and trade premises and entertainment venues as defined by the Regulations.</p> <p>It sets the methodology for assessing the effective noise level to determine unreasonable noise under the Regulations.</p>	<p>The Noise Protocol sets out how to determine the following:</p> <ul style="list-style-type: none"> <li>• Noise limits</li> <li>• Background levels</li> <li>• Effective noise levels</li> </ul>
<i>Civil construction, building and demolition guide, EPA Publication 1834 (EPA Victoria, 2020)</i>	<p>This publication supports the civil construction, building and demolition industries to eliminate or reduce the risk of harm to human health and the environment through good environmental practice by minimising noise and vibration at all times.</p> <p>Chapter 4 addresses noise and vibration.</p>	<p>Provides recommendations for the management of construction noise, including a definition of 'normal working hours' and specific noise requirements for works conducted outside these time periods. It also provides definitions of Unavoidable and Managed-Impact Works that may be able to be conducted outside nEPA normal working hours without requiring compliance with the noise requirements, subject to implementation of reasonably practicable management measures.</p>
<i>Noise guidelines: Assessing low frequency noise, EPA Publication 1996 (Victorian EPA, 2021)</i>	<p>This guideline is for acoustic consultants and other qualified professionals who assess low frequency noise (10 Hz to 160 Hz)</p>	<p>Provides guidance for the consultants and EPA authorised officers to determine whether the emissions of low frequency noises from commercial, industrial and trade premises is unreasonable under Section 166 of the Environment Protection Act 2017.</p>
<i>Guide to the Environment Reference Standard, EPA Publication 1992 (Victorian EPA, 2021)</i>	<p>This guide provides information about how the ERS should be applied to support decision making, and how the environmental values, indicators and objectives for each element of the environment should be interpreted.</p>	<p>This guide is primarily for decision makers who need to consider the ERS. Decision makers can include Environment Protection Authority Victoria (EPA) officers, officers from other government authorities and departments, environmental auditors, and representatives from local government and planning authorities. The guide will also assist applicants of proposals for new developments, infrastructure or sites that may be assessed with reference to the ERS. It will also be of assistance to site owners, environmental managers and consultants.</p>

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## 4.2 General Environmental Duty

The general environmental duty (GED) is at the centre of the EP Act and it applies to all Victorians. GED states that a person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise those risks, so far as reasonably practicable.

The concept of minimising risks of harm to human health and the environment, so far as reasonably practicable, requires the person:

- to eliminate risks of harm to human health and the environment so far as reasonably practicable; and
- if it is not reasonably practicable to eliminate risks of harm to human health and the environment, to reduce those risks so far as reasonably practicable.

Under the Act, harm, in relation to human health or the environment, means an adverse effect on human health or the environment (of whatever degree or duration) and includes:

- an adverse effect on the amenity of a place or premises that unreasonably interferes with or is likely to unreasonably interfere with enjoyment of the place or premises; or
- a change to the condition of the environment so as to make it offensive to the senses of human beings; or
- anything prescribed to be harm for the purposes of the Act or the Regulations.

Harm may arise as a result of the cumulative effect of harm arising from an activity combined with harm arising from other activities or factors.

To determine what is (or was at a particular time) reasonably practicable in relation to the minimisation of risks of harm to human health and the environment, regard must be had to the following matters:

- the likelihood of those risks eventuating,
- the degree of harm that would result if those risks eventuated,
- what the person concerned knows, or ought reasonably to know, about the harm or risks of harm and any ways of eliminating or reducing those risks,
- the availability and suitability of ways to eliminate or reduce those risks,
- the cost of eliminating or reducing those risks.

In the assessment of noise impacts with reference to GED, consideration must first be given to eliminating risks so far as reasonably practicable, and then to reducing those risks so far as reasonably practicable.

## 4.3 Regulated Noise Criteria

Certain types of noise within Victoria are regulated. The following sections provide an overview of how regulated noise is assessed in Victoria.

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#### 4.3.1 Environment Protection Act 2017

In Victoria, the Environment Protection Act 2017 (EP Act), Part 7.6, Division 2 Section 166, prescribes that a person must not, from a place or premises that are not residential premises—

- emit an unreasonable noise; or
- permit an unreasonable noise to be emitted

Unreasonable noise is defined in the Act [Paragraph (a)(v) Section 3(1)] as noise that:

- is unreasonable having regard to the following—
  - its volume, intensity or duration
  - its character
  - the time, place and other circumstances in which it is emitted
  - how often it is emitted
  - any prescribed factors, or
- is prescribed to be unreasonable noise

For the purposes of the above definition, ‘frequency spectrum’ is a prescribed factor.

The EP Act, Part 7.6, Division 2 Section 168, prescribes that, noise emitted from commercial, industrial and trade premises is prescribed to be aggravated noise if:

- in the case of noise emitted during the day period, the effective noise level exceeds the lower of the following:
  - 75 dBA
  - the noise limit plus 15 dB, and
- in the case of noise emitted during the evening period, the effective noise level exceeds the lower of the following:
  - 70 dBA
  - the noise limit plus 15 dB, and
- in the case of noise emitted during the night period, the effective noise level exceeds the lower of the following—
  - 65 dBA
  - the noise limit plus 15 dB.

#### 4.3.2 Environment Protection Regulations and Noise Protocol 2021

In Victoria, noise from commercial, industrial and trade premises are subject to the provisions of the Environment Protection Regulations 2021 (the Regulations), and the “*Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*”, EPA Publication 1826.4 (the Noise Protocol).

The Noise Protocol presents the methodology for determining the noise limits above which noise is prescribed to be unreasonable. Noise sensitive areas are defined in the Regulations as that part of the land within the boundary of a parcel of land that is within 10 m of the outside of the external walls of a dwelling (homes, dormitories, hotels, hospitals, correctional facilities etc.), schools (including childcare centres) and tourist establishments in rural areas (campgrounds, caravan parks, etc.).

Assessment periods, provided by the Regulations are presented in **Table 3**.

**Table 3 Definitions of Day, Evening and Night (Environmental Protection Regulations 2021)**

Period	Day	Time
Day	Monday to Saturday (except public holidays)	7 am – 6 pm
Evening	Monday to Saturday Sunday and public holidays	6 pm – 10 pm 7 am – 10 pm
Night	Monday to Sunday	10 pm – 7 am

Noise limits for **earth resources premises** where the noise sensitive area is in a rural area (farming zone) are provided by the Noise Protocol as follows.

**Table 4 Definition of Noise Limits (Noise Protocol)**

Period	Noise limit is the greater of:	
	Earth Resource Level	Adjusted Background Level
Day	46 dBA	Day background + 8
Evening	41 dBA	Evening background + 5 dB
Night	36 dBA	Night background + 5 dB (but not greater than 55 dBA)

Background levels are measured as L90, dBA.

Noise is assessed over a 30-minute period during which the premises operate. The measured or predicted noise level is adjusted for duration, character (tonality, intermittency and impulsiveness) and measurement position (reflection, indoor) to determine the effective noise level for assessment against the noise limit.

The Noise Protocol provides for variations to the noise limits which may be applied to particular open-air activities at mines, quarries and landfills where there is significant open-air surface activity during site preparation, particular operational activities, or rehabilitation. These variations are detailed in **Table 5**.

**Table 5 Mine, Quarry and Landfill Variations**

Activity	Application of variations	Variations to noise limits
Installation of constructed noise control works	<p>The variation applies to the construction of structures that are specifically designed for a noise-control purpose, (such as walls or earth bunds) to meet the noise limits.</p> <p>The variation applies to noise control works to protect different noise sensitive areas at a later stage in the Project e.g. where extraction works take place in a different part of a large site.</p> <p>The variation does not include mining or quarrying works carried out during the Project that have a coincidental, secondary noise-control benefit e.g. general overburden stockpiling, or building construction or demolition.</p>	Noise from the activity may be exempted from noise limits during the day period.
Site clearing and preparation works	<p>The variation applies to vegetation removal, topsoil removal, subsoil removal, road construction and civil works such as site drainage where the activity will happen before acoustic mounds can feasibly be constructed.</p> <p>The variation does not apply to overburden removal.</p>	Noise from the activity may be exempted from noise limits during the day period.
Site rehabilitation	<p>The variation applies to progressive and final site rehabilitation, occurring at the final surface level.</p> <p>The variation does not apply to backfilling of a pit.</p>	During the day period, the noise limit may be increased by up to 10 decibels, to a maximum of 68 dBA.
Necessary unshielded work	The variation applies to waste dump extensions (at a mine or quarry) or tailings dam construction that is necessary but cannot practicably be shielded by barriers, landforms or natural topography	During the day period, the noise limit may be increased by up to 10 decibels, to a maximum of 68 dBA.

Whilst the Regulations and Noise Protocol establish noise limits that apply to noise emissions from a commercial, industrial or trade premises, the requirements of GED to eliminate or minimise the risks of harm to human health and the environment so far as reasonably practicable still apply independently of the Regulations and Noise Protocol.

#### 4.3.3 Low Frequency Noise Guidelines

EPA Publication 1996 *"Noise guidelines: Assessing low frequency noise"* (LFN Guidelines) provides guidance for acoustic consultants and other qualified professionals who assess low frequency noise (LFN).



Frequency spectrum is a prescribed factor under the EP Act and subordinate legislation. The assessment of frequency spectrum applies to noise from commercial, industrial and trade premises only.

Low frequency noise should be assessed by comparing its frequency spectrum to the relevant threshold levels. Specifically, Z-frequency weighted (unweighted or linear) measurements in one-third octave bands from 10 Hz to 160 Hz are compared with low frequency threshold levels.

The threshold levels are not set limits. Rather, they are levels that indicate a potential risk of problematic low frequency noise. The disturbance from low frequency noise depends on the:

- noise level,
- characteristics that can increase annoyance with the noise, for example, tonality, frequency modulation,
- baseline noise levels in the absence of the noise of concern.

**Table 6** provides outdoor noise threshold criterion to be used for outdoor measurements. The noise threshold level for outdoor low frequency is based on the assumed façade noise reductions given in Downey and Parnell (2017).

**Table 6 Outdoor one-third octave low frequency noise threshold levels from 10 Hz to 160 Hz**

Outdoor one-third octave low frequency noise threshold levels													
Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Leq (dB)	92	89	86	77	69	61	54	50	50	48	48	46	44

## 4.4 Non-Regulated Noise Criteria

Other sources of noise that are not assessed under the Regulations still require evaluation under the EP Act once the principles of GED have been applied. The following sections provide an overview of how ‘non-regulated’ noise is assessed in Victoria.

### 4.4.1 Environment Reference Standard

The Environment Reference Standard (ERS) is a new tool made under the EP Act. The ERS:

- identifies environmental values that the Victorian community want to achieve and maintain
- provides a way to assess those environmental values in locations across Victoria.

The ERS is made up of four main components in relation to ambient sound:

- **Environmental values:** These are the central parts of the ERS. An environmental value is a statement about a desired outcome for human health and the environment. For example, an ambient sound environment that supports child development and learning. Environmental values are the uses, attributes or functions of the environment that the Victorian community wants to achieve and maintain.
- **Areas of application:** The ERS defines the area or areas to which the environmental values, or specific indicators and objectives, apply. For example, most ambient sound indicators and objectives relate to specified land use planning zones.
- **Indicators:** These are usually defined in relation to each environmental value. The indicators are the parameters or markers used to assess whether environmental values are being achieved or maintained, or if they are threatened. For example ‘outdoor LAeq’ (‘outdoor LAeq,16h from 6 am to 10 pm’ or ‘outdoor LAeq,8h from 10 pm to 6 am’), which is a key indicator used for ambient sound (ERS Table 3.3).
- **Objectives:** These are the assessment benchmarks. An objective is the character, level, load, concentration or amount of an indicator used to assess whether an environmental value (or several environmental values) is being achieved, maintained or threatened. Most objectives are scientifically derived quantitative assessment levels or a prescribed scientific basis for assessment. For example, the ambient sound objective for ‘natural areas’ is ‘a sound quality that is conducive to human tranquillity and enjoyment having regard to the ambient natural soundscape’ (ERS Table 3.3).

**Table 7** presents the ERS environmental values relating to the ambient sound environment.

**Table 7 ERS environmental values relating to the ambient sound environment**

Environmental value	Description of environmental value
Sleep during the night	An ambient sound environment that supports sleep at night
Domestic and recreational activities	An ambient sound environment that supports recreational and domestic activities in a residential setting
Normal conversation	An ambient sound environment that allows for a normal conversation indoors without the need to raise voices

Environmental value	Description of environmental value
Child learning and development	An ambient sound environment that supports cognitive development and learning in children
Human tranquillity and enjoyment outdoors in natural areas	An ambient sound environment that allows for the appreciation and enjoyment of the environment for its natural condition and the restorative benefits of tranquil soundscapes in natural areas
Musical entertainment	An ambient sound environment that recognises the community's demand for a wide range of musical entertainment

For the purposes of 'areas of application' the ERS outlines a framework for assessing the ambient sound environment over a period of time based on the land use category of the area of assessment. **Table 8** presents the land use categories relating to the ambient sound environment.

**Table 8 Land use categories for the ambient sound environment**

Land use category	General description	Planning zones
Category I	An urban form with distinctive features or characteristics of taller buildings, high commercial and residential intensity and high site coverage.	Industrial Zone 1 (IN1Z) Industrial Zone 2 (IN2Z) Port Zone (PZ) Road 1 Zone (RDZ1) Capital City Zone (CCZ) Docklands Zone (DZ)
Category II	Medium rise building form with a strong urban or commercial character. Typically contains mixed land uses including activity centres and larger consolidated sites, and an active public realm.	Industrial Zone 3 (IN3Z) Commercial 1 Zone (C1Z) Commercial 2 Zone (C2Z) Commercial 3 Zone (C3Z) Activity Centre Zone (ACZ) Mixed Use Zone (MUZ) Road 2 Zone (RDZ2)
Category III	Lower rise building form including lower density residential development and detached housing typical of suburban residential settings or in towns of district or regional significance.	Residential Growth Zone (RGZ) General Residential Zone (GRZ) Neighbourhood Residential Zone (NRZ) Urban Floodway Zone (UFZ) Public Park and Recreation Zone (PPRZ) Urban Growth Zone (UGZ)

Land use category	General description	Planning zones
Category IV	Lower density or sparse populations with settlements that include smaller hamlets, villages and small towns that are generally unsuited for further expansion. Land uses include primary industry and farming.	Low Density Residential Zone (LDRZ) Township Zone (TZ) Rural Living Zone (RLZ) Green Wedge A Zone (GWAZ) Rural Conservation Zone (RCZ) Public Conservation and Resource Zone (PCRZ) Green Wedge Zone (GWZ) Farming Zone (FZ) Rural Activity Zone (RAZ)
Category V	Unique combinations of landscape, biodiversity and geodiversity. These natural areas typically provide undisturbed species habitat and enable people to see and interact with native vegetation and wildlife	Natural areas are classified as land within Category V irrespective of the planning zones that apply to that land. natural areas means national parks, state parks, state forests, nature conservation reserves, wildlife reserves and environmentally significant areas and landscapes outside metropolitan Melbourne that are identified in a planning scheme
Category I, II, III or IV depending on surrounding land uses and the intent of the specific planning zone (which may have a diversity of uses) as specified in a schedule to the planning zone		Comprehensive Development Zone (CDZ) Priority Development Zone (PDZ) Special Use Zone (SUZ) Public Use Zone (PUZ)

For the ambient sound environment, for each land use category, the ERS sets out indicators and objectives. The objectives for each land use category are typical ambient sound level values and are neither noise limits nor noise design criteria. **Table 9** presents the indicators and objectives relating to the ambient sound environment.

**Table 9 Indicators and objectives for the ambient sound environment**

Land use category	Indicators	Objectives
Category I	Outdoor LAeq,8h from 10 pm to 6 am	55 dBA
	Outdoor LAeq,16h from 6 am to 10 pm	60 dBA
Category II	Outdoor LAeq,8h from 10 pm to 6am	50 dBA
	Outdoor LAeq,16h from 6 am to 10 pm	55 dBA
Category III	Outdoor LAeq,8h from 10 pm to 6 am	40 dBA

Land use category	Indicators	Objectives
	Outdoor LAeq,16h from 6 am to 10 pm	50 dBA
Category IV	Outdoor LAeq,8h from 10 pm to 6 am	35 dBA
	Outdoor LAeq,16h from 6 am to 10 pm	40 dBA
Category V	Qualitative	A sound quality that is conducive to human tranquillity and enjoyment having regard to the ambient natural soundscape

Where non-regulated noise is generated as part of the Project, it will be evaluated against the ERS in accordance with the guidance provided in EPA Publication 1992: *"Guide to the Environment Reference Standard"*.

In relation to Category V natural areas, the ERS defines natural areas as national parks, state parks, state forests, nature conservation reserves and wildlife reserves. The ERS definition of natural areas also includes environmentally significant areas and landscapes outside metropolitan Melbourne that are identified in a planning scheme that refers to clause 12.05 of the Victoria Planning Provisions.

According to the Victorian Environmental Assessment Council (VEAC) and Victorian National Parks Association (VNPA) nature conservation reserves include:

- Flora & fauna reserve
- Wildlife reserves (no hunting)
- Flora reserves
- Nature conservation reserves

The identified natural areas near the Project that align with the above definitions are as follows:

- Koorangie Wildlife Reserve
- Yassom Swamp Flora and Fauna Reserve
- Bael Bael Grassland Nature Reserve
- Tutchewop Wildlife Reserve

In relation to the identified natural areas, while there are no quantitative indicators or objectives for Category V areas in the ERS, the Project noise has been compared to the averaged background level collected at the quietest of the noise logging locations to provide an indication of the likelihood of the noise to be audible. The measured averaged baseline background noise level for the day was 28 dBA (refer to **Section 7.4.1**).

Bushland reserves are not considered nature conservation reserves but 'natural features reserves'.

The following areas did not meet the ERS definitions nor are they identified in the planning scheme as environmentally significant areas and landscapes.

- Talgitcha Bushland Reserve
- Lalbert Recreation Reserve
- Mystic Park Bushland Reserve
- Forest Plantation East Road
- Adj. Kangaroo Lake and Murray Valley Highway

Given the location of these sites, and their zoning, it is considered appropriate to adopt ERS Category IV based indicators and objectives.

#### 4.4.2 Construction Noise Guidelines

The *Civil construction, building and demolition guide*, (EPA Publication 1834) of November 2020 replaced earlier documents EPA Publication 480 and relevant section of EPA Publication 1254.

EPA Publication 1834 adopts a primary mechanism of reducing noise and vibration impacts through limiting the times of operation of noisy equipment, vehicles and operations. Whilst EPA Publication 1834 does not establish objective noise goals or limits for works conducted during EPA normal working hours, it states that construction noise should be minimised as far as possible in any situation and that a noise impact assessment may be used to inform the risk assessment process for construction works and to inform plans for the management of noise generated during construction.

**Table 10** presents the construction noise guidelines.

**Table 10 EPA Publication 1834 construction noise guidelines**

Time of day	Construction noise guidelines
Normal working hours: 7 am – 6 pm Monday to Friday 7 am – 1 pm Saturday	Minimise as far as possible in any situation
Weekend/evening work hours: 6 pm – 10 pm Monday to Friday 1 pm – 10 pm Saturday 7 am – 10 pm Sunday and Public Holidays	Noise level at any residential premises not to exceed background noise (L90) by: <ul style="list-style-type: none"><li>• 10 dBA or more for up to 18 months</li><li>• 5 dBA or more after 18 months</li></ul>
Night period: 10 pm – 7 am Monday to Sunday	Noise inaudible within a habitable room of any residential premises

EPA Publication 1834 details that whilst projects should aim to constrain works to normal working hours, where necessary, works or activities outside normal working hours may occur for:

**Low-noise impact works** – these are inherently quiet or unobtrusive, for example, manual painting, internal fitouts, and cabling. Low-noise works do not have intrusive characteristics such as impulsive noise or tonal movement alarms.

**Managed-impact works** – works where the noise emissions are managed through actions specified in a noise and vibration management plan (may be part of a broader environmental management plan), to minimise impacts on sensitive receivers. Managed-impact works do not have intrusive characteristics such as impulsive noise or tonal movement alarms.

**Unavoidable works** – are works which pose an unacceptable risk to life or property or a major traffic hazard and can be justified. Includes an activity which has commenced but cannot be stopped. A project would need to demonstrate that planned unavoidable works cannot be reasonably moved to normal work hours. This requires additional consideration of potential noise and vibration generating activities and controls to minimise noise and vibration. These can be recorded within the noise and vibration management plan (may be part of a broader environmental management plan).

It is anticipated that most construction activities related to the Project will be able to be completed during EPA normal working hours, with the exception of unavoidable works (if required) and low-noise impact works.

#### 4.4.3 Project Related Traffic Noise

Project related traffic on the public road network is not considered by the Regulations or the Noise Protocol. Similarly, the VicRoads *Traffic Noise Reduction Policy* 2005 details noise limits for new or upgraded arterial roads and highways but has no provision within it to evaluate project related traffic noise.

Therefore the issue of project related traffic is evaluated as a non-regulated noise emission through the framework of the Environment Reference Standard (ERS) where the relevant environmental values (e.g. sleep during the night, domestic and recreational activities, normal conversation etc.) for the ambient sound environment are preserved for each land use category.

When considering the anticipated road network being used by the Project the relevant land-use (Category IV) has outdoor indicators and objectives of night-time  $L_{Aeq,8h}$  from 10 pm to 6 am of 35 dBA and a daytime  $L_{Aeq,16h}$  from 6 am to 10 pm of 40 dBA.

### 4.5 Application Hierarchy of Noise Criteria

The EP Act and subordinate legislation provides different assessment pathways for regulated and non-regulated noise. Whilst classifications of regulated and non-regulated noise are dependent on both the type of noise source and the type of receiver, the hierarchy for both classifications of noise adopts the following steps:

1. Apply GED and seek to eliminate risks of harm to human health and the environment so far as reasonably practicable. If it is not reasonably practicable to eliminate risks of harm to human health and the environment, then reduce those risks so far as reasonably practicable.
- 2a. Assess residual impacts against the Regulations (regulated noise) or the ERS (non-regulated noise).
- 2b. Assess residual impacts against relevant guidelines (both regulated and non-regulated noise).

**Table 11** presents the various types of noise sources and receivers identified for the Project, and the relevant noise criteria to assess them against.

**Table 11 Noise evaluation criteria**

Type of Noise Source	Type of Receiver	Type of noise	Criteria to evaluate impacts against
All	All	All	The EP Act and GED
Operational noise	Noise sensitive areas	Regulated	Noise Protocol and LFN Guidelines
Operational noise	Areas relating to human tranquillity and enjoyment outdoors in natural areas	Non-regulated	ERS
Construction noise relating to the Project	Noise sensitive areas	Non-regulated	ERS EPA Publication 1834
Construction noise relating to the Project	Areas relating to human tranquillity and enjoyment outdoors in natural areas	Non-regulated	ERS EPA Publication 1834
Off-site vehicle movements	Noise sensitive areas	Non-regulated	ERS



## 5 Consultation and engagement

Development of the Project and preparation of the EES have been informed by consultation with stakeholders and the community. **Table 12** lists specific community and stakeholder feedback on noise and how this feedback has been considered by the Project in this impact assessment.

**Table 12 Stakeholder Engagement Undertaken for Noise**

Community and Stakeholder Feedback	Consideration in Project Design or Impact Assessment
February 2019 SRG Meeting. General noise emission concerns raised by a number of nearby residents and that it needed to be managed.	Ensure project meets all relevant noise limits and apply the principles of GED by minimising noise as far as practicable.

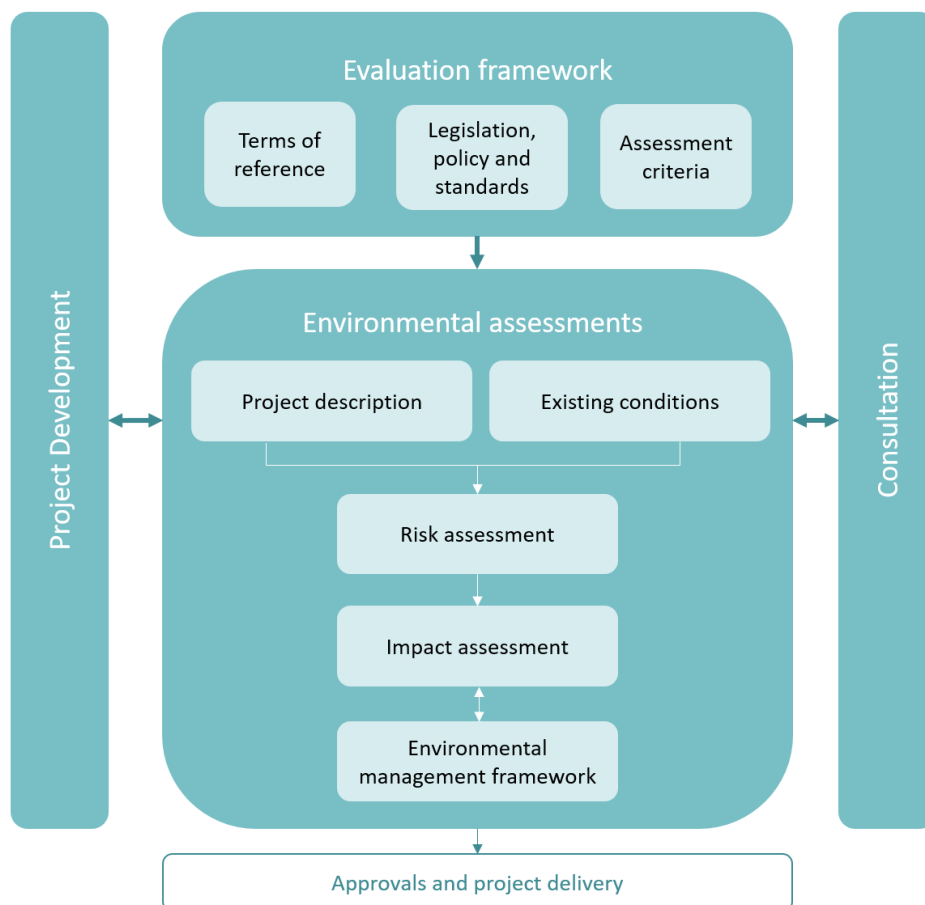
## 6 Methodology

### 6.1 Overview of Assessment Method

This section describes the method that was used to assess the potential noise impacts of the Project. **Figure 6** shows an overview of the assessment method. A risk-based approach was applied to prioritise the key issues for assessment and inform measures to avoid, minimise and offset potential effects.

The approach used in the assessment has been guided by the evaluation framework that applies to the Project comprising the regulatory framework (that is, applicable legislation and policy) as well as the scoping requirements set by the Victorian Minister for Planning.

**Figure 6 Overview of Assessment Framework**



The environmental assessments were undertaken according to the following steps:

- Establishment of a study area and characterisation of existing environment

- Review of the Project description, comprising the key project components (including locations and form), proposed construction and operation activities (in the context of existing environment) and decommissioning activities to determine the location, type, timing, intensity, duration and spatial distribution of potential project interactions with sensitive receivers.
- In the assessment of noise impacts with reference to GED, consideration must first be given to eliminating risks so far as reasonably practicable, and then to reducing those risks so far as reasonably practicable.
- An initial risk-based analysis to evaluate the potential effects of proposed project activities and their likelihood of occurring (considering initial mitigation measures) to determine the relative importance of environmental impacts associated with the Project and therefore prioritise issues for attention in the subsequent assessment of impacts. Initial mitigation measures would include measures that are common industry practice or required to meet legislation.
- An assessment of impacts that examines the severity, extent, and duration of the potential impacts and considers the sensitivity and significance of the affected receivers. This process is iterative, considering additional mitigation measures that will lead to a better outcome.
- Evaluation of predicted outcomes against benchmarks and criteria such as those described in applicable legislation, policy and standards
- Evaluation of the potential for cumulative impacts (where relevant) caused by impacts of the Project in combination with impacts of other existing and proposed projects that may have an overall significant impact on the same environmental asset
- Identification of additional mitigation measures where necessary to address potentially significant environmental impacts
- Evaluation and reporting of the residual environmental impacts including magnitude, duration and extent, taking into account the proposed mitigation measures and their likely effectiveness.

Based on the findings of the environmental assessments, an Environmental Management Framework (EMF) has been prepared to monitor and control environmental performance during project implementation. The EMF has specified the committed mitigation measures to avoid, minimise and manage impacts, proposed contingency measures and offset commitments, and describe the roles and responsibilities for implementation throughout project construction, operation and decommissioning.

The specific methods adopted during the key steps are described in the sections below.

## 6.2 Study Area

An appropriate study area may be defined as the approximate geographical extent required for the propagation of noise emissions from various Project activities to result in minimal change to the existing ambient background noise environment.

For the anticipated fleet of fixed plant and mobile equipment such as those that may be expected from the Project activities, a study area of approximately 10 km by 10 km centred on the Project, would generally be considered sufficient to meet the definition of an appropriate study area. Due to the geographical spread of the Project Areas (Area 1 and Area 3) and the distribution of nearby sensitive receivers around the Project, a study area of approximately 15 km by 15 km, centred towards the south-eastern corner of Area 3 has been chosen.

In addition to the above, the following were also considered:

- A study area of approximately 1.5 km x 1.5 km for the pumping station.
- A study area extending approximately 3 km from the pipeline alignment.
- Impacts along the ore truck transport route to the Ultima Intermodal facility.

### 6.3 Existing Environment

A comprehensive assessment was undertaken to quantify the existing acoustic environment of the study area to inform the environmental impact assessment for the works. This assessment incorporated identification of sensitive receivers and a background noise monitoring campaign over roughly four weeks in October 2018. The monitoring did not include Kangaroo Lake, as it was a late addition to project, however, it is anticipated that it would be similar to the area surveyed.

Details of the existing noise environment is presented in **Section 7**.

### 6.4 Avoidance and Minimisation

Relevant to this topic, the following measures have been adopted in relation to the design, construction and operation of the Project to avoid and minimise impacts:

#### Design

- In Area 1 and Area 3, ore will be hauled by truck between the mining blocks and the MUP where it will be turned into a slurry and piped to the processing plant in Area 1. This minimises truck haulage in Area 1 and avoids truck haulage between Area 3 and Area 1, reducing the truck noise emissions on haul routes.
- For mining block operations closer to sensitive receivers, mining will be limited to day period hours only, reducing the potential noise impact on these receivers during periods that people are more sensitive to noise.
  - Where possible the strategic placement of overburden stockpiles will be used where possible to provide additional noise screening to nearby receivers from noisier activities.
- Noise bunds will be constructed and implemented as early as possible, utilising reclaimed topsoil, taking into consideration mine pit sequencing.
- VHM is seeking landowner agreements with some neighbouring properties to vacate the residence at a point during the Project where noise impacts are anticipated.
- The main power plant is anticipated to be operating continuously 24/7 and represents a significant potential source of noise emissions. The Project shall incorporate the highest levels of noise control for the power station including, placing all gensets in acoustic enclosures and containing all gensets within a generator building, use of high-performance exhaust mufflers and low noise cooling radiators. The objective is to reduce power station noise as far as practicable.
- Upgraded high performance exhaust silencers (e.g. Humex, Mammoth etc.) will be fitted to all haul fleet vehicles, which will have the benefit of reducing overall haul truck noise emissions by approximately 3 dB compared to standard, and reducing low frequency noise even further.
- Procurement of subcontracted mining fleet will include a vehicle noise emission requirement to ensure that all vehicle meet or better that which has been assumed in the noise model.

#### Construction

- Limiting the construction to EPA normal working hours.
- Works to be completed under a Construction Environmental Management Plan (CEMP) incorporating a Noise Management Plan (NMP).
- Provide adequate prior notification and consultation with potentially affected communities prior to works.

### *Operation*

Minimise noise emissions from operations as far as practicable by:

- All staff to receive a site induction including details of the ways potentially impacting noise is generated, methods to minimise noise impacts both on -site and on public roads particularly for road trucks.
- Maintaining site roads in good condition to minimise noise from vehicle traffic over corrugations and pot holes.
- Turning off plant, equipment and vehicles when not in use for an extended period.
- Fitting broadband reversing noise signals to all applicable mobile plant to avoid tonal noise emissions.
- Provide a suitable site access routes for all third-party trucks that do not involve reversing, if control over their reversing alarms is limited.
- Ensuring all plant, equipment and vehicles are fitted with appropriate noise attenuation devices as per manufacturer specification (e.g. enclosures, baffles, silencers, mufflers etc.) and all equipment is maintained in good repair.
- Prohibiting the use of engine Jacobs brake by ore product trucks in built up areas such as Lalbert

The Project will aim to meet its obligations under the GED by minimising noise as far as practicable.

## **6.5 Risk Assessment**

A risk assessment of project activities was performed to prioritise the focus of the impact assessments and development of mitigation measures. The risk pathways link project activities (causes) to their potential effects on the environmental assets, values or uses that are considered in more detail in the impact assessment. Risks were assessed for the construction, operation and closure phases of the Project.

The likelihood and consequence ratings determined during the risk assessment process and the adopted mitigation measures are presented in **Appendix A**. The risk assessment has been undertaken in line with the *Preparation of Work Plans and Work Plan Variations Guideline for Mining Projects* December 2020 (version 1.3).

## **6.6 Impact Assessment**

A change to baseline conditions (or the no-project case) caused by project activities in any of the Project phases (construction, operation or closure) may give rise to impacts.

The impact assessment involved identifying the location of noise sensitive receivers (including public spaces and natural areas), and evaluating the severity, extent and duration of any impacts, positive or negative, that the Project may have on the existing environment and identified noise sensitive receivers.

The significance of the impacts has been assessed in accordance with the evaluation framework, based on applicable legislation, policy and standards and the evaluation objectives and environmental significance guidelines arising from the government terms of reference established to guide the assessments.

This study has assessed the impacts of construction, operation and closure of the Project on noise assets and values to be protected.

### 6.6.1 Assessment Methodology

Noise impacts have been assessed to determine the potential of harm to human health and the environment, and the potential of diminished social wellbeing caused by noise emissions from the Project. The assessment of noise impacts against criteria prescribed in relevant legislation, policy, guidelines and standards, ensures that the potential of harm is minimised, and avoids the potential for unreasonable or aggravated noise that may impact on social wellbeing, as defined in the EP Act and subordinate legislation.

Noise modelling of several key stages in the mine's operation was conducted using SoundPLAN 8.2 noise modelling software, incorporating algorithms in accordance with ISO 9613-2:1996 *Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation*.

The ISO 9613 algorithm predicts the A-weighted sound pressure levels under meteorological conditions favourable to propagation from sources of known sound power levels. This enhanced propagation is equivalent to downwind propagation or a moderate ground-based temperature inversion. The model also includes attenuation due to air absorption, ground attenuation and shielding.

The noise predictions consider:

- Noise emission data for on-site equipment (refer to **Appendix B**)
- The distance between the sources and receivers
- The presence of obstacles such as pit walls or terrain features that obstruct the noise path (digital terrain model based on 1m interval elevation contours)
- The hardness of ground between the source and receiver ( $G = 0.6$ )
- The presence of hard reflective surfaces that may enable additional noise paths.
- Operational scenarios associated with peak operational periods when staged mining activities are being undertaken at proximity to receivers (refer to **Table 17**).

The assessment methodology includes consideration for the likelihood that received noise potentially exhibits noise character with features that potentially increase annoyance, including:

- tonal noise
- noise impulsive in character
- intermittent noise
- low frequency noise

Further details of the evaluation of noise character and penalties are included in **Appendix B** and discussed further in the report where relevant.

## 6.6.2 Construction Noise Modelling

Three construction scenarios were developed, two for the processing plant and one modelling the construction of the buried water pipeline running from Kangaroo Lake to site as detailed in **Table 13**.

**Table 13 Construction Noise Modelling Scenarios**

Scenario	Name	Description
1a	Processing Plant: Earthworks	Site preparation: clearing, excavation, compaction, concreting etc.
1b	Processing Plant: Building and lifting	Installation of equipment and erection of buildings
2	Water pipeline	Trenching and laydown of the water pipeline

### 6.6.2.1 Equipment Noise Levels - Construction

Construction equipment will be as per typical industry usage. **Table 14** and **Table 15** shows the construction equipment modelled for the earthworks and building scenarios respectively. The sound power level of the equipment was summed and spread over an area equivalent to the processing plant boundary. Truck movements to and from the site are modelled as line sources.

**Table 16** presents the sound power level of typical equipment involved in trenching and pipe laying. Pipe laying work is transient, the noise sources move along the pipeline as the work progresses. Therefore, a sensitive receiver will only be exposed to this noise for a relatively short period. To account for this fact, the noise sources were modelled as point sources and the relationship between predicted sound pressure level and distance established. Buffer distances can then be defined giving expected sound pressure levels at a distance perpendicular to location of the current work.

**Table 14 Scenario 1: Processing Plant: Earthworks Sound Power Levels**

Qty	Equipment Description	Octave Band Linear Sound Power Level ( $L_{eq, 15 \text{ min}}$ ), dB, per unit								OA
		63	125	250	500	1k	2k	4k	8k	
1	Excavator 200 t	116	119	115	114	111	109	104	96	117
1	Excavator 110 t	119	120	111	112	108	106	105	98	115
1	Bulldozer	117	118	109	101	102	98	96	92	108
1	Tractor scraper	109	115	107	105	105	102	98	95	110
1	Road sweeper	108	103	97	103	99	95	89	86	104
1	Vibratory Roller	110	108	104	101	98	98	91	87	105
2	Cement truck	108	97	94	98	99	97	92	86	103
1	Scraper	109	115	107	105	105	102	98	95	110
1	1.25 kW diesel generator*	115	111	106	102	97	90	90	87	104
	<b>Overall</b>	<b>123</b>	<b>125</b>	<b>118</b>	<b>117</b>	<b>115</b>	<b>112</b>	<b>109</b>	<b>103</b>	<b>120</b>
4	Trucks	110	108	106	103	104	106	103	97	111

Trucks are modelled as a line source. Four movements per assessment period is assumed.

\* 2dB penalty applied to fixed plant to account for potential noise character

**Table 15 Scenario 2: Processing Plant: Building Sound Power Levels**

Qty	Equipment Description	Octave Band Linear Sound Power Level ( $L_{eq, 15 \text{ min}}$ ), dB, per unit								OA
		63	125	250	500	1k	2k	4k	8k	
3	90 t crane	115	110	106	102	99	95	88	80	105
3	Mobile lifting plant	108	104	99	91	92	91	84	78	98
1	Service vehicle	110	108	106	103	104	106	103	97	111
2	Welder	95	96	97	96	97	94	89	84	101
2	Generator for welder	105	97	89	82	78	74	71	63	87
4	Grinder and other powered hand tools	93	106	100	98	98	98	94	87	104
1	1.25 kW diesel generator	115	111	106	102	97	90	90	87	104
	<b>Overall</b>	<b>123</b>	<b>119</b>	<b>114</b>	<b>111</b>	<b>109</b>	<b>109</b>	<b>105</b>	<b>99</b>	<b>116</b>
4	Trucks	110	108	106	103	104	106	103	97	111

Trucks are modelled as a line source. Four movements per assessment period is assumed.

**Table 16 Scenario 3: Pipelaying Sound Power Levels**

Qty	Equipment Description	Octave Band Linear Sound Power Level ( $L_{eq, 15 \text{ min}}$ ), dB, per unit								OA
		63	125	250	500	1k	2k	4k	8k	
2	Excavator earthworks	104	107	103	103	104	101	98	93	108
1	Wheel loader	112	116	109	102	102	99	94	93	108
2	Truck	110	108	106	103	104	106	103	97	111
	<b>Overall</b>	<b>116</b>	<b>118</b>	<b>113</b>	<b>110</b>	<b>111</b>	<b>111</b>	<b>107</b>	<b>102</b>	<b>116</b>

### 6.6.3 Operations Noise Modelling

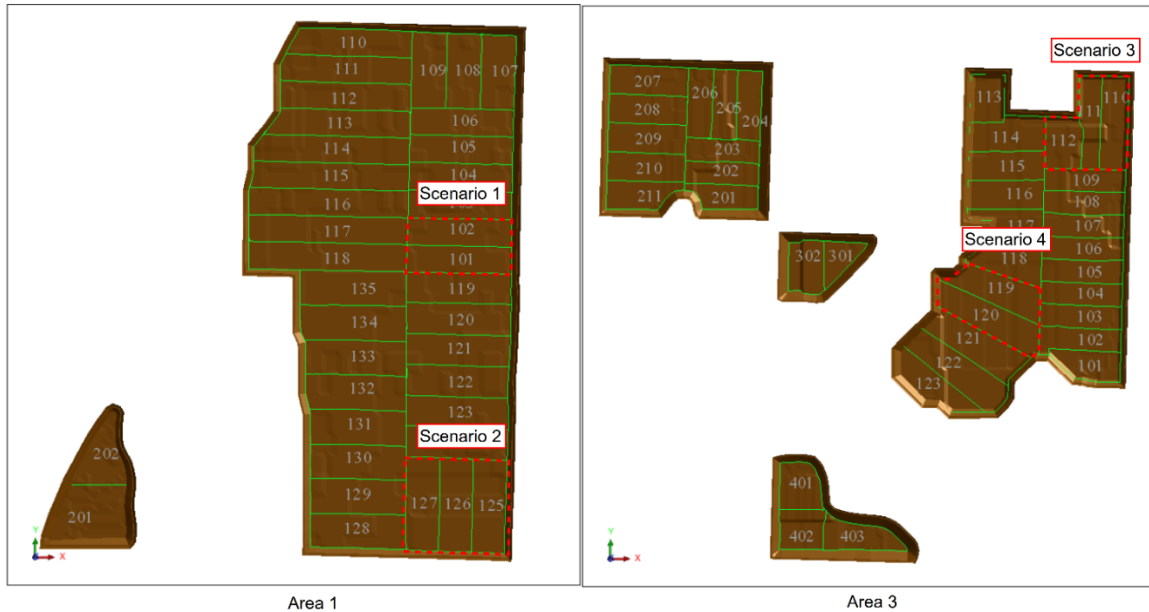
#### 6.6.3.1 Mining Scenarios

The mining schedule for the Project indicates that the focus of activities will progress across the site extracting and backfilling the mining blocks systematically. As a noise model can only effectively represent a snapshot in time of the overall mining schedule, a review of the material movement schedule and mining block layouts established two mining scenarios for each area which would represent potential worst-case scenarios based on activity intensity in terms of material moved, the distance between the mining activities and the closest sensitive receivers.

**Figure 7** shows the location and sequencing of the mined cells.

**Figure 7 Cell Map – Area 1 Left, Area 3 Right.**





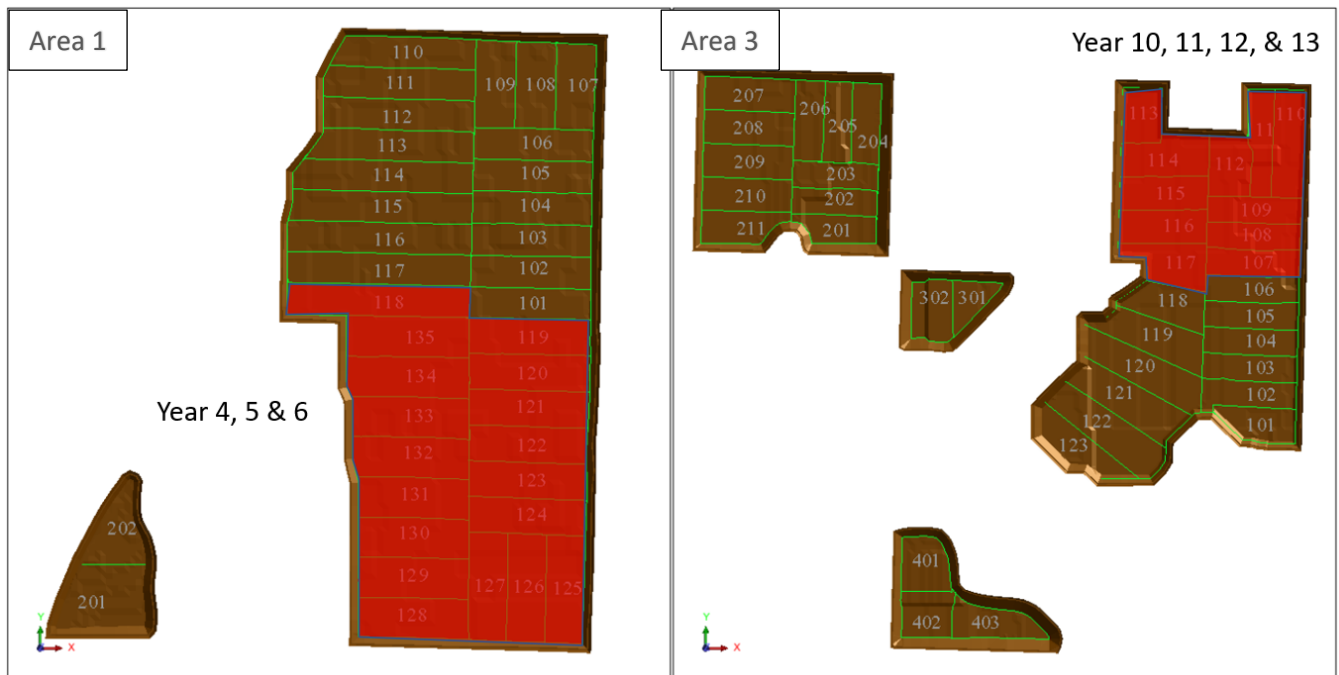
**Table 17** summarises the noise modelling scenarios. It should be noted that these were also modelled as potential worst-case air quality scenarios.

**Table 17 Noise Modelling Scenarios**

Scenario	Name	Description
1	Area 1, Year 1 Quarter 1 (opening months)	Haulage to Area 1 MUP, topsoil, clay and overburden stockpiles. Mine fleet operating on western boundary of Area 1 close to R0014, cells 101 & 102. Day and night shift.
2	Area 1, Year 6 Quarter 2	Haulage to Area 1 MUP, topsoil, clay and overburden stockpiles. Mine fleet operating on southern boundary, cells 125, 126 & 127. Day shift only.
3	Area 3, Year 11 Quarter 3	Haulage to Area 3 MUP, topsoil, clay and overburden stockpiles. Mine fleet operating on northern boundary cells 110, 111 & 112. Day shift only.
4	Area 3, Year 15 Quarter 2	Haulage to Area 3 MUP, topsoil, clay and overburden stockpiles. Mine fleet operating on cells 119 & 120. Day and night shift.

It is anticipated that the southern cells of Area 1 and the northern cells of Area 3 will have day shift only mining operations as shown in **Figure 8**

**Figure 8 Day Shift Only Mining Operations**



\* Red shaded cell denotes day shift only

### 6.6.3.2 Noise Sources - Operations

Comprehensive equipment schedules for the processing plant, mobile mining equipment fleet and Mining Unit Plants (MUP) were provided VHM, with source noise level, measured at 1 metre, provided where available. Source sound power levels for some other items were taken from representative measurements published in BS5228 -1:2009<sup>1</sup> (*Code of practice for noise and vibration control on construction and open sites*), or from SLR's noise source database.

Modelled equipment sound power levels are presented in **Table 18**, and a summary of the implemented octave band sound power levels of the modelled equipment can be found in **Appendix B**.

<sup>1</sup> The BS 5228-1 / DEFRA / database contains field measurements taken at 10 m from the source. Noise levels may vary depending upon make & maintenance. There is a low risk of sound power levels being higher as the database is based on older historical data (<2005); newer equipment is quieter and typically better maintained.

**Table 18 Sound Power Level Summary**

Equipment Description	Octave Band Linear Sound Power Level ( $L_{eq, 15 \text{ min}}$ ), dB, per unit								OA
	63	125	250	500	1k	2k	4k	8k	
Processing Plant	116	116	113	110	109	106	102	98	114
Power Station exhaust	102	93	90	89	87	81	71	63	91
Power Station, internal $L_p$ , rev	73	80	79	78	80	79	71	63	84*
MUP	113	116	110	104	105	103	100	98	111
Mining Fleet	125	126	120	118	117	114	110	104	122
Stockpiles	112	113	104	96	97	93	91	87	103
Haul Fleet	109	109	122	118	122	123	115	110	128

\* internal reverberant sound pressure level

### 6.6.3.3 Power Station

The Power Station plant was identified as the potentially most significant noise source of fixed plant in the processing area. It consists of twelve Cummins KTA50-G9 diesel powered generator sets housed within a building. The building has large opening roller doors on the north and south facades and the eastern façade is also heavily louvered to assist airflow, with exhaust and cooling radiators incorporated into the western façade. The rest of the building construction is assumed to be constructed of a material with weighted sound reduction index not less than  $R_w + C_{tr} 23$ .

Figure 9 shows a 3D render of the Power Station building.

**Figure 9 Render of Proposed Power Station Layout**



To reduce noise breakout from the building as well as to satisfy workplace occupational health and safety requirements (not to exceed internal sound pressure level greater than 85 dBA), each engine will be placed inside 'drop over' acoustic enclosures with a minimum weighted sound reduction index of  $R_w + C_{tr}$  23. This recommendation is based on preliminary assumptions and subject to detailed design.

High performance exhaust silencers will be installed on the diesel engine exhausts; Maxim MSA55 or equivalent (35 dB to 50 dB noise reduction). The sound power level of the exhaust noise presented in **Table 19** includes the insertion loss provided by the exhaust silencers.

The objective to reduce noise from the power plant to as low as reasonably practicable aligns with the principles of GED.

#### 6.6.3.4 Haul Fleet

The fleet of haul trucks was identified as the potentially most significant mobile fleet noise source as most haul routes will generally be completed at the surface, whereas most other mobile sources will operate for much of the time in excavated pits below natural ground surface and therefore benefit from additional acoustic shielding. The haul fleet is proposed to comprise of approximately 8 of 130t non articulated haul trucks, (e.g. CAT 785 or equivalent). These vehicles are relatively common on large opencut mines and consequently there are several options of noise control available for them.

In light of the above, the Project has determined that upgraded exhaust silencers (e.g. Humex, Mammoth etc.) will be fitted to all haul fleet vehicles, which will have the benefit of reducing overall haul truck noise emissions by approximately 3 dB compared to standard, and reducing low frequency noise even further.

The objective to reduce noise from the haul fleet to as low as reasonably practicable aligns with the principles of GED.

#### 6.6.4 Kangaroo Lake Pumping Station

Water is to be supplied to the site from Kangaroo Lake via a 38 km long underground pipeline. Two 400 kW electric motor horizontal pumps, located on the Kangaroo Lake bank will supply the water. The motors can be connected to the electricity or powered by diesel generators at Kangaroo Lake. **Figure 10** shows the proposed pump station layout.

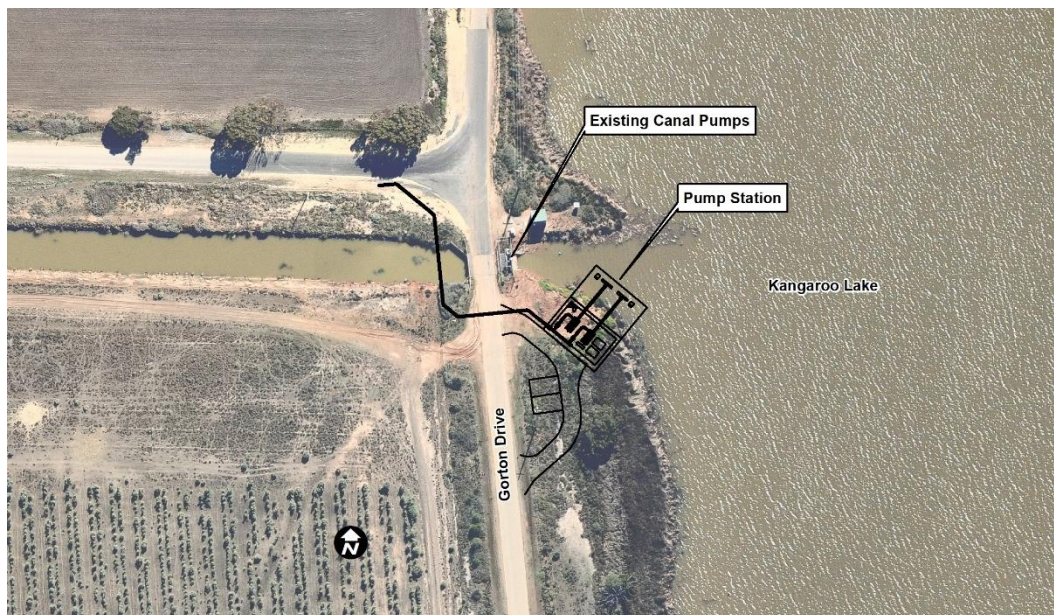
Whilst it is anticipated that the diesel generators will be used as back up, they may be initially used at the commencement of operations for extended periods of time as it is not yet clear when (or whether) the pump station will be connected to the electricity grid.

For the purposes of this assessment, it is assumed that a single 1.5 MVA generator will be operating continuously, and the pump/motor sets and the diesel generator will each be housed in acoustic enclosures to assist in soundproofing. The sound power levels presented in **Table 19** are based on empirical data for similar sized plant, there is low risk they will be higher, however, the generators and enclosure will be reviewed during the detailed design stage to ensure appropriate acoustic design to achieve compliance.

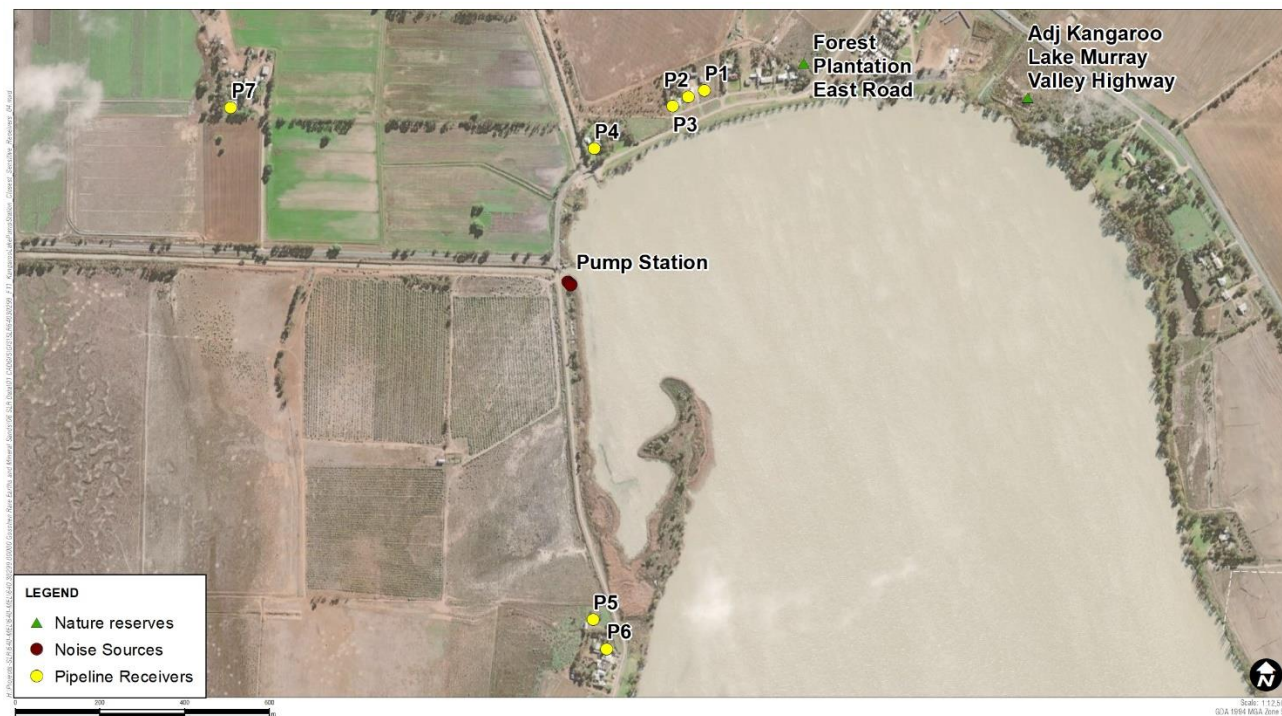
**Figure 11** shows the pump station location with reference to the nearest sensitive receivers.



**Figure 10 Kangaroo Lake Pump Station Proposed Layout**



**Figure 11 Kangaroo Lake Pump Station and Closest Sensitive Receivers**



**Table 19 Kangaroo Lake Pump Station Noise Sources**

Equipment Description	Octave Band Linear Sound Power Level (Leq, 15 min), dB, per unit								OA
	63	125	250	500	1k	2k	4k	8k	
400 kW electric motor and pump (enclosed)	95	91	87	82	77	71	73	69	84
1.5 MVA diesel generator (enclosed) <sup>1</sup>	114	110	105	101	95	88	89	86	103
Diesel exhaust noise (attenuated) <sup>2</sup>	102	93	90	89	87	81	71	63	91

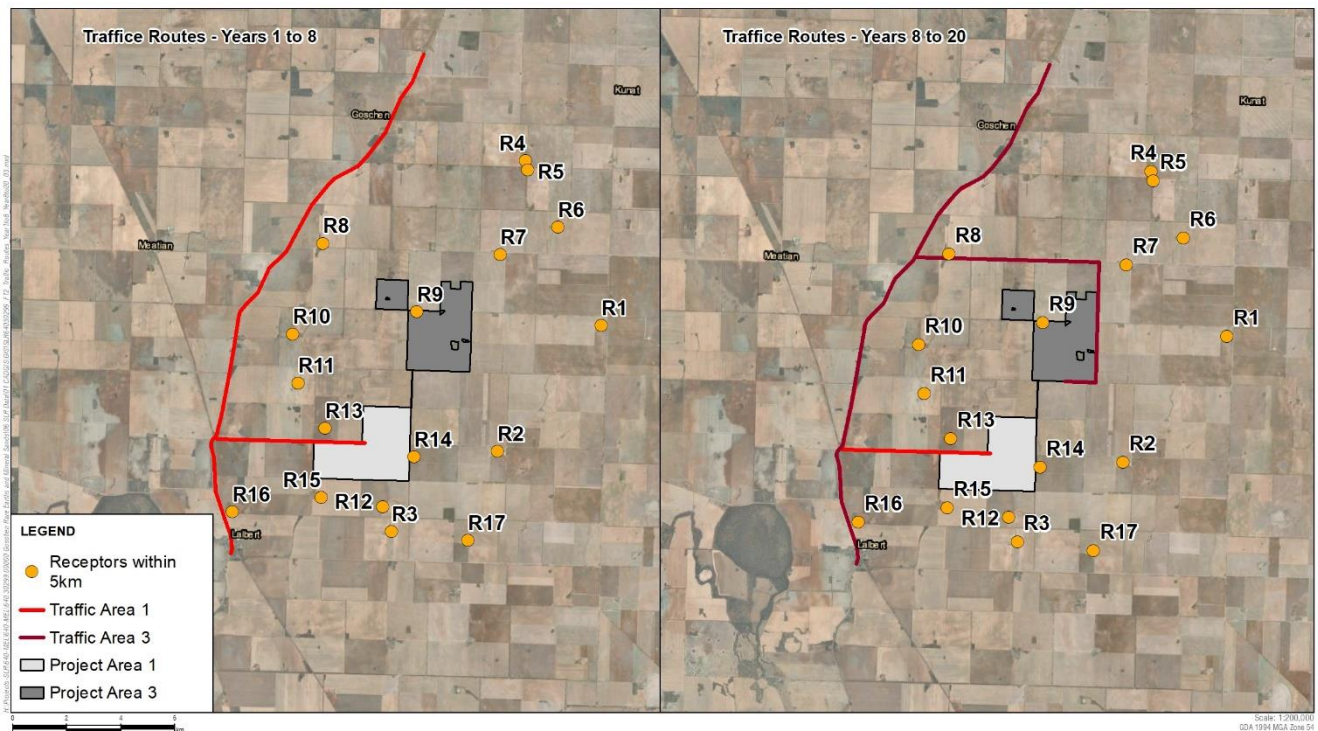
1 enclosure assumed to be Rw+Ctr 23 or greater

2 silencer is assumed to be high performance (35 dB to 50 dB noise reduction)

### 6.6.5 Project Related Traffic

From year 1 to year 8 all traffic (staff, deliveries and ore product) will access the Processing Plant and Mine Area 1 via Bennett Road. From year 8 to year 20, operations commence at Area 3 and the operational mining staff will access Area 3 via Mystic Park Meatian Road while other staff movements, deliveries and ore product continue to access the Processing Plant via Bennett Road. Transport routes are shown in **Figure 12**.

**Figure 12 Traffic Routes: Years 1 to 8 (left) and Years 8 to 20 (right)**



Operational traffic movements predict an average of 197 light vehicle and 15 heavy vehicles (which includes transport of ore product), accessing the site each day. Heavy vehicles are assumed to access the Processing Plant by passing through Lalbert on Donald Swan Hill Road and on to Bennett Road, leaving site the same way.

Half of the light vehicles are assumed to access site by traveling southbound on Donald Swan Hill Road onto Bennett Road and the other half by travelling northbound on Donald Swan Hill Road.



The majority of light vehicle movements are assumed to occur during the change of shift during the first hour and the final hour of each shift, both are assumed to occur during the day period. Heavy vehicle movement is spread out across the 16-hour day period.

The Leq, 16h traffic noise level was calculated for the year 1 to 8 and year 8 to 20 scenarios based on the number of vehicle movements shown in **Table 20**.

**Table 20 Daily Vehicle Movements**

Route (Return)	Vehicle Type	Year 1 to 8	Year 8 to 20
Donald Swan Hill Rd northbound to Area 1	Heavy	30	30
Donald Swan Hill Rd northbound to Area 1	Light	197	187
Donald Swan Hill Rd southbound to Area 1	Light	197	187
Donald Swan Hill Rd northbound to Area 3	Light	-	10
Donald Swan Hill Rd southbound to Area 3	Light	-	10

The worst-case scenario, when all light vehicle movements occur within a single one-hour period was also calculated. This scenario coincides with a change in shift when there is significant movement around the site.

Night movements of ore transport was eliminated to reduce noise impacts. Therefore, heavy vehicle movements are spread evenly over the day period.

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## 6.7 Limitations, Uncertainties and Assumptions

The following limitations, uncertainties and assumptions apply to this predictive noise assessment:

### 6.7.1 Baseline Ambient Noise Levels

- The existing conditions of the region around the Project area have been determined by a baseline noise survey of approximately 1 month in duration, with an inherent assumption being that the measured noise environment is sufficiently indicative, noting that a number of factors (e.g., seasonal influences) may change it over time.
- The noise monitoring equipment used is classified as an IEC 61672-1 Type 1 instrument, which has a typical accuracy of  $\pm 1$  dBA. All equipment was calibrated before and after use and carries current NATA calibration certification.

### 6.7.2 Noise Prediction Model

- The ISO 9613-2 standard upon which the prediction algorithms are based, states that for downwind propagation conditions and a mean propagation height of up to 30 m and a maximum source-receiver distance of 1,000 m, it has an accuracy of  $\pm 3$  dBA. The standard doesn't preclude predictions outside of these parameters, but no statement of accuracy is provided. The noise model prepared for this project is generally within these parameters for the proposed activities.

### 6.7.3 Meteorological Conditions

- ISO 9613-2 predictions assume that all receivers are generally downwind from each noise source. In the context of this assessment, this implies that each source – receiver pair experiences downwind conditions simultaneously.
- The noise model assumes the propagation of sound through air based on a standardised assumption for temperature, pressure and relative humidity, which is conducive to propagation.
- In practical terms, such assumptions are pragmatic and appropriate for the purposes of an engineering assessment intended to provide a reliable representation of the upper noise levels expected. However, in practice and under real world weather conditions, such as wind blowing from the receiver to the source, or warmer temperatures, it would likely result in lower noise levels than those predicted.

### 6.7.4 Equipment Noise Emissions

- Sound power data for equipment in the noise model has been selected from a combination of current standards and library data to represent the upper (higher) range of quoted operating noise levels, when manufacturer data has not been available. This would represent a generally conservative assessment of anticipated noise emissions from equipment.
- The noise model prediction is based on all equipment operating at a typical full load condition simultaneously. In practice most mining and earthmoving operations operate a fleet of mobile equipment which operate on a much varied pattern, including everything from time at full load operation, time spent idling and periods of inactivity. The noise model prediction has not been de-rated to account for some of the variety of operation and hence it likely represents a conservative assessment of anticipated noise emissions from all equipment.



## 7 Existing Environment

### 7.1 Local Setting

The majority of the Project would occur on farmland, with remnant native vegetation existing principally along road reserves. Rural residences are located over the Project area and surrounds, which are identified and discussed below. Of significance with relation to noise are:

- Areas defined as 'noise sensitive areas' in accordance with the EP Act and subordinate legislation. These areas are residences located nearby the Project in farming zoned land (FZ) and the Mystic Park township zone (TZ).
- Category IV public conservation and resources zones close to the Project are:
  - Talgitcha Bushland Reserve
  - Lalbert Recreation Reserve
- Category IV public conservation and resources zones close to Kangaroo Lake are:
  - Mystic Park Bushland Reserve
  - Forest Plantation East Road
  - Adj. Kangaroo Lake and Murray Valley Highway
- Category V natural areas close to Kangaroo Lake are:
  - Koorangie Wildlife Reserve
  - Yassom Swamp Flora and Fauna Reserve
  - Bael Bael Grassland Nature Reserve
  - Tutchewop Wildlife Reserve

Refer also to **Section 4.4.1** regarding the basis of the above categorisations.

### 7.2 Sensitive Receivers

In general, noise sensitive receivers include residential dwellings and other places where sleep occurs (e.g. hospitals, hotels, and camping grounds in rural areas etc), or where learning occurs (e.g. schools, kindergarten, child care etc).

The only noise sensitive receivers identified in the vicinity of the Project comprise a number of nearby rural residential dwellings. There are no other noise sensitive places in proximity to the Project (Lake Boga Primary School ~17 km, Nullawil Primary School ~32km, Kerang Primary School & Kerang District Health ~44km).

The nearest existing sensitive receivers to the Facility are listed in **Table 21** and presented in **Figure 13**.

Receivers within 800 m of the Kangaroo Lake Pump Station and the 38 km long water pipeline between Kangaroo Lake and the Facility are identified with the 'P' prefix and shown in **Table 22** and presented in **Figure 14**.

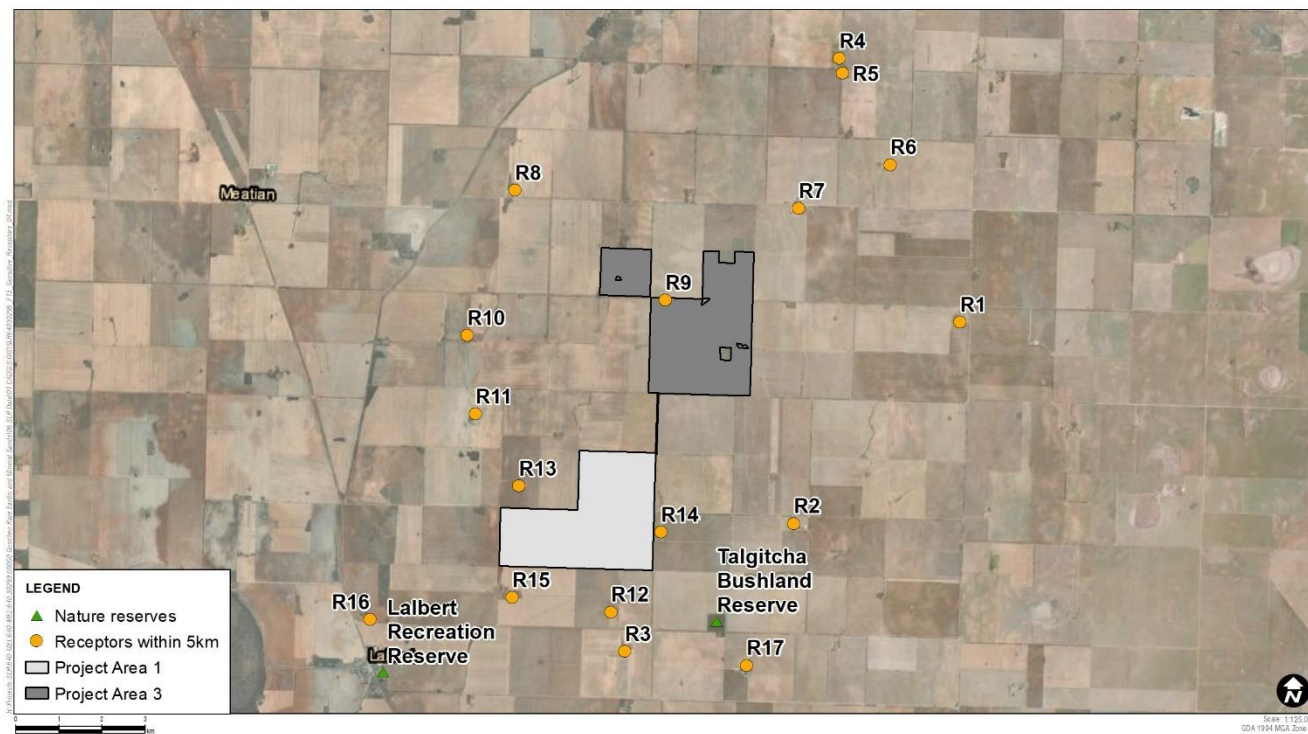
In accordance with the Noise Protocol, the potential impacts at the identified residences have been determined as part of this assessment.

Several other sensitive receivers are located in the vicinity of, but generally further away than those listed in **Table 21** and **Table 22**. While these are not included in the assessment, due to their increased separation from the Project and the pumping station, these will be impacted by Project emissions to a lesser degree than those receivers that are included.

**Table 21 Identified Nearest Sensitive Receivers Within 5 km of the Facility**

ID	Address	UTM Coordinates (Zone 54)	
		(m East)	(m South)
R1	2547 Quambatook-Swan Hill Rd	728,695	6,057,913
R2	397 Bennett Rd	724,850	6,053,261
R3	618 Nadler Rd	720,945	6,050,305
R4	597 Holmes Rd	725,900	6,064,002
R5	614 Holmes Rd	725,979	6,063,658
R6	971 Mystic Park-Meatian Rd	727,086	6,061,550
R7	774 Mystic Park-Meatian Rd	724,968	6,060,540
R8	129 Mystic Park-Meatian Rd	718,405	6,060,955
R9	636 Thompson Rd	721,880	6,058,420
R10	227 Jobling Rd	717,293	6,057,603
R11	679 Pola Rd	717,489	6,055,795
R12	607 Nalder Rd	720,623	6,051,214
R13	522 Pola Rd	718,485	6,054,126
R14	695 Bennett Rd	721,779	6,053,064
R15	270 Pola Rd	718,344	6,051,555
R16	35 Nalder Rd	715,051	6,051,041
R17	3602 Lalbert-Kerang Rd	723,762	6,049,984

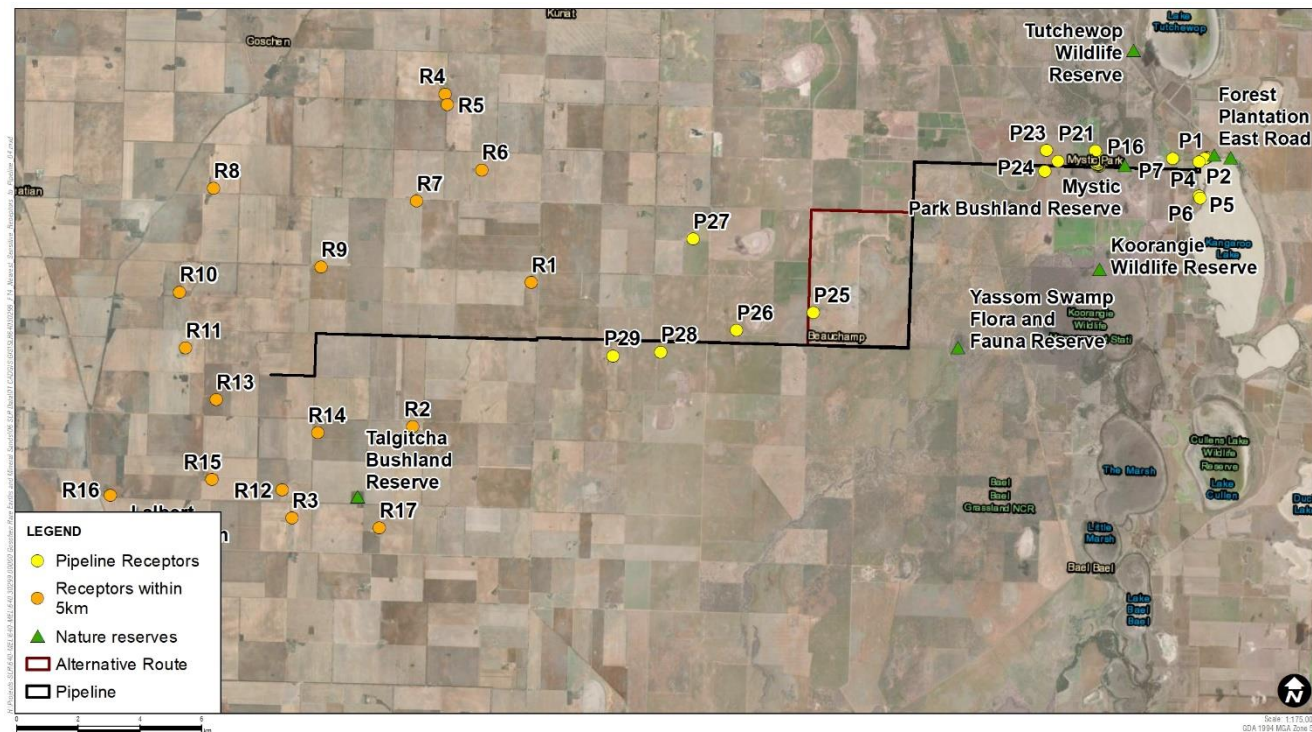
**Figure 13 Identified Nearest Sensitive Receivers to the Facility**



**Table 22 Identified Sensitive Receivers Within 800 m of Kangaroo Lake Water Pipeline**

ID	Address	UTM Coordinates (Zone 54)	
		(m East)	(m South)
P1	64 Mystic Park East Road	6,061,956	750,579
P2	68 Mystic Park East Road	6,061,941	750,541
P3	72 Mystic Park East Road	6,061,919	750,504
P4	94 Mystic Park East Road	6,061,819	750,319
P5	88 Gorton Road	6,060,707	750,316
P6	92 Gorton Road	6,060,637	750,348
P7	190 Mystic Park East Road	6,061,915	749,460
P8	432 Mystic Park East Road	6,061,664	747,093
P9	2 Wilson Street	6,061,662	747,045
P10	4 Wilson Street	6,061,698	747,057
P11	6 Wilson Street	6,061,720	747,056
P12	1-5 Wilson Street	6,061,732	746,999
P13	8 Wilson Street	6,061,747	747,050
P14	12 Wilson Street	6,061,784	747,049
P15	1 Mystic Park Road	6,061,834	747,049
P16	3 Mystic Park Road	6,061,832	747,104
P17	4 Mystic Park Road	6,061,884	747,107
P18	22 Wilson Street	6,061,920	747,058
P19	24 Wilson Street	6,061,941	747,067
P20	7 Wilson Street	6,061,826	747,002
P21	49 Tresco-Mystic Park Road	6,062,163	746,969
P22	2237 Mystic Park-Beauchamp Road	6,061,833	745,745
P23	51 Bartel Road	6,062,184	745,383
P24	2194 Mystic Park-Beauchamp Road	6,061,511	745,320
P25	974 Mystic Park Beauchamp Road	6,056,942	737,818
P26	649 Mystic Park Beauchamp Road	6,056,368	735,344
P27	100 Steer Road	6,059,321	733,930
P28	410 Mystic Park Beauchamp Road	6,055,669	732,893
P29	240 Mystic Park-Beauchamp Road	6,055,545	731,343

**Figure 14 Nearest Sensitive Receivers to the Pipeline**







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## 7.4 Background Noise Levels

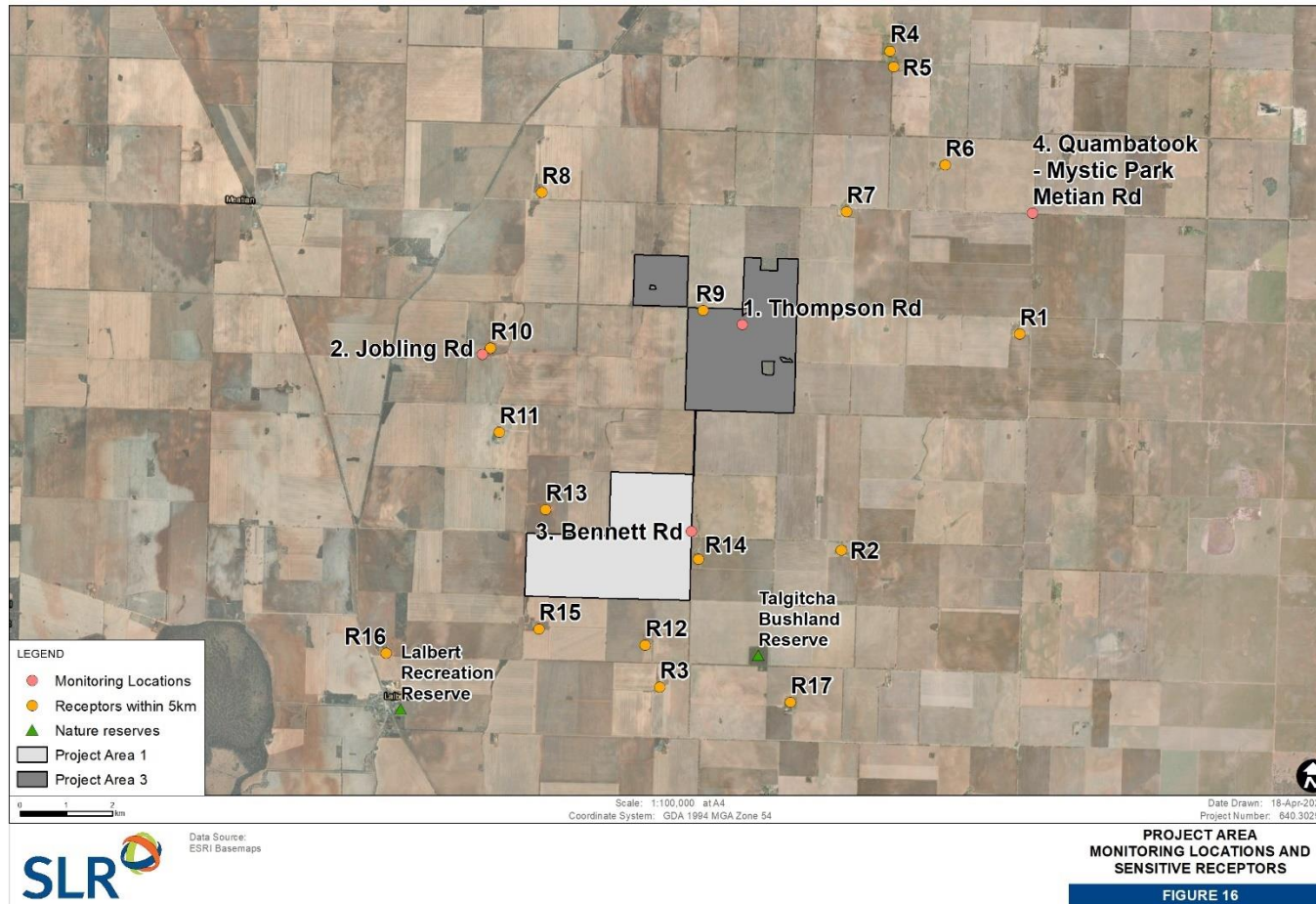
The existing noise environment in the Project area is typical of rural farming area, with background noise levels being generally low and determined by non-anthropogenic sources such as wind and insects. However, at some locations the existing noise environment would feature noise generated by farming activity and equipment (e.g. tractors, harvesters, grain trucks etc.) for periods during the year. On the shores of Kangaroo Lake the noise environment would also feature occasional noise from recreational boating.

A background noise monitoring programme was completed in the Project area at four locations over a period of approximately four weeks in October 2018. No monitoring was completed in the vicinity of Kangaroo Lake, however, it is anticipated that background noise levels in this region would be similar to that measured at the other sites.

The monitoring locations are shown in **Figure 16** in relation to the Project area and sensitive receivers and detailed in **Table 23**. Full details of the baseline noise monitoring programme are included in **Appendix C**.

While the monitoring was undertaken in 2018, it is not anticipated that there is any significant change in background noise levels to date, noting that the statistical analysis used to quantify the background level uses the typical lowest measured noise levels that occurred over the monitoring campaign, and as such is a conservative representation of the background noise environment.

**Figure 16 Project Area, Monitoring Locations and Sensitive Receivers**





**Table 23 Monitoring Locations**

Location	Closest Sensitive Receiver	Monitoring Period
2. Thompsons Rd	R9 (860m)	2 October 2018 – 1 November 2018
3. Jobling Rd	R10 (200m)	2 October 2018 – 21 October 2018
4. Bennett Rd	R14 (630m)	2 October 2018 – 30 October 2018
5. Quambatook – Mystic Park Meatian Rd	R6 (2160m)	2 October 2018 – 31 October 2018

#### 7.4.1 Background Noise Level Assessment

The measured day, evening and night background noise level at the monitoring locations are shown in **Table 24**. The levels presented include the arithmetic average of the collected 1 hour L90 data over the entire monitoring period for each location, as well as the single quietest day, evening or night period background level over the entire monitoring period. This second parameter is used to determine the applicable noise limits in accordance with the Noise Protocol (as per EPA Guideline 1997) but is considered a highly conservative indicator of the typical background level at the measurement locations.

**Table 24 Measured Background Noise Levels (based on L90, 1 hr)**

, based Period	2. Thompson Rd Average / Lowest	3. Jobling Rd Average / Lowest	4. Bennett Rd Average / Lowest	5. Quambatook – M.P.M. Rd Average / Lowest
Day	28 dBA / 23 dBA	34 dBA / 26 dBA	31 dBA / 25 dBA	34 dBA / 24 dBA
Evening	26 dBA / 20 dBA	39 dBA / 28 dBA	33 dBA / 24 dBA	30 dBA / 20 dBA
Night	23 dBA / 20 dBA	30 dBA / 22 dBA	26 dBA / 21 dBA	25 dBA / 18 dBA

\*NOTE: Background levels of 20 dBA or below are affected by the equipment noise floor. Actual background levels could be lower.

Existing background noise levels were found to be generally low. Noise limits were determined in accordance with the Noise Protocol for **earth resources premises** where the noise sensitive area is in a rural area (farming zone). **Table 25** shows the resulting operational noise limits.

**Table 25 Noise Protocol Noise Limits (Leq, 30 min)**

Period	2. Thompson Rd	3. Jobling Rd	4. Bennett Rd	5. Quambatook – MPM Rd
Day	46 dBA	46 dBA	46 dBA	46 dBA
Evening	41 dBA	41 dBA	41 dBA	41 dBA
Night	36 dBA	36 dBA	36 dBA	36 dBA

## 7.5 Background Vibration

The ambient vibration environment in the Project site area is anticipated to be very low, below the threshold of perception, with only occasional and very localised vibration being generated by vehicular movement, farming or domestic related activity.

## 8 Risk Assessment

The identified risks and associated residual risk ratings are listed in **Table 26**. The likelihood and consequence ratings determined during the risk assessment process and the mitigation measures to be achieved are presented in **Appendix A**.

**Table 26 Noise Risks**

Risk ID	Potential Threat and Effects on the Environment	Residual Risk Rating
<b>Construction</b>		
C1	Temporary noise disturbance to receivers during construction of process plant and power station area	Low
C2	Temporary noise disturbance to receivers during construction of pumping station	Low
C3	Temporary noise disturbance to receivers during construction of pipeline route	Low
<b>Operation</b>		
O1	Excessive noise generation from fixed processing plant, power station and pumping station equipment	Medium
O2	Excessive noise generation from mobile equipment working in-pit, on overburden dumps and material haulage.	Medium
T1	Increased traffic noise on local roads from project	Low

## 9 Construction Impact Assessment

This section discusses the potential impacts of the Project as a result of construction activities and the associated mitigation measures that aim to reduce impacts to as low a level as possible. Mitigation measures referred to are summarised in **Section 13**.

### 9.1 Construction Scenarios

#### 9.1.1 Processing Plant

Process plant construction will occur in a staged approach, starting at the WCP and progressing to the MSP (Dry Plant). In these areas construction will initially be typical of earthworks including site ground improvement and hardstand construction with equipment as per typical industry usage (excavators, scrapers, vibratory rollers, asphalt/concrete etc.), followed by construction of the process plant infrastructure which includes cranes and mobile lifting plant, service vehicles, welding plant, assembly workshops, etc.

The construction contractor will provide all temporary construction power, administration and services buildings, ablutions, waste management and site security.

Construction work will start as soon as possible, however there will be some overlap with operations as mining operations will commence prior to the completion of the processing plant. This allows for the sale of some upstream ore products whilst the downstream processes are still being commissioned. Construction noise scenarios are generally considered independent of operational noise modelling in this assessment, however, some consideration of the cumulative noise during this overlap period is also provided in **Section 12**.

High impact construction activities will take place during EPA normal working hours, with the provision that some unavoidable works (such as extended concrete pours if necessary) or low noise activities (such as finishing works) may occur during the evening or night periods.

Two construction scenarios were developed for the processing plant:

1. Earthworks: site preparation, hardstands etc. Including clearing, excavation, compaction, concreting etc.
2. Building and lifting: installation of fixed plant and erection of buildings

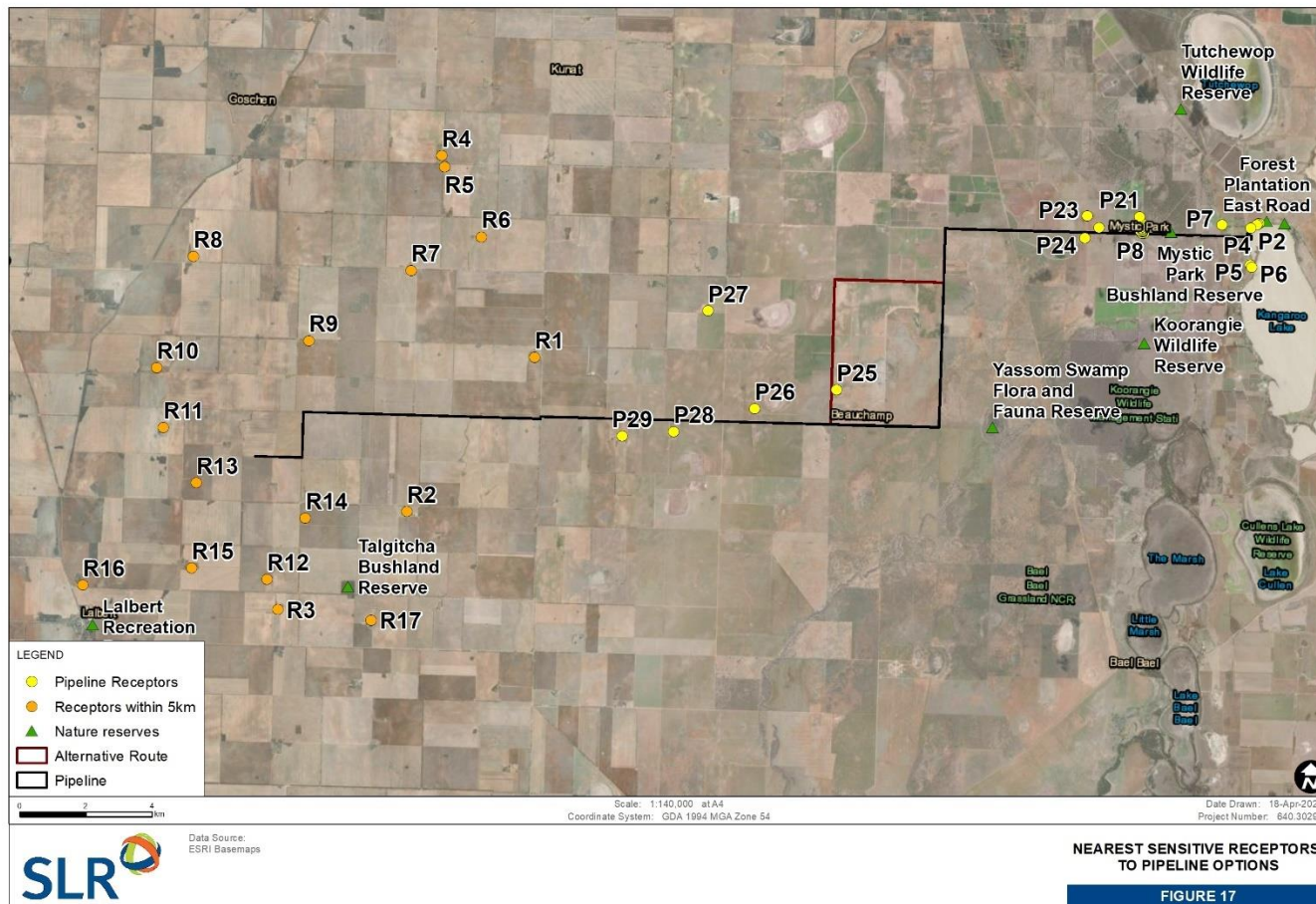
#### 9.1.2 Water Pipeline

The installation of the 38 km long buried water pipeline between Kangaroo Lake and the Facility was modelled.

The pipeline will be installed by a trenching and backfilling method; a trench is dug with an excavator and the section of pipe is lowered in and connected to the previous section before the trench is backfilled and trenching is continued on the next section. Construction work will occur during EPA normal working hours only.

Two pipeline route options have been considered, as shown in **Figure 17** (shown as 'Pipeline' and 'Alternative Route'). All options begin at Mystic Park-Beauchamp Rd at Kangaroo Lake and cross Quambatook-Swan Hill Rd at the Mystic Park Beauchamp Rd intersection and run parallel to Jobling Rd, with the two routes being different between these points.

**Figure 17 Nearest Sensitive Receivers to the Pipeline Options**



## 9.2 Construction Modelling Results

This section presents construction modelling results for the Processing Plant and the Water Pipeline from Kangaroo Lake to the Processing Plant.

Noise contour intervals were selected to coincide with:

- 75 dBA which defines the threshold for aggravated noise under the EP Act
- 46 dBA which defines the Noise Protocol noise limit for day-time
- 40 dBA, being the established ERS objective ambient sound environment for Category IV land use
- 28 dBA which was the average day period background noise level measured at the quietest monitoring location during the baseline monitoring. This is a further benchmark for evaluation of ERS objective ambient sound environment for Category V natural areas and represents a low risk of audibility.

It should be noted that EPA Publication 1834 does not prescribe construction noise limits for EPA normal working hours, and the above only serve to indicate the potential or likelihood of an impact.

## 9.3 Processing Plant

### 9.3.1 Regulated Noise Impacts

Construction noise is typically classified as non-regulated noise; therefore the Noise Protocol does not prescribe noise limits for construction activities. The *civil construction building and demolition guide, EPA Publication 1834*, provides recommendations for managing construction noise.

### 9.3.2 Non-regulated Noise Impacts

**Table 27** presents the construction noise modelling results for earthworks and building. **Figure 18** and **Figure 19** show noise contour maps for the earthworks and building scenarios respectively, which also includes heavy vehicles accessing the processing plant site via Bennett Rd.

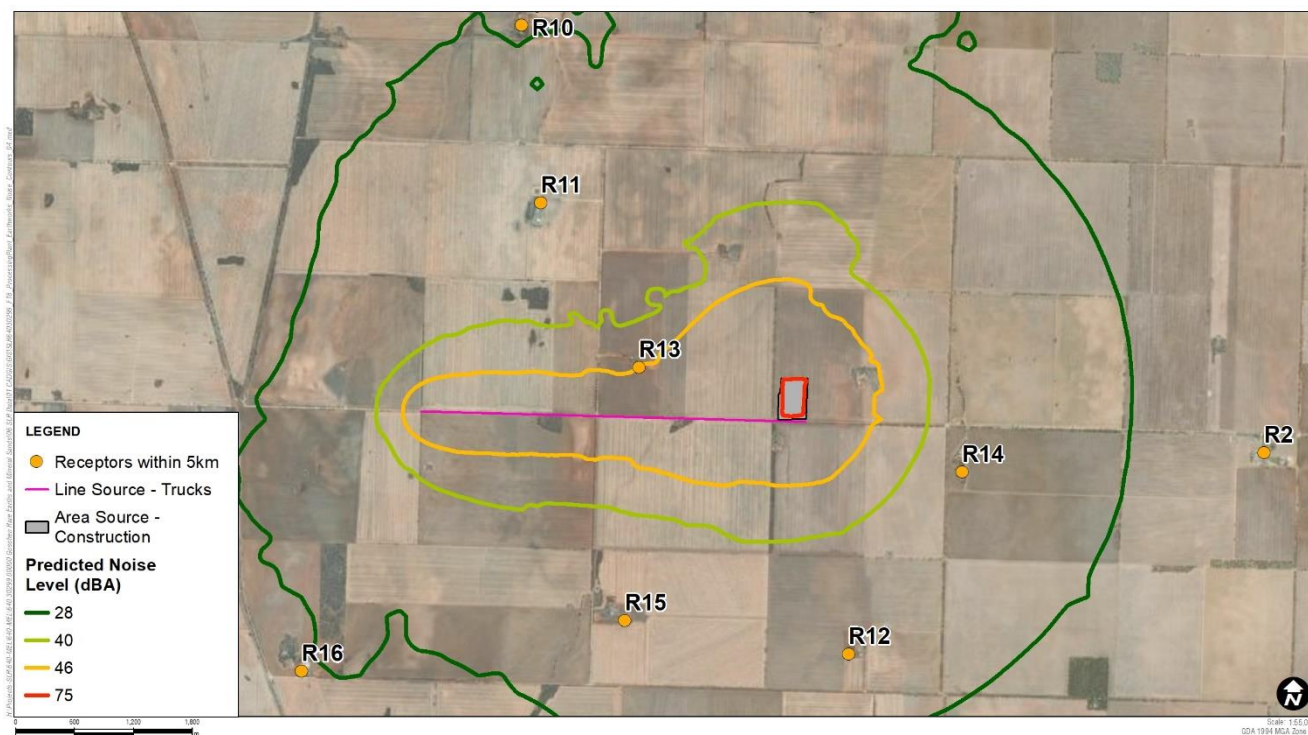
**Table 27 Processing Plant Construction Noise Results**

Receiver	Predicted Noise, Leq dBA	
	1. Earthworks	2. Building
R1	< 20	< 20
R2	23	< 20
R3	27	23
R4	< 20	< 20
R5	< 20	< 20
R6	< 20	< 20
R7	< 20	< 20
R8	22	< 20
R9	27	23

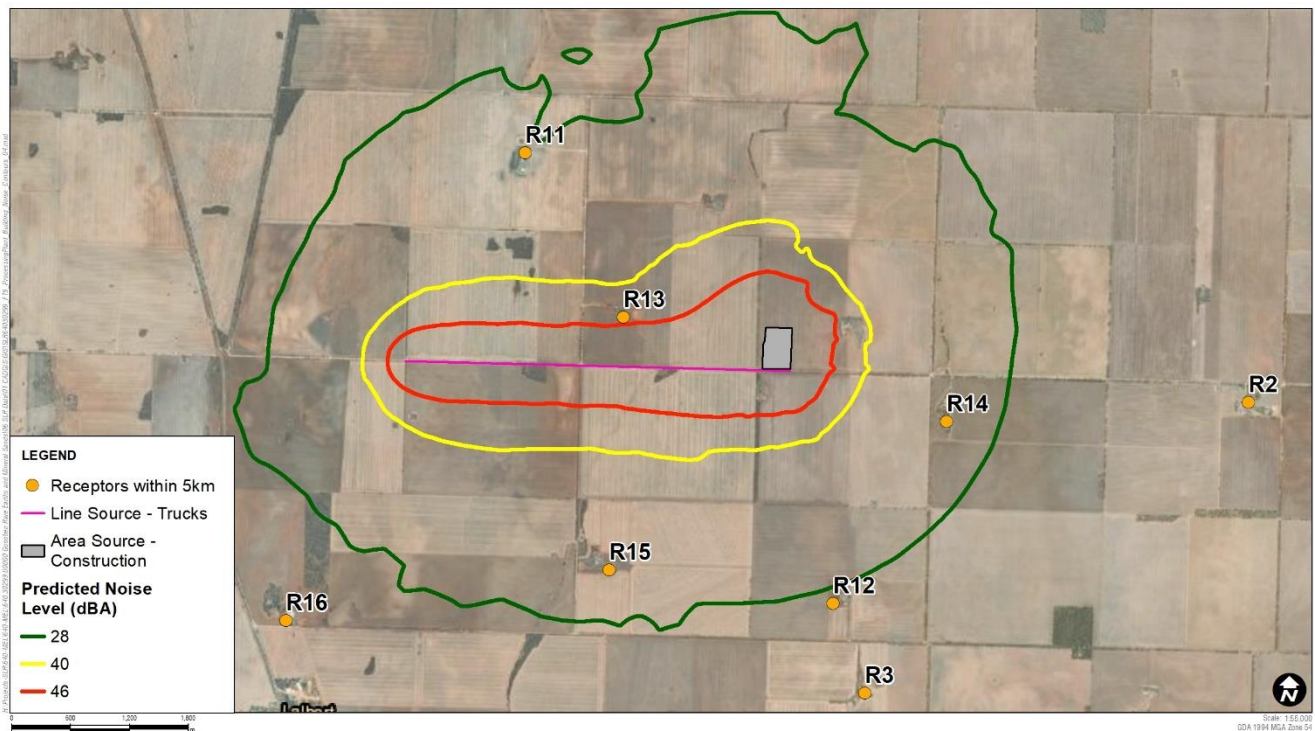


Receiver	Predicted Noise, Leq dBA	
	1. Earthworks	2. Building
R10	28	24
R11	30	28
R12	31	27
R13	45	45
R14	35	31
R15	32	30
R16	27	25
R17	21	< 20

**Figure 18 Processing Plant: Earthworks Noise Map**



**Figure 19 Processing Plant: Building Noise Map**



To assess pipeline construction noise to natural areas, predicted noise levels have been considered against the Category IV indicators and objectives in the ERS relating to Public Conservation and Resource Zone (PCRZ). **Table 28** presents the predicted noise levels at surrounding noise sensitive areas for both construction scenarios.

**Table 28 Processing Plant Construction Predicted Noise Levels (non-regulated)**

Receiver Type	Predicted noise level dBA		ERS objective noise level, $L_{eq,8h}$ dBA
	1. Earthworks	2. Building	
Lalbert Recreation Reserve	< 20	< 20	40
Talgitcha Bushland Reserve	21	21	40

### Impact:

Predicted construction noise from the main project site is likely to be below ambient background noise levels at most receivers, with only the closest receiver to the site (Receiver R13) anticipated to receive construction noise at levels above ambient. The predicted noise level at R13, 45 dBA, however, is similar to ambient noise levels (46 dBA  $L_{eq}$ , see Section 7.4.1) and is unlikely to result in adverse impact.

Predicted noise levels at the closest natural areas are below the ERS objective noise level. Construction noise is likely to be inaudible at these locations during day periods.

## Mitigation:

Works will be conducted under a Construction Environmental Management Plan (CEMP) incorporating a Noise Management Plan (NMP). Given the similar nature of the works, the management and mitigation measures will be the same as those for the operational phase (refer **Section 13**) with best practice noise control applied to building construction.

## Residual impact:

With the implementation of the management and mitigation measures the potential noise impacts at sensitive receivers are generally below ambient noise levels and the ERS objective noise level and result in no residual noise impacts.

## 9.4 Water Pipeline Construction

Noise modelling of construction of the water pipeline as detailed in Section 6.6.2 has been undertaken to determine potential impacts from construction activities during the day period.

### 9.4.1 Regulated Noise Impacts

Construction noise is typically classified as non-regulated noise; therefore the Noise Protocol does not prescribe noise limits for construction activities. The *civil construction building and demolition guide, EPA Publication 1834*, provides recommendations for managing construction noise.

### 9.4.2 Non-regulated Noise Impacts

Sound pressure levels as a function of perpendicular distance from the pipeline were calculated based on the sound power level of the anticipated equipment as construction traverses the pipeline route.

The following buffer distances have been predicted for the pipeline construction activity:

- 75 dBA at 50 m
- 46 dBA at 800 m
- 40 dBA at 1250 m
- 28 dBA at 2800 m

**Figure 20**, **Figure 21** and **Figure 23** show these buffers as offsets from the two pipeline route options. These buffer zones are used to inform the maximum impact of this work, they are not enforceable noise limits.



Figure 20 Proposed Pipeline Noise Map

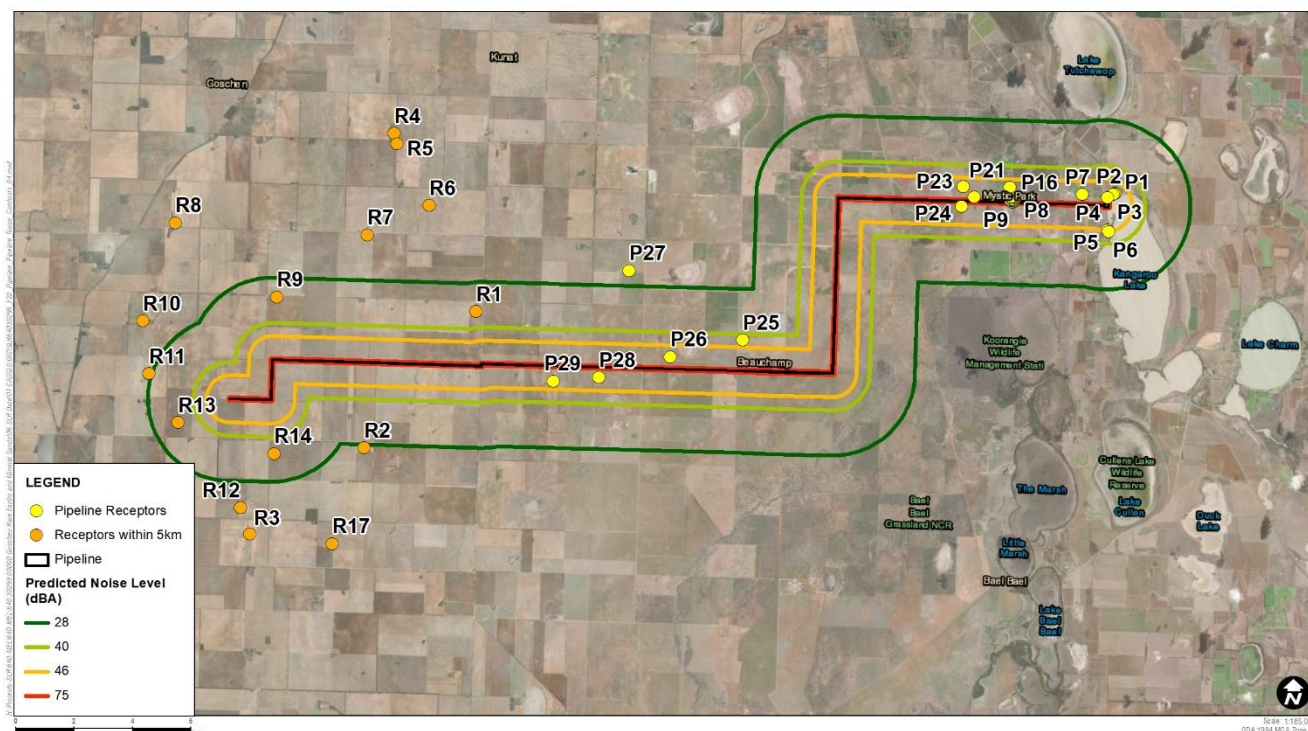
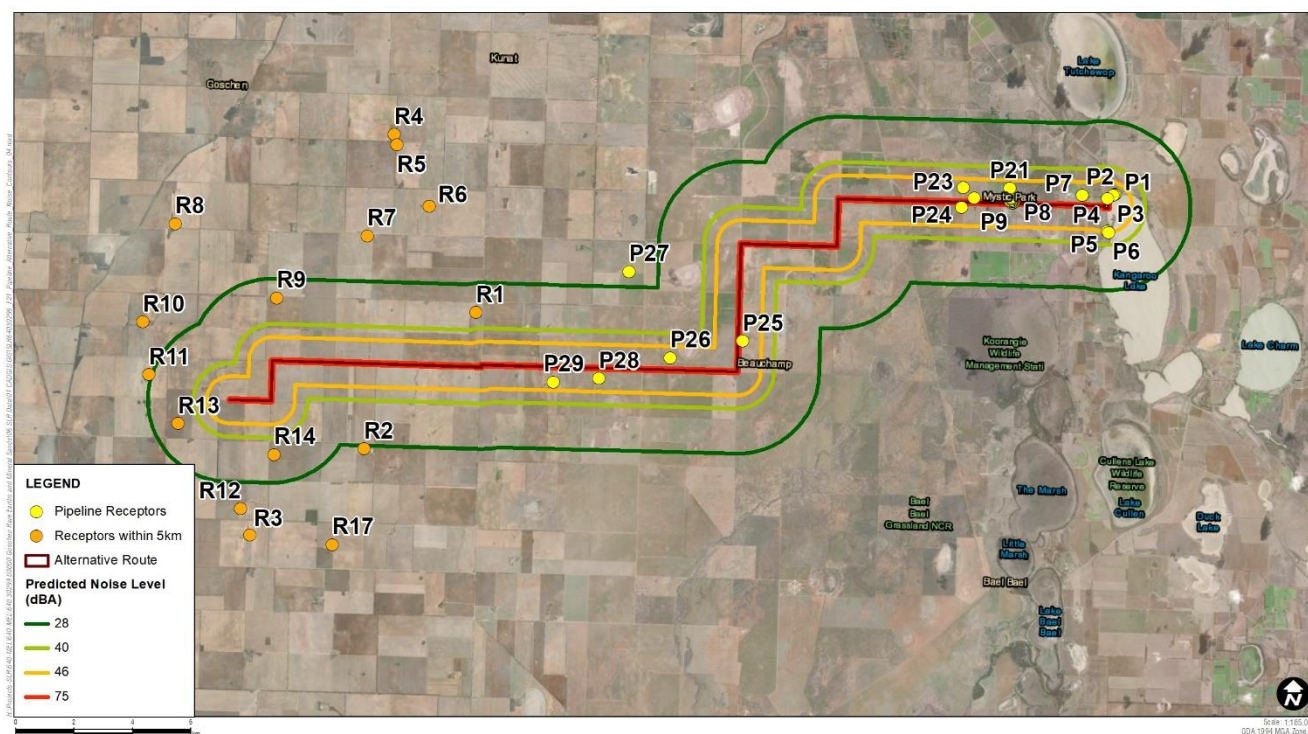


Figure 21 Alternative Route Pipeline Noise Map



To assess pipeline construction noise to natural areas, predicted noise level have been considered against the Category IV and Category V indicators and objectives in the ERS relating to Public Conservation and Resource Zone (PCRZ) and natural areas including wildlife reserves, nature reserves and flora and fauna reserves. **Table 29** presents the predicted noise levels for the three pipeline options.

**Table 29 Water Pipeline Construction – Predicted Noise Levels (natural areas)**

Receiver Type	Predicted noise level dBA		Adopted ERS objective noise level, $L_{eq,16h}$ dBA	Level of exceedance
	Proposed	Alternative Route		
Mystic Park Bushland Reserve	64	64	40	<b>24</b>
Forest Plantation East Road	49	49	40	<b>9</b>
Adj. Kangaroo Lake and Murray Valley Highway	44	44	40	<b>4</b>
Koorangie Wildlife Reserve	26	26	Qualitative	-
Yassom Swamp Flora and Fauna Reserve	< 20	< 20	Qualitative	-
Bael Bael Grassland Nature Reserve	< 20	< 20	Qualitative	-
Tutchewop Wildlife Reserve	22	22	Qualitative	-

**Impact:**

All route options pass through the township of Mystic Park, where receivers P8 to P20 are clustered. The closest sensitive receivers were identified at the intersection of Mystic Park East Road and Wilson Street, Mystic Park, see

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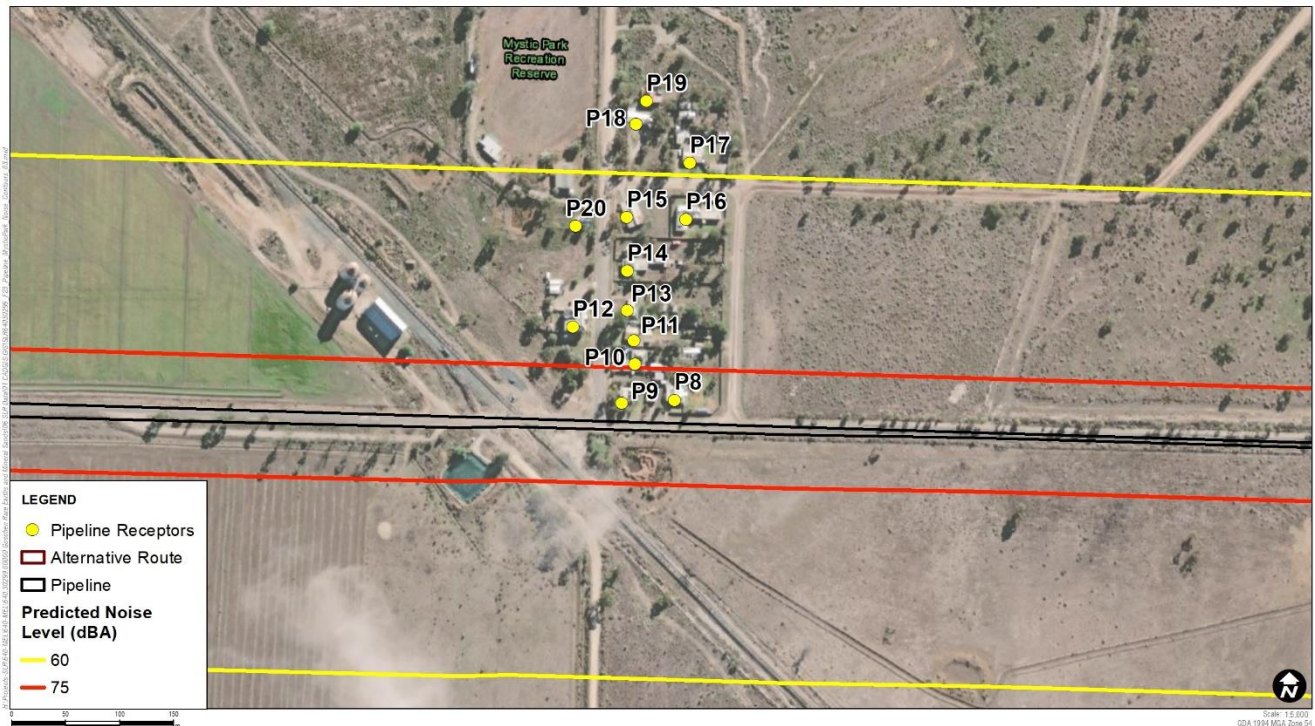
**Figure 22.** Receivers P8 and P9 are predicted to be exposed to noise levels potentially exceeding 75 dBA when the works are immediately adjacent these receivers.

The difference in predicted noise impacts between the two options is not significant, with the exception of noise to P25 which varies from option to option. However, the overall exposure (level and duration of construction) is similar or less than to other receivers in Mystic Park.

Predicted noise from water pipeline construction activity is likely to be below ambient background noise levels at those receivers close to the mining and processing plant area (R receivers), with a small number of receivers in the town of Mystic Park and along the pipeline route (P receivers) anticipated to receive construction noise at an elevated level.



**Figure 22 Mystic Park Pipeline Noise Map Detail**



During the construction of the Kangaroo Lake pumping station and the eastern-most section of the pipeline it is anticipated that the ERS objective noise level are potentially exceeded at some Category IV reserves and parks. In considering the potential ambient noise environment of these parks (proximity to Murray Valley Highway and domestic noise sources) the risk of further construction noise impact at these reserves during construction is considered to be low.

Category V natural area indicators are qualitative with the objective of preserving a long term sound quality that is conducive to human tranquillity and enjoyment having regard to the ambient natural soundscape. Construction noise at the Category V natural areas are predicted to be relatively low, due to the distance to the pipeline from these natural areas. The risk of noise impacts at these natural areas during construction is considered to be low.

### Mitigation:

Works will be conducted under a CEMP incorporating a Noise Management Plan and would occur during normal working hours only. Prior to construction commencement a programme of community consultation will be undertaken to help inform residents of the works and notification will be given to potentially impacted receivers.

### Residual impact:

As the work is short in duration (anticipated to be only a few days in Mystic Park) and would occur during day time only, the level of impact is considered manageable under a CEMP provided prior community consultation and notification occur.

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## 10 Operational Impact Assessment

This section discusses the potential impacts of the Project as a result of operation of the Project and the associated mitigation measures that aim to reduce impacts as far as reasonably practicable. Mitigation measures referred to are defined in **Section 13**.

### 10.1 Scenario 1 – Area1 Y1Q1

The projected amount of material to be mined during the first year of Area 1 is approximately half that of the highest in year 6. However, the first year of operation is deemed to have potentially the greatest noise impacts as the mine fleet is located at ground level as the topsoil and overburden must be removed and stored in onsite stockpiles before ore mining can commence.

Subsequent phases are anticipated to have a lower level of impact as; once the initial cell pits have been established, further overburden and then topsoil will be backfilled in previously mined cells, reducing onsite haulage distances.

A significant portion of the mining activities will occur in the cell pit below ground level, providing additional acoustic shielding to close receivers.

Trucks will haul the ore to the Mining Unit Plant (UP) located in the vicinity of the mine area for initial processing before being slurry pumped to the Feed Preparation Plant (FPP) and the rest of the processing circuit located in the processing plant.

Continuous operations are required initially for the establishment of the mine. Initial mine sequencing is planned to commence with mining at the eastern mid-section of Area 1 (at cells 101 and 102) and progress to the northern extent of Area 1 before returning south along the western side in a counter-clockwise direction.

Receivers R12, R13 and R14 are identified as critical receivers for Area 1 as they are the three closest receivers to the south, west and east respectively.

It is understood that an agreement will be reached with receiver R14 for the duration of works in Area 1. Whilst receiver R14 has been documented in this assessment for the purposes of completeness, it is unlikely to be considered a sensitive receiver should the Project proceed as the residents will be relocated whilst mine operations impact on the property.

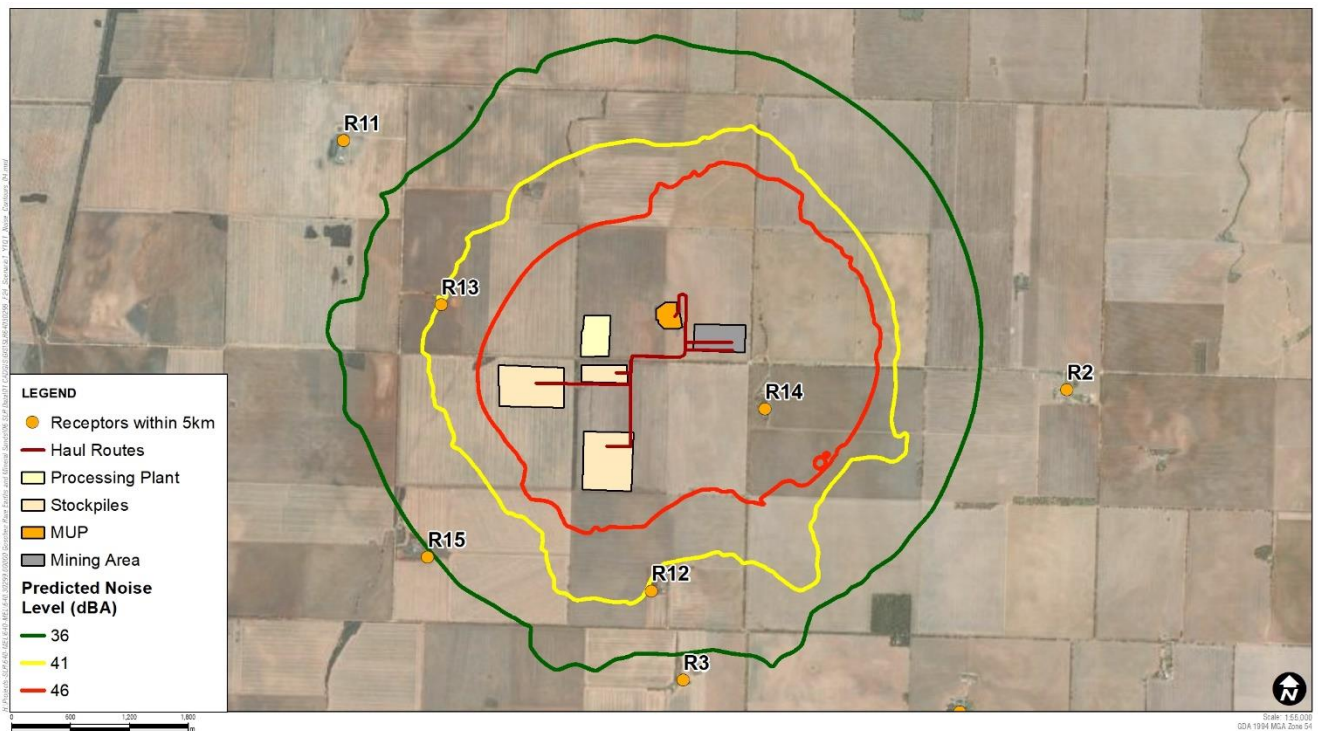
#### 10.1.1 Regulated Noise Impacts

Scenario 1 noise emissions are regulated to noise sensitive areas in accordance with the EP Act and subordinate legislation. **Table 30** presents the predicted noise levels at the sensitive receivers within 5 km of the mine.

The results have been separated into individual source contributions of the primary mine activities; processing plant, powerplant, Mine Fleet, MUP and haulage (truck movements to the MUP and stockpiles). It can be seen from **Table 30** that the dominant activities are mining and haulage.

The noise contours for the proposed initial mine operation are shown in **Figure 23**. The processing plant, MUP, mining area and stockpiles can be seen as area sources. Haulage to the stockpiles and MUP are modelled as line sources. The three noise contours have been selected to coincide with the Noise Protocol noise limits for night (green), evening (amber) and day (red).

**Figure 23 Scenario 1: Y1Q1 Noise Map**



**Table 30 Noise Model Results (dBA) - Scenario 1 - Area 1 Y1Q1**

Receiver	Area 1 Y1Q1: Mining Activity Noise Contributions, $L_{eq}$ dBA.							Noise Limit (night)	Exceed-ance
	Stock-piles	Haul	Mine Area	MUP	Power-plant	Process plant	Overall		
R1	<20	<20	<20	<20	<20	<20	21	36	-
R2	<20	30	27	<20	<20	<20	32	36	-
R3	<20	33	27	<20	<20	<20	35	36	-
R4	<20	<20	<20	<20	<20	<20	<20	36	-
R5	<20	<20	<20	<20	<20	<20	<20	36	-
R6	<20	<20	<20	<20	<20	<20	<20	36	-
R7	<20	21	<20	<20	<20	<20	22	36	-
R8	<20	22	<20	<20	<20	<20	24	36	-
R9	<20	30	23	<20	<20	<20	31	36	-
R10	<20	27	<20	<20	<20	20	29	36	-
R11	<20	31	24	<20	<20	21	33	36	-
R12	26	38	33	<20	<20	24	40	36	4

Receiver	Area 1 Y1Q1: Mining Activity Noise Contributions, $L_{eq}$ dBA.							Noise Limit (night)	Exceed-ance
	Stock-piles	Haul	Mine Area	MUP	Power-plant	Process plant	Overall		
R13	29	39	30	22	26	33	41	36	5
R14	27	50	50	33	23	29	53	36	17
R15	22	34	26	<20	<20	23	36	36	-
R16	<20	25	<20	<20	<20	<20	27	36	-
R17	<20	28	23	<20	<20	<20	30	36	-

### Impact:

In this scenario receivers R12 and R13 are predicted to exceed the 36 dBA night-time noise limit. Receiver R14 will exceed the day, evening and night limits.

It is understood that an agreement will be reached with receiver R14 for the duration of works in Area 1. Whilst receiver R14 has been documented in this assessment for the purposes of completeness, it is unlikely to be considered a sensitive receiver should the Project proceed.

Noise modelling has considered the presence of low frequency noise levels associated with operations (refer to **Appendix B**), noting that there are some technical limitations and uncertainties associated with modelling low frequency noise. Disregarding receiver R14, the predictive assessment indicates that the EPA LFN Guidelines threshold levels are potentially exceeded at R3, R12, R13, and R15. Predicted exceedances range from 2 dB to 6 dB at 80 Hz at these receivers. It should be noted that EPA LFN Guidelines threshold levels are not set limits, but rather they are levels that indicate a potential risk of problematic low frequency noise.

### Mitigation:

A limited amount (~ 1 dB) of additional beneficial mitigation could be gained at receiver R12 by constructing a 6 m earth bund from the initially mined topsoil immediately to the south of cell 101.

The mining fleet operating in the mine area is the primary source for both overall levels and LFN. The mine fleet is modelled at operating at surface level and at 100% utilisation. In actuality part of the fleet will be below ground level as the mine cells are excavated, providing some acoustic shielding to nearby receivers. This will help reduce exposure to LFN.

### Residual Impact:

Compliance to day period noise limits cannot be achieved at R14. It is understood that an agreement will be reached with receiver R14 for the duration of works in Area 1. All other receivers are able to meet the day time noise limit.

It may be possible to further reduce noise levels at R12 and R13 to meet the night-time noise limit through:

- addition of engineered noise suppression kits to haul fleet vehicles
- higher levels of noise suppression on the processing plant building
- restricting mining activities to below ground pits only.

The viability of these solutions will be evaluated during detailed design.

### 10.1.2 Non-Regulated Noise Impacts

Scenario 1 noise emissions are non-regulated in relation to human tranquillity and enjoyment outdoors in natural areas. To assess Scenario 1 impacts to natural areas, predicted noise levels have been considered against the Category IV indicators and objectives in the ERS relating to Public Conservation and Resource Zone (PCRZ) areas at Talgitcha Bushland Reserve and Lalbert Recreation Reserve. **Table 31** presents the predicted noise levels at surrounding noise sensitive areas.

**Table 31 Scenario 1 – Predicted Noise Levels (non-regulated)**

Receiver Type	Category	Predicted noise level dBA	Established ERS objective noise level, Leq,8h dBA	Level of exceedance
Lalbert Recreation Reserve	IV	25	35	0
Talgitcha Bushland Reserve	IV	34	35	0

#### Impact:

The ERS objective levels are typical ambient sound level values and are neither noise limits nor noise design criteria.

Predicted noise from the Project is not expected to exceed the ERS objective noise levels for the Category IV land use (PCRZ) zones of Lalbert Recreation Reserve and Talgitcha Bushland Reserve.

Noise from the Project will likely be inaudible from Lalbert Recreation Reserve and occasionally audible from Talgitcha Bushland Reserve.

#### Mitigation:

There are limited opportunities to further mitigate noise to the nearby park and recreational areas.

#### Residual Impact:

Noise to the park and recreational areas is to be minimised so far as reasonably practicable.



## 10.2 Scenario 2 – Area1 Y6Q2

Noise modelling of operations as detailed in **Section 6.6.3** has been undertaken to determine noise impacts from mining the southern cells of Area 1 during the day period only.

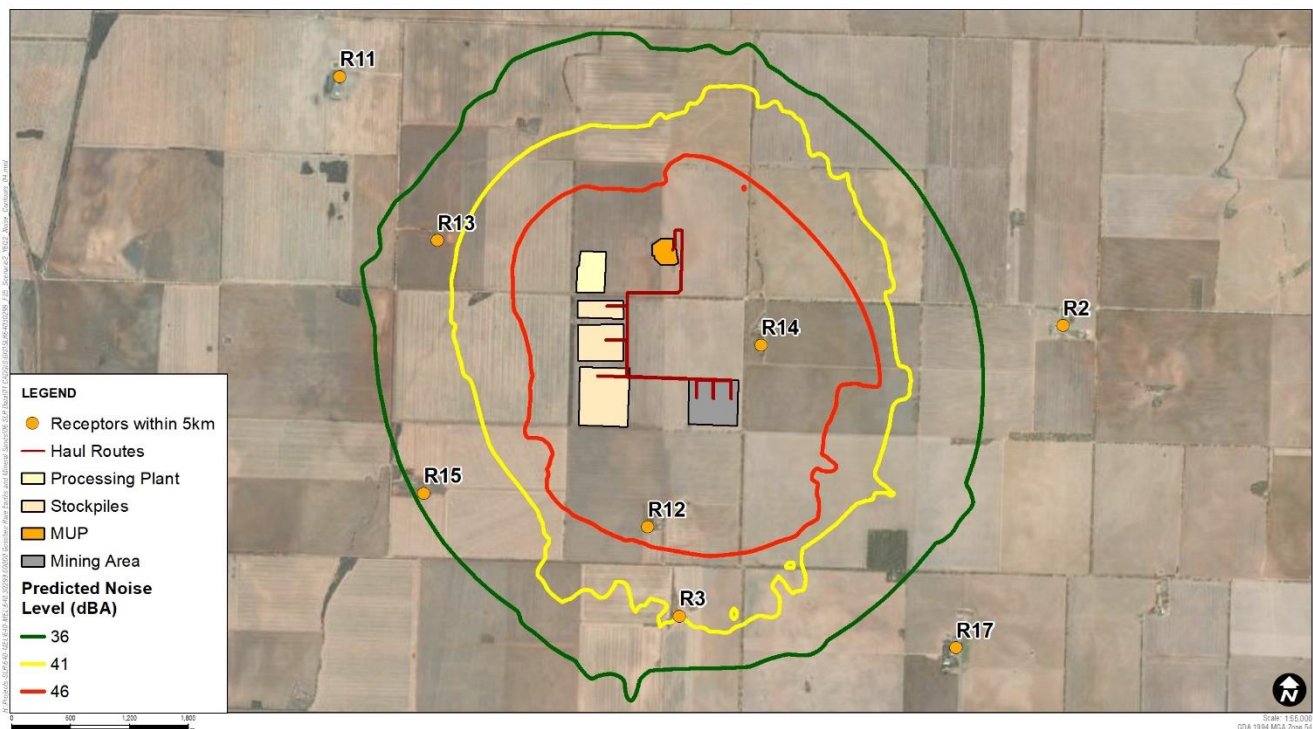
The mining schedule indicates that the maximum amount of material to be mined in Area 1 will occur during year 6. During year 6, quarter 2 (Y6Q2) the distance between the mining blocks (cells 127 and 126) and the stockpiles is relatively far, increasing the potential for longer truck movements and therefore potentially greater haul truck noise emissions, however the percentage of material sent to stockpile is significantly reduced as a much material is used to backfill block 125.

### 10.2.1 Regulated Noise Impacts

Scenario 2 noise emissions are regulated to noise sensitive areas in accordance with the EP Act and subordinate legislation. Scenario 2 simulates mining operations at the southern part of Area 1, closest to receiver R12 (cells 125, 126 and 127).

**Figure 24** and **Table 32** show the noise contour maps and results tables for this scenario.

**Figure 24 Scenario 2 – Y6Q2 Noise Map**



**Table 32 Noise Model Results (dBA) - Scenario 2 - Area 1 Y6Q2**

Receiver	Area 1 Y6Q2: Mining Activity Noise Contributions, $L_{eq}$ , dBA.							Noise Limit (day)	Exceed- ance
	Stock-piles	Haul	Mine Area	MUP	Power-plant	Process plant	Overall		
R1	<20	<20	<20	<20	<20	<20	20	46	-
R2	<20	31	26	<20	<20	<20	32	46	-
R3	20	37	34	<20	<20	<20	41	46	-
R4	<20	<20	<20	<20	<20	<20	<20	46	-
R5	<20	<20	<20	<20	<20	<20	<20	46	-
R6	<20	<20	<20	<20	<20	<20	<20	46	-
R7	<20	<20	<20	<20	<20	<20	21	46	-
R8	<20	20	<20	<20	<20	<20	22	46	-
R9	<20	28	<20	<20	<20	<20	29	46	-
R10	<20	25	<20	<20	<20	20	28	46	-
R11	<20	29	21	<20	<20	21	31	46	-
R12	26	42	39	<20	<20	24	47	46	1
R13	24	36	28	22	26	33	39	46	-
R14	28	55	51	33	23	29	56	46	10
R15	22	35	29	<20	<20	23	36	46	-
R16	<20	25	<20	<20	<20	<20	27	46	-
R17	<20	31	27	<20	<20	<20	32	46	-

#### Impact:

Operations in this area are limited to day period only. A minor exceedance at receiver R12 and a significant exceedance at receiver R14 is predicted for mining and hauling activities during day periods.

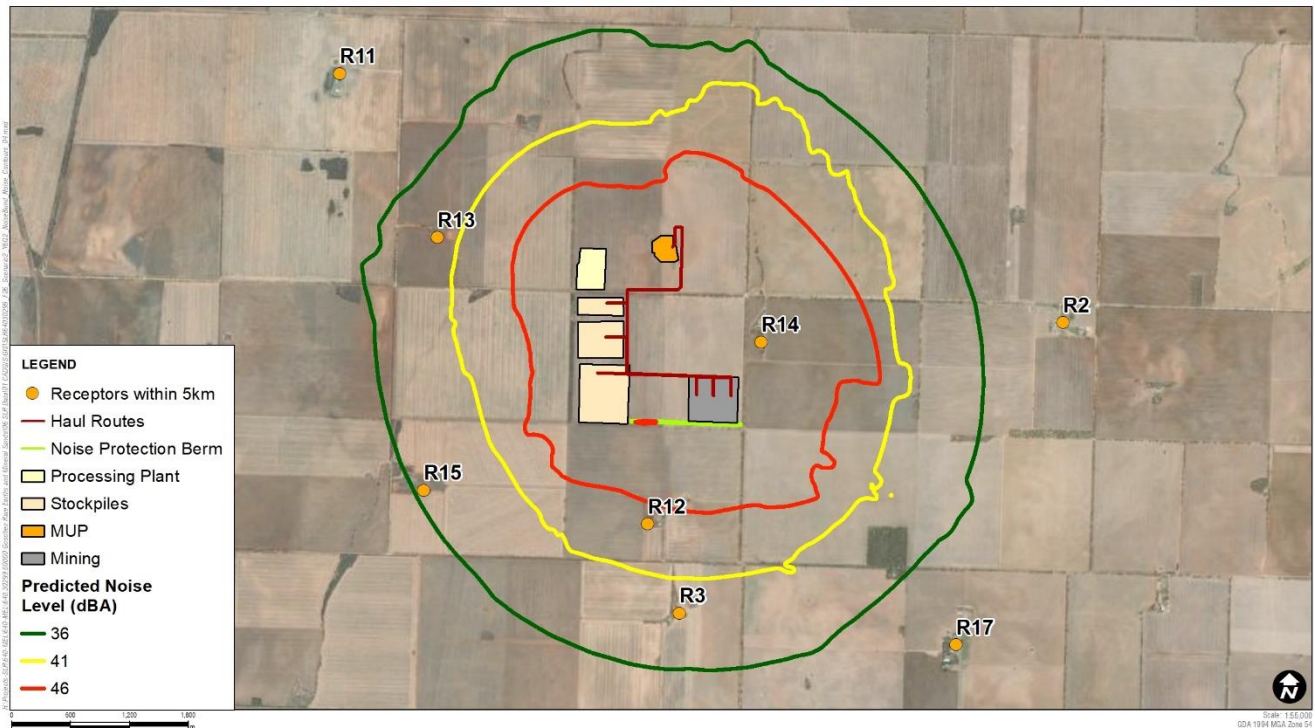
Noise modelling has considered the presence of low frequency noise levels associated with operations (refer to **Appendix B**), noting that there are some technical limitations and uncertainties associated with modelling low frequency noise. Disregarding receiver R14, the predictive assessment indicates that the EPA LFN Guidelines threshold levels are potentially exceeded at receivers R3, R12, R13 and R15. Predicted exceedances range from 4 dB to 11 dB at 80 Hz at these receivers. It should be noted that EPA LFN Guidelines threshold levels are not set limits, but rather they are levels that indicate a potential risk of problematic low frequency noise.

#### Mitigation:

Some beneficial mitigation can be gained at receiver R12 by constructing a 6 m earth bund from the initially mined topsoil immediately to the south of cells 125, 126, 127 and 128. The results for this option are shown in **Figure 25** and **Table 33**.

The mining fleet operating in the mine area is the primary source for both overall levels and LFN. The mine fleet is modelled at operating at surface level and at 100% utilisation. In actuality part of the fleet will be below ground level as the mine cells are excavated, providing some acoustic shielding to nearby receivers. This will help reduce exposure to LFN.

**Figure 25 Scenario 2 – Y6Q2 Noise Map – with Noise Bund**



**Table 33 Noise Model Results (dBA) - Scenario 2 - Area 1 Y6Q2 incl. Noise Bund**

Receiver	Area 1 Y1Q1 Bund: Mining Activity Noise Contributions, Leq, dBA.							Noise Limit (day)	Exceedance
	Stock-piles	Haul	Mine Area	MUP	Power-plant	Process plant	Overall		
R1	<20	<20	<20	<20	<20	<20	20	46	-
R2	<20	30	26	<20	<20	<20	32	46	-
R3	20	36	34	<20	<20	<20	39	46	-
R4	<20	<20	<20	<20	<20	<20	<20	46	-
R5	<20	<20	<20	<20	<20	<20	<20	46	-
R6	<20	<20	<20	<20	<20	<20	<20	46	-
R7	<20	<20	<20	<20	<20	<20	21	46	-
R8	<20	<20	<20	<20	<20	<20	22	46	-
R9	<20	27	<20	<20	<20	<20	29	46	-
R10	<20	25	<20	<20	<20	20	28	46	-
R11	<20	29	21	<20	<20	21	31	46	-

Receiver	Area 1 Y1Q1 Bund: Mining Activity Noise Contributions, $L_{eq}$ , dBA.							Noise Limit (day)	Exceedance
	Stock-piles	Haul	Mine Area	MUP	Power-plant	Process plant	Overall		
R12	26	41	39	<20	<20	24	44	46	-
R13	24	35	28	22	26	33	39	46	-
R14	28	54	51	33	23	29	56	46	10
R15	22	34	29	<20	<20	23	36	46	-
R16	<20	24	<20	<20	<20	<20	27	46	-
R17	<20	30	27	<20	<20	<20	32	46	-

Day period compliance can be achieved at receiver R12 with the inclusion of the earth bund. The noise limits for all of the day, evening and night periods would be exceeded at R14.

Disregarding receiver R14, the predictive assessment indicates that the EPA LFN Guidelines threshold levels are potentially exceeded at receivers R3, R12, R13 and R15. Predicted exceedances range from 2 dB to 9 dB at 80Hz at these receivers.

### Residual Impact:

Compliance to day period noise limits cannot be achieved at R14. It is understood that an agreement will be reached with receiver R14 for the duration of works in Area 1.

Operations have been limited to day periods, reducing the risk of LFN impacts.

### 10.2.2 Non-regulated Noise Impacts

Scenario 2 noise emissions are non-regulated in relation to human tranquillity and enjoyment outdoors in natural areas. To assess Scenario 2 impacts to natural areas, predicted noise levels have been considered against the Category IV indicators and objectives in the ERS relating to Public Conservation and Resource Zone (PCRZ) areas at Talgitcha Bushland Reserve and Lalbert Recreation Reserve. **Table 34** presents the predicted noise levels at surrounding noise sensitive areas.

**Table 34 Scenario 2 – Predicted Noise Levels (non-regulated)**

Receiver	Category	Predicted noise level dBA	ERS objective noise level, $L_{eq,8h}$ dBA	Level of exceedance
Lalbert Recreation Reserve	IV	26	35	0
Talgitcha Bushland Reserve	IV	37	35	2

### Impact:

Predicted noise from the Project is not expected to exceed the ERS objective noise levels for the Category IV land use (PCRZ) zone of Lalbert Recreation Reserve and may exceed the ERS objective noise levels at Talgitcha Bushland Reserve by 2 dB.

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Noise from the Project will likely be inaudible from Lalbert Recreation Reserve and occasionally audible from Talgitcha Bushland Reserve. Amenity is unlikely to be affected during operational hours at either location.

**Mitigation:**

There are limited opportunities to further mitigate noise to the nearby park zones.



## 10.3 Scenario 3 – Area3 Y11Q3

Noise modelling of operations as detailed in **Section 6.6.3**, has been undertaken to determine noise impacts from mining the northern cells of Area 3 during day periods only.

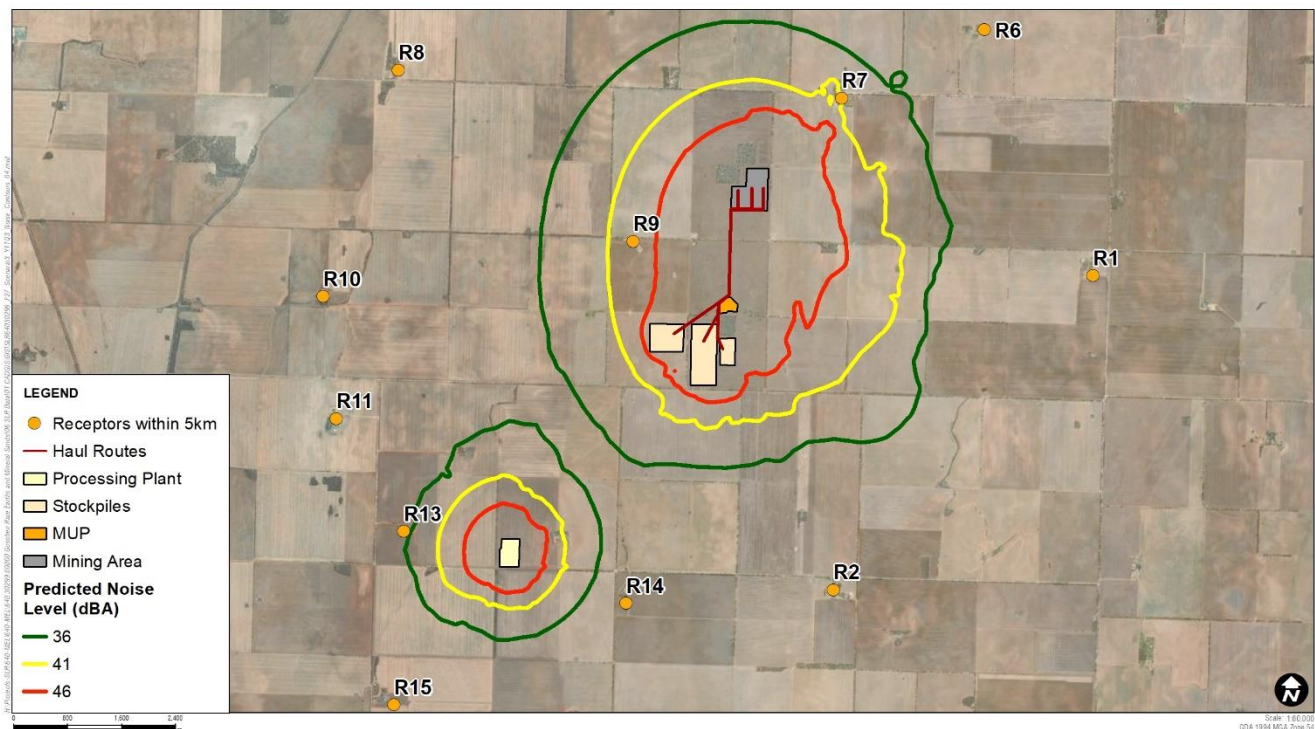
The sensitive receivers are more distant from mining in Area 3. The two critical receivers are R9 (to the west) and R7 (northeast). It is understood that R9 has been acquired by VHM and will be used as an administrative office for the duration of works in Area 3. Whilst receiver R9 has been documented in this assessment for the purposes of completeness, it is unlikely to be considered a sensitive receiver should the Project proceed.

The Projected amount of material to be mined during the initial few years (year 8 - year 12) of the mining Area 3 is approximately half that of the highest in year 19. However, the distance between the mining blocks (Cell 112 and 111) and receiver R7 is anticipated to be at a minimum during year 11, quarter 3 (Y11Q3).

### 10.3.1 Regulated Noise Impacts

Scenario 3 noise emissions are regulated to noise sensitive areas in accordance with the EP Act and subordinate legislation. **Figure 26** and **Table 35** presents the noise contour maps and receiver levels for this scenario.

**Figure 26 Scenario 3 –Y11Q3 Noise Map**



**Table 35 Noise Model Results (dBA) - Scenario 3 - Y11Q3**

Receiver	Area 3 Y11Q3: Mining Activity Noise Contributions, $L_{eq}$ dBA.							Noise Limit (day)	Exceed-ance
	Stock-piles	Haul	Mine Area	MUP	Power-plant	Process plant	Overall		
R1	<20	27	21	<20	<20	<20	28	46	-
R2	<20	27	<20	<20	<20	<20	28	46	-
R3	<20	21	<20	<20	<20	<20	24	46	-
R4	<20	28	22	<20	<20	<20	29	46	-
R5	<20	25	21	<20	<20	<20	27	46	-
R6	<20	28	24	<20	<20	<20	30	46	-
R7	<20	39	38	<20	<20	<20	42	46	-
R8	<20	26	<20	<20	<20	<20	27	46	-
R9	25	42	35	26	<20	<20	43	46	-
R10	<20	25	<20	<20	<20	20	27	46	-
R11	<20	24	<20	<20	<20	21	27	46	-
R12	<20	22	<20	<20	<20	24	27	46	-
R13	<20	24	<20	<20	26	33	34	46	-
R14	<20	27	<20	<20	23	29	32	46	-
R15	<20	20	<20	<20	<20	23	26	46	-
R16	<20	<20	<20	<20	<20	<20	21	46	-
R17	<20	21	<20	<20	<20	<20	22	46	-

#### Impact:

Predicted operational noise from the site is below the Noise Protocol limits at noise sensitive areas. Mining is anticipated to be undertaken during the day period only.

Notwithstanding that there are limitations associated with modelling low frequency noise impacts, the noise modelling has considered the presence of low frequency noise associated with operational activities and indicates that the EPA LFN Guidelines threshold levels are potentially exceeded at R7 by up to 4 dB at 80 Hz due to works, resulting in a low risk of problematic low frequency noise.

#### Mitigation:

Operations have been limited to the day period, mitigating potential impacts during the night period.

For the duration of mining in Area 3 receiver R9, which has been acquired by VHM, will be used as an administrative office.

#### Residual Impact:

Residual Impacts to noise sensitive areas are minimised so far as reasonably practicable.



### 10.3.2 Non-Regulated Noise Impacts

Scenario 3 noise emissions are non-regulated in relation to human tranquillity and enjoyment out doors in natural areas. To assess Scenario 3 impacts to natural areas, predicted noise levels have been considered against the Category IV indicators and objectives in the ERS relating to Public Conservation and Resource Zone (PCRZ) areas at Talgitcha Bushland Reserve and Lalbert Recreation Reserve. **Table 36** presents the predicted noise levels at surrounding noise sensitive areas.

**Table 36 Scenario 3 – Predicted Noise Levels (non-regulated)**

Receiver	Category	Predicted noise level dBA	ERS objective noise level, $L_{eq,8h}$ dBA	Level of exceedance
Lalbert Recreation Reserve	IV	< 20	35	0
Talgitcha Bushland Reserve	IV	25	35	0

#### Impact:

The ERS objective levels are typical ambient sound level values and are neither noise limits nor noise design criteria.

Predicted noise from the Project is not expected to exceed the ERS objective noise levels for the Category IV land use (PCRZ) zones of Lalbert Recreation Reserve and Talgitcha Bushland Reserve.

Noise from the Project will likely be inaudible from Lalbert Recreation Reserve and Talgitcha Bushland Reserve.

#### Mitigation:

There are limited opportunities to further mitigate noise to the nearby park and recreational areas.

#### Residual Impact:

Noise to the park and recreational areas is likely to be minimised so far as reasonably practicable.

## 10.4 Scenario 4 – Area3 Y15Q2

Noise modelling of operations as detailed in **Section 6.6.3** has been undertaken to determine noise impacts from mining the southern cells of Area 3 during day, evening and night periods.

The amount of material to be mined during the year 15, quarter 2 (Y15Q2) is relatively high and all of it is to be transported by truck to the topsoil, clay and overburden stockpiles or to the MUP.

### 10.4.1 Regulated Noise Impacts

Scenario 4 noise emissions are regulated to noise sensitive areas in accordance with the EP Act and subordinate legislation. Scenario 4 simulates mining operating at the southern part of Area 3.

**Figure 27** and **Table 37** shows the noise contour maps and results tables respectively.

Figure 27 Scenario 4 Area 3 Y15Q2 Noise Map

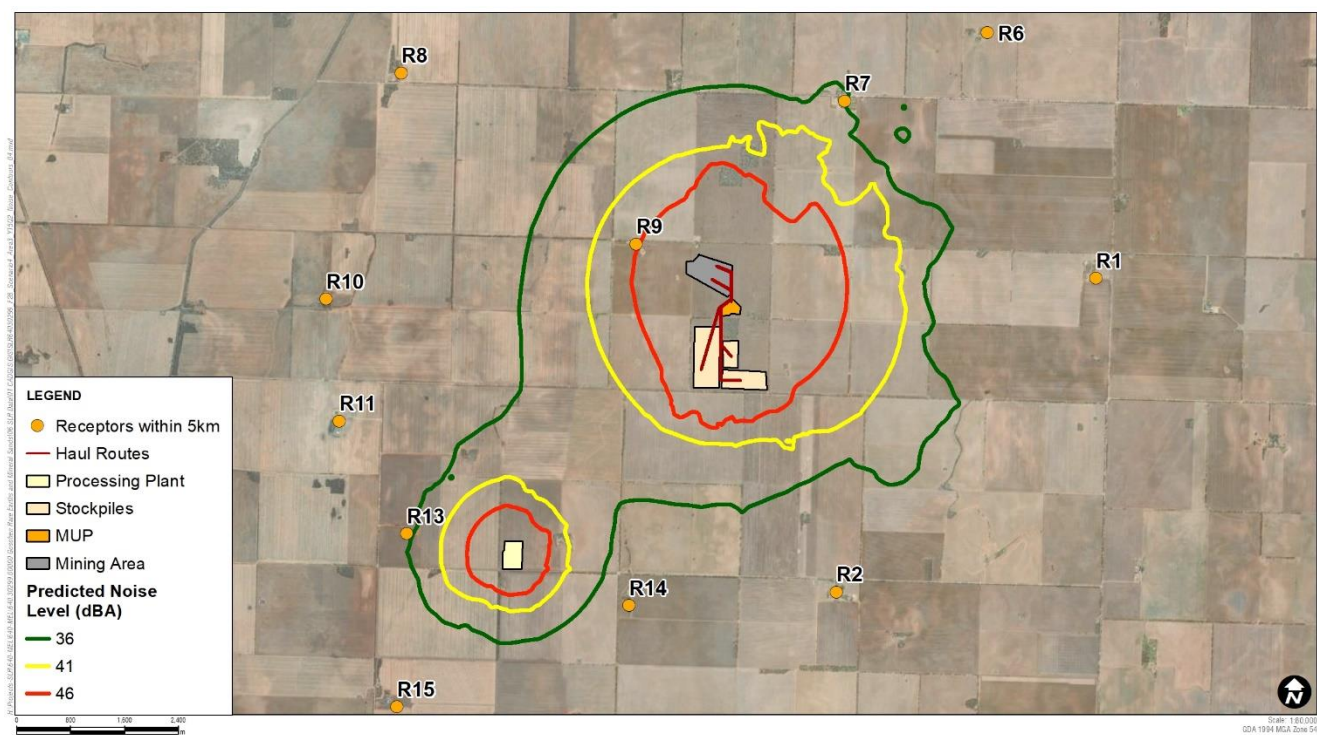


Table 37 Noise Model Results (dBA) - Scenario 4 - Area 3 Y15Q2

Receiver	Area 3 Y15Q2: Mining Activity Noise Contributions, Leq, dBA.							Noise Limit (night)	Exceed-ance
	Stock-piles	Haul	Mine Area	MUP	Power-plant	Process plant	Overall		
R1	<20	26	21	<20	<20	<20	27	36	-
R2	<20	29	21	<20	<20	<20	30	36	-
R3	<20	22	<20	<20	<20	<20	25	36	-
R4	<20	27	20	<20	<20	<20	28	36	-
R5	<20	24	<20	<20	<20	<20	25	36	-
R6	<20	26	20	<20	<20	<20	28	36	-
R7	<20	36	31	<20	<20	<20	<b>37</b>	36	<b>1</b>
R8	<20	25	20	<20	<20	<20	27	36	-
R9	22	43	41	26	<20	<20	<b>45</b>	36	<b>8</b>
R10	<20	25	<20	<20	<20	20	27	36	-
R11	<20	25	<20	<20	<20	21	28	36	-
R12	<20	23	<20	<20	<20	24	28	36	-
R13	<20	25	<20	<20	26	33	34	36	-
R14	<20	28	21	<20	23	29	33	36	-
R15	<20	21	<20	<20	<20	23	26	36	-
R16	<20	<20	<20	<20	<20	<20	21	36	-

Receiver	Area 3 Y15Q2: Mining Activity Noise Contributions, $L_{eq}$ , dBA.							Noise Limit (night)	Exceedance
	Stock-piles	Haul	Mine Area	MUP	Power-plant	Process plant	Overall		
R17	<20	22	<20	<20	<20	<20	23	36	-

### Impact:

Whilst the material throughput is high for this quarter, the mined cells are generally further from receivers (apart from receiver R9).

Night time exceedance of 8 dB is predicted at receiver R9, however this property has been acquired by VHM and will be used as an administrative office. A minor night time exceedance (1 dB) is predicted at R7.

Notwithstanding that there are limitations associated with modelling low frequency noise impacts, the noise modelling has considered the presence of low frequency noise associated with operational activities and indicates that the EPA LFN Guidelines threshold is potentially exceeded by 1 dB at 80 Hz at R7 due to works, resulting in a low risk of problematic low frequency noise.

### Mitigation:

For the duration of mining in Area 3 receiver R9, which has been acquired by VHM, will be used as an administrative office.

It is anticipated that the predicted minor exceedance at receiver R7 would be resolved through a combination of:

- Restricting mining activities to below ground pits only, and
- relocating haul route further to the west, or
- providing noise bund to the north of the extraction pit area, or
- addition of engineered noise suppression kits to haul fleet vehicles

These solutions will be evaluated during detailed design.

### Residual Impacts:

Residual impacts to noise sensitive areas are minimised so far as reasonably practicable.

#### 10.4.2 Non-regulated Noise Impacts

Scenario 4 noise emissions are non-regulated in relation to human tranquillity and enjoyment out doors in natural areas. To assess Scenario 4 impacts to natural areas, predicted noise levels have been considered against the Category IV indicators and objectives in the ERS relating to Public Conservation and Resource Zone (PCRZ) areas at Talgitcha Bushland Reserve and Lalbert Recreation Reserve. **Table 38** presents the predicted noise levels at surrounding noise sensitive areas.

**Table 38 Scenario 3 – Predicted Noise Levels (non-regulated)**

Receiver	Category	Predicted noise level dBA	ERS objective noise level, $L_{eq,8h}$ dBA	Level of exceedance
Lalbert Recreation Reserve	IV	< 20	35	0
Talgitcha Bushland Reserve	IV	25	35	0

**Impact:**

The ERS objective levels are typical ambient sound level values and are neither noise limits nor noise design criteria.

Predicted noise from the Project is not expected to exceed the ERS objective noise levels for the Category IV land use (PCRZ) zones of Lalbert Recreation Reserve and Talgitcha Bushland Reserve.

Noise from the Project will likely be inaudible from Lalbert Recreation Reserve and Talgitcha Bushland Reserve.

**Mitigation:**

There are limited opportunities to further mitigate noise to the nearby park and recreational areas.

**Residual Impact:**

Noise to the park and recreational areas is likely to be minimised so far as reasonably practicable.

## 10.5 Pumping Station - Kangaroo Lake

Noise modelling of existing operations at Kangaroo Lake, as detailed in **Section 6.6.4**, has been undertaken to determine noise impacts from the pumping station to nearby sensitive areas.

### 10.5.1 Regulated Noise Impacts

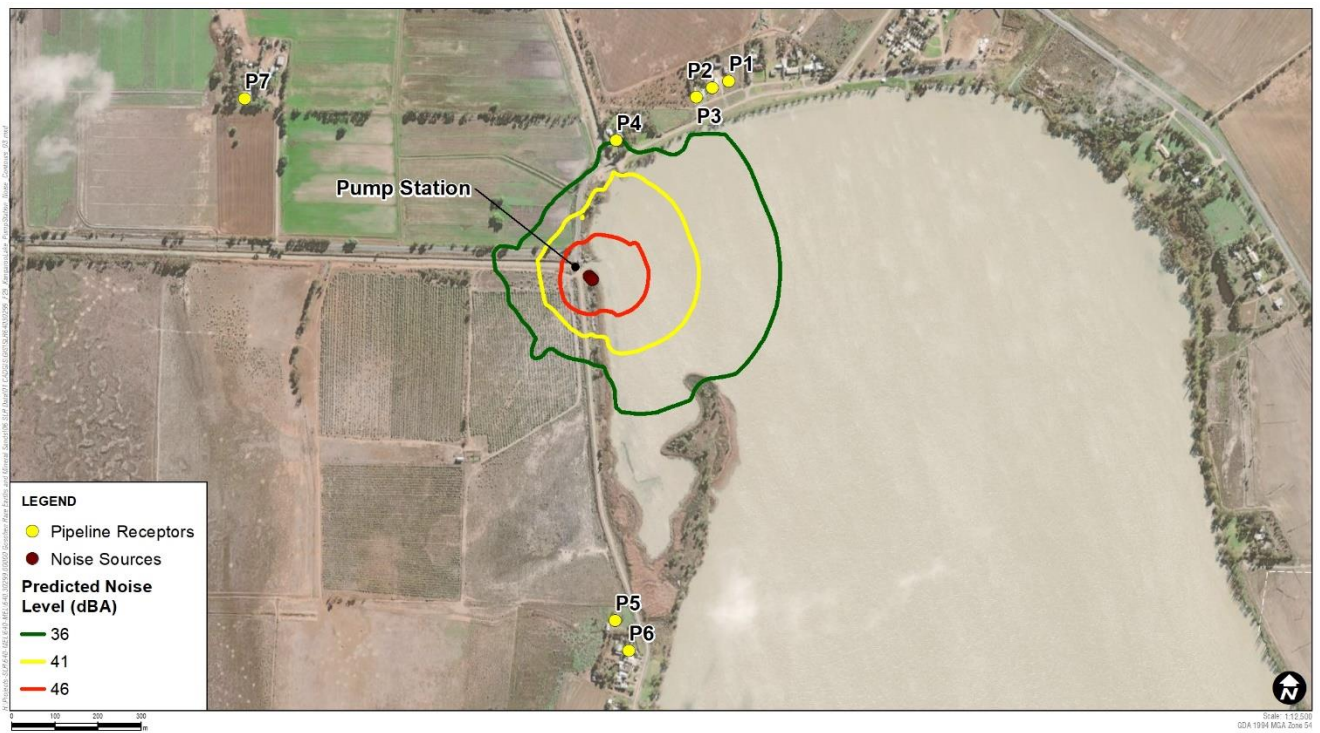
Noise emissions are regulated to noise sensitive areas in accordance with the EP Act and subordinate legislation. A maximum allowable noise level of 36 dBA applies to regulated noise emissions during the night period.

**Table 39** shows the predicted sound pressure levels at the closest receivers and **Figure 28** presents the noise contour map.

**Table 39 Noise Model Results (dBA) - Scenario 5 – Pumping Station**

Receiver	Distance to Pump Station, m	Predicted Receiver Noise Levels, $L_{eq}$ , dBA	Noise Limit (Night), dBA	Exceedance
P1	560	30	36	-
P2	530	27	36	-
P3	490	28	36	-
P4	300	35	36	-
P5	790	20	36	-
P6	860	< 20	36	-
P7	900	20	36	-

**Figure 28 Kangaroo Lake Pump Station Noise Map**



### Impacts:

Predicted noise from the Kangaroo Lake pump station is below the Noise Protocol noise limits at noise sensitive areas. Receiver P4, located 300 m north of the pump station was identified as the closest receiver and the diesel generator case breakout noise was the dominant noise source. Noise from the electric motors and pumps are negligible at the closest receiver.

Notwithstanding that there are limitations associated with modelling low frequency noise impacts, the noise modelling has considered the presence of low frequency noise associated with operational activities and indicates that the EPA LFN Guidelines threshold levels are predicted to be exceeded at P4 by 3 dB at 80 Hz, resulting in a low risk of problematic low frequency noise.

### Mitigation:

Noise from the diesel generator will be controlled via an acoustic enclosure and silencer and will be reviewed during detailed design to ensure compliance with the noise limits and the EPA LFN Guidelines. Consideration of cumulative noise impacts from existing pumping infrastructure will also be accounted for in the design.

### Residual Impacts:

With the implementation of the mitigation strategies, residual noise impacts to noise sensitive areas are likely to be minimised so far as reasonably practicable.



### 10.5.2 Non-regulated Noise Impacts

The Kangaroo Lake pump station noise emissions are non-regulated to human tranquillity and enjoyment outdoors in natural areas. To assess potential impacts, predicted noise levels have been considered against the Category IV and Category V indicators and objectives in the ERS relating to Public Conservation and Resource Zone (PCRZ) and natural areas such as wildlife reserves, nature reserves and flora and fauna reserves.

**Table 40** presents the predicted noise levels at surrounding noise sensitive areas.

**Table 40 Kangaroo Lake Pump Station – Predicted Noise Levels (non-regulated)**

Receiver	Category	Predicted noise level dBA	ERS objective noise level, $L_{eq,8h}$ dBA	Level of exceedance
Mystic Park Bushland Reserve	IV	< 20	35	0
Forest Plantation East Road	IV	24	35	0
Adj. Kangaroo Lake and Murray Valley Highway	IV	< 20	35	0
Koorangie Wildlife Reserve	V	< 20	Qualitative	-
Yassom Swamp Flora and Fauna Reserve	V	< 20	Qualitative	-
Bael Bael Grassland Nature Reserve	V	< 20	Qualitative	-
Tutchewop Wildlife Reserve	V	< 20	Qualitative	-

#### Impact:

The ERS objective levels are typical ambient sound level values and are neither noise limits nor noise design criteria.

Noise levels at the Category IV natural areas are predicted to be less than the objective noise level of 35 dBA. The pump station will likely be inaudible from these locations.

Category V indicators are qualitative with the objective of a sound quality that is conducive to human tranquillity and enjoyment having regard to the ambient natural soundscape. Predicted noise levels at the Category V noise sensitive areas are predicted to be less than 20 dB, due to them being located between 4 km and 9 km from the pumping station. The pump station will be inaudible from these natural areas.

#### Mitigation:

Noise from the diesel generator can be controlled by ensuring that the acoustic enclosure achieves a combined overall sound pressure level no greater than 70 dBA at 10 m.

#### Residual Impact:

With the implementation of the mitigation strategies, residual noise impacts to noise sensitive areas are likely to be minimised so far as reasonably practicable.



## 10.6 Summary of Residual Impacts

Residual impacts are those that remain once all reasonably practicable mitigation and management measures have been implemented. This section describes potential residual impacts during the operation phase of the Project, once mitigation and management measures have been considered and applied.

- Moderate exceedances (4 dBA to 7 dBA) are predicted for at R14 during day-time operation. The primary recommendation for management of R14 is that this dwelling is not to be used as a residential property for the duration of mining in Area 1. It is understood that an agreement will be reached with receiver R14 and the property would not be considered a sensitive receiver should the Project proceed as the residents will be relocated whilst mine operations impact on the property.
- Moderate exceedances are also predicted for R9 during day-time operations. The primary recommendation for management of R9 is that this dwelling is not to be used as a residential property for the duration of mining in Area 3. It is understood that the property will be used as a project operations office and therefore not considered a sensitive receiver.
- A moderate exceedance (4-5 dBA) for night-time are predicted at R12 and R13. It is anticipated that compliance can be achieved by a combination of applying:
  - addition of specialist engineered noise suppression kits to haul fleet vehicles (see below)
  - higher levels of noise suppression on the processing plant building
  - restricting mining activities to below ground pits only during the night.

The viability of these solutions will be evaluated during detailed design.

- The haul and mining mobile plant were identified as dominant noise sources for all receivers at some stage of the mine's life. A further contingency mitigation may be considered for the mobile plant (haul trucks, excavators, scrapers, dozers, etc) and includes specialist engineered noise reduction kits, where local screening is not feasible. Typically, noise suppression kits from specialist providers such as Hushpak, Mintek etc. include upgraded exhaust mufflers, acoustic louvred fan packages and acoustic treatment to engine compartments and air inlet plenums. The addition of noise suppression kits typically results in an overall reduction of approximately 5-10 dBA from the standard model. The additional cost of such engineered noise reduction kits is quite significant and hence the need for and type and extent of mitigation is best considered a contingency measure and evaluated in more detail once there is greater clarity of the operations.
- Low frequency noise impacts from the Kangaroo Lake pumping station can be controlled through the design of the generator enclosure during detailed design.

## 10.7 Project Related Traffic Noise

When considering the anticipated road network being used by the Project the relevant land-use (Category IV) has outdoor indicators and objectives of night-time  $L_{Aeq, 8h}$  (10pm to 6am) of 35 dBA and  $L_{Aeq, 16h}$  (6am to 10pm) of 40 dBA.

**Table 41** presents the predicted traffic noise levels at the closest receivers in the project area.

**Table 41 Predicted Project Traffic Noise Levels**

Receiver	Predicted Traffic Noise Levels, $L_{eq,16h}$ , dBA		Predicted Highest Single Hour, $L_{eq,1h}$ , dBA	
	Year 1 to 8	Year 8 to 20	Year 1 to 8	Year 8 to 20
R1	< 20	< 20	< 20	20
R2	< 20	< 20	< 20	22
R3	< 20	< 20	24	< 20
R4	< 20	< 20	< 20	23
R5	< 20	< 20	< 20	23
R6	< 20	< 20	< 20	23
R7	< 20	25	< 20	34
R8	30	37	35	46
R9	< 20	23	25	31
R10	25	25	31	30
R11	26	24	32	28
R12	20	< 20	27	21
R13	36	34	43	35
R14	20	< 20	27	23
R15	26	23	32	26
R16	33	30	41	38
R17	< 20	< 20	< 20	< 20

The additional traffic on local roads due to the Project is not predicted to exceed the relevant ERS  $L_{Aeq, 16h}$  objective of 40 dBA at any receiver in the project area. Furthermore, the predicted worst-case single hour ( $L_{eq,1h}$ ) during shift changeover, is only marginally above 40 dBA at two receivers.

In relation to the remaining ore product transport route outside of the project area, to the Ultima intermodal facility, noise modelling indicates that the ERS objective of 40 dBA  $L_{Aeq, 16h}$  would typically be met at 50 m from the roadway. Review of receiver locations along the possible routes indicates most dwellings are set back more than 50 m. A small number of dwellings may be closer to the road and could be exposed to project noise levels slightly higher than the ERS objectives.

Traffic movements are all anticipated to occur during the ERS day period only and therefore the environmental value of “sleep during the night” will not be compromised by project traffic.

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The mined areas will be progressively backfilled in a staged manner, with tailings dewatered in-pit to allow overburden and topsoil placement in a profile that reinstates the background soil structure. This process of rehabilitation result in the ability for a return to the current agricultural land uses within 3 – 5 years.

In qualitative terms, rehabilitation activities are typically quieter than operational activities due to the reduction in noise associated with the ceasing of high noise generating operational activities. It is expected that noise emissions associated with rehabilitation activities will be quieter than operational activities due to the progressive nature of the works and the reduced activity of noise generating equipment on site. It is also envisaged that noise emissions from rehabilitation activities will be regulated under the work plan.

## 11 Closure Phase Impact Assessment

As part of the closure and rehabilitation phase of the project, the mined areas will be progressively backfilled in a staged manner, with tailings dewatered in-pit to allow overburden and topsoil placement in a profile that reinstates the background soil structure. This process of rehabilitation result in the ability for a return to the current agricultural land uses within 3 – 5 years.

Rehabilitation activities are typically quieter than operational activities due to the reduction in noise associated with the ceasing of high noise generating operational activities. It is expected that noise emissions associated with the closure phase will be equal to or less than those associated with construction (refer **Section 9**). Mitigation measures that aim to reduce impacts to as low a level as possible are summarised in **Section 13.1**.

## 12 Cumulative Impacts

Two types of potential cumulative noise impacts have been considered for the project as follows:

- During any overlap periods of construction and operational stages.
- From any existing industry operations in or near the Project area.

### 12.1 Construction and Operational Stage Cumulative Impacts

As discussed in **Section 9.1** there is potential for some overlap of mining operations to occur during construction of the processing plant during early stages of the Project.

While construction and operational noise are considered separately in this report, and are assessed to different legislation, further consideration of cumulative noise impacts is provided below.

A conservative cumulative assessment can be provided quantitatively by ‘summing’ the predicted noise from the operational assessment for Area1 Y1Q1 (**Section 10.1**) with the predicted construction noise levels during construction of the processing plant building (**Section 9.3**).

**Table 42** shows the previously determined results of the construction stage logarithmically summed with the operational noise assessment, along with the associated noise increase (from the highest of either) during the combined works.

**Table 42 Cumulative Noise Assessment – Construction of Processing Plant and Y1Q1 of Operations**

Receiver	Predicted Noise, Leq dBA				Increase in noise
	1. Construction - Earthworks	2. Construction - Building	Operational Noise – Y1Q1	Cumulative Noise (combined noise levels from highest of construction scenarios and Operational Noise)	
R1	< 20	< 20	21	21	0
R2	23	< 20	32	33	1

Receiver	Predicted Noise, Leq dBA				Increase in noise
	1. Construction - Earthworks	2. Construction - Building	Operational Noise – Y1Q1	Cumulative Noise (combined noise levels from highest of construction scenarios and Operational Noise)	
R3	27	23	35	36	1
R4	< 20	< 20	<20	<20	0
R5	< 20	< 20	<20	< 20	0
R6	< 20	< 20	<20	< 20	0
R7	< 20	< 20	22	22	0
R8	22	< 20	24	26	2
R9	27	23	31	32	1
R10	28	24	29	32	3
R11	30	28	33	35	2
R12	31	27	40	41	1
R13	45	45	41	46	1
R14	35	31	53	53	0
R15	32	30	36	37	1
R16	27	25	27	30	3
R17	21	< 20	30	31	1
Lalbert Recreation Reserve	<20	<20	25	25	0
Talgitcha Bushland Reserve	21	21	34	34	0

NOTE: Where predicted noise levels are < 20 dB they have been assumed to not contribute to the calculated cumulative noise level.

The above summary indicates a negligible noise increase during the potential overlap works, with a 0-2 dB increase in most instances. For instances where a 3 dB increase occurs, it is noted the predicted absolute levels (32 dBA at R10, 30 dBA at R16) are well below the noise protocol operational noise limits for the day of 46 dB, below the 40 dBA established ERS objective ambient sound environment for Category IV land use, and generally not likely to be above the ambient noise environment.

On the above basis, the cumulative noise impacts are considered to be negligible.

## 12.2 Cumulative Impacts with existing industry

Noise impacts from existing industry and the Project operations have the potential to cumulatively impact sensitive receivers.

Based on our site surveys and general review of the project area and surrounds, SLR did not identify any notable industry operations that could cumulatively impact sensitive receivers that will be impacted by the Project.

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The only identified risk of cumulative noise impacts was from the proposed pumping station in Kangaroo Lake, which will be located near an existing pumping station (refer to **Figure 10**). The specific noise emissions and operational details of the existing pump station are not known at this stage. The proposed new pumping station will need to be designed to account for potential cumulative noise, as per the discussion in **Section 10.5.1** and proposed mitigation measures (**Table 43**).

## 13 Summary of Mitigation, Monitoring and Contingency Measures

### 13.1 Mitigation Measures

The mitigation measures that are proposed to avoid, mitigate or manage noise impacts associated with the Project are summarised in **Table 43**. A process will be in place to verify (e.g. via audits or inspections) that the behaviour-related measures remain implemented.

**Table 43 Mitigation Measures Relevant to Noise**

Measure ID	Mitigation Measure	Phase
1	Community consultation to occur with affected residents located in the vicinity of the site should be undertaken during the course of the Project to discuss planned activities as well as explore possible alternative noise control measures depending on each individual situation	Construction, Operation, Closure
2	Procurement of subcontracted mining fleet will include a vehicle noise emission requirement to ensure that the quietest suitable vehicles are used, that in any case their noise emissions do not exceeded the SWL used in the noise model, and that the risk of high sound energy in the low frequency range be minimised so far as reasonably practicable.	Construction, Operation
3	Procurement of noise generating fixed-plant will include a noise emission requirement to ensure that the quietest suitable vehicles are used and that in any case their noise emissions do not exceeded the SWL used in the noise model, and that the risk of high sound energy in the low frequency range be minimised so far as reasonably practicable.	Construction, Operation
4	Limiting the construction to EPA normal working hours (Mon-Fri 7 am to 6 pm, Sat 7 am to 1 pm, EPA publication 1834) with the provision that some Low-noise impact works (inherently quiet or unobtrusive) may occur during evening or night periods. All works to be carried out under a CEMP incorporating a NMP.	Construction
5	All staff to receive a site induction including details of the ways potentially impacting noise is generated, methods to minimise noise impacts both on -site and on public roads particularly for road trucks. Inspections and/or audits as part of the noise monitoring program will ensure adherence of these methods	Construction, Operation, Closure
6	Maintaining site roads in good condition to minimise noise from vehicle traffic over corrugations and pot holes.	Construction, Operation, Closure



Measure ID	Mitigation Measure	Phase
7	Turning off plant, equipment and vehicles when not in use for an extended period.	Construction, Operation, Closure
8	Fitting broadband reversing noise signals to all applicable mobile plant to avoid tonal noise emissions	Construction, Operation, Closure
9	Provide a suitable site access routes for all third-party trucks that do not involve reversing, if control over their reversing alarms is limited.	Construction, Operation, Closure
10	<p>Ensuring all plant, equipment and vehicles are fitted with appropriate noise attenuation devices as per manufacturer specification (e.g. enclosures, baffles, silencers, mufflers etc.) and all equipment is maintained in good repair.</p> <p>Type and extent of mitigation to be considered in more detail once there is greater clarity of the operations and finalised equipment selections.</p> <p>Specific consideration should be given to the effectiveness of mitigation measures with respect to low frequency noise emissions.</p> <p>Determine if such measures are to be implemented pro-actively, or are to be contingency measures (supported by evidence that it is not reasonably practicable to implement them pro-actively)</p>	Construction, Operation, Closure
11	In any area restrict the use of engine brake to ensure it is used only when justified for safety reason (long downhill slopes).	Operation
12	Develop and implement a strategy for optimising the placement and configuration of overburden stockpiles so as to provide additional noise screening to nearby receivers from noisier activities.	Operation
13	<p>Develop and implement a strategy to ensure that noise bunds are constructed as early as possible, utilising reclaimed topsoil, taking into consideration mine pit sequencing.</p> <p>Before the bunds are constructed, noise works that impact on receivers that will be eventually protected by the bunds should be avoided (or their intensity reduced)</p>	Construction, Operation
14	The Project shall incorporate the highest levels of noise control for the power station including, placing all gensets in acoustic enclosures and containing all gensets within a generator building, use of high-performance exhaust mufflers and low noise cooling radiators	Operation
15	Ore movement to offsite by road trucks limited to day hours to minimise night time impacts	Operations

Measure ID	Mitigation Measure	Phase
16	Risk of cumulative noise impacts (from existing pumps) and low frequency noise impacts from the Kangaroo Lake pumping station will be controlled by the generator performance and engineered acoustic enclosure during the detailed design stage.	Operation
17	Risk of low frequency noise impacts from the power plant will be controlled by the highest levels of noise control including, placing all gensets in acoustic enclosures within a generator building, use of high performance mufflers and low noise cooling radiators.	Operation
18	Mining operations limited to day times for certain mining blocks close to sensitive receivers as identified by noise modelling.	Operation
19	<p>A Noise Management Plan (NMP) will be proactively prepared and implemented within the Work Plan, which formally documents all of the processes and procedures to control and minimise noise from the site. The NMP will be based on an updated and validated noise model based on the results of the proposed Noise Monitoring Program and commissioning measurements.</p> <p>The NMP shall document how the risk of harm from noise will be minimised so far as reasonably practicable, and the procedures for evaluating impacts as more detailed information becomes available.</p> <p>In developing the NMP consideration shall be given to frequency spectrum as a prescribed factor and specifically the potential risk of problematic low frequency noise.</p>	Construction, Operation, Closure

## 13.2 Monitoring and Contingency Measures

The monitoring and contingency measures that are proposed to assess noise impacts associated with the Project are summarised in **Table 44**.

**Table 44 Monitoring and Contingency Measures Relevant to Noise**

Measure ID	Monitoring or Contingency Measure	Phase
1	<p>A <b>Noise Management Plan</b> will be developed proactively, which formally documents all of the managerial and engineering measures to be implemented to control noise from the site.</p> <p>The Noise Management Plan ensures that the risk of harm from noise will be minimised so far as reasonably practicable, consistent with the GED, throughout all stages of the Project.</p> <p>This will include a comprehensive <b>Noise Monitoring Programme</b> which will be implemented to determine if compliance with the noise criteria is maintained throughout the full duration of the Project, the effectiveness of noise mitigation and management measures, as well as highlight the most significant sources of noise to receivers and any opportunity to reduce them further.</p> <p><b>Commissioning noise surveys</b> will be completed for all major fixed plant components e.g. power station, processing plant, pumping station etc. to ensure they achieve their respective noise emission requirements. If any non-conformance or unanticipated additional noise sources are identified, then evaluated and options for amelioration considered.</p> <p>As the mine cells and operations will change through the duration of the Project a programme of <b>annual noise monitoring surveys</b> will be developed and implemented. Monitoring will be completed at the nearest affected receivers as well as an appropriately located reference location.</p> <p>Monitors will be used that are compliant with the relevant Australian Standards and EPA guidelines (e.g. publications 1996 and 1997)C. Monitoring will be conducted by a suitably qualified person holding NATA accreditation for the monitoring methods.</p>	Construction, Operation, Closure
2	<p>The Procurement of subcontracted mining fleet will include a vehicle noise emission requirement to ensure that the quietest suitable equipment is used, (and that in any case their noise emissions do not exceeded the SWL used in the noise model) and that the risk of tonal, impulsive or intermittent character and of high sound energy in the low frequency range is minimised so far as reasonably practicable.</p> <p>During commissioning and at regular intervals a programme of <b>vehicle spot noise checks</b> will be undertaken to determine if vehicles comply with the sound power level specification and are will maintained, with functioning mufflers.</p>	Construction, Operation

Measure ID	Monitoring or Contingency Measure	Phase
3	<p>Procurement of noise generating fixed-plant will include a noise emission requirement to ensure that all fixed plant meet or better that which has been assumed in the noise model.</p> <p>During commissioning a programme of <b>noise commissioning checks</b> will be undertaken to determine if fixed plant comply with the sound power level specification and do not present an unexpected risk of tonal, impulsive or intermittent character or of excessive sound energy in the low frequency range.</p>	Construction, Operation
4	<p>A workplace <b>OH&amp;S noise survey</b> will be undertaken in noisy areas frequently accesses by mining personnel. It is anticipated that this will include areas such as the power station and the processing plant.</p>	Construction, Operation
5	<p>A potential contingency mitigation for mobile mining plant is the addition of engineered noise suppression kits to specific items of plant where local screening is not feasible to provide noise mitigation.</p> <p>Typically noise suppression kits from specialist providers such as Hushpak, Mintek, Mammoth etc. include upgraded exhaust mufflers, acoustic louvred radiator packages and acoustic treatment to engine compartment and air inlet plenums.</p> <p>The addition of noise suppression kits to typical mobile plant such as excavators, scrapers, haul trucks and dozers would typically result in an overall reduction of approximately 5 dBA from the standard model.</p>	Construction, Operation

## 14 Summary of Implications Under Relevant Legislation

This study has assessed the impacts of construction and operational noise of the Project on sensitive receivers and values to be protected.

The significance of the impacts has been assessed in accordance with the evaluation framework, based on applicable legislation, policy and standards and the evaluation objectives and environmental significance guidelines arising from the government terms of reference established to guide the assessments.

The following sections summarise these identified impacts under the relevant Commonwealth and Victorian legislation.

### 14.1 Commonwealth

The Australian Government environment minister does not have power under the EPBC Act to regulate a proposal that will have impacts on matters such as air quality, noise, odour, general amenity or animals that are not listed as threatened or endangered under the EPBC Act. These environmental matters are the responsibility of the relevant state government to consider during any state assessment and approval process.

### 14.2 Victorian

In relation to the evaluation objectives set out in the EES Scoping Requirements, the Project would not have significant impacts on noise for the following reasons:

#### Construction

- Construction phase noise emissions have been predicted and assessed and found to comply with the requirements of the *Civil construction, building and demolition guide*, (EPA Publication 1834). Construction activities will be limited to EPA normal working hours, with the exception of unavoidable works and low-noise impact works (if required).
- Predicted construction noise from the main project site is likely to be below ambient background noise levels at most receivers, with only a single receiver anticipated to receive construction noise at an elevated level. The predicted noise level at this receiver, however, is similar to existing ambient noise levels ( $L_{eq}$ ) and is unlikely to result in adverse impact.
- Predicted noise from water pipeline construction activity is likely to be below ambient background noise levels at most receivers, with only a small number of receivers in the town of Mystic Park anticipated to receive construction noise at an elevated level. Two receivers are predicted to be exposed to noise levels exceeding 75 dBA and nine receivers between 60 dBA and 75 dBA. Since the work is short in duration (anticipated to be only a few days in Mystic Park) and occurs during EPA normal working hours, the level of impact is considered manageable under a CEMP provided prior community consultation and notification is undertaken.

#### Operational noise

- Operational phase noise emissions have been predicted and assessed to the requirements of the *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*, (EPA Publication 1826).

- During Area 1 mining operations (Year 1 to Year 8) a moderate exceedance (7-10 dBA) of the day-time noise limit was predicted for receiver R14. It is understood that an agreement will be reached with receiver R14 for the duration of works in Area 1; it is unlikely to be considered a sensitive receiver should the Project proceed as the residents will be relocated whilst mine operations impact on the property. All other receivers will comply with day time noise limits.
- During Area 1 mining operations (Year 1 to Year 8) a moderate exceedance (4-5 dBA) for night-time are predicted at receiver R12 and R13. It is anticipated that compliance can be achieved by a combination of applying:
  - addition of specialist engineered noise suppression kits to haul fleet vehicles (see below)
  - higher levels of noise suppression on the processing plant building
  - restricting mining activities to below ground pits only during the night.

The viability of these solutions will be evaluated during detailed design.

- The haul and mining mobile plant were identified as dominant noise sources for all receivers at some stage of the mine's life. A further contingency mitigation may be considered for the mobile plant (haul trucks, excavators, scrapers, dozers, etc) and includes specialist engineered noise reduction kits, where local screening is not feasible. Typically, noise suppression kits from specialist providers such as Hushpak, Mintek etc. include upgraded exhaust mufflers, acoustic louvred fan packages and acoustic treatment to engine compartments and air inlet plenums. The addition of noise suppression kits typically results in an overall reduction of approximately 5-10 dBA from the standard model. The additional cost of such engineered noise reduction kits is quite significant and hence the need for and type and extent of mitigation is best considered a contingency measure and evaluated in more detail once there is greater clarity of the operations.
- During Area 3 mining operations the house denoted as R9 will be used as a project operations office and therefore not considered a sensitive receiver. Mining in the northernmost cells of Area 3 (Year 11) is closest to receiver R7 which is predicted to comply with day-time noise limits. Subsequent mining in Area 3 (Year 15) is sequenced for cells further from R7 and it is anticipated to comply with day, evening and night-time noise limits once more detailed evaluation is completed.
- Noise from the pumping station at Kangaroo Lake is predicted to comply with all nearest receivers for all time periods.

#### Road traffic noise

- There are no statutory requirements in Victoria with respect to project related traffic that is travelling on a public road. Notwithstanding the above, the relevant ERS environmental values, indicators and objectives have been referenced for informative purposes to evaluate potential for impacts and it has been determined that they are unlikely to be compromised by project traffic.



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## 15 Conclusion

The purpose of this report is to assess the potential noise impacts associated with the Project to inform the preparation of the EES required for the Project. A summary of the key assets, values or uses potentially affected by the Project, and an associated assessment of noise impacts and recommended mitigation measures, are summarised below.

### Existing environment

The Project is located in relatively flat farming land that is used predominantly for cropping with several rural residences surrounding the Project area. In the vicinity of the pumping station next to Kangaroo Lake the flat land is used for agriculture as well as recreation and tourism purposes, with residences mainly on the west and northern shores of the lake,

The existing noise environment in the Project area is typical of rural farming area, with background noise levels being generally low and determined by non-anthropogenic sources such as wind and insects. However, at some locations the existing noise environment would feature noise generated by farming activity and equipment (e.g. tractors, harvesters, grain trucks etc.) for periods during the year. On the shores of Kangaroo Lake the noise environment would also feature occasional noise from recreational boating.

A background noise monitoring programme was completed at four locations around the Project area over a period of approximately four weeks in October 2018. No monitoring was completed in the vicinity of Kangaroo Lake.

### Impact assessment findings

#### Construction

- Construction phase noise emissions have been predicted and assessed and found to comply with the requirements of the *Civil construction, building and demolition guide*, (EPA Publication 1834). Construction activities will be limited to EPA normal working hours, with the exception of unavoidable works and low-noise impact works (if required).
- Predicted construction noise from the main project site is likely to be below ambient background noise levels at most receivers, with only a single receiver anticipated to receive construction noise at an elevated level, however, it is unlikely to result in adverse impact.
- Predicted noise from water pipeline construction activity is likely to be below ambient background noise levels at most receivers, with only a small number of receivers in the town of Mystic Park anticipated to receive construction noise at an elevated level. Two receivers are predicted to be exposed to noise levels exceeding 75 dBA and nine receivers between 60 dBA and 75 dBA. Since the work is short in duration (anticipated to be only a few days in Mystic Park) and occurs during normal working hours, the level of impact is considered manageable under a CEMP provided prior community consultation and notification is undertaken.
- The risk of noise impacts at wildlife reserves and other Category V natural areas close to Kangaroo Lake is considered low due to distance to works.

## Operational noise

- Operational phase noise emissions have been predicted and assessed to the requirements of the *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*, (EPA Publication 1826).
- During Area 1 mining operations (Year 1 to Year 8) a moderate exceedance (7-10 dBA) of the day period noise limit was predicted for receiver R14. It is understood that an agreement will be reached with receiver R14 for the duration of works in Area 1; it is unlikely to be considered a sensitive receiver should the Project proceed as the residents will be relocated whilst mine operations impact on the property. All other receivers will comply with day time noise limits.
- During Area 1 mining operations (Year 1 to Year 8) a moderate exceedance (4-5 dBA) of the night period noise limit was predicted at receivers R12 and R13. It is anticipated that compliance can be achieved by a combination of applying:
  - addition of specialist engineered noise suppression kits to haul fleet vehicles (see below)
  - higher levels of noise suppression on the processing plant building
  - restricting mining activities to below ground pits only during the night.

The viability of these solutions will be evaluated during detailed design.

- During Area 3 mining operations the house denoted as R9 will be used as a project operations office and therefore not considered a sensitive receiver. Mining in the northernmost cells of Area 3 (Year 11) is closest to receiver R7 which is predicted to comply with day-time noise limits. Subsequent mining in Area 3 (Year 15) is sequenced for cells further from R7 and it is anticipated to comply with day, evening and night period noise limits once more detailed evaluation is completed.
- Noise modelling has considered the presence of low frequency noise levels. Whilst there are limitations associated with modelling low frequency noise impacts, receivers R3, R12 and R14 may be exposed to low frequency noise over the Project's life.
- The haul and mining mobile plant were identified as dominant noise sources for all receivers at some stage of the mine's life. A further contingency mitigation may be considered for the mobile plant (haul trucks, excavators, scrapers, dozers, etc) and includes specialist engineered noise reduction kits, where local screening is not feasible. Typically, noise suppression kits from specialist providers such as Hushpak, Mintek etc. include upgraded exhaust mufflers, acoustic louvred fan packages and acoustic treatment to engine compartments and air inlet plenums. The addition of noise suppression kits typically results in an overall reduction of approximately 5-10 dBA from the standard model. The additional cost of such engineered noise reduction kits is quite significant and hence the need for and type and extent of mitigation is best considered a contingency measure and evaluated in more detail once there is greater clarity of the operations.
- Noise from the pumping station at Kangaroo Lake is predicted to comply at all nearest receivers for all time periods.

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- Review of potential cumulative noise impacts from operational and construction stage works (during the early mining stage where construction of the processing plant may occur concurrently) indicated negligible impacts. Cumulative noise from operational noise with existing sources of industry noise in the general project area and surrounds was also considered and expected to be negligible, however, potential cumulative noise was identified in relation to the Kangaroo Lake pumping station which will be constructed near existing pumps. It is recommended that the enclosure of the new pumping station is designed to ensure cumulative noise from both sources complies with the noise protocol noise limits and achieves the relevant low frequency noise criteria. This will need to be evaluated in more detail during the detailed design phase.

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## Road traffic noise

- There are no statutory requirements in Victoria with respect to project related traffic that is travelling on a public road. Notwithstanding the above, the relevant ERS environmental values, indicators and objectives have been referenced for informative purposes to evaluate potential for impacts and it has been determined that they are unlikely to be compromised by project traffic.

## Mitigation and contingency measures

A number of key mitigations have been assumed in the Project design, including:

- Minimising truck haulage in Area 1 and between Area 3 and the processing plant by piping a slurry between the MUP and the processing plant.
- For mining block operations closer to sensitive receivers, mining will be limited to day period only, reducing the potential noise impact on these receivers during periods that people are more sensitive to noise.
- The main power plant is anticipated to be operating continuously 24/7 and represents a significant potential source of noise emissions. The Project shall incorporate the highest levels of noise control for the power station including, placing all gensets in acoustic enclosures and containing all gensets within a generator building, use of high-performance exhaust mufflers and low noise cooling radiators. The objective is to reduce power station noise as far as practicable.
- The pumping station will be specified with an appropriate acoustic enclosure, and allow for consideration of cumulative noise from existing pumps in the Kangaroo Lake area.

Construction phase impacts will be managed under a CEMP and mitigated by limiting the hours of construction to EPA normal working hours and ensuring prior community consultation and notification occurs.

Operations phase impacts will be mitigated by:

- Employing best practice noise management, and
- Removing receiver R9 by utilising this location as a site administrative office whilst mining Area 3.
- Relocating the residents of receiver R14 for the duration of mining in Area 1.
- The risks of low frequency noise impacts are controlled by elimination (eliminate low frequency noise emissions through regular maintenance), engineering controls (high performance silencers and enclosures to power plant building) and administrative controls (limiting certain activities and mining locations to day periods only).

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## 17 References

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# APPENDIX A

## Risk Register



**Table A1 Risk Register**

Risk ID	Risk Pathway	Causes / Background	Initial Risk Level			Final Mitigation	Residual Risk Level		
			Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
Construction									
	Temporary noise disturbance to receivers during construction of process plant and power station area	Short term high noise activity associated with construction	Possible	Moderate	Medium	Construction only to occur during normal working hours. Resident consultation.	Unlikely	Minor	Low
	Temporary noise disturbance to receivers during construction of pumping station	Short term high noise activity associated with construction	Unlikely	Moderate	Medium	Construction only to occur during EPA normal working hours. Resident consultation.	Unlikely	Minor	Low
	Temporary noise disturbance to receivers during construction of pipeline route	Short term high noise activity associated with construction	Unlikely	Moderate	Medium	Construction only to occur during EPA normal working hours. Resident consultation.	Unlikely	Minor	Low

Operation									
	Noise generated by the Project impacts neighbouring sensitive residential receivers	Excessive noise generation from fixed processing plant, power station and pumping station equipment	Likely	Major	Very high	Use attenuated plant and equipment. Use of stockpiles. Implement a Noise Management Plan and undertake a noise monitoring programme to verify noise levels. Consider dwelling acoustic treatment, private agreements or property acquisition.	Unlikely	Moderate	Medium
	Noise generated by the Project impacts neighbouring sensitive residential receivers	Excessive noise generation from mobile equipment working in-pit, on overburden dumps and material haulage.	Likely	Major	Very high	Conduct a noise impact assessment to identify potential noise impacts from the Project under future operating scenarios. Use attenuated plant and equipment. Generators, including exhaust systems, to be operated and maintained to the manufacturer's specifications to minimise exhaust emissions. Use of noise bunds. Restrict operations to daytime only in areas that are most impacted. Implement a Noise Management Plan and undertake a noise monitoring programme to verify noise levels. Consider dwelling acoustic treatment, private agreements or property acquisition.	Unlikely	Moderate	Medium

Traffic Noise									
	Noise impacts from traffic movements on public roads	Increased traffic on local roads from project	Likely	Moderate	High	Limit heavy vehicle to only day-time movements. Maintain local and access roads in good condition. Limit / prohibit the use of Jacobs exhaust brakes.	Unlikely	Minor	Low

**Table A2:** ERR likelihood descriptions

Severity	Description	Probability of event occurring
Almost certain	The risk event is expected to occur in most circumstances.	90–100%
Likely	The risk event will probably occur in most circumstances.	70–90%
Possible	The risk event might occur at some time.	30–70%
Unlikely	The risk event could occur at some time.	5–30%
Rare	Highly unlikely, but the risk event may occur in exceptional circumstances.	0–5%

**Figure A1:** ERR Risk Matrix

Likelihood	Almost Certain	Medium	High	Very High	Very High	Very High
	Likely	Medium	Medium	High	Very High	Very High
	Possible	Low	Medium	Medium	High	Very High
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Medium	Medium	High
		Insignificant	Minor	Moderate	Major	Critical
Consequence						

# APPENDIX B

## Source Noise Levels

This appendix summarises the source sound power levels, based on equipment schedules provided by VHM. In instances where noise data was unavailable, noise measurements of similar equipment published by BS5228 (code of practice for noise and vibration control on construction and open sites) was utilised.

## Processing Plant

It is understood that noise and dust producing equipment in the processing plant will be enclosed when possible.

The processing plant detailed layout has not been finalised, therefore the processing plant was modelled as an area source based on the proposed site footprint. This is a reasonable preliminary assumption as the closest receiver (R0013) is located 1.4 km from the processing plant.

**Table 45** presents the assumed noise-emitting processing plant building footprints. Building footprints were estimated from schematics. Building cladding was assumed to be a construction with weighted sound reduction index,  $R_w + C_{tr}$  23.

The internal reverberant sound pressure level of each processing plant building was taken to be 85 dBA, with an octave band frequency spectrum characteristic of industrial pumps (spectrum from Bies and Hansen empirical formula).

**Table 45 Key Processing Plant Buildings**

Building	Dimensions, m	Notes
WCP Building	20x50x20	Ground floor exposed
Process Sands Tailing Building	45x98x10	Enclosed
WHIMS Building	30x30x20	Ground floor exposed
Dry Plant Building	30x50x10	Enclosed
Chrome Reduction Building	15x25x10	Enclosed

**Table 46 Processing Plant Equipment List**

Qty	Equipment Description	Octave Band Linear Sound Power Level ( $L_{eq}$ ), dB, per unit								OA
		63	125	250	500	1k	2k	4k	8k	
	<b>Wet Concentrator Plant (WCP)</b>									
4	Feed Preparation Plant (FPP)	94	89	92	88	86	87	87	85	94
4	Cyclones (fine waste removal)	94	89	92	88	86	87	87	85	94
1	WCP building (enclosed upper levels)	98	96	94	93	93	86	77	69	96
1	WCP building (open ground floor)	97	98	100	100	103	100	96	90	107
	<b>Thickener</b>									
2	Pumps	98	93	94	92	92	91	84	74	97
	<b>Mineral Separation Plant (MSP)</b>									
1	WHIMS building (enclosed upper levels)	98	95	93	92	93	85	76	69	95
1	WHIMS building (open ground floor)	95	96	98	98	101	98	94	88	105
1	Dry Plant building (enclosed)	96	94	92	91	91	84	75	67	94
1	Process Sands Tailing Building (enclosed)	101	99	97	96	96	89	80	72	99
1	Chrome Reduction building (enclosed)	94	92	89	88	89	81	72	65	92

Qty	Equipment Description	Octave Band Linear Sound Power Level ( $L_{eq}$ ), dB, per unit								OA
		63	125	250	500	1k	2k	4k	8k	
	<b>Mobile Equipment</b>									
1	Crane or franna	115	110	106	102	99	95	88	80	<b>105</b>
1	Wheeled loader	112	116	109	102	102	99	94	93	<b>108</b>
2	Bobcat or forklift	102	100	99	99	97	95	88	79	<b>102</b>
1	Mobile crane	108	104	99	91	92	91	84	78	<b>98</b>
1	Water tanker	108	103	97	103	99	95	89	86	<b>104</b>
1	Refuelling truck	103	98	95	95	97	94	88	81	<b>101</b>
2	EWP	102	100	96	96	92	89	85	84	<b>98</b>
6	Light vehicles	100	106	102	94	90	84	74	66	<b>98</b>
	<b>Overall Processing Plant</b>	<b>116</b>	<b>116</b>	<b>113</b>	<b>110</b>	<b>109</b>	<b>106</b>	<b>102</b>	<b>98</b>	<b>114</b>

## Powerplant

Broadband exhaust and case breakout noise for the proposed diesel generator model KTA50-G9 was provided by Cummins. Since the frequency data was not provided, empirical spectra for exhaust and casing noise was adopted from Bies and Hansen and offset to match the Cummins overall levels. See **Table 47**.

Each engine was located inside a drop over acoustic enclosure. The acoustic enclosure is such that achieves a weighted sound reduction index of  $R_w + C_{tr}$  25

The diesel engines enclosures are situated inside a structure. The reverberant sound pressure level was calculated from the building volume and estimated reverberation time.

Engine exhaust noise were modelled as point sources at an elevation of 8m. The powerplant building was modelled as an industrial building with casing noise breakout through the building façade.

**Table 47 Powerplant Equipment List**

Qty	Equipment Description	Octave Band Linear Sound Power Level ( $L_{eq}$ ), dB, per unit								OA
		63	125	250	500	1k	2k	4k	8k	
10	Cummins KTA50-G9 Exhaust	140	146	142	134	130	124	114	106	138
10	Cummins KTA50-G9 Casing noise	108	115	115	114	116	115	109	102	120

**Table 48 Powerplant Building element Transmission Losses**

Equipment Description	Octave Band Sound Transmission Loss, dB								$R_w + C_{tr}$
	63	125	250	500	1k	2k	4k	8k	
'drop over' acoustic enclosure (nominal)	25	25	25	25	25	25	25	25	25
Shed façade and roof	10	14	16	20	25	29	23	20	23
Louvre	0	0	0	0	0	0	0	0	0

## Mining Unit Plant (MUP)

All sources at the MUP were summed and modelled as an area source encompassing the MUP site footprint with the octave band spectra shown in **Table 49**. A source height of 2m was assumed. Area 1 and Area 3 MUPs contain identical equipment.

**Table 49 MUP Equipment List**

Qty	Equipment Description	Octave Band Linear Sound Power Level ( $L_{eq}$ ), dB, per unit								OA
		63	125	250	500	1k	2k	4k	8k	
1	ROM pad (loader dumping rock)	112	116	109	102	102	99	94	93	<b>108</b>
38	Dozer trap (conveyor, per metre)	86	80	80	71	71	70	75	75	<b>81</b>
1	Scrubber trommel	94	89	92	88	86	87	87	85	<b>94</b>
2	Slurry pump	98	93	94	92	92	91	84	74	<b>97</b>
2	Process water pump	80	81	83	83	86	83	79	73	<b>89</b>
1	Air compressor	95	95	94	97	100	100	98	95	<b>106</b>
	<b>Overall MUP</b>	<b>113</b>	<b>116</b>	<b>110</b>	<b>104</b>	<b>105</b>	<b>103</b>	<b>100</b>	<b>98</b>	<b>111</b>

Dozer Trap modelled as a 38m conveyor.

## Mining Fleet

The mine fleet sources were summed and modelled as an area source encompassing the mining blocks modelled. Source levels per unit are shown in **Table 50**.

**Table 50 Mine Fleet Equipment List**

Qty	Equipment Description	Octave Band Linear Sound Power Level ( $L_{eq}$ ), dB, per unit								OA
		63	125	250	500	1k	2k	4k	8k	
1	Excavator 200t	116	119	115	114	111	109	104	96	<b>117</b>
1	Excavator 110t	119	120	111	112	108	106	105	98	<b>115</b>
1	Bulldozer	117	118	109	101	102	98	96	92	<b>108</b>
1	Wheeled loader	112	116	109	102	102	99	94	93	<b>108</b>
2	Tractor scraper	109	115	107	105	105	102	98	95	<b>110</b>
1	Motor grader	116	115	111	107	112	106	102	93	<b>115</b>
2	Water tanker trucks	108	103	97	103	99	95	89	86	<b>104</b>
1	Maintenance / service truck	110	108	106	103	104	106	##	97	<b>111</b>
1	Refuelling truck	103	98	95	95	97	94	88	81	<b>101</b>
15	Diesel powered lighting towers	106	99	94	90	87	83	84	77	<b>94</b>
5	Light vehicles	100	106	102	94	90	84	74	66	<b>98</b>
1	6WD tray back mounted air drill rig*	113	121	106	107	108	107	104	102	<b>114</b>
	<b>Overall Mining Fleet</b>	<b>125</b>	<b>126</b>	<b>120</b>	<b>118</b>	<b>117</b>	<b>114</b>	<b>110</b>	<b>104</b>	<b>122</b>

\*The 6WD tray back mounted air core drill rig was not modelled. Assume it is used intermittently.



## Stockpiles

It is assumed that a bulldozer is operates between the active clay, topsoil and overburden stockpiles. The bulldozer was modelled as area sources at each active stockpile. However only the highest source contribution for each receiver was included in the assessment (the bulldozer is assumed to be operating at the closest stockpile to each receiver).

**Table 51 Stockpiles Equipment List**

Qty	Equipment Description	Octave Band Linear Sound Power Level ( $L_{eq}$ ), dB								OA
		63	125	250	500	1k	2k	4k	8k	
1	Bulldozer	117	118	109	101	102	98	96	92	<b>108</b>

## Haul Routes

Haul routes are modelled as line sources. Trucks are assumed to backfill, haul to clay, topsoil, overburden and to the MUP equally (i.e. when haul routes branch at the stockpiles, one third of the overall sound power level is assigned to the clay, topsoil and overburden each).

**Table 52** shows the sound power spectrum for a standard haul truck, one with an upgraded exhaust silencer as well as the sum total of the haul fleet.

**Table 52 Haul Routes Equipment List**

Qty	Equipment Description	Octave Band Linear Sound Power Level ( $L_{eq}$ ), dB								OA
		63	125	250	500	1k	2k	4k	8k	
1	Rigid Haul Truck 130 t (standard)	133	129	125	116	113	112	107	104	<b>121</b>
1	Rigid Haul Truck 130 t (upgraded exhaust)	125	115	122	112	113	112	105	102	<b>119</b>
	<b>Overall Haul Fleet *</b>	<b>135</b>	<b>125</b>	<b>131</b>	<b>121</b>	<b>122</b>	<b>121</b>	<b>114</b>	<b>111</b>	<b>128</b>

\* based on fleet of 8 Haul trucks with upgraded exhaust, 80% utilisation & 20% on standby/maintenance

## Noise character

The assessment methodology includes consideration for the likelihood that the resultant noise at a receiver potentially exhibits noise character with features that potentially increase annoyance, and applying a penalty where appropriate.

Importantly, the evaluation of noise character is based on the total received noise from industry, the cumulative sum of all contributing noise sources, which is able to be determined from measurement when applied to an existing operation. However, when being predictively assessed from a proposed operation an evaluation of risk of adverse noise character and subsequent penalty is required.

- **Tonal noise** – EPA Publication 1997: *Technical guide: Measuring and analysing industry noise and music noise* describes an objective method for determining tonality and any penalty. The method requires the analysis of the received 1/3 octave band spectrum, which is not possible to be predicted based on current level of detail of the Project. However, experience tells us that whilst individual items of mobile plant typical of that being used in the Project may exhibit some minor tonal character when operated at a steady state or individually, it is unlikely that a large fleet of mobile plant operating in a varying and non-steady state is likely to have a cumulative received spectrum exhibiting clear tonal character. For items of fixed plant that operate for extended period at steady state conditions it has been assumed that the engineered noise control (e.g. acoustic enclosures, high performance silencers etc) will be such that there is no significant tonal character. During construction, some smaller plant items without specific noise control (e.g. gensets, hand tools) may exhibit some tonal characteristics, however analysis of the noise modelling results at the most critical receivers indicated that individually those sources were significantly lower in noise level compared to the cumulative noise from all other sources and therefore unlikely to be clearly audible at receiver locations. It should further be noted that broadband reverse signals on all mobile equipment are a base case assumed mitigation measure. On the above basis, no tonal corrections were applied.
- **Impulsive noise** – describes noise that includes banging, impacting or hammering elements. As opposed to hard rock mining or quarrying it is unlikely that the operations from sand mining include such elements in either the mining, hauling or processing activities. No penalty has been included for operations. In relation to construction, there may be some items or activities that exhibit impulsive character, however, analysis of the noise modelling results at the most critical receivers indicated that individually those sources were significantly lower in noise level compared to the cumulative noise from all other sources and therefore unlikely to be clearly audible at receiver locations. On the above basis, no impulsive corrections were applied.
- **Intermittent noise** – describes when the industry noise being assessed varies and gets louder (by at least 5 dB for at least 1 minute on at least two occasions during a 30-minute period;) then drops back to the original lower level. It is anticipated that the received noise emission from operations (mining, hauling or processing activities) are likely to be relatively steady state. No penalty has been included.
- **Low frequency noise (LFN)** - EPA Publication 1997: *Noise guidelines: Assessing low frequency noise* (EPA LFN Guidelines) provides guidance on assessment of low frequency noise (LFN). The method requires the analysis of the received 1/3 octave band spectrum, in the low frequency range of 10 Hz to 160 Hz. The guideline acknowledges the difficulty and limitations of being able to reliably predict low frequency, noting; a lack of suitable manufacturer or test data and limitations of the prediction algorithms at low frequencies. Notwithstanding the guideline suggests using extrapolating data from measurement of similar facilities or verifiable literature references, which is problematic for less common operations such as sand mining.

A predictive LFN screening methodology was used where the measured spectra (only available to 16 Hz) of large diesel powered mobile plant was collated and summed to provide a typical low frequency spectrum, refer to **Figure 29**. The energy sum of the 63 Hz Octave band was then used to benchmark the 63 Hz octave values predicted by the noise model for the scenarios investigated. The pseudo-extrapolated LFN spectra were then compared against the Outdoor low frequency threshold criterion detailed in EPA LFN Guidelines, refer to **Figure 30**.

It should be noted that the EPA LFN Guidelines threshold levels are not set limits. Rather, they are levels that indicate a potential risk of problematic low frequency noise.

Figure 29 Derivation of typical LFN spectrum

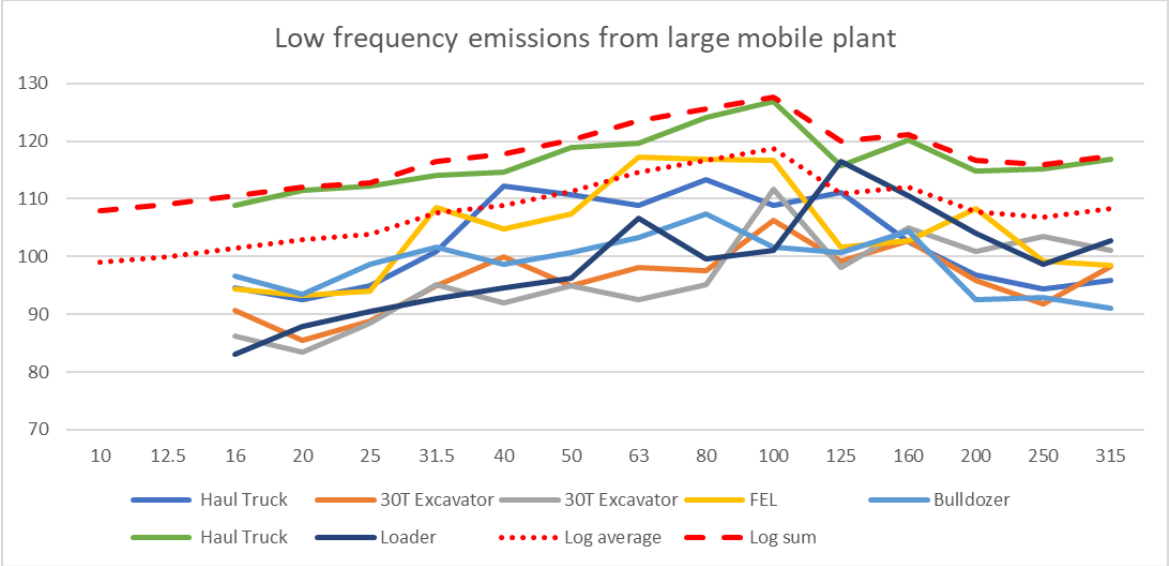
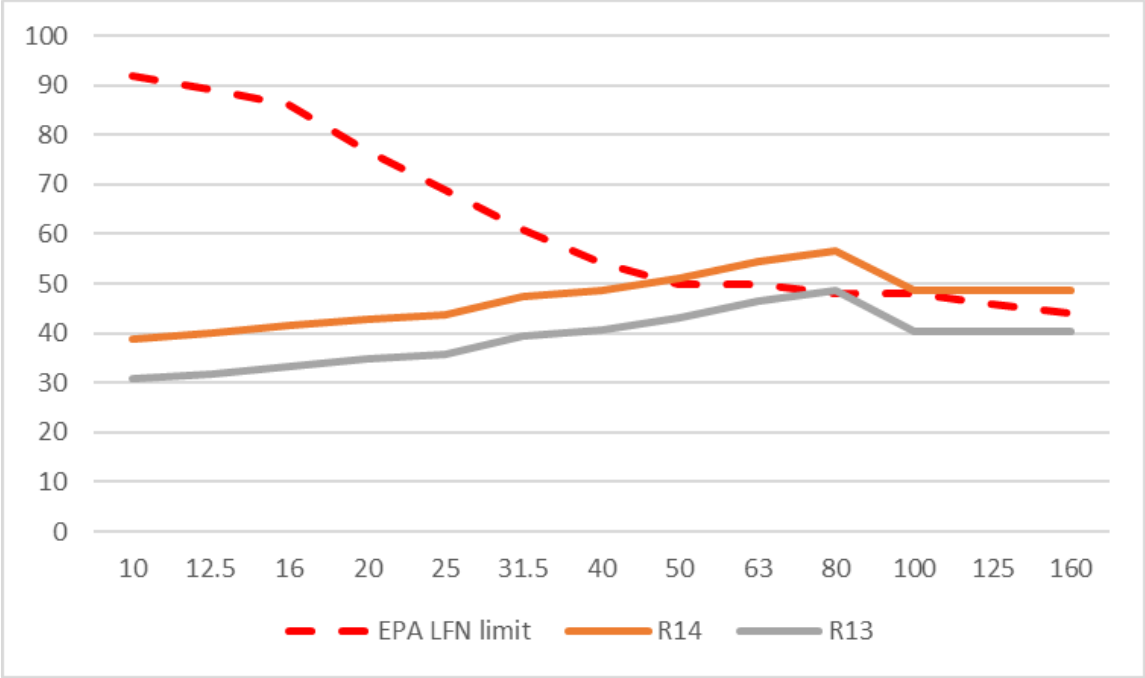



Figure 30 Example of extrapolated LFN spectra against EPA LFN Guidelines threshold levels



# APPENDIX C

## Baseline Noise Monitoring

Noise Monitoring Location		Thompson Rd		Photo of Noise Monitoring Location
<p>Noise monitor located in field approximately 860 m southwest of receiver R9.</p> <p>Noise sources includes insects, occasional traffic of Thompson Rd and farming activity.</p>				
Summary of Measured Noise Levels				
Assessment Period	Noise Level (dBA)			Bruel & Kjaer Sentinel. S/N 3007014 Coordinates: 35°35'44.19"S, 143°27'30.21"E
	L <sub>A90</sub> (Average)	L <sub>A90</sub> (Lowest)	L <sub>Aeq</sub>	
Daytime	28	23	37	
Evening	26	20*	29	
Night	23	20*	28	

\*Results likely affected by noise floor of test equipment



## Results of Noise Monitoring

**Client:** Goschen Mineral Sands  
**Job Number:** 640.11763 **Location:** Thompson Rd  
**Microphone position:** 1.5 m **Initials:** BF  
**Initial calibration:** 94 dBA **Final calibration:** 94 dBA

Hour	Sound Pressure Level, dB(A)																				
	Tue, 02-10-2018			Wed, 03-10-2018			Thu, 04-10-2018			Fri, 05-10-2018			Sat, 06-10-2018			Sun, 07-10-2018			Mon, 08-10-2018		
	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>
00:00 to 01:00				27.7	22.0	27.6	47.0	36.0	43.4	27.7	21.5	26.0	19.8	19.4	20.7	19.8	19.4	19.6	20.6	19.6	30.7
01:00 to 02:00				26.2	20.6	24.2	46.9	35.9	43.7	22.7	20.1	21.4	20.8	19.5	30.5	19.9	19.4	25.6	22.9	19.5	34.9
02:00 to 03:00				22.5	20.1	21.5	46.4	33.4	42.1	23.4	20.2	21.6	22.8	20.1	21.5	19.5	19.4	19.6	19.7	19.5	19.6
03:00 to 04:00				21.5	19.7	21.9	48.6	36.8	45.0	22.3	20.0	21.0	21.3	19.6	24.5	20.5	19.4	20.2	20.8	19.5	20.1
04:00 to 05:00				19.9	19.5	19.8	47.2	31.5	42.6	21.9	19.7	20.8	20.1	19.7	19.9	19.9	19.4	19.9	20.5	19.5	19.9
05:00 to 06:00				33.3	19.5	38.0	34.3	24.8	30.9	23.9	20.3	23.0	24.6	19.6	26.4	25.8	19.5	23.4	26.7	19.9	24.6
06:00 to 07:00				26.6	20.1	24.4	32.5	24.7	29.6	28.6	20.7	25.1	28.7	20.6	28.2	29.0	20.7	26.2	34.3	21.5	45.7
07:00 to 08:00				28.5	20.3	25.6	46.1	32.5	42.1	36.8	27.2	33.6	36.0	25.9	33.3	31.3	21.3	35.0	31.7	23.3	29.6
08:00 to 09:00				27.9	21.1	27.1	47.5	37.2	44.9	38.4	30.8	35.7	42.2	33.4	39.0	37.9	24.8	38.5	34.5	24.0	48.1
09:00 to 10:00				31.3	23.1	29.4	51.1	38.9	47.7	36.2	27.4	33.4	40.3	28.4	36.3	37.9	25.7	34.3	35.3	24.4	31.9
10:00 to 11:00				30.7	22.3	32.4	47.2	36.1	43.8	31.7	22.7	29.3	34.5	24.0	32.2	41.4	24.9	38.4	37.4	23.9	37.9
11:00 to 12:00				33.4	23.3	31.4	47.0	34.0	42.7	28.0	22.3	26.5	29.7	22.0	26.1	31.8	21.5	31.9	37.3	22.8	34.1
12:00 to 13:00	58.4	35.7	52.8	32.4	23.0	31.6	47.9	32.3	43.8	29.3	22.0	26.4	27.2	21.9	24.8	36.6	22.3	32.6	38.6	22.7	34.3
13:00 to 14:00	46.7	34.5	43.3	32.1	23.3	28.7	44.2	32.4	40.7	25.7	22.1	23.6	29.8	22.3	26.5	31.8	21.8	29.3	38.4	23.1	34.1
14:00 to 15:00	46.8	33.0	42.8	35.5	24.4	32.0	45.6	31.4	42.3	26.5	22.3	32.1	30.0	22.1	26.9	31.0	21.8	29.3	37.7	22.3	34.4
15:00 to 16:00	49.0	35.9	45.7	33.9	24.1	30.9	46.8	36.2	43.6	26.0	22.2	26.6	25.1	22.0	23.6	28.9	22.0	26.7	32.9	23.3	30.3
16:00 to 17:00	47.2	33.1	42.7	30.3	23.0	28.4	47.5	34.9	43.5	28.2	22.9	26.5	26.9	22.2	27.3	29.5	21.8	31.1	28.5	21.8	26.4
17:00 to 18:00	43.9	30.5	38.9	30.5	24.4	30.5	46.7	34.3	43.1	27.1	23.0	27.1	28.1	23.6	27.9	27.8	22.4	28.8	35.7	22.8	33.6
18:00 to 19:00	43.9	27.3	39.6	33.3	27.0	30.6	42.9	31.8	39.4	26.8	21.2	25.7	28.3	25.4	34.2	27.0	24.9	26.3	37.4	31.2	45.7
19:00 to 20:00	44.0	23.9	41.4	42.4	27.8	38.1	39.8	30.5	36.7	21.1	19.7	21.4	25.3	20.8	23.7	24.2	21.3	23.3	29.5	24.8	28.1
20:00 to 21:00	24.9	23.2	24.4	45.2	33.9	41.9	40.5	29.0	36.8	23.0	19.5	31.9	20.6	19.8	20.1	21.7	20.4	23.3	26.4	23.9	25.5
21:00 to 22:00	26.2	23.6	25.0	46.6	36.3	42.9	32.9	24.7	30.8	19.7	19.5	19.5	19.7	19.5	19.8	20.0	19.6	19.8	24.7	23.3	24.8
22:00 to 23:00	30.5	24.3	28.9	51.2	36.2	46.6	32.7	24.6	29.3	20.2	19.4	21.6	20.4	19.5	20.5	20.1	19.5	24.0	27.3	22.8	25.5
23:00 to 24:00	29.4	24.5	27.1	51.1	38.5	46.8	29.9	23.2	27.0	19.8	19.4	22.1	21.8	19.5	26.1	20.9	19.6	25.5	27.5	22.9	24.6
L <sub>10</sub> (18h), ar.av. 6-24h				35.7			42.7			27.4			28.6			29.4			33.1		
L <sub>eq</sub> (16h) log av. 6-22h						35.3			42.5			29.9			31.5			32.6			40.1
L <sub>eq</sub> (8h) log av. 22-6h			30.5			44.1			24.9			24.9			22.7			28.4			30.9
L <sub>eq</sub> (24h) log av. 0-24h						38.1			42.2			28.5			30.3			31.0			38.5
L <sub>90</sub> Day					22.9			34.6			24.1			25.9						23.1	
L <sub>90</sub> Evening		24.5			31.2			29.0			20.0			22.0			22.4			25.8	
L <sub>90</sub> Night		21.2			33.1			21.2			19.7			19.6			19.8			23.6	
Wind @0900h, km/h																					
Wind @1500h, km/h																					





## Results of Noise Monitoring

**Client:** Goschen Mineral Sands  
**Job Number:** 640.11763      **Location:** Thompson Rd  
**Microphone position:** 1.5 m      **Initials:** BF  
**Initial calibration:** 94 dBA      **Final calibration:** 94 dBA

Hour	Sound Pressure Level, dB(A)																				
	Tue, 09-10-2018			Wed, 10-10-2018			Thu, 11-10-2018			Fri, 12-10-2018			Sat, 13-10-2018			Sun, 14-10-2018			Mon, 15-10-2018		
	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>
00:00 to 01:00	28.4	21.8	26.2	47.0	35.0	43.4	41.0	32.2	38.1	21.4	19.5	20.7	21.5	19.8	31.3	23.4	20.0	31.0	24.9	21.5	28.3
01:00 to 02:00	24.8	21.9	35.5	51.6	37.0	47.2	40.2	32.7	39.5	21.8	19.8	20.8	24.3	20.1	33.6	21.9	19.8	24.6	29.5	23.3	30.0
02:00 to 03:00	22.0	21.1	21.6	51.2	38.5	48.3	35.6	27.0	32.4	20.7	19.6	20.0	28.7	22.2	25.7	21.9	20.1	20.9	36.9	23.8	32.8
03:00 to 04:00	25.6	21.2	23.4	42.4	29.6	38.7	30.0	22.7	27.1	20.0	19.6	19.8	31.6	24.5	28.8	20.8	19.5	20.0	36.3	25.6	32.5
04:00 to 05:00	35.5	24.4	31.9	30.8	23.0	27.8	30.2	23.0	27.7	20.5	19.5	20.8	32.1	24.5	29.5	22.7	20.0	21.3	39.7	24.4	35.0
05:00 to 06:00	40.1	24.8	35.1	30.8	22.9	28.4	26.8	21.6	24.6	26.7	19.8	24.6	28.0	22.8	25.4	25.2	20.7	25.0	47.9	38.0	44.6
06:00 to 07:00	37.6	31.0	34.8	32.7	24.7	29.3	34.9	24.7	31.6	35.2	22.4	31.9	34.6	23.1	31.3	32.8	23.8	29.6	52.1	38.7	47.7
07:00 to 08:00	38.0	23.4	34.0	44.4	33.6	41.2	40.9	30.9	40.5	44.7	29.4	41.1	43.8	33.3	40.3	45.8	32.5	41.4	54.5	43.3	51.2
08:00 to 09:00	34.0	24.2	32.5	53.2	40.9	49.3	41.9	34.0	39.2	49.1	39.3	45.4	47.0	38.5	44.1	46.6	36.1	43.3	56.4	45.0	53.1
09:00 to 10:00	34.9	22.8	31.3	50.5	40.3	46.9	45.2	35.2	42.4	46.2	36.9	43.2	46.3	37.0	43.0	51.1	40.2	47.7	55.8	42.8	51.8
10:00 to 11:00	30.4	22.3	33.8	50.0	36.4	45.7	44.2	30.0	39.8	45.7	36.1	42.9	47.2	36.6	43.9	54.8	43.8	51.2	57.3	46.0	54.2
11:00 to 12:00	30.8	20.7	37.8	50.4	40.0	47.2	38.8	24.6	36.0	46.5	33.4	43.1	47.6	33.9	43.1	54.2	40.1	50.5	57.7	46.7	54.2
12:00 to 13:00	29.1	20.5	26.4	51.1	38.8	47.4	36.6	25.4	33.2	46.8	32.7	42.5	46.4	35.6	43.2	54.5	40.8	50.4	57.2	48.0	54.2
13:00 to 14:00	36.0	21.5	31.6	44.3	33.0	40.7	39.7	26.4	36.6	47.7	30.7	43.5	49.1	38.3	46.0	55.5	41.9	51.6	55.9	42.3	51.5
14:00 to 15:00	42.1	28.6	38.2	37.5	26.6	33.8	41.5	25.2	37.2	46.2	29.0	42.3	49.4	36.2	45.6	55.4	40.1	51.5	46.8	29.5	42.3
15:00 to 16:00	35.7	26.1	33.7	31.0	22.0	30.2	37.9	23.6	34.9	44.6	30.0	41.1	45.8	35.5	42.4	55.4	41.9	51.8	45.1	30.3	41.2
16:00 to 17:00	34.3	26.9	31.6	43.8	24.6	40.4	37.1	23.7	33.2	42.5	29.9	38.8	46.4	36.6	43.2	53.5	42.2	50.2	52.2	40.6	49.0
17:00 to 18:00	39.7	28.9	36.4	45.2	34.4	41.8	32.4	24.9	29.9	40.6	29.3	40.2	42.4	33.2	39.5	52.4	41.8	48.9	45.3	35.8	42.6
18:00 to 19:00	46.1	36.2	43.3	39.0	28.6	35.3	27.2	23.2	26.2	31.6	25.7	28.9	41.1	30.7	37.9	42.2	32.9	39.1	43.8	32.6	40.7
19:00 to 20:00	47.1	33.2	44.1	37.4	24.5	33.2	22.4	20.2	21.1	25.1	21.8	23.6	32.5	25.5	32.2	35.9	29.2	33.2	50.5	32.2	51.2
20:00 to 21:00	45.6	34.2	41.7	36.4	26.9	37.1	20.2	19.6	20.1	21.6	20.1	24.2	24.9	23.1	24.0	28.9	26.9	27.9	45.0	37.4	42.1
21:00 to 22:00	44.0	32.3	40.8	41.4	30.3	37.3	19.6	19.5	20.1	20.2	19.7	20.0	25.5	22.1	25.7	26.6	25.1	26.0	50.0	40.2	46.5
22:00 to 23:00	44.5	32.4	40.5	42.5	33.3	39.0	19.7	19.4	21.2	20.0	19.6	19.8	26.2	21.3	31.6	25.4	23.1	24.7	57.1	44.0	53.1
23:00 to 24:00	47.6	32.9	43.3	42.0	33.3	39.0	19.5	19.4	19.5	19.9	19.6	20.0	24.4	20.1	27.5	22.9	21.6	24.8	60.2	40.5	55.8
L <sub>10</sub> (18h), ar.av. 6-24h	38.8			42.9			33.3			37.5			40.0			44.1			52.4		
L <sub>eq</sub> (16h), log av. 6-22h			38.3			43.4			36.6			41.2			42.3			48.6			50.7
L <sub>eq</sub> (8h), log av. 22-6h			43.6			36.3			24.6			29.2			27.6			40.3			49.0
L <sub>eq</sub> (24h), log av. 0-24h			37.9			43.3			35.7			39.2			40.4			46.5			50.1
L <sub>90</sub> Day		24.2			33.7			27.7			32.4			35.8						40.9	
L <sub>90</sub> Evening		34.0			27.6			20.6			21.8			31.3			37.0			35.6	
L <sub>90</sub> Night		30.6			27.8			19.9			21.8			20.6			26.7			31.9	
Wind @0900h, km/h																					
Wind @1500h, km/h																					



## Results of Noise Monitoring

**Client:** Goschen Mineral Sands  
**Job Number:** 640.11763      **Location:** Thompson Rd  
**Microphone position:** 1.5 m      **Initials:** BF  
**Initial calibration:** 94 dBA      **Final calibration:** 94 dBA

Hour	Sound Pressure Level, dB(A)																				
	Tue, 16-10-2018			Wed, 17-10-2018			Thu, 18-10-2018			Fri, 19-10-2018			Sat, 20-10-2018			Sun, 21-10-2018			Mon, 22-10-2018		
	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>
00:00 to 01:00	49.5	37.6	47.5	20.6	19.7	24.1	26.8	20.3	23.8	19.6	19.4	20.6	42.0	29.2	38.7	20.5	19.4	19.8	20.0	19.4	19.6
01:00 to 02:00	48.6	35.8	45.0	19.9	19.5	19.8	30.3	21.1	29.9	19.5	19.4	19.5	45.5	31.4	42.3	19.5	19.4	20.3	21.0	19.6	20.2
02:00 to 03:00	39.9	26.4	45.0	19.6	19.5	19.5	22.5	19.6	21.4	19.7	19.4	19.6	50.6	37.4	46.5	19.5	19.3	20.5	23.4	20.1	22.8
03:00 to 04:00	40.0	31.7	36.8	20.1	19.5	19.7	19.8	19.5	19.7	19.9	19.5	19.6	50.9	38.1	47.2	19.6	19.3	19.8	21.5	20.0	20.7
04:00 to 05:00	37.5	25.6	34.1	20.6	19.5	19.9	25.8	19.5	27.1	20.3	19.5	20.0	49.9	36.5	45.7	20.3	19.3	21.5	22.7	20.2	21.4
05:00 to 06:00	28.4	23.0	25.8	27.6	21.1	29.3	28.7	21.3	25.8	29.9	21.5	27.0	50.4	36.6	46.1	26.9	19.8	26.6	29.7	20.5	29.3
06:00 to 07:00	26.9	22.4	24.9	32.0	22.8	28.9	31.7	21.7	34.6	32.2	23.6	40.7	51.7	40.8	48.0	29.3	21.4	28.7	33.7	25.7	46.7
07:00 to 08:00	35.7	23.4	32.8	35.3	24.9	32.6	30.1	22.1	33.9	38.2	28.6	37.1	54.3	42.5	53.6	26.1	20.2	24.3	39.7	27.4	36.5
08:00 to 09:00	38.2	29.2	35.1	36.6	25.2	34.7	36.1	25.2	36.2	38.6	29.7	35.3	42.9	25.6	42.0	29.3	20.7	31.6	46.0	36.3	42.5
09:00 to 10:00	36.6	26.7	35.7	33.4	23.8	29.7	35.7	25.5	32.2	44.0	33.1	40.4	44.5	23.2	41.2	30.2	20.8	35.7	44.3	35.9	41.3
10:00 to 11:00	46.3	26.8	42.8	37.1	23.9	31.8	35.4	24.8	33.3	48.6	38.8	45.7	49.2	36.1	45.1	33.3	21.9	34.2	42.6	31.0	38.9
11:00 to 12:00	40.7	25.5	38.1	38.6	23.6	35.2	35.0	24.4	32.4	50.7	38.4	46.9	50.0	35.7	46.1	32.8	21.5	33.1	44.3	30.5	40.6
12:00 to 13:00	41.1	22.9	38.1	33.5	22.3	29.7	33.4	23.7	29.8	48.7	36.2	45.1	52.4	39.7	48.8	32.3	21.7	37.9	44.3	30.4	40.5
13:00 to 14:00	37.3	23.3	32.9	39.6	28.0	35.9	35.4	24.5	31.6	47.4	33.8	43.8	54.6	40.0	50.0	27.7	21.7	25.6	38.2	24.2	35.1
14:00 to 15:00	43.1	25.0	38.4	39.1	27.0	35.0	34.8	24.1	32.4	47.6	30.9	44.2	52.2	36.0	48.3	33.2	22.3	32.3	37.5	22.8	34.5
15:00 to 16:00	32.9	25.2	35.3	46.9	31.0	43.6	32.6	23.1	30.6	48.8	35.0	44.9	52.2	38.9	48.3	27.6	21.9	30.1	38.5	24.8	36.0
16:00 to 17:00	29.4	25.2	27.5	42.4	31.5	38.8	31.8	23.1	37.2	42.9	32.5	39.5	46.8	34.9	43.8	27.1	21.5	25.5	38.8	26.1	34.8
17:00 to 18:00	32.3	26.1	35.4	39.5	28.2	36.9	28.9	22.5	26.5	44.7	29.8	44.1	45.8	34.7	42.0	28.1	23.7	27.8	35.5	26.1	31.8
18:00 to 19:00	29.6	25.5	44.0	33.4	24.3	30.0	26.2	23.1	25.2	28.3	24.8	32.2	40.1	23.7	37.5	29.9	23.8	29.6	30.4	28.0	30.4
19:00 to 20:00	26.8	23.4	27.1	35.7	25.6	32.4	24.8	20.8	22.5	28.6	27.6	28.0	22.3	19.9	21.2	24.6	20.4	22.6	30.8	28.8	31.1
20:00 to 21:00	23.7	22.6	23.3	33.6	24.5	33.6	21.3	19.8	20.7	39.0	27.5	35.1	24.7	19.8	22.2	20.7	19.6	20.1	29.0	27.4	29.1
21:00 to 22:00	26.0	21.0	24.8	27.3	21.9	32.3	22.0	19.5	37.1	34.5	25.0	31.8	21.6	19.5	25.7	19.8	19.5	19.6	35.9	28.8	33.2
22:00 to 23:00	23.5	20.4	26.6	26.1	21.5	31.1	20.0	19.5	22.4	36.3	26.4	35.9	22.7	19.5	21.2	20.0	19.4	19.6	34.2	28.5	31.7
23:00 to 24:00	22.6	20.3	21.4	33.0	22.0	32.9	19.6	19.4	19.6	36.2	25.3	36.2	19.9	19.4	20.0	19.5	19.4	19.4	31.5	25.3	33.8
L <sub>10</sub> (18h), ar.av. 6-24h	32.9			35.7			29.7			40.8			41.6			27.3			37.5		
L <sub>eq</sub> (16h), log av. 6-22h			37.4			36.1			32.8			42.4			46.6			31.6			37.6
L <sub>eq</sub> (8h), log av. 22-6h			25.0			29.7			31.6			44.8			23.5			37.3			30.8
L <sub>eq</sub> (24h), log av. 0-24h			39.4			34.4			31.6			40.7			46.0			29.9			37.6
L <sub>90</sub> Day		25.4			26.3			23.9			33.3			33.8						28.7	
L <sub>90</sub> Evening		23.1			24.1			20.8			26.2			29.7			21.4			28.3	
L <sub>90</sub> Night		20.3			20.7			20.1			33.5			19.6			20.5			23.1	
Wind @0900h, km/h																					
Wind @1500h, km/h																					



## Results of Noise Monitoring

**Client:** Goschen Mineral Sands  
**Job Number:** 640.11763      **Location:** Thompson Rd  
**Microphone position:** 1.5 m      **Initials:** BF  
**Initial calibration:** 94 dBA      **Final calibration:** 94 dBA


Hour	Sound Pressure Level, dB(A)																				
	Tue, 23-10-2018			Wed, 24-10-2018			Thu, 25-10-2018			Fri, 26-10-2018			Sat, 27-10-2018			Sun, 28-10-2018			Mon, 29-10-2018		
	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>
00:00 to 01:00	28.1	21.9	29.7	25.9	21.3	23.8	23.8	19.6	23.7	27.0	21.3	25.4	19.7	19.4	19.6	22.8	19.9	21.4	29.2	22.9	26.8
01:00 to 02:00	24.4	20.3	30.1	29.6	21.9	26.3	23.6	20.0	28.2	24.9	20.7	22.9	20.5	19.4	27.8	28.5	21.7	26.0	38.7	26.4	35.3
02:00 to 03:00	21.5	20.1	20.6	22.1	19.7	21.4	25.4	20.2	23.2	23.9	19.9	22.0	19.5	19.4	19.5	33.5	24.6	29.8	37.3	23.8	33.7
03:00 to 04:00	24.5	20.2	22.5	20.2	19.5	20.3	20.9	19.8	20.3	20.1	19.5	20.0	20.1	19.4	19.8	30.4	20.8	26.8	28.2	21.4	25.4
04:00 to 05:00	27.9	20.6	24.3	20.6	19.4	20.0	20.8	19.6	20.5	22.9	19.6	21.3	33.0	19.4	27.5	26.2	19.7	23.6	22.6	19.6	22.4
05:00 to 06:00	32.2	23.9	29.4	24.2	19.8	22.2	26.9	20.2	29.1	24.3	21.0	23.2	26.4	21.0	25.6	27.4	21.2	25.1	27.1	20.1	25.9
06:00 to 07:00	39.6	27.2	35.6	29.6	21.3	30.8	29.3	21.9	29.7	32.3	23.6	38.7	33.1	22.2	29.1	36.7	26.6	33.1	33.9	21.6	35.6
07:00 to 08:00	44.6	33.4	41.1	43.7	27.1	39.3	30.6	23.7	31.1	42.3	31.9	38.7	34.2	25.5	35.3	42.0	30.8	38.5	35.8	27.9	34.1
08:00 to 09:00	48.1	36.4	44.8	47.3	38.1	43.9	30.5	22.4	53.8	40.8	31.6	37.7	38.8	26.3	58.1	38.4	26.5	34.7	32.7	22.8	28.7
09:00 to 10:00	50.1	38.4	46.2	45.2	33.0	43.0	26.4	21.8	25.2	37.4	25.4	33.9	43.4	29.3	39.4	35.1	22.0	31.6	27.8	21.6	25.3
10:00 to 11:00	51.8	38.5	48.2	40.8	26.3	37.1	25.5	21.6	25.1	41.9	29.0	39.3	42.7	29.9	39.5	35.1	22.5	41.2	27.4	21.6	24.8
11:00 to 12:00	51.5	37.5	47.3	38.0	23.3	33.6	27.5	21.5	30.7	40.2	27.0	36.3	44.5	28.3	41.6	34.0	22.2	30.6	31.3	22.0	27.9
12:00 to 13:00	49.3	35.8	45.2	35.6	22.4	31.6	32.4	21.6	29.4	42.4	26.8	38.5	42.2	31.3	38.7	31.2	21.9	27.3	29.8	21.7	26.0
13:00 to 14:00	50.0	36.0	46.4	35.3	23.4	32.1	31.5	21.7	27.8	39.0	23.3	34.8	46.2	31.3	42.3	27.5	21.3	24.9	28.4	21.9	25.5
14:00 to 15:00	50.6	34.6	45.5	38.2	24.4	34.8	39.7	22.0	40.8	38.7	24.8	34.6	47.6	32.2	43.0	28.1	21.6	25.5	29.5	21.8	26.1
15:00 to 16:00	51.1	36.1	47.5	37.4	23.8	33.0	37.7	23.4	34.1	38.3	25.0	34.3	47.7	33.0	43.3	34.9	22.5	30.5	28.9	21.7	26.4
16:00 to 17:00	50.9	38.6	47.4	36.4	22.8	32.2	37.8	24.4	34.1	37.7	24.9	33.7	46.7	32.0	42.9	28.3	21.5	26.8	26.0	21.2	23.8
17:00 to 18:00	46.8	34.8	43.1	33.0	23.3	30.0	33.8	24.9	33.8	34.4	27.0	31.4	42.8	30.4	39.7	27.6	21.8	24.8	25.2	21.6	23.7
18:00 to 19:00	40.3	28.5	37.4	26.0	22.7	26.7	29.2	26.4	28.4	29.7	24.9	34.0	35.6	27.7	32.3	30.4	22.7	27.1	26.3	22.9	25.0
19:00 to 20:00	32.5	24.3	29.5	22.2	19.9	21.0	27.6	24.0	25.9	24.9	22.5	24.4	27.7	24.4	26.5	25.1	20.7	24.1	25.5	23.0	24.8
20:00 to 21:00	31.1	23.5	28.2	19.8	19.5	19.7	25.2	21.5	23.5	23.3	21.6	22.4	36.1	24.3	32.2	20.3	19.7	20.1	21.3	19.8	20.5
21:00 to 22:00	28.5	21.7	26.0	19.9	19.5	19.7	22.5	20.1	24.8	23.1	19.9	21.5	34.0	24.2	30.9	29.4	19.7	25.7	20.4	19.6	20.2
22:00 to 23:00	31.6	23.8	28.3	21.6	19.5	20.4	29.2	20.3	30.0	19.9	19.5	19.7	26.8	19.8	23.6	34.9	26.6	31.8	19.9	19.5	19.8
23:00 to 24:00	26.1	20.5	24.2	20.5	19.7	20.8	31.4	23.5	32.2	20.0	19.4	20.5	25.4	19.8	22.6	29.5	23.6	26.9	19.5	19.4	19.5
L <sub>10</sub> (18h), ar.av. 6-24h	43.0			32.8			30.4			33.7			38.6			31.6			27.2		
L <sub>eq</sub> (16h), log av. 6-22h			44.8			36.8			42.5			35.3			47.2			33.0			27.0
L <sub>eq</sub> (8h), log av. 22-6h			25.7			25.6			30.9			25.0			27.4			31.5			22.4
L <sub>eq</sub> (24h), log av. 0-24h			42.9			34.9			40.5			34.0			45.2			31.8			28.9
L <sub>90</sub> Day		36.4			26.2			22.7			27.0			28.4						22.3	
L <sub>90</sub> Evening		24.5			20.4			23.0			22.2			28.8			22.5			21.3	
L <sub>90</sub> Night		20.8			20.1			21.0			19.9			21.6			22.9			19.8	
Wind @0900h, km/h																					
Wind @1500h, km/h																					



## Results of Noise Monitoring

**Client:** Goschen Mineral Sands  
**Job Number:** 640.11763      **Location:** Thompson Rd  
**Microphone position:** 1.5 m      **Initials:** BF  
**Initial calibration:** 94 dBA      **Final calibration:** 94 dBA

Hour	Sound Pressure Level, dB(A)																	
	Tue, 30-10-2018			Wed, 31-10-2018			Thu, 01-11-2018											
	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>
00:00 to 01:00	19.6	19.5	19.8	27.5	22.9	26.5	25.6	23.2	28.1									
01:00 to 02:00	19.6	19.5	19.5	30.8	25.5	28.2	23.3	21.2	22.3									
02:00 to 03:00	19.8	19.5	19.6	29.6	23.6	27.1	22.1	21.0	21.5									
03:00 to 04:00	19.9	19.5	19.8	31.7	25.0	29.1	22.9	20.7	21.6									
04:00 to 05:00	22.4	19.5	22.0	33.1	25.4	30.1	23.7	20.6	22.5									
05:00 to 06:00	25.8	19.9	27.5	31.2	24.8	28.9	29.1	20.9	34.7									
06:00 to 07:00	26.7	21.7	24.7	33.0	26.7	30.3	30.2	22.9	29.0									
07:00 to 08:00	27.4	20.9	26.2	36.1	29.8	33.5	36.4	26.2	32.8									
08:00 to 09:00	23.1	20.8	23.2	36.1	28.1	33.1	39.5	29.3	36.1									
09:00 to 10:00	27.9	21.1	25.1	32.9	23.3	29.8	45.2	33.0	41.2									
10:00 to 11:00	34.0	22.3	30.3	31.7	21.1	27.4	47.0	36.5	43.8									
11:00 to 12:00	35.9	22.3	32.5	28.8	21.0	27.5	52.1	38.8	48.8									
12:00 to 13:00	37.8	21.7	33.6	31.6	21.2	34.1												
13:00 to 14:00	36.3	21.4	31.7	34.0	21.0	33.4												
14:00 to 15:00	36.7	21.3	32.2	28.3	21.0	25.4												
15:00 to 16:00	35.2	21.9	32.6	34.2	21.1	29.5												
16:00 to 17:00	35.4	21.7	30.4	29.8	20.9	26.7												
17:00 to 18:00	31.6	21.7	28.1	27.9	21.2	24.8												
18:00 to 19:00	30.6	23.8	28.2	37.2	22.4	33.6												
19:00 to 20:00	31.7	28.8	30.6	35.6	31.9	33.8												
20:00 to 21:00	28.9	24.7	26.9	33.5	32.2	33.1												
21:00 to 22:00	27.2	23.1	25.3	32.2	31.2	31.7												
22:00 to 23:00	32.9	27.0	30.6	30.9	28.6	29.8												
23:00 to 24:00	31.0	24.8	28.3	28.7	25.8	27.4												
L <sub>10</sub> (18h), ar. av. 6-24h	31.7			32.4														
L <sub>eq</sub> (16h), log av. 6-22h			30.1			31.5												
L <sub>eq</sub> (8h), log av. 22-6h			29.0			28.6												
L <sub>eq</sub> (24h), log av. 0-24h			28.9			30.7												
L <sub>90</sub> Day		21.6			22.7			32.8										
L <sub>90</sub> Evening		25.1			29.4													
L <sub>90</sub> Night		25.1			22.8													
Wind @0900h, km/h																		
Wind @1500h, km/h																		

Noise Monitoring Location		Jobling Rd	Photo of Noise Monitoring Location	
<p>Noise monitor located on a private road adjacent to a dam, approximately 200 m west of receiver R10 and 1 km north of Jobling Rd.</p> <p>Noise sources includes insects and potentially frogs, farming activity around receiver R10.</p>				
Summary of Measured Noise Levels				
Assessment Period	Noise Level (dBA)			
	L <sub>A90</sub> (Average)	L <sub>A90</sub> (Lowest)	L <sub>Aeq</sub>	
Daytime	34	26	44	
Evening	39	28	50	
Night	30	22	37	

Bruel & Kjaer Sentinel. S/N 3008635

Coordinates: 35°36'9.72"S, 143°23'49.27"



## Results of Noise Monitoring

**Client:** Goschen Mineral Sands  
**Job Number:** 640.11763      **Location:** Jobling Rd  
**Microphone position:** freefield      **Initials:** BF  
**Initial calibration:** 94 dBA      **Final calibration:** 94 dBA

Hour	Sound Pressure Level, dB(A)																				
	Tue, 02-10-2018			Wed, 03-10-2018			Thu, 04-10-2018			Fri, 05-10-2018			Sat, 06-10-2018			Sun, 07-10-2018			Mon, 08-10-2018		
	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>
00:00 to 01:00				48.9	34.29*	45.1	51.4	43.4	48.5	28.2	22.1	26.7	30.3	21.9	29.6	29.4	22.7	33.0	28.6	23.0	29.8
01:00 to 02:00				38.4	28.4	35.0	48.4	41.9	46.1	22.6	21.5	22.7	27.7	21.5	31.7	35.4	22.7	35.3	25.6	22.2	30.2
02:00 to 03:00				35.4	24.5	31.3	49.6	41.9	47.2	22.8	21.8	22.6	28.9	23.5	27.6	22.9	21.6	24.8	26.4	22.1	24.8
03:00 to 04:00				27.8	22.2	26.9	50.7	39.9	47.6	23.0	21.5	23.0	27.1	22.0	25.2	23.7	21.5	24.4	24.9	22.0	24.1
04:00 to 05:00				25.7	21.7	25.4	42.5	34.5	41.3	28.0	21.3	25.1	28.8	22.4	27.3	29.0	21.4	26.1	31.4	22.4	29.4
05:00 to 06:00				35.5	21.8	34.0	36.9	32.0	37.6	35.8	21.7	35.7	39.2	26.2	38.3	39.6	24.0	39.2	39.7	26.9	38.5
06:00 to 07:00				36.1	25.5	35.1	40.3	31.6	37.7	37.1	23.7	38.9	38.7	28.3	36.0	40.0	29.8	38.0	40.0	30.3	46.7
07:00 to 08:00				37.9	25.0	36.2	49.3	41.4	46.6	38.2	25.0	37.3	41.7	30.7	39.5	43.1	30.2	40.4	40.8	30.1	38.1
08:00 to 09:00				38.6	24.8	37.7	52.0	43.4	49.2	39.9	30.8	43.1	45.4	37.6	43.2	42.4	31.4	40.1	41.9	30.5	40.7
09:00 to 10:00				36.2	26.7	36.4	52.8	43.6	55.3	39.4	29.9	39.5	42.5	35.2	41.2	45.5	33.4	57.0	41.7	32.0	39.6
10:00 to 11:00				35.6	24.8	39.1	52.5	42.5	49.6	37.2	25.7	41.7	42.0	29.9	39.9	43.4	30.4	55.3	41.9	30.2	39.1
11:00 to 12:00				36.3	26.3	41.6	51.1	39.5	48.3	36.7	24.7	36.5	37.8	26.4	36.1	38.7	26.3	38.8	40.9	28.8	41.2
12:00 to 13:00	48.0	34.6	54.6	38.2	26.6	36.6	49.8	36.9	47.1	36.2	24.1	43.0	37.4	25.5	34.2	36.5	25.0	36.5	40.9	28.8	38.4
13:00 to 14:00	51.3	36.7	49.2	39.8	26.0	41.2	52.4	40.2	54.4	34.8	24.1	36.8	36.1	24.7	40.5	34.5	24.5	40.1	39.2	26.8	36.2
14:00 to 15:00	50.0	38.1	59.6	40.8	27.1	45.2	53.8	41.6	53.1	35.5	24.5	34.7	38.0	24.6	42.2	35.7	25.1	33.3	40.5	25.3	40.4
15:00 to 16:00	52.4	37.5	49.3	38.7	26.8	38.0	54.6	45.7	51.8	35.3	23.8	39.7	36.3	26.0	34.5	33.6	24.5	41.0	37.9	25.8	40.7
16:00 to 17:00	52.8	41.3	56.7	38.1	28.2	36.0	54.6	45.8	54.4	36.8	24.3	37.8	42.3	26.7	40.5	44.0	25.4	39.3	35.9	26.0	37.6
17:00 to 18:00	44.6	36.0	46.1	39.2	30.6	41.8	52.7	46.0	50.5	44.9	28.7	41.5	49.6	35.2	45.6	54.8	31.92*	50.1	48.7	29.7	43.8
18:00 to 19:00	50.3	36.9	46.9	55.9	36.0	49.9	48.4	42.1	46.0	58.3	43.96*	55.6	58.6	41.3	54.9	59.9	50.97*	57.5	61.9	46.26*	57.9
19:00 to 20:00	49.3	45.86*	47.7	59.2	56.16*	57.9	51.0	43.4	48.0	57.1	52.58*	55.4	58.4	55.35*	57.1	59.4	56.79*	58.3	61.9	57.91*	60.4
20:00 to 21:00	46.6	43.65*	45.3	57.7	53.65*	56.2	48.6	40.9	45.9	53.6	35.28*	48.9	56.6	51.76*	54.8	57.6	51.69*	55.5	58.6	56.02*	57.5
21:00 to 22:00	45.2	42.23*	44.0	55.8	49.19*	53.7	40.6	31.4	37.5	41.9	28.54*	40.8	53.7	40.01*	50.5	53.6	35.68*	49.2	56.1	52.41*	54.7
22:00 to 23:00	46.5	41.78*	44.4	55.3	46.2*	52.9	34.2	27.5	32.0	40.9	25.4	38.1	50.8	30.52*	44.6	42.1	30.24*	41.1	55.1	50.26*	53.7
23:00 to 24:00	48.9	41.36*	45.9	54.0	45.05*	51.4	30.1	23.1	27.3	30.6	21.9	32.9	46.2	28.8	41.3	34.6	23.4	32.8	55.6	50.63*	53.8
L <sub>10</sub> (18h), ar.av. 6-24h				44.1			48.3			40.8			45.1			44.4			46.6		
L <sub>eq</sub> (16h) log av. 6-22h						49.7			50.6			47.6			49.4			52.3			52.3
L <sub>eq</sub> (8h) log av. 22-6h			41.3			48.5			29.5			33.7			38.5			35.0			50.6
L <sub>eq</sub> (24h), log av. 0-24h						48.9			49.4			45.9			47.8			50.5			51.3
L <sub>90</sub> Day					26.6			42.4			26.0			30.9						28.5	
L <sub>90</sub> Evening		36.9			36.0			39.4						29.7			27.6				
L <sub>90</sub> Night								22.7			23.7										
Wind @0900h, km/h																					
Wind @1500h, km/h																					





## Results of Noise Monitoring

**Client:** Goschen Mineral Sands  
**Job Number:** 640.11763      **Location:** Jobling Rd  
**Microphone position:** freefield      **Initials:** BF  
**Initial calibration:** 94 dBA      **Final calibration:** 94 dBA

Hour	Sound Pressure Level, dB(A)																				
	Tue, 09-10-2018			Wed, 10-10-2018			Thu, 11-10-2018			Fri, 12-10-2018			Sat, 13-10-2018			Sun, 14-10-2018			Mon, 15-10-2018		
	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>
00:00 to 01:00	55.0	48.07*	52.9	48.4	41.1	46.0	40.5	33.4	37.8	27.1	22.4	25.8	32.0	26.1	31.1	45.4	26.3	39.2	54.9	49.3	53.1
01:00 to 02:00	54.3	46.01*	51.4	54.8	45.9	51.8	41.1	35.4	41.1	31.9	23.5	29.1	31.0	25.8	31.5	45.5	25.1	38.7	54.5	47.1	52.1
02:00 to 03:00	52.8	38.85*	48.8	53.2	43.6	50.4	38.0	31.9	35.7	25.4	22.8	25.6	28.7	25.0	27.1	30.9	25.2	29.4	55.8	47.6	53.1
03:00 to 04:00	46.0	36.18*	43.2	43.4	36.5	41.4	39.7	33.8	37.6	25.1	22.7	24.1	29.9	25.5	28.0	27.4	23.4	26.7	55.0	44.8	52.2
04:00 to 05:00	45.4	34.83*	42.0	40.4	35.9	38.5	36.1	26.9	33.3	30.7	23.0	28.5	31.6	26.7	29.6	30.3	23.8	28.6	49.9	40.1	46.8
05:00 to 06:00	39.0	29.0	36.8	40.0	32.4	38.6	38.0	28.5	37.4	39.7	27.6	37.7	39.3	30.1	37.8	40.1	29.1	38.4	49.5	41.0	46.5
06:00 to 07:00	38.4	32.1	37.9	38.8	33.0	45.3	41.6	29.2	40.4	37.3	29.0	37.3	38.0	29.7	36.6	41.6	31.2	41.6	50.2	41.4	48.1
07:00 to 08:00	39.8	30.6	40.1	46.2	37.2	43.4	42.6	34.5	40.2	44.2	34.2	41.8	45.2	35.0	43.2	48.1	36.1	45.7	56.1	45.6	53.8
08:00 to 09:00	41.3	29.0	41.4	55.2	45.6	52.5	44.2	36.4	42.8	47.8	39.7	46.5	43.8	35.4	41.3	49.6	42.5	50.8	58.1	48.6	55.9
09:00 to 10:00	42.3	30.5	41.3	54.0	45.9	51.3	47.9	38.1	46.4	46.3	38.5	43.9	45.6	38.1	43.1	52.1	44.2	50.2	58.5	49.2	56.0
10:00 to 11:00	43.6	29.3	44.0	51.1	42.0	48.8	44.8	34.2	42.1	46.2	36.7	43.8	46.0	35.9	43.1	56.4	45.4	55.1	59.9	49.0	57.2
11:00 to 12:00	40.1	26.8	39.9	52.0	43.8	49.3	40.3	28.0	40.6	47.3	35.2	51.2	46.4	35.8	43.5	56.0	43.7	52.7	55.9	46.9	53.8
12:00 to 13:00	37.0	26.7	34.9	52.1	42.9	49.3	40.1	28.6	40.2	44.4	32.9	42.2	45.8	36.5	43.6	54.1	43.9	51.8	59.3	48.4	57.0
13:00 to 14:00	45.1	30.9	42.4	46.7	36.4	43.9	43.0	30.1	39.7	46.9	33.4	48.1	48.1	39.1	45.9	56.4	42.4	53.8	55.3	44.8	52.7
14:00 to 15:00	46.1	38.3	43.6	43.4	33.0	42.4	43.7	30.6	41.4	45.3	32.8	43.4	47.4	36.8	44.8	55.1	43.8	52.8	48.8	34.3	45.4
15:00 to 16:00	41.6	33.2	39.0	39.0	27.1	39.6	42.4	27.8	42.7	45.6	32.0	43.7	45.8	36.4	43.5	55.0	44.0	53.2	46.6	32.8	44.4
16:00 to 17:00	46.1	32.9	46.8	47.2	31.4	43.7	40.3	30.7	42.7	42.2	33.0	39.6	47.6	38.1	45.0	55.2	45.9	52.6	50.6	41.8	48.7
17:00 to 18:00	46.8	36.3	43.0	45.1	38.6	42.7	49.2	31.7	50.9	52.4	36.2	47.5	50.7	38.2	46.8	52.7	43.9	50.5	44.3	36.8	42.2
18:00 to 19:00	50.7	43.4	48.5	45.1	32.4	40.5	55.3	42.4	52.4	57.9	48.1	54.5	55.6	45.7	53.2	57.8	44.2	53.5	53.3	39.7	49.0
19:00 to 20:00	51.3	43.5	48.6	45.7	36.8	42.5	55.7	42.9	52.7	60.0	54.5	58.2	60.4	57.4	59.1	60.7	59.0	59.9	56.6	50.7	58.5
20:00 to 21:00	49.5	42.0	47.3	44.9	36.7	42.0	45.9	31.3	42.2	56.8	45.5	53.7	57.8	53.6	56.2	59.7	56.8	58.6	56.1	53.2	54.8
21:00 to 22:00	51.2	43.7	48.7	40.8	32.7	38.1	36.9	23.4	32.8	45.8	30.6	41.4	56.0	48.4	53.7	58.1	55.2	57.0	56.1	52.4	54.7
22:00 to 23:00	47.3	39.6	44.8	43.4	36.6	40.7	26.1	21.9	26.1	43.8	26.5	37.6	54.2	37.5	50.4	57.0	53.6	55.7	56.2	51.8	54.8
23:00 to 24:00	52.0	42.5	49.1	42.5	36.3	39.9	25.5	22.7	24.5	30.4	24.9	28.2	46.8	31.1	42.5	55.5	50.7	53.8	63.0	50.0	60.6
L <sub>10</sub> (18h), ar.av. 6-24h	45.0			46.3			42.5			46.7			48.9			54.5			54.7		
L <sub>eq</sub> (16h), log av. 6-22h			44.7			46.8			46.5			50.4			51.2			54.6			54.3
L <sub>eq</sub> (8h), log av. 22-6h			47.4			38.6			32.0			33.8			42.7			52.2			54.2
L <sub>eq</sub> (24h), log av. 0-24h			46.3			46.6			44.8			48.4			49.4			53.1			54.2
L <sub>90</sub> Day		31.3			38.5			31.9			35.0			36.1						43.5	
L <sub>90</sub> Evening		43.1			34.6			35.0			44.7			43.7			46.1			49.0	
L <sub>90</sub> Night		38.9			32.4			24.0			26.7			28.1			46.2			44.5	
Wind @0900h, km/h																					
Wind @1500h, km/h																					






## Results of Noise Monitoring

**Client:** Goschen Mineral Sands  
**Job Number:** 640.11763      **Location:** Jobling Rd  
**Microphone position:** freefield      **Initials:** BF  
**Initial calibration:** 94 dBA      **Final calibration:** 94 dBA

Hour	Sound Pressure Level, dB(A)																				
	Tue, 16-10-2018			Wed, 17-10-2018			Thu, 18-10-2018			Fri, 19-10-2018			Sat, 20-10-2018			Sun, 21-10-2018			L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>
	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>			
00:00 to 01:00	56.3	50.2	55.3	28.0	22.1	26.7	33.0	24.3	29.0	29.3	21.4	29.1	57.4	52.6	55.5	31.9	21.6	28.3			
01:00 to 02:00	54.2	48.1	52.0	23.4	21.9	22.7	35.6	27.2	34.9	23.8	21.4	23.8	56.8	43.8	54.2	23.0	21.5	26.7			
02:00 to 03:00	54.1	47.0	53.9	22.4	21.4	23.2	30.3	21.7	27.4	23.1	21.5	23.9	55.8	47.8	53.1	24.4	21.5	29.9			
03:00 to 04:00	52.8	47.2	50.6	24.2	21.4	25.5	24.8	21.6	23.4	22.7	21.6	23.5	55.7	46.8	52.5	22.1	21.4	23.2			
04:00 to 05:00	50.4	42.3	47.7	30.6	22.1	28.3	33.2	22.2	34.2	32.6	21.7	29.8	56.6	42.6	52.2	29.0	21.5	25.7			
05:00 to 06:00	43.6	33.9	40.5	37.1	26.6	34.8	39.5	28.4	38.0	40.5	30.8	39.3	53.2	44.8	50.4	39.1	27.7	36.9			
06:00 to 07:00	40.2	30.3	39.3	38.3	28.0	36.6	40.3	27.6	37.9	39.7	30.8	38.3	53.3	46.7	50.9	36.2	24.5	37.2			
07:00 to 08:00	39.7	32.2	38.9	40.1	28.4	43.6	37.9	28.0	39.3	42.2	34.9	42.0	54.0	46.2	53.5	34.7	23.3	39.5			
08:00 to 09:00	40.4	31.9	37.9	39.2	28.8	39.9	39.5	30.1	39.4	43.3	35.4	40.9	42.5	28.9	42.2	34.5	23.9	35.6			
09:00 to 10:00	40.8	31.0	41.2	40.0	28.2	39.7	39.8	30.3	40.5	50.1	40.4	47.2	48.1	32.9	44.5	38.2	24.3	40.8			
10:00 to 11:00	42.4	27.8	42.3	40.6	28.5	41.6	40.7	30.7	39.8	54.8	45.6	52.0	52.7	43.1	49.7	41.5	25.0	38.4			
11:00 to 12:00	42.1	27.1	41.7	41.5	28.6	39.5	40.9	29.9	38.8	55.2	44.9	53.7	52.3	43.0	49.4	40.3	24.4	37.1			
12:00 to 13:00	40.1	28.3	40.2	43.2	29.7	40.0	39.7	28.6	37.5	56.3	40.7	53.2	55.9	45.8	52.7	38.8	24.5	35.8			
13:00 to 14:00	38.4	28.2	37.9	45.1	33.8	42.2	39.4	28.7	37.8	52.5	36.5	49.0	56.5	47.0	53.4	35.5	24.5	33.9			
14:00 to 15:00	40.6	29.5	38.7	44.3	34.0	41.5	38.5	27.2	35.5	53.2	40.0	49.9	56.9	44.9	53.9	36.3	24.2	33.6			
15:00 to 16:00	37.8	30.1	36.7	50.9	38.1	48.2	37.6	28.4	38.2	55.3	40.4	54.2	54.5	46.2	51.6	36.3	24.7	33.3			
16:00 to 17:00	39.0	29.8	36.8	46.7	37.4	44.0	37.8	27.2	43.6	50.7	41.2	49.5	52.6	42.7	49.4	41.1	26.9	39.8			
17:00 to 18:00	42.4	30.5	39.9	42.5	33.1	40.4	39.5	29.7	37.2	52.1	40.8	48.8	51.5	43.0	48.6	47.7	36.0	44.3			
18:00 to 19:00	50.4	33.0	46.2	40.9	32.3	39.2	51.6	37.3	46.1	60.9	46.1	56.7	42.6	36.3	41.5	61.1	50.7	58.0			
19:00 to 20:00	54.0	48.1	51.9	53.2	45.2	50.8	54.8	48.4	52.7	62.7	60.6	61.9	53.7	34.8	49.1	61.9	55.0	59.5			
20:00 to 21:00	51.7	45.0	49.4	51.8	39.0	48.1	43.7	25.5	40.0	62.0	58.8	60.8	35.2	23.7	37.3	55.2	38.4	50.9			
21:00 to 22:00	44.6	30.1	39.9	47.8	34.4	42.5	32.8	22.1	29.3	61.3	56.9	59.8	28.8	21.8	30.8	34.9	22.9	32.1			
22:00 to 23:00	35.4	23.2	31.5	38.7	30.6	36.4	31.4	21.6	27.8	60.4	56.9	59.2	28.0	21.6	27.7	29.5	21.7	28.5			
23:00 to 24:00	34.9	23.5	30.7	37.8	29.7	35.9	29.5	21.4	28.8	59.7	54.6	58.1	29.5	21.6	27.1	29.8	21.7	27.4			
L10 <sub>(18h)</sub> , ar. av. 6-24h	41.9			43.5			39.7			54.0			47.1			40.7					
L <sub>eq</sub> (16h) log av. 6-22h			44.2			44.4			43.5			55.6			50.0			50.6			
L <sub>eq</sub> (8h) log av. 22-6h			31.3			34.9			33.3			55.0			31.9			21.5			
L <sub>eq</sub> (24h), log av. 0-24h			47.4			42.6			41.7			54.6			50.8			48.6			
L90 Day		29.7			31.7			29.0			40.1			40.0							
L90 Evening		39.1			37.7			33.3			55.6			37.8			29.9				
L90 Night		23.3			25.9			23.6			48.5			22.5			21.7				
Wind @0900h, km/h																					
Wind @1500h, km/h																					

Noise Monitoring Location		Bennett Rd		Photo of Noise Monitoring Location	
<p>Noise monitor located on the Shepherd Rd road side, 130 m north of the Bennett Rd – Shepherd Rd intersection and 630 m north of receiver R14.</p> <p>Noise sources includes insects, birds occasional local traffic and farming activity.</p>					
Summary of Measured Noise Levels					
Assessment Period	Noise Level (dBA)			Bruel & Kjaer Sentinel. S/N 3006994 Coordinates: 35°38'9.72"S, 143°26'51.19"E	
	L <sub>A90</sub> (Average)	L <sub>A90</sub> (Lowest)	L <sub>Aeq</sub>		
Daytime	31	25	42		
Evening	33	24	41		
Night	26	21*	33		

\*Results likely affected by noise floor of test equipment



## Results of Noise Monitoring

**Client:** Goschen Mineral Sands  
**Job Number:** 640.11763      **Location:** Bennett Rd  
**Microphone position:** 1.5m      **Initials:** BF  
**Initial calibration:** 94 dBA      **Final calibration:** 94 dBA

Hour	Sound Pressure Level, dB(A)																				
	Tue, 02-10-2018			Wed, 03-10-2018			Thu, 04-10-2018			Fri, 05-10-2018			Sat, 06-10-2018			Sun, 07-10-2018			Mon, 08-10-2018		
	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>
00:00 to 01:00				35.7	26.0	33.0	43.9	37.8	41.7	27.9	24.0	27.1	26.3	22.6	25.4	25.6	22.1	25.2	26.6	22.8	28.0
01:00 to 02:00				32.7	23.9	30.4	42.5	34.4	39.6	25.6	22.9	24.3	25.9	22.2	30.4	25.8	22.0	29.3	26.1	22.5	31.4
02:00 to 03:00				32.1	24.6	29.3	45.0	37.9	42.5	25.6	22.6	24.2	28.6	23.7	26.7	25.5	21.8	23.7	26.0	22.6	24.6
03:00 to 04:00				30.4	23.0	26.7	46.0	39.0	43.8	25.2	21.9	23.7	29.1	23.7	27.5	25.5	21.6	24.2	25.6	22.3	26.5
04:00 to 05:00				25.7	22.3	24.1	41.0	31.0	38.3	25.6	22.3	24.1	27.1	23.8	25.7	25.4	21.6	23.7	25.4	22.0	23.7
05:00 to 06:00				41.46*	22.12*	38.6*	31.4	25.3	32.9	40.8	22.7	40.8	40.1	23.3	35.7	41.1	22.5	44.5	43.5	23.3	41.5
06:00 to 07:00				28.4	22.8	35.6	32.7	24.4	38.4	29.4	22.4	34.5	28.8	23.6	35.6	31.7	22.6	40.3	31.5	23.3	32.7
07:00 to 08:00				34.0	23.4	36.2	44.1	32.8	41.1	34.7	26.9	34.2	38.2	27.8	35.7	35.1	22.6	37.6	32.7	27.1	31.9
08:00 to 09:00				36.2	25.5	34.9	45.7	39.4	45.6	40.0	31.4	38.2	40.9	34.2	43.2	36.8	25.1	42.5	33.4	26.5	35.5
09:00 to 10:00				40.9	27.8	46.6	47.8	38.8	47.1	41.7	31.2	49.2	37.6	29.0	35.7	34.4	27.6	33.1	34.4	26.9	33.3
10:00 to 11:00				38.5	27.2	41.0	46.9	37.7	44.4	34.3	23.7	41.5	37.5	26.5	51.0	36.6	25.9	39.4	37.7	26.0	39.7
11:00 to 12:00	46.3	32.7	49.8	37.3	27.2	36.6	46.7	36.6	44.9	31.0	23.6	41.6	33.3	24.6	31.5	35.9	23.8	46.0	37.3	24.6	39.3
12:00 to 13:00	40.6	29.5	37.9	38.6	27.9	44.7	47.6	36.0	45.0	31.3	23.5	34.3	30.2	23.6	30.3	35.1	23.7	35.8	36.9	23.8	33.6
13:00 to 14:00	47.3	33.4	43.8	41.8	27.9	40.2	47.1	36.3	45.0	31.5	23.8	47.0	32.0	23.8	31.4	33.2	23.5	29.8	39.8	24.6	36.1
14:00 to 15:00	45.8	34.1	43.6	48.2	30.1	45.5	50.2	36.9	48.2	34.1	24.1	42.1	36.3	24.6	39.3	32.8	23.3	30.0	35.8	24.6	33.8
15:00 to 16:00	47.7	36.1	47.2	51.2	30.4	47.4	51.7	42.0	48.9	29.9	23.8	35.0	33.9	23.8	39.7	30.8	23.3	41.8	33.9	25.1	32.9
16:00 to 17:00	44.6	33.8	41.4	38.8	28.7	43.1	50.8	42.0	48.2	29.8	25.2	32.1	34.4	25.4	39.0	31.5	24.1	37.1	33.3	24.4	33.6
17:00 to 18:00	37.4	31.5	39.9	40.3	31.7	39.4	51.9	43.9	49.2	35.0	27.9	33.4	37.9	29.8	43.2	35.7	26.9	33.6	35.3	27.9	43.8
18:00 to 19:00	41.5	34.6	40.3	51.7	39.1	47.4	48.8	40.9	45.9	44.0	34.9	42.9	45.1	35.3	41.7	45.7	36.0	47.6	41.5	35.4	39.0
19:00 to 20:00	40.3	35.9	38.7	47.7	41.2	45.2	45.7	38.4	43.3	44.1	31.84*	40.6	46.1	40.0	44.2	45.9	39.7	43.7	41.1	39.1	40.3
20:00 to 21:00	38.1	32.6	36.1	44.4	37.3	41.8	42.8	32.8	39.8	42.4	25.16*	37.5	45.8	35.1	43.1	45.4	34.5	42.5	39.9	37.7	39.0
21:00 to 22:00	37.4	32.3	35.5	40.8	34.5	38.2	35.0	29.3	33.8	41.1	22.2	34.2	44.5	26.8	40.8	43.8	25.5	38.9	38.9	36.0	37.7
22:00 to 23:00	38.0	33.1	36.7	47.1	39.9	44.4	33.4	27.3	31.3	26.3	22.4	24.7	37.4	23.0	32.6	42.1	23.5	35.4	37.9	33.4	36.1
23:00 to 24:00	38.0	33.2	36.2	46.1	38.3	43.4	29.5	25.9	27.9	26.0	22.1	24.3	26.1	22.6	25.8	30.0	22.8	32.0	36.9	32.2	35.2
L <sub>10</sub> (18h), ar.av. 6-24h				41.8			44.4			34.8			37.0			36.8			36.6		
L <sub>eq</sub> (16h), log av. 6-22h						43.3			45.7			41.7			42.4			41.4			37.8
L <sub>eq</sub> (8h), log av. 22-6h			#####			41.9			32.9			29.5			36.1			34.4			36.6
L <sub>eq</sub> (24h), log av. 0-24h						#####			44.4			40.2			40.8			40.3			37.0
L <sub>90</sub> Day					28.0			38.4			25.9			27.6						25.6	
L <sub>90</sub> Evening		33.8			38.0			35.3			28.5			29.4			27.0			37.1	
L <sub>90</sub> Night		26.1			34.2			23.5			23.0			22.2			22.8			29.7	
Wind @0900h, km/h																					
Wind @1500h, km/h																					



## Results of Noise Monitoring

**Client:** Goschen Mineral Sands  
**Job Number:** 640.11763      **Location:** Bennett Rd  
**Microphone position:** 1.5m      **Initials:** BF  
**Initial calibration:** 94 dBA      **Final calibration:** 94 dBA


Hour	Sound Pressure Level, dB(A)																				
	Tue, 09-10-2018			Wed, 10-10-2018			Thu, 11-10-2018			Fri, 12-10-2018			Sat, 13-10-2018			Sun, 14-10-2018			Mon, 15-10-2018		
	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>
00:00 to 01:00	36.4	32.0	34.9	42.4	36.8	40.1	40.9	34.9	38.6	26.3	22.7	25.6	28.2	24.9	29.8	28.9	25.1	30.9	34.5	29.5	33.3
01:00 to 02:00	33.8	29.0	36.2	46.1	39.5	43.6	40.2	35.9	40.4	29.2	24.2	27.0	31.2	25.0	32.1	27.9	24.2	26.5	34.4	29.6	32.8
02:00 to 03:00	31.3	26.6	29.5	46.9	39.0	44.1	35.2	29.6	32.5	26.4	23.0	25.1	34.6	28.4	31.8	27.5	24.8	27.1	41.3	33.3	38.4
03:00 to 04:00	33.3	27.7	30.8	41.5	30.9	37.8	32.2	25.9	29.5	26.6	24.2	25.5	35.8	29.5	33.7	27.2	23.5	25.7	39.0	32.8	36.0
04:00 to 05:00	36.8	27.6	33.0	33.9	28.2	31.7	33.2	28.2	31.5	26.5	23.6	25.2	38.5	34.3	36.7	28.5	24.9	27.2	35.1	31.2	33.3
05:00 to 06:00	42.6	27.6	42.6	38.9	29.5	37.0	39.5	25.2	36.8	39.9	23.4	39.8	41.2	32.3	41.3	40.8	25.4	37.9	48.94*	41.4*	47.8*
06:00 to 07:00	37.5	31.6	36.5	34.2	28.8	33.5	36.5	26.5	33.5	31.9	23.6	34.6	40.2	31.4	37.7	36.8	29.3	34.4	50.7	40.9	47.3
07:00 to 08:00	37.8	26.1	36.6	44.3	33.2	47.4	43.7	37.3	41.1	48.7	35.1	44.8	46.3	38.9	45.6	47.3	38.6	45.0	55.2	46.8	52.3
08:00 to 09:00	34.7	24.1	32.4	50.2	41.2	48.0	44.0	37.5	41.3	49.5	42.9	47.5	47.6	41.1	45.0	47.5	40.0	44.7	53.0	44.0	50.0
09:00 to 10:00	39.7	24.3	40.6	49.9	42.2	47.7	48.1	38.2	46.4	47.4	40.2	45.0	47.4	40.3	44.6	49.0	40.9	46.1	51.2	44.3	48.6
10:00 to 11:00	36.4	26.2	37.1	51.5	42.4	49.7	44.3	32.8	41.1	47.4	36.5	44.2	47.0	38.4	44.3	53.1	44.6	50.1	55.1	46.0	52.1
11:00 to 12:00	52.0	23.7	53.4	52.4	46.7	50.2	40.8	27.3	37.7	48.4	36.0	44.8	48.2	37.9	45.1	51.5	42.1	48.3	55.3	46.7	52.3
12:00 to 13:00	39.0	26.7	43.6	52.1	44.7	50.4	39.4	27.4	36.0	46.8	33.4	44.6	49.0	38.1	45.4	52.0	42.6	49.2	57.5	51.0	55.1
13:00 to 14:00	44.5	27.3	45.3	46.6	37.0	43.6	43.1	29.7	39.5	47.8	36.0	44.4	51.2	40.3	47.4	52.1	42.5	48.8	53.1	44.6	50.2
14:00 to 15:00	44.2	32.2	41.4	48.7	35.2	45.6	42.7	29.1	39.5	48.4	35.8	45.1	50.7	38.9	47.2	52.7	42.6	49.7	44.2	30.3	40.5
15:00 to 16:00	34.8	29.7	34.0	35.5	25.5	35.1	39.2	26.7	37.3	47.6	34.9	43.8	47.2	40.8	44.8	52.5	41.4	48.8	43.0	31.6	39.3
16:00 to 17:00	35.3	31.2	34.5	42.2	30.0	39.5	36.7	29.7	49.8	43.5	33.4	42.9	48.7	40.2	45.7	51.1	43.6	48.3	50.7	42.6	47.9
17:00 to 18:00	45.7	34.6	42.5	43.6	35.2	55.5	43.1	30.8	38.3	45.1	37.1	53.7	45.4	38.5	42.9	51.0	41.4	47.9	45.8	35.7	42.7
18:00 to 19:00	49.5	40.2	47.2	42.5	30.5	41.2	42.4	33.6	40.6	43.1	37.0	42.0	43.5	37.5	41.0	44.6	38.4	43.4	42.9	36.0	40.3
19:00 to 20:00	47.0	37.3	43.4	41.9	31.0	38.2	40.7	31.59*	37.6	41.7	36.3	39.6	41.6	38.0	40.2	44.9	41.5	43.5	49.4	40.1	52.9
20:00 to 21:00	45.2	36.6	41.9	39.8	29.4	37.6	41.0	26.68*	36.4	38.3	30.1	35.0	38.7	33.9	37.1	42.5	40.0	41.5	46.7	43.4	45.3
21:00 to 22:00	46.2	38.5	43.6	40.0	33.2	37.4	33.8	23.2	30.1	28.9	25.6	27.5	36.3	30.1	35.5	40.7	37.3	39.3	50.7	45.5	48.6
22:00 to 23:00	43.9	35.4	40.9	41.6	35.5	39.2	26.5	22.4	27.0	27.5	23.9	26.0	33.7	26.1	32.3	38.5	33.2	37.3	52.4	46.5	49.9
23:00 to 24:00	44.8	37.0	42.3	40.4	35.7	38.3	25.7	22.2	24.1	26.7	23.4	25.4	29.7	24.5	28.6	35.8	31.5	34.3	59.4	44.3	57.4
L <sub>10</sub> (18h), ar.av. 6-24h	42.1			44.3			39.5			42.1			44.0			46.9			50.9		
L <sub>eq</sub> (16h), log av. 6-22h			44.5			47.7			42.1			45.8			44.4			47.2			50.0
L <sub>eq</sub> (8h), log av. 22-6h			41.0			37.2			32.2			35.4			32.1			####			52.6
L <sub>eq</sub> (24h), log av. 0-24h			43.3			46.3			40.5			43.9			42.7			45.3			####
L <sub>90</sub> Day		27.8			37.6			31.5			36.5			39.1						42.1	
L <sub>90</sub> Evening		38.1			31.0			28.4			32.2			37.6			41.2			41.3	
L <sub>90</sub> Night		33.9			30.8			23.3			28.1			25.3			32.7			34.2	
Wind @0900h, km/h																					
Wind @1500h, km/h																					



## Results of Noise Monitoring

**Client:** Goschen Mineral Sands  
**Job Number:** 640.11763      **Location:** Bennett Rd  
**Microphone position:** 1.5m      **Initials:** BF  
**Initial calibration:** 94 dBA      **Final calibration:** 94 dBA

Hour	Sound Pressure Level, dB(A)																				
	Tue, 16-10-2018			Wed, 17-10-2018			Thu, 18-10-2018			Fri, 19-10-2018			Sat, 20-10-2018			Sun, 21-10-2018			Mon, 22-10-2018		
	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>
00:00 to 01:00	53.1	38.6	51.5	25.9	21.9	25.1	33.5	25.4	30.4	25.2	21.3	24.2	52.6	41.97*	50.0	25.1	21.2	23.5	25.2	21.5	23.5
01:00 to 02:00	44.5	35.0	41.4	25.5	21.7	23.9	37.3	25.3	35.0	25.0	21.3	23.3	51.2	39.34*	48.2	25.0	21.2	26.0	25.3	21.8	23.7
02:00 to 03:00	38.4	31.0	58.9	25.0	21.3	23.5	33.9	25.2	31.4	25.1	21.6	23.4	51.8	44.65*	49.4	25.0	21.1	25.6	26.4	23.2	24.9
03:00 to 04:00	41.7	36.5	39.5	25.0	21.3	25.5	25.7	22.0	24.2	25.4	22.2	24.0	59.2	45.26*	56.1	24.9	21.0	24.9	27.3	24.1	25.9
04:00 to 05:00	39.9	28.4	36.7	25.3	21.7	24.5	28.4	23.5	32.0	25.2	21.9	23.9	53.2	42.33*	51.0	24.9	21.1	26.4	28.6	24.7	31.1
05:00 to 06:00	45.8	24.2	44.2	41.7	23.7	43.1	41.0	23.7	40.1	43.6	24.1	42.3	52.7	44.55*	50.7	38.6	21.9	38.9	41.4	25.8	41.9
06:00 to 07:00	28.9	23.1	31.4	39.8	25.6	45.1	32.9	24.5	35.4	36.2	25.0	33.8	54.4	46.35*	51.9	38.2	23.0	39.5	36.5	29.0	40.1
07:00 to 08:00	35.9	24.7	34.6	40.7	29.7	37.9	34.1	26.9	32.9	40.6	33.1	38.0	55.8	46.88*	56.2	36.8	22.2	43.4	42.0	30.9	40.8
08:00 to 09:00	38.9	30.7	36.1	41.1	30.0	39.6	38.0	30.0	38.3	40.9	33.7	38.1	44.5	28.8	42.7	34.7	23.0	36.2	47.3	37.1	44.9
09:00 to 10:00	41.8	33.7	40.3	38.9	27.2	38.8	39.8	31.2	37.1	44.0	34.5	42.6	49.7	26.6	46.0	35.3	24.0	47.7	47.7	35.8	44.3
10:00 to 11:00	40.9	31.1	43.8	40.1	27.3	37.3	39.4	30.9	36.9	45.9	37.7	46.5	52.7	42.8	49.9	36.9	25.1	35.0	46.0	33.2	42.7
11:00 to 12:00	39.9	27.0	39.8	42.6	30.2	39.3	39.6	30.2	37.4	47.8	37.7	45.2	52.9	41.8	50.1	34.8	24.3	32.9	46.2	32.4	42.6
12:00 to 13:00	40.8	26.3	40.9	41.1	24.8	36.4	40.3	30.1	37.9	47.3	36.9	44.5	56.4	44.0	53.5	36.3	24.4	33.4	47.0	31.1	43.2
13:00 to 14:00	37.1	25.7	33.6	46.3	37.1	44.5	41.1	28.4	37.6	47.3	34.5	44.2	57.1	45.9	54.5	34.1	25.0	31.6	46.4	25.7	46.0
14:00 to 15:00	39.6	25.4	36.7	45.8	35.4	43.1	40.6	29.1	38.1	49.2	33.2	46.4	55.1	44.6	52.4	36.1	25.3	33.7	42.7	25.3	43.3
15:00 to 16:00	32.8	25.4	36.7	54.0	38.9	50.3	37.3	27.5	34.3	52.8	33.8	49.0	53.9	44.2	51.2	36.3	27.6	41.3	42.1	25.4	38.2
16:00 to 17:00	31.1	26.0	33.1	49.7	40.3	47.0	35.2	28.6	33.1	47.6	34.8	45.0	51.9	39.7	49.0	34.0	25.9	42.1	38.2	27.3	35.9
17:00 to 18:00	32.6	26.5	34.2	42.3	35.7	41.6	38.2	33.9	36.8	45.4	35.2	42.3	50.6	40.5	47.6	36.7	32.0	38.8	40.6	30.8	53.7
18:00 to 19:00	32.8	25.6	39.0	43.0	35.0	40.8	37.5	32.0	35.8	57.6	38.5	50.7	42.8	31.1	40.2	41.5	36.9	39.8	44.8	38.3	43.0
19:00 to 20:00	37.4	31.2	34.7	41.0	35.1	38.7	38.6	27.0	35.4	59.3	52.01*	57.3	36.1	25.5	39.9	55.4	42.97*	52.9	58.1	47.95*	55.7
20:00 to 21:00	36.7	28.7	33.4	38.2	32.0	35.7	26.8	22.5	25.5	57.2	48.58*	54.7	26.7	23.4	26.5	50.5	24.7	43.9	52.3	42.54*	49.7
21:00 to 22:00	29.8	24.2	27.6	37.7	29.8	34.8	25.7	21.7	24.0	56.2	41.97*	53.5	25.9	21.8	28.7	26.4	22.6	24.8	51.0	40.42*	46.7
22:00 to 23:00	26.6	22.3	27.3	35.9	26.3	33.2	25.4	21.5	23.9	53.0	38.83*	49.2	25.6	21.7	25.9	25.6	21.8	23.9	47.6	37.67*	42.5
23:00 to 24:00	26.0	22.2	25.7	38.8	31.6	36.6	25.2	21.4	23.5	52.8	42.17*	50.4	25.0	21.2	23.2	25.2	21.5	23.5	39.5	34.67*	37.9
L10(18h), ar.av. 6-24h	35.0			42.1			35.3			49.0			45.4			36.4			45.3		
L <sub>eq</sub> (16h), log av. 6-22h			37.9			42.8			36.0			50.0			50.4			43.8			48.1
L <sub>eq</sub> (8h), log av. 22-6h			37.9			34.9			33.7			51.4			33.2			35.0			43.1
L <sub>eq</sub> (24h), log av. 0-24h			46.5			41.6			35.3			48.5			50.5			42.0			46.3
L90 Day		27.5			32.4			29.7			35.0									30.4	
L90 Evening		27.4			33.0			25.8			38.5			35.2			25.9			38.3	
L90 Night		22.4			25.3			22.2						21.5			23.7				
Wind @0900h, km/h																					
Wind @1500h, km/h																					

Noise Monitoring Location		Mystic Park Meatian Rd		Photo of Noise Monitoring Location	
<p>Noise monitor located 40 m west of the intersection of Quambatook – Swan Hill Rd and Mystic Park- Meatian Rd. 2160 m southwest of receiver R6 and 2600 m north of receiver R1</p> <p>Noise sources includes insects and occasional local traffic and heavy vehicles on around receiver Quambatook – Swan Hill Rd.</p> <p>Note, short term <math>L_{eq}</math> was not captured at this location</p>					
Summary of Measured Noise Levels					
Assessment Period	Noise Level (dBA)				
	$L_{A90}$ (Average)	$L_{A90}$ (Lowest)	$L_{Aeq}$		
Daytime	34	24	50		
Evening	30	20*	42		
Night	25	18*	37		

Bruel & Kjaer Sentinel. S/N 3004637

Coordinates: 35°34'21.54"S, 143°31'35.31"E

\*Results likely affected by noise floor of test equipment





## Results of Noise Monitoring

**Client:** Goschen Mineral Sands  
**Job Number:** 640.11763      **Location:** Quambatook Rd  
**Microphone position:** 1.5 m      **Initials:** BF  
**Initial calibration:** 94 dBA      **Final calibration:** 94 dBA

Hour	Sound Pressure Level, dB(A)																				
	Tue, 02-10-2018			Wed, 03-10-2018			Thu, 04-10-2018			Fri, 05-10-2018			Sat, 06-10-2018			Sun, 07-10-2018			Mon, 08-10-2018		
	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>
00:00 to 01:00				36.0	28.2	33.4	50.4	42.81*	47.8	37.5	29.4	35.5	19.8	17.9	25.1	22.5	20.2	21.5	18.9	17.5	30.7
01:00 to 02:00				33.9	23.7	31.0	48.7	38.65*	45.3	32.5	28.6	31.2	22.2	18.3	34.0	26.9	19.7	32.9	20.3	17.4	33.1
02:00 to 03:00				35.8	21.3	35.6	51.9	41.39*	48.5	29.7	26.9	28.4	20.4	18.0	21.1	24.2	21.0	22.7	20.0	18.1	19.9
03:00 to 04:00				36.2	21.6	35.7	56.5	44.57*	52.9	29.7	26.5	38.7	23.3	18.6	23.9	24.3	21.2	23.2	21.5	19.0	22.5
04:00 to 05:00				25.3	20.0	34.6	52.1	42.76*	48.8	30.5	26.9	28.9	21.5	18.0	20.0	25.2	20.1	38.3	21.8	17.5	40.4
05:00 to 06:00				41.5	21.1	43.2	48.4	37.91*	45.6	49.5	24.6	52.3	42.0	18.5	42.4	47.4	21.0	44.3	48.6	18.3	50.2
06:00 to 07:00				36.1	19.2	42.7	46.3	35.64*	45.6	42.7	23.7	47.7	28.7	22.5	32.6	31.8	19.2	46.9	48.1	20.7	47.9
07:00 to 08:00				41.5	22.2	46.4	51.6	39.97*	50.3	48.0	27.1	48.7	44.4	27.0	45.0	34.4	18.4	48.6	46.5	23.6	45.9
08:00 to 09:00				41.8	29.0	45.9	55.3	46.37*	53.3	51.5	39.5	50.7	50.6	38.4	48.9	42.3	20.0	44.9	46.4	28.7	47.6
09:00 to 10:00	52.5	26.6	62.2	43.0	31.0	48.3	55.1	45*	52.3	49.4	29.9	59.0	51.9	38.7	53.9	44.3	29.4	47.0	47.4	31.7	50.0
10:00 to 11:00	45.7	24.2	56.8	44.9	28.8	45.4	57.8	45.06*	54.6	43.5	23.4	46.4	47.3	34.5	46.9	43.8	30.2	42.0	47.9	29.5	51.9
11:00 to 12:00	45.2	29.3	47.2	45.2	32.2	45.4	56.0	42.36*	54.1	41.0	22.0	46.2	44.1	25.4	50.0	42.4	24.3	40.7	46.5	27.1	44.7
12:00 to 13:00	54.7	35.5	51.7	44.6	27.3	42.7	53.1	38.71*	53.6	39.0	21.2	43.1	41.9	22.5	45.7	42.2	23.4	44.1	47.7	25.5	48.4
13:00 to 14:00	56.2	41.9	55.6	45.3	23.9	47.4	54.2	39.28*	51.2	37.1	21.7	42.8	43.3	23.1	56.3	41.2	21.4	40.5	48.0	30.8	46.8
14:00 to 15:00	56.7	44.8	53.4	44.6	26.5	45.6	54.9	40.58*	51.1	38.3	20.9	43.9	40.4	22.3	45.7	40.0	22.1	43.4	45.8	26.3	45.0
15:00 to 16:00	59.8	42.9	55.8	44.8	26.2	43.6	56.8	41.67*	54.3	40.1	21.6	44.1	41.6	23.5	51.5	38.4	20.9	41.8	46.8	23.2	51.0
16:00 to 17:00	56.0	43.7	52.9	43.4	31.7	44.7	57.1	46.86*	54.0	38.8	20.4	47.6	38.3	21.0	52.1	33.0	20.2	41.4	39.2	22.5	42.0
17:00 to 18:00	49.6	31.5	51.2	42.7	28.6	45.1	53.0	41.78*	50.4	44.9	21.0	53.6	38.8	24.9	43.7	35.3	22.9	40.2	43.6	25.2	46.4
18:00 to 19:00	51.2	27.3	49.6	40.5	28.5	43.6	55.0	47.4	52.6	47.8	23.3	48.4	40.9	26.6	50.0	33.6	25.8	44.6	43.6	26.2	46.5
19:00 to 20:00	31.6	27.5	42.7	53.0	26.5	48.8	52.4	44.7	49.7	34.6	19.8	42.3	35.6	24.3	41.5	30.5	24.3	42.4	28.5	26.9	37.7
20:00 to 21:00	29.5	26.8	37.0	54.5	44.6*	51.6	49.0	40.4	46.3	32.8	17.7	39.8	29.0	23.3	38.9	23.3	19.2	21.8	28.7	24.5	39.9
21:00 to 22:00	31.3	27.2	42.7	52.5	41.29*	49.1	38.8	31.6	38.5	34.6	17.5	48.2	28.1	21.3	37.1	22.5	20.1	21.8	26.7	23.5	36.4
22:00 to 23:00	36.6	29.9	38.1	52.4	41.34*	49.5	38.1	30.7	36.4	30.0	17.6	43.1	27.2	23.0	37.5	23.2	20.0	22.2	26.7	21.8	24.5
23:00 to 24:00	38.2	32.1	35.8	51.0	42.53*	48.9	36.3	30.5	37.0	18.9	17.6	24.8	37.0	23.9	41.8	21.9	17.6	35.9	24.0	20.1	41.5
L10(18h), ar.av. 6-24h				45.7			51.2			39.6			39.4			34.7			40.7		
L <sub>eq</sub> (16h)+ log av. 6-22h						46.8			52.0			50.2			49.6			43.7			47.2
L <sub>eq</sub> (8h)+ log av. 22-6h			37.5			49.0			43.8			37.1			38.5			41.9			39.6
L <sub>eq</sub> (24h), log av. 0-24h						46.0			51.0			48.9			48.0			42.4			46.1
L90 Day					27.9						24.4			31.1						26.7	
L90 Evening		27.2			27.5			41.0			19.6			23.4			22.8			25.3	
L90 Night		24.1						27.5			18.5			21.0			18.5			25.6	
Wind @0900h, km/h																					
Wind @1500h, km/h																					





## Results of Noise Monitoring

**Client:** Goschen Mineral Sands  
**Job Number:** 640.11763      **Location:** Quambatook Rd  
**Microphone position:** 1.5 m      **Initials:** BF  
**Initial calibration:** 94 dBA      **Final calibration:** 94 dBA

Hour	Sound Pressure Level, dB(A)																				
	Tue, 09-10-2018			Wed, 10-10-2018			Thu, 11-10-2018			Fri, 12-10-2018			Sat, 13-10-2018			Sun, 14-10-2018			Mon, 15-10-2018		
	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>
00:00 to 01:00	26.1	19.8	22.9	52.0	42.2	48.8	42.6	35.2	39.9	29.2	18.9	26.1	32.2	23.5	38.4	31.4	25.1	39.8	29.4	24.9	28.5
01:00 to 02:00	34.3	27.0	34.3	54.6	45.5	51.5	38.7	30.5	36.4	23.9	18.3	22.1	39.8	26.6	36.7	29.0	25.2	30.6	41.5	28.1	37.7
02:00 to 03:00	27.8	22.2	30.6	55.4	44.3	52.1	42.4	29.9	39.2	24.0	17.9	21.5	44.8	34.2	42.3	28.0	24.6	26.5	49.1	36.9	45.8
03:00 to 04:00	36.6	25.2	33.0	50.9	41.4	48.1	39.9	26.9	36.4	20.4	18.0	19.0	47.9	36.3	44.4	26.7	22.0	24.8	47.0	35.6	43.9
04:00 to 05:00	44.4	31.5	42.8	46.9	37.1	43.9	35.2	24.1	37.2	22.9	18.2	35.2	43.7	34.2	40.8	31.9	25.2	29.4	50.5	33.8	46.5
05:00 to 06:00	42.5	32.7	45.2	40.8	32.0	46.6	38.4	20.7	41.8	43.1	19.0	45.8	45.3	32.9	44.2	40.2	24.7	38.8	53.3	44.6	50.5
06:00 to 07:00	45.9	30.2	49.3	43.5	34.8	45.7	45.7	23.8	45.2	48.8	25.5	46.3	45.5	32.2	45.7	41.1	28.0	43.9	58.8	44.3	54.9
07:00 to 08:00	43.6	24.3	47.7	49.5	37.5	52.9	53.3	37.1	51.2	57.2	42.9	53.2	53.3	40.3	50.6	50.3	37.4	47.4	61.1	51.1	57.7
08:00 to 09:00	41.1	22.0	42.9	55.7	42.3	52.5	54.3	43.4	51.5	59.6	47.8	56.2	55.2	43.8	52.0	55.8	46.2	52.8	61.4	51.2	58.0
09:00 to 10:00	38.9	22.6	43.0	58.5	43.4	55.0	54.3	40.0	50.8	58.8	47.3	55.4	57.2	44.2	53.6	56.6	42.9	53.4	62.2	51.1	58.5
10:00 to 11:00	42.8	23.9	48.5	57.5	44.4	54.4	53.5	38.6	50.2	55.5	42.4	52.8	57.1	44.6	53.5	58.0	47.8	54.9	62.5	51.9	59.1
11:00 to 12:00	45.7	21.9	45.5	64.2	51.6	60.7	48.6	31.1	46.0	57.8	41.4	54.2	55.7	41.7	52.2	60.7	48.7	57.2	62.5	53.0	59.3
12:00 to 13:00	53.5	28.8	52.1	63.0	51.3	59.4	47.4	26.9	44.5	57.1	38.2	53.1	55.8	42.0	52.2	60.0	49.0	56.6	63.0	51.9	59.5
13:00 to 14:00	55.1	30.8	53.5	57.4	43.0	53.8	53.6	30.9	49.9	56.9	36.3	53.6	58.1	45.3	54.8	61.2	49.4	57.8	59.6	48.0	56.1
14:00 to 15:00	51.5	27.4	49.8	50.8	35.7	48.8	52.8	30.0	49.4	55.4	37.4	51.4	57.0	42.0	53.4	61.9	50.2	58.2	53.0	33.4	50.9
15:00 to 16:00	48.3	29.3	51.2	42.1	22.1	44.4	50.3	26.3	47.9	54.9	38.8	51.2	53.7	40.7	50.8	59.2	49.7	56.0	53.7	38.9	51.8
16:00 to 17:00	43.2	27.6	47.4	48.0	26.1	45.4	49.4	25.2	46.3	54.0	37.2	51.9	57.3	44.7	53.8	58.7	47.7	55.5	57.8	45.4	54.5
17:00 to 18:00	46.3	31.9	48.1	48.0	38.4	46.6	46.1	25.5	46.5	50.7	32.1	50.4	56.8	43.5	53.2	55.5	43.9	52.5	53.2	40.9	50.1
18:00 to 19:00	47.1	37.8	48.0	41.1	24.7	46.7	36.6	23.3	43.5	42.4	27.6	44.6	50.3	36.9	48.3	48.3	39.2	48.5	45.9	34.8	43.7
19:00 to 20:00	46.3	36.5	45.5	39.3	20.6	39.9	29.3	20.6	41.4	29.0	24.4	38.8	41.5	30.6	41.9	40.9	32.4	42.4	52.1	39.4	61.1
20:00 to 21:00	45.7	38.5	43.9	41.4	33.8	40.1	20.8	18.9	35.2	39.3	21.8	50.2	37.5	29.0	44.1	34.7	31.3	41.4	55.6	46.0	52.5
21:00 to 22:00	50.4	40.1	48.0	41.1	33.0	40.4	21.5	17.9	41.4	27.3	19.0	40.0	41.0	28.9	45.5	32.8	30.0	38.2	58.3	49.1	55.2
22:00 to 23:00	45.3	38.2	45.3	44.0	34.0	41.6	20.4	17.8	35.8	20.3	18.9	20.0	38.3	27.8	38.5	31.8	28.7	30.4	58.3	50.0	55.3
23:00 to 24:00	52.3	41.5	49.0	46.7	38.3	43.8	19.0	17.7	18.6	22.5	19.0	20.5	29.7	25.4	35.8	29.4	26.8	28.3	65.6	46.5	62.5
L <sub>10</sub> (18h), ar.av. 6-24h	46.8			49.5			42.0			47.1			50.0			49.8			58.0		
L <sub>eq</sub> (16h), log av. 6-22h			48.8			53.4			48.0			52.3			51.8			54.3			56.9
L <sub>eq</sub> (8h), log av. 22-6h			48.9			40.3			39.9			41.6			37.9			47.7			55.3
L <sub>eq</sub> (24h), log av. 0-24h			47.6			52.3			46.3			50.4			50.1			52.3			56.2
L <sub>90</sub> Day		26.4			39.6			32.3			40.1			42.7						47.0	
L <sub>90</sub> Evening		38.2			28.0			20.2			23.2			38.0			43.1			42.3	
L <sub>90</sub> Night		39.7			29.3			19.0			28.6			25.3			33.7			35.3	
Wind @0900h, km/h																					
Wind @1500h, km/h																					



## Results of Noise Monitoring

**Client:** Goschen Mineral Sands

**Job Number:** 640.11763

**Location:** Quambatook Rd

**Microphone position:** 1.5 m

**Initials:** BF

**Initial calibration:** 94 dBA

**Final calibration:** 94 dBA

Hour	Sound Pressure Level, dB(A)																				
	Tue, 16-10-2018			Wed, 17-10-2018			Thu, 18-10-2018			Fri, 19-10-2018			Sat, 20-10-2018			Sun, 21-10-2018			Mon, 22-10-2018		
	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>
00:00 to 01:00	49.7	32.2	48.9	27.9	20.1	30.1	34.3	23.9	31.6	19.7	17.5	20.9	47.6	34.2	45.3	20.4	17.8	19.3	23.5	20.4	24.0
01:00 to 02:00	62.3	39.2	57.7	31.9	18.2	28.2	46.4	26.7	43.0	21.5	18.0	20.1	59.1	41.7	55.7	23.8	18.4	41.8	25.6	21.8	23.9
02:00 to 03:00	52.9	37.6	49.1	31.9	21.1	28.6	33.5	18.1	30.3	23.0	20.3	21.8	62.5	50.6	59.3	24.2	19.6	42.7	26.5	22.5	24.8
03:00 to 04:00	44.9	36.0	42.0	25.6	19.2	36.1	19.7	17.7	18.9	22.1	20.2	22.5	65.7	49.1	62.2	24.0	20.5	22.5	28.5	24.2	37.8
04:00 to 05:00	41.5	26.7	40.7	26.6	18.0	38.6	29.6	17.6	34.5	24.8	19.3	41.2	60.5	47.3	57.3	25.1	21.6	37.3	30.3	23.2	34.0
05:00 to 06:00	44.2	25.7	47.9	39.9	21.0	42.7	43.1	23.2	46.0	45.0	23.6	43.4	63.7	53.0	60.8	31.5	21.7	38.1	44.4	27.3	46.4
06:00 to 07:00	47.1	24.2	50.1	46.9	23.5	49.2	46.3	25.2	48.6	47.5	26.4	45.7	65.0	53.4	61.7	39.9	21.8	47.3	46.4	28.0	46.1
07:00 to 08:00	48.8	27.3	50.3	50.9	30.8	53.6	48.5	30.2	50.2	49.4	30.9	50.0	63.2	52.6	60.4	36.8	19.6	42.6	51.6	33.4	53.2
08:00 to 09:00	52.8	36.1	50.5	51.8	35.2	50.7	51.2	39.9	50.8	49.7	34.9	48.1	54.4	34.9	52.5	38.7	21.6	49.6	58.0	45.3	54.5
09:00 to 10:00	54.9	43.0	52.6	50.7	30.3	50.7	54.3	38.0	52.4	55.2	40.9	52.7	47.9	29.8	48.5	39.5	21.2	39.5	56.6	45.3	54.4
10:00 to 11:00	55.2	41.2	64.3	50.5	33.1	52.6	52.4	35.5	51.0	57.2	46.4	54.1	61.1	48.8	57.8	41.7	24.6	40.7	54.5	42.0	51.2
11:00 to 12:00	50.3	37.0	49.5	52.3	32.4	54.7	55.9	37.7	53.0	59.3	47.8	55.8	62.3	47.7	58.9	41.2	24.2	40.4	55.3	38.9	51.7
12:00 to 13:00	44.3	28.8	45.9	53.6	31.0	54.2	52.6	33.9	51.5	60.0	46.4	56.3	63.5	48.9	60.4	44.3	24.4	43.5	51.8	34.8	48.7
13:00 to 14:00	48.3	25.6	48.2	54.5	35.8	52.0	54.6	33.2	52.9	57.9	42.8	54.6	64.0	50.9	60.7	41.5	24.5	39.8	53.3	36.0	50.1
14:00 to 15:00	51.7	33.7	50.5	52.5	33.2	52.2	53.5	30.1	52.2	61.0	45.7	57.5	65.0	53.0	61.8	42.1	23.4	42.0	53.7	28.6	49.8
15:00 to 16:00	48.5	25.9	48.3	59.4	38.0	56.2	47.7	28.0	49.7	61.5	46.5	58.1	61.6	49.2	58.4	40.3	21.5	43.6	51.3	26.0	49.1
16:00 to 17:00	46.6	25.3	48.4	62.9	41.1	58.8	43.7	26.0	45.5	58.4	46.3	54.9	58.7	47.7	55.4	36.3	21.7	42.3	49.9	28.1	48.6
17:00 to 18:00	44.4	30.4	46.5	58.1	38.9	54.6	41.0	24.8	47.7	51.0	38.8	47.9	57.9	47.6	55.0	36.1	23.7	44.2	46.2	32.2	44.7
18:00 to 19:00	34.7	26.8	42.6	55.2	35.2	53.7	36.1	25.6	41.7	36.3	32.3	41.7	53.3	32.7	49.3	33.6	28.8	39.0	40.0	33.0	44.4
19:00 to 20:00	35.0	24.4	40.5	44.2	30.0	44.7	31.8	22.6	41.7	37.1	34.7	43.1	33.7	27.3	40.6	29.8	25.4	36.5	44.0	35.7	45.0
20:00 to 21:00	28.1	20.9	43.6	51.2	36.0	49.1	25.0	20.3	39.2	45.5	34.9	42.8	31.7	26.4	35.6	28.1	19.3	41.9	47.7	34.6	44.9
21:00 to 22:00	31.7	19.9	36.3	47.0	31.8	44.5	20.6	17.7	42.7	41.0	33.3	48.6	29.9	26.7	29.3	20.2	17.9	19.9	40.8	34.4	40.9
22:00 to 23:00	29.3	23.2	27.7	40.2	26.0	36.5	21.7	17.6	39.6	62.9	44.3	58.7	34.9	23.0	40.6	22.7	17.9	20.8	46.3	36.7	42.9
23:00 to 24:00	26.1	20.6	23.8	45.0	26.9	41.8	18.6	17.5	21.0	45.3	33.4	44.8	24.7	17.9	25.0	23.2	20.6	22.7	45.9	34.4	42.0
L <sub>10</sub> (18h), ar.av. 6-24h	43.2			51.5			42.0			52.0			51.8			35.3			49.6		
L <sub>eq</sub> (16h), log av. 6-22h			53.8			53.5			49.9			53.6			57.2			42.8			50.3
L <sub>eq</sub> (8h), log av. 22-6h			41.1			42.4			39.6			58.9			40.9			40.2			42.4
L <sub>eq</sub> (24h), log av. 0-24h			52.8			51.6			48.3			52.5			57.7			42.0			48.6
L <sub>90</sub> Day		32.2			34.5			32.5			42.5			43.8						35.5	
L <sub>90</sub> Evening		23.0			33.3			21.6			33.8			40.2			22.8			34.4	
L <sub>90</sub> Night		20.5			22.8			20.0			45.2			20.3			22.9			29.1	
Wind @0900h, km/h																					
Wind @1500h, km/h																					



## Results of Noise Monitoring

**Client:** Goschen Mineral Sands  
**Job Number:** 640.11763      **Location:** Quambatook Rd  
**Microphone position:** 1.5 m      **Initials:** BF  
**Initial calibration:** 94 dBA      **Final calibration:** 94 dBA

Hour	Sound Pressure Level, dB(A)																				
	Tue, 23-10-2018			Wed, 24-10-2018			Thu, 25-10-2018			Fri, 26-10-2018			Sat, 27-10-2018			Sun, 28-10-2018			Mon, 29-10-2018		
	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>
00:00 to 01:00	43.1	31.9	40.5	33.5	24.2	30.4	20.6	19.0	21.4	28.0	21.5	31.2	24.6	18.8	40.7	29.4	20.4	35.5	28.9	20.7	25.2
01:00 to 02:00	41.4	23.7	36.6	27.1	22.5	25.2	21.9	19.2	33.1	31.1	22.5	28.4	25.7	22.0	34.9	24.0	20.0	24.0	32.5	24.2	29.3
02:00 to 03:00	31.0	20.3	34.6	27.2	20.8	24.8	21.8	18.4	20.2	31.4	23.5	28.9	28.1	21.6	24.6	29.5	21.7	27.1	34.4	26.6	31.7
03:00 to 04:00	27.5	23.0	25.8	25.1	20.3	38.2	19.2	17.9	19.0	34.2	25.5	31.4	30.9	26.7	29.0	30.6	23.2	27.8	27.8	21.2	25.7
04:00 to 05:00	34.3	22.4	34.7	26.8	22.6	39.9	39.2	17.6	47.1	34.2	27.4	39.9	30.5	26.1	31.5	27.3	22.2	29.5	27.4	20.2	37.2
05:00 to 06:00	45.7	32.4	45.8	48.6	25.6	49.1	46.0	19.9	51.3	41.3	25.2	46.9	39.5	22.6	41.3	36.3	23.5	37.5	39.8	21.9	43.9
06:00 to 07:00	49.4	37.2	48.0	43.3	24.5	45.6	47.9	23.0	53.3	45.0	29.1	43.8	43.4	24.5	43.1	41.1	29.9	41.5	45.9	24.6	47.3
07:00 to 08:00	58.6	47.1	56.0	48.1	35.5	46.7	45.6	24.3	46.5	49.3	35.9	49.4	46.3	36.2	45.3	46.8	33.9	45.9	47.6	32.0	48.3
08:00 to 09:00	60.9	50.0	57.9	51.7	40.5	49.3	40.9	22.1	48.5	46.9	34.6	47.8	49.2	37.6	46.3	46.2	31.6	44.4	43.5	24.7	47.6
09:00 to 10:00	61.1	49.8	58.4	50.6	33.6	46.8	40.0	21.8	48.3	46.8	31.9	46.0	53.6	36.4	50.1	43.2	26.3	43.6	41.9	23.7	49.2
10:00 to 11:00	62.8	51.4	59.7	48.2	28.8	44.8	39.9	21.9	44.0	49.4	31.1	46.2	56.7	40.5	58.2	43.0	25.4	42.6	40.7	22.6	45.9
11:00 to 12:00	61.7	49.3	58.9	44.7	26.9	45.7	34.8	21.6	37.7	49.9	31.4	46.9	52.7	38.2	49.5	39.6	22.9	42.2	44.2	24.6	52.8
12:00 to 13:00	60.9	44.1	57.7	43.6	26.7	42.4	40.5	23.3	40.8	52.4	35.0	48.9	56.3	40.2	52.9	40.1	22.1	38.5	39.6	24.3	47.6
13:00 to 14:00	61.7	45.3	58.3	46.0	29.2	46.3	42.2	25.6	41.9	51.4	31.6	47.8	56.3	41.7	52.3	38.2	21.6	42.9	44.4	25.0	50.2
14:00 to 15:00	61.6	44.2	57.9	48.3	29.1	50.6	44.6	25.5	46.5	49.1	31.5	47.3	56.0	37.3	52.1	38.9	22.3	44.3	40.2	22.9	45.3
15:00 to 16:00	61.9	46.6	58.4	46.3	27.0	45.5	49.5	27.3	49.9	50.1	33.2	48.2	58.1	42.8	54.6	43.6	24.5	45.6	38.7	22.4	44.8
16:00 to 17:00	63.4	49.2	60.1	41.8	25.9	42.9	44.3	29.2	43.1	46.1	29.4	44.8	57.6	44.6	54.3	38.6	22.1	44.9	38.8	21.6	45.8
17:00 to 18:00	59.1	46.8	56.1	40.1	24.8	44.1	44.5	28.3	43.0	43.4	31.7	42.8	53.8	42.0	50.4	37.0	25.6	38.0	38.3	23.3	42.5
18:00 to 19:00	52.8	39.7	50.1	36.5	26.6	42.1	37.5	30.0	43.6	40.2	31.2	43.4	45.7	32.4	46.2	38.4	28.9	41.0	36.4	28.7	45.5
19:00 to 20:00	47.5	38.1	44.9	47.0	19.9	40.9	47.4	33.1	43.6	36.8	33.0	42.4	35.7	33.3	35.2	34.5	31.2	41.0	35.8	32.6	44.3
20:00 to 21:00	44.1	37.1	41.7	24.7	17.5	39.6	45.8	27.5	39.2	38.2	32.8	38.9	38.9	30.4	40.0	32.6	28.9	31.1	32.8	27.6	41.2
21:00 to 22:00	39.4	31.4	41.5	22.0	17.6	39.2	29.5	22.1	26.6	32.5	22.5	29.8	31.6	22.6	34.9	35.6	28.1	36.5	28.1	21.2	40.2
22:00 to 23:00	38.6	27.4	36.9	23.8	18.5	30.1	29.8	21.7	45.1	24.0	17.5	39.8	32.0	24.1	34.5	40.8	33.4	39.6	22.0	19.9	21.1
23:00 to 24:00	31.6	23.9	28.7	24.1	18.7	43.0	28.4	23.3	32.1	19.6	17.6	19.1	27.0	19.9	25.0	29.9	23.7	28.1	25.2	21.9	39.5
L <sub>10</sub> (18h), ar.av. 6-24h	54.3			40.6			40.7			42.8			47.3			39.3			38.0		
L <sub>eq</sub> (16h), log av. 6-22h			57.0			45.6			45.0			46.2			51.6			42.7			47.3
L <sub>eq</sub> (8h), log av. 22-6h			42.0			46.7			41.3			38.3			35.0			40.3			42.5
L <sub>eq</sub> (24h), log av. 0-24h			55.1			44.7			45.8			44.8			49.7			41.2			45.7
L <sub>90</sub> Day		47.6			29.8			24.6			32.5			38.2						24.3	
L <sub>90</sub> Evening		36.6			20.4			28.2			29.9			36.3			26.3			27.5	
L <sub>90</sub> Night		23.5			19.1			24.4			21.9			22.8			24.1			22.5	
Wind @0900h, km/h																					
Wind @1500h, km/h																					



## Results of Noise Monitoring

**Client:** Goschen Mineral Sands

**Job Number:** 640.11763

**Location:** Quambatook Rd

**Microphone position:** 1.5 m

**Initials:** BF

**Initial calibration:** 94 dBA

**Final calibration:** 94 dBA

Hour	Sound Pressure Level, dB(A)																	
	Tue, 30-10-2018			Wed, 31-10-2018														
	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>	L <sub>10</sub>	L <sub>90</sub>	L <sub>eq</sub>
00:00 to 01:00	26.3	22.9	24.9	31.7	27.7	30.0												
01:00 to 02:00	26.8	22.3	24.8	32.1	25.9	29.8												
02:00 to 03:00	25.5	22.4	28.2	27.2	19.7	24.9												
03:00 to 04:00	27.4	23.2	39.0	30.8	21.6	37.4												
04:00 to 05:00	30.1	22.6	38.1	31.5	20.9	37.6												
05:00 to 06:00	42.6	22.2	48.3	40.0	22.1	42.7												
06:00 to 07:00	47.0	24.9	48.3	47.7	22.6	47.9												
07:00 to 08:00	41.3	23.4	46.3	48.9	34.5	50.2												
08:00 to 09:00	36.9	22.5	41.4	45.0	29.0	48.3												
09:00 to 10:00	46.0	25.9	49.9	46.0	28.5	51.3												
10:00 to 11:00	49.5	27.6	47.8	45.6	25.1	48.9												
11:00 to 12:00	49.4	27.9	48.5	61.9	25.1	56.6												
12:00 to 13:00	49.2	28.0	48.1	61.4	24.3	56.1												
13:00 to 14:00	49.9	28.3	48.2	64.7	26.2	58.2												
14:00 to 15:00	51.6	26.6	51.5															
15:00 to 16:00	50.2	27.2	50.5															
16:00 to 17:00	42.4	25.7	43.3															
17:00 to 18:00	45.1	26.1	43.8															
18:00 to 19:00	36.8	30.4	41.0															
19:00 to 20:00	40.1	35.4	45.7															
20:00 to 21:00	36.0	32.1	38.5															
21:00 to 22:00	33.6	30.2	42.8															
22:00 to 23:00	33.0	30.0	31.7															
23:00 to 24:00	32.3	28.2	30.7															
L <sub>10</sub> (18h), ar.av. 6-24h	42.8																	
L <sub>eq</sub> (16h) log av. 6-22h			47.2															
L <sub>eq</sub> (8h) log av. 22-6h			40.3															
L <sub>eq</sub> (24h), log av. 0-24h			46.0															
L <sub>90</sub> Day		26.3			27.5													
L <sub>90</sub> Evening		32.0																
L <sub>90</sub> Night		24.3																
Wind @0900h, km/h																		
Wind @1500h, km/h																		

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