

NOISE AND VIBRATION MANAGEMENT PLAN

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Project Name: Nolans Rare Earth Project

Revision History

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1.0 INTRODUCTION

1.1 Background

The Nolans Rare Earths Project (the Project) is located approximately 135 km northwest of Alice Springs, Northern Territory. The Project targets the Nolans Bore mineral deposit for rare earth elements. Activities will focus on construction, mining, processing, rehabilitation and decommissioning of an open-cut, rare earth mine, processing facility and its associated infrastructure.

The Project involves several key activities with the potential to produce noise and vibration impacts on human and biological receptors, to which it must manage in accordance with the Noise and Vibration Management Plan (NVMP).

1.2 Purpose

The purpose of the NVMP is to provide a framework for noise and vibration management across and adjacent to the Project site as well as providing information which is to be used in decision making and project management, detail planning and methods of work, and provide for a record of performance. The Plan has been developed in accordance with NTEPA requirements and references Commonwealth noise and vibration legislation.

This document and its subsequent revisions form an integral part of the Project's Mining Management Plan (MMP), which is to be reviewed and updated regularly (or as determined by the MMP), enabling an accurate reflection of the current operational requirements and practices whilst allowing for responsiveness to conditions, input from stakeholders, and enabling flexibility in planning and prioritisation where required.

All referenced company policies, standards, registers, operational procedures, activity specific documents, forms and templates are stored and can be accessed from within the Arafura Resources Integrated Management System (ARMS).

1.3 Objectives

This management plan aims to minimise the health risk or loss of amenity due to production of noise and vibration from the site activities to the environment and has been designed to achieve this objective through the following process:

- Characterising and ranking potential impacts of major noise and vibration sources.
- Implementation of a noise and vibration prevention strategies.
- Monitoring of noise and vibration impacts, followed by the identification of the sources.
- Regular performance reviews against monitoring results to determine if additional mitigation measures are required.

Responsibilities for the implementation of this plan are outlined in Table 2—3.

1.4 Relevant Legislation and Guidelines

The Project is obliged to comply with all relevant environmental legislation and Regulatory Authorities. A summary of key legislation and guidelines is outlined in the MMP, Section 3: Regulatory Requirements.

1.5 Sensitive Receptors

The Project lies within the Burt Plain bioregion. Land use immediately adjacent is pastoral activities. Existing infrastructure includes the Stuart Highway, the Amadeus Gas Pipeline, pastoral station tracks and wells for stock watering. The nearest non-mining sensitive receptor is Aileron Roadhouse approximately 13 km to the southeast of the mine and 10 km east of the processing facilities, respectively. The Alyuen outstation is about 12 km east of the processing facilities and the Nolans Project accommodation village is approximately five kilometres southeast of the processing plant. The planned bitumen project access road runs northwest off the Stuart Highway with the main intersection located approximately 3 km south of the Alyuen outstation. A number of sensitive receptors identified in the wider region are listed in Table 1—1, distance has been taken from the reference point of Nolans Bore.

Table 1—1 Sensitive Receptor Locations

Name	Coordinates		Distance from site (km)
	Easting	Northing	
Accommodation Facility	322800	7493100	5
Annas Reservoir ^A	309200	7500600	9
Aileron Roadhouse	330000	7494900	13
Alyuen outstation	330600	7492000	16.5
Pinehill Station	299500	7523300	27.5
Laramba	269200	7506400	50
Napperby Station	268900	7509000	50
Coniston	241600	7559800	96
Alice Springs	386000	7378600	135

Note: ^A Potential ad-hoc camping location

1.6 Potential Noise and Vibration Impacts

An assessment of potential impacts from noise and vibration from the Project was completed as part of the EIS process (GHD, 2016). The assessment included the adjacent area to the mining area boundary and to the nearest sensitive receptors.

Aerial photography and a site visit were used to determine the proximity of the closest noise receptors. The study area for this assessment is defined as including:

- The land within the mine mineral lease boundary.
- The Aileron Roadhouse and an access road to the Project site.
- The proposed Nolans Project accommodation village to be located approximately 5 kilometres southeast of the processing plant.

Attended and unattended noise monitoring was conducted in the area surrounding the proposed Project site. The purpose of the noise monitoring was to determine the existing baseline noise levels in the area to assist in setting the operational noise goals for the Project. Monitoring occurred at the Aileron sportsground in the vicinity of the Aileron Roadhouse.

Acoustic modelling was undertaken to predict the effects of industrial (operational) noise generated by the Project. Applicable noise criteria for the project is 48 dB(A)Leq(15min) for construction and 35 dB(A)Leq(15min) for operation. A summary of the results is provided in Table 1—2.

Table 1—2 Summary of unattended noise monitoring results dB(A)

Logger	Background LA90 dB(A) ¹			Ambient LAeq dB(A) ²		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Logger 1 RBL and Leq Overall	28	27	26	43	36	35
Logger 2 RBL and Leq Overall	27	26	25	45	32	34

Note

1: Background noise: The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the LA90 descriptor.

2: Ambient noise: The all-encompassing noise associated with a given environment. It is the composite of sounds from many sources, both near and far.

Attended noise monitoring occurred over 15-minute periods at each of the long-term monitoring locations. Details of the existing noise environment including noise sources and ambient/background noise levels recorded during these monitoring periods are provided in Table 1—3.

The background noise levels are low and typical of a rural environment. Measured background noise levels were below the minimum recommended noise level in the *NSW Industrial Noise Policy* (NSW EPA 2000). Therefore, the minimum background noise levels were adjusted up to the recommended 30 dB(A) LA90 before setting the operational noise criteria.

Table 1—3 Attended 15-minute period noise monitoring results

Monitoring location and description	LAeq, 15min	LA90, 15min	LA10, 15min	Comments on noise environment
Logger 1 Racecourse (near Aileron Roadhouse) 10/8/2010 : 2.47 pm	38	32	41	Typical rural environment with birds nearby and insects influencing the ambient noise. Wind in foliage was audible. Dam water pump noise was faintly audible during monitoring.
Logger 1 Racecourse (near Aileron Roadhouse) 11/8/2010 : 8.12 am	39	34	42	Typical rural environment with animals and nearby insects influencing the ambient noise. Wind in foliage was audible. Stuart Highway traffic noise was faintly audible and intermittent during monitoring.
Logger 2 Racecourse (near Aileron Roadhouse) 10/08/2010 : 3.06 pm	43	34	47	Typical rural environment with birds and nearby insects influencing the ambient noise. Wind in foliage was audible. Dam water pump noise was faintly audible during monitoring.
Logger 2 Racecourse (near Aileron Roadhouse) 11/08/2010 : 8.29 am	41	33	43	Typical rural environment with birds and nearby insects influencing the ambient noise. Stuart Highway traffic noise was faintly audible and intermittent during monitoring.

Notes:

LAeq(15mins) Equivalent sound pressure level: the steady sound level that, over a 15-minute period, would produce the same energy equivalence as the fluctuating sound level actually occurring.

LA10(15mins): Sound pressure level that is exceeded for 10% of the 15-minute measurement period.

LA90(15mins): Sound pressure level that is exceeded for 90% of the 15-minute measurement period.

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1.6.1 Noise Assessment Guideline Values

The noise assessment guideline values were adopted from the following references with the most conservative value utilised for the assessment:

- NT EPA Noise guidelines for development sites in the Northern Territory and;
- NSW Industrial Noise Policy (NSW EPA 2000)

1.6.2 Potential Construction Noise Impacts

Typical noise levels produced by construction plant anticipated to be used on site were sourced from AS 2436 – 2010 Guide to Noise Control on Construction, Maintenance and Demolition Sites and from GHD’s internal database. Applicable construction noise criteria the Project is 48 dB(A)Leq(15min).

Received noise produced by anticipated activities during the construction phase are shown in Table 1—4 for a variety of distances, with no noise barriers or acoustic shielding in place and with each plant item operating at full power. The sound pressure levels shown are maximum levels (dB(A) L_w) produced when machinery is operated under full load. The results indicate that noise levels from construction of the proposed Nolans Project is predicted to comply with the adopted criteria at all noise sensitive receivers.

Table 1—4 Attended 15-minute period noise monitoring results

Plant item	dB(A) L _w	Distance of source to receiver (m)							
		50	250	500	750	1000	2000	5000	8000
Crane	105	63	49	43	39	37	31	23	19
Backhoe	104	62	48	42	38	36	30	22	18
Compressor	101	59	45	39	35	33	27	19	15
Concrete pump	108	66	52	46	42	40	34	26	22
Dump truck	117	75	61	55	51	49	43	35	31
Water tanker	107	65	51	45	41	39	33	25	21
Compactor	113	71	57	51	47	45	39	31	27

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1.6.3 Potential Construction Vibration Impact

Blasting normally generates the highest levels of ground vibration. The predicted ground vibrations at various distances are shown in Table 1—5 for typical construction equipment. Given the distance to the nearest receiver from the proposed processing site is approximately 5 km, construction vibration is highly unlikely to exceed the human perception criteria. It should also be noted that it is unlikely that blasting will be needed at the processing facilities. The mine site is an additional 7km to the north of this receiver.

Table 1—5 Predicted construction equipment vibration levels(mm/s PPV)

Plant item ¹	Human perception preferred criteria (maximum criteria)		Predicted ground vibration at given distances				
	Day	Night	10 m	30 m	50 m	100 m	300 m
15 t roller	0.28 (0.56)	0.2 (0.4)	7.5	1.4	0.7	0.2	<0.1
Dozer			3.3	0.6	0.3	0.1	<0.1
7 t compactor			6.0	1.2	0.5	0.2	<0.1
Rock breaking			7	1.3	0.6	0.2	<0.1
Backhoe			1	0.2	0.1	<0.1	<0.1

1. NSW RTA Environment noise management manual

Blasting will likely to be required during construction and will be needed during operation of the mine. Indicative vibration impact assessment for typical blasting activity has been estimated with consideration to Australian Standard AS 2187.2:2006 Explosives – Storage and use Part 2: Use of Explosives (Standards Australia, 2006). Reductions in levels of ground vibration can be achieved by reducing either the charge mass or increasing the distance to the receptor which reduces the airblast overpressure.

Ground vibration generally attenuates faster than airblast overpressure, and as such airblast overpressure is generally the critical factor controlling the distance at which blasting can occur without exceeding the human perception preferred criteria. Blasting at distances to receivers of less than 500 m would be restricted by the maximum instantaneous charge.

The maximum construction criteria for airblast overpressure is 115 dB(L) and ground vibration is 5 mm/s PPV. Airblast overpressure and ground vibration were predicted for a range of charge masses. As shown in the airblast overpressure and ground vibration levels for the assessed charge masses are expected to be well under the criteria at the nearest sensitive receiver located approximately 10 kilometers from the source.

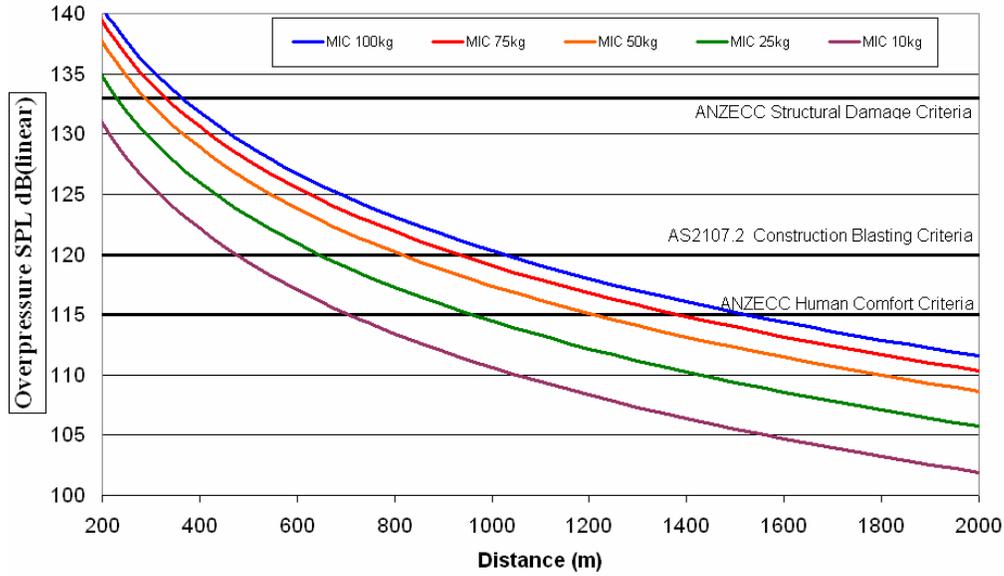


Figure 1—1 Airblast overpressure predictions for different charge masses and distances

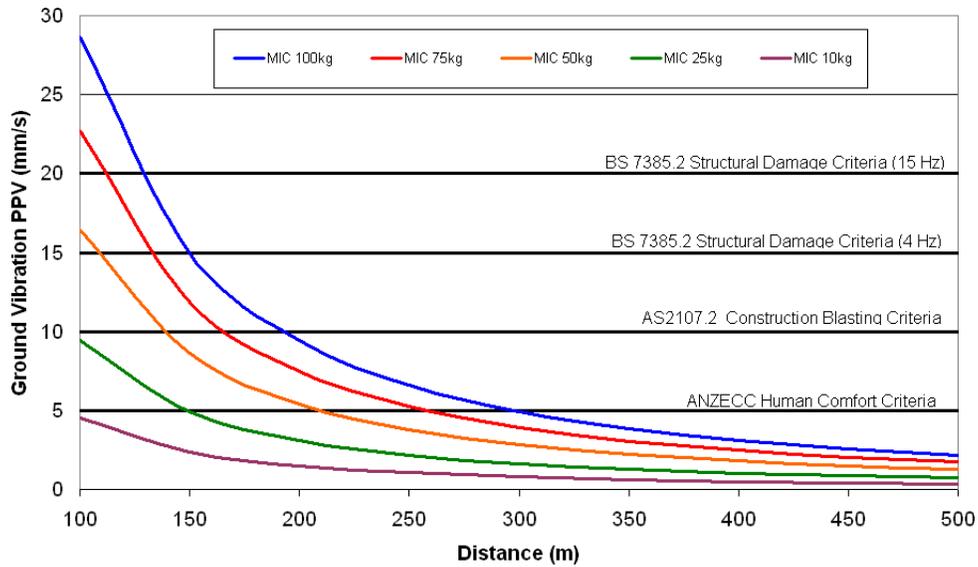


Figure 1—2 Ground vibration predictions for different charge masses and distances

Adverse meteorological conditions such as temperature inversions and wind direction can significantly increase airblast overpressure levels. Temperature inversions are most common during night and early morning periods. This should not affect blasting during the daytime, as open pit mining will be operating only during the daytime.

A maximum instantaneous charge of greater than 100 kg should not be required and a charge of 50 kg or less is likely to be appropriate. As the nearest receiver is greater than ten kilometres away, ground vibration from blasting is not predicted to be an issue.

If blasting activity occurs, the design of blast will be determined by the blast contractor and therefore the above information has been assumed for this assessment only in the absence of specific information regarding blasting at the proposed site.

1.6.4 Potential Operational Impacts

Due to staging of the mine pit and waste rock dumps, noise impact will vary over the proposed life of the mine, depending on where machinery is operating. Modelled sound levels for mobile and fixed sources (modelled as point sources) for the proposed mine and processing sites are summarised in Table 1—6. The plant and equipment listed in the table are expected to be the major noise sources from the Project, and the associated sound power levels (dB(A) Lw) per unit are the maximum predicted levels produced when machinery is operating under full load.

Table 1—6 Modelled operational noise sources

Plant item ¹	Make and model	dB(A) Lw per unit	Peak quantity	Modelled source height (m)
Excavator	Hitachi EXI 200	123	3	3
Dump truck	CAT 777F	117	11	4
Dozer	CAT D9T	111	3	3
Grader	CAT 16M	109	2	4
Service truck	MAN 6x6	107	1	3
Water truck	MAN 6x6	107	2	3
Rock breaker	CAT 336DL	118	1	1
Lighting plant	Alight	90	12	1
Front end loader	CAT 990H	112	2	4
Surface crawlerdrill	Sandvik DP1100	119	6	2
RC drill	Atlas CopcoRC127	119	1	2

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Dewatering pump	Chesterton	98	3	1
Acid plant compressor	n/a	122	1	5 (ground plant source) 20 (stack source)
Milling	n/a	118		4
Screener	n/a	111	1	2
Primary crusher	n/a	116	1	3
Secondary crusher	n/a	112	1	3
5 MW gas turbines	n/a	127 (engine noise) 136 (exhaust stack)	3	5 (ground plant source) 12.5 (stack source)

The predicted sound pressure levels due to the operation of the Project at nearby noise sensitive receivers are summarised in Table 1—7, and spatially presented on Figure 1—3.

Applicable and adopted operational noise criteria for the Project is 35 dB(A)Leq(15min), with the Project's operational noise impact at the Aileron Roadhouse and Annas Reservoir receivers both expected to be below this limit.

A potential 10 dB(A) exceedance is predicted to occur at the Nolans accommodation village receiver, based on the modelling assumptions, which estimates that the gas turbine stacks at the power station site as the primary contributor. Design of the turbines will include installation of a noise attenuator (silencer or equivalent) at the gas turbine exhaust stacks. The installed attenuator should achieve an overall noise reduction level of 20 dB(A) or more to the stack noise levels. Predicted operational sound pressure levels with the noise attenuator are summarised in Table 1—7.

Table 1—7 Predicted operational sound pressure levels dB(A) at modelled receivers

Nearest sensitive receiver locations ¹	Project noise criteria dB(A) LAeq(15min)	Predicted noise levels dB(A) LAeq(15min)	Predicted noise levels dB(A) LAeq(15min) with noise attenuator
Accommodation village	35	45	34
Aileron Roadhouse	35	12	8
Annas Reservoir	35	< 5	13

1. Predicted for all periods

1.6.5 Traffic noise

Road access for construction, service, delivery and workforce traffic will be via an upgraded station road in the area, which ultimately connects to Stuart Highway. The distance between the sealed access road past the Nolans Project accommodation village is approximately 0.5 kilometres. The Aileron Roadhouse is located about 7 kilometres east from the village. Based on typical truck sound power level of 107 dB(A), which equates to a sound pressure level of 35 dB(A) at 1.5 kilometres and 19 dB(A) at 9.5 kilometres. Based on these calculations, as well as the intermittent nature of truck movements, traffic noise along the access road due to the Project is not expected to cause impact at the assessed receivers.

Stuart Highway is a government-controlled road potentially affected by the Project. The Aileron Roadhouse receiver is located approximately 5 km to the north of the intersection between Nolans site access road and Stuart Highway. Due to this significant distance, Project traffic noise impact along Stuart Highway is not expected to cause significant impact at the Aileron Roadhouse receiver.

Due to substantial distance separation between the sealed access road and the sensitive receivers, as well as the transport route along Stuart Highway to Alice Springs, traffic noise from the Project is not expected to cause significant impact at the assessed receivers.

1.6.6 Construction and operational vibration

All rotating equipment within the Project site will be vibration isolated using vibration isolation mounts, as per manufacturer's recommendations. Due to the extensive distance (+5 km) from source-to-receiver, it is expected that equipment vibration associated with the operation of the Project would be insignificant at identified nearby sensitive receivers.

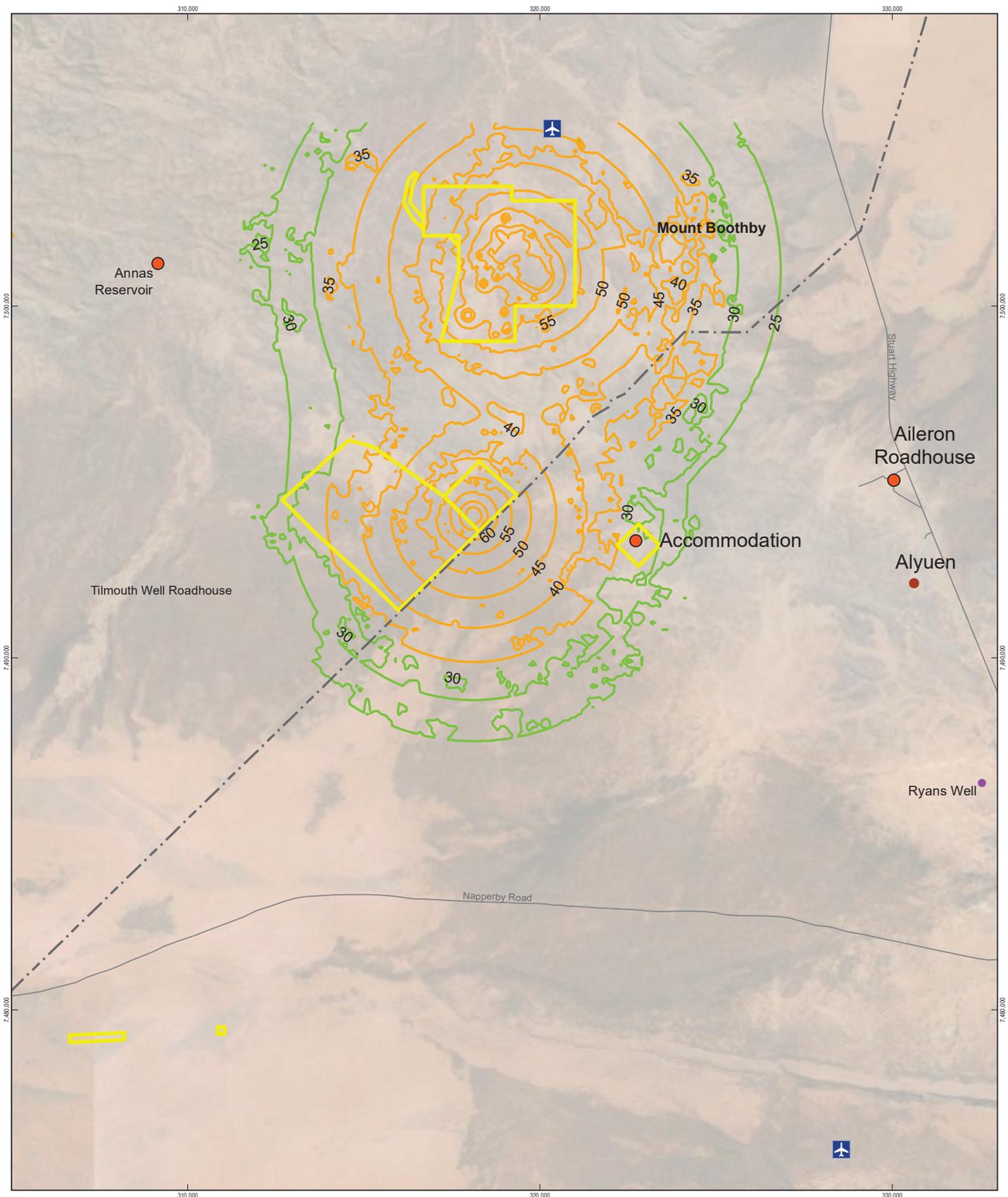
1.6.7 Noise impacts on livestock

Sudden noise has the potential to startle or upset domestic livestock and pets. Studies (Heggies 2009) have considered the effect on farm animals to sonic booms (sonic booms being similar in character to airblast from blasting). These studies have indicated that reactions of sheep, horses and cattle to sonic booms (125 dB to 136 dB) were considered slight to mild.

Results showed that less than 20 percent of the sonic booms studied caused even a mild reaction on sheep, horses and dairy cattle in temporary cessation of eating, rising of heads and slight startle effects. The total individual milk yield was observed, and no affect was found on the overall milk production. Given these conclusions, it is considered unlikely that the Project will have an adverse effect on livestock in the vicinity of the Project.

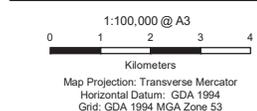
1.6.8 Noise impacts on native fauna

Disturbance to fauna associated with generation of unexpected and/or excessive noise and vibration from mining and processing activities during construction can result in the displacement of fauna and disruption to nesting/roosting/foraging behaviour. Management and monitoring measures outlined in Table 2—2 and the Biodiversity Management Plan (ARMS-0000-H-PLN-N-0002 Rev 0) will be used to minimize potential impacts.



LEGEND

- | | | | | |
|-------------|--------------------|--------------------|-----------------|-----------------------|
| ● Town | ✈ Station | — Major Waterways | ▭ Project Areas | Noise Contours |
| ● Community | ● Site of Interest | - - - Gas Pipeline | ▭ Waterbodies | — < 35 dB(A)LA(eq) |
| ▲ Mountain | ✈ Airport | — Major Roads | | — =< 35 dB(A)LA(eq) |



Arafura Resources Limited
Noise and Vibration Management Plan

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Predicted operational noise impact contours with mitigation measures

Figure 1-3

2.0 MANAGEMENT AND MITIGATION

Noise and vibration management refers to previous monitoring and modelling carried out across the Project as detailed in the EIS process (GHD, 2016). Management of noise and vibration at the Project is to be structured as follows:

- **Key Activities Impacts and Residual Risks:** A summary of the key activities being undertaken during the management period. The potential environmental impacts and residual risk levels are identified for each environmental aspect.
- **Objective:** The guiding environmental management objective(s) and activities that apply to the element.
- **Mitigation Measures:** The procedures to be used to ensure that the relevant objectives are met.
- **Responsibility:** Nominates the responsible position for implementing actions and monitoring.
- **Trigger, Action, Response Plan (TARP):** The actions to be implemented in the case of non-compliance. This includes strategies of remediation and the person(s) responsible for the actions.

2.1 Key Activities and Impacts

The key activities and potential environmental impacts that have been identified from noise and vibration are listed in Table 2—1.

Table 2—1 Key Activities and Impacts

ID No	Activity	Potential Environmental Impact
1	Construction activities and mining operations, including earthworks (drilling, blasting, excavations, etc.), power station and other processing plant and equipment resulting in audible airborne noise at elevated levels.	<p>Excessive noise levels resulting in disruption to nesting / roosting / foraging habitats or displacement of fauna into sub-optimal habitats, increasing their susceptibility to predation and competition.</p> <p>Excessive noise levels at nearby sensitive receptors, including Aileron Roadhouse, project accommodation village and Anna's Reservoir.</p> <p>Personnel exposed to increased noise levels during operation of the mine, processing plant and associated infrastructure.</p>

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ID No	Activity	Potential Environmental Impact
2	Mining operations, including drilling, blasting and excavations result in ground borne vibration at elevated levels.	<p>Excessive vibration levels at nearby sensitive receptors, including Aileron Roadhouse, project accommodation village and Anna's Reservoir. Human impacts from vibration will ultimately be muscular skeletal disorders.</p> <p>Excessive vibration levels resulting in disruption to nesting / roosting / foraging behaviour or displacement of fauna into sub-optimal habitats, increasing their susceptibility to predation and competition.</p> <p>Altered character of Aboriginal sacred sites or heritage places sites caused by vibration impacts (e.g. subsidence or modification to observed deposits and outcrops).</p> <p>Consequences of whole body vibration will ultimately be muscular skeletal disorders.</p>

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2.3 Mitigation Objectives

The noise and vibration pollution management objectives are outlined below:

- **Objective:** Minimise noise and vibration impacts from project.
- **Target:** No report of noise of vibration impact from the project at sensitive receptors.
- **KPI:** Number of incidents/complaints at sensitive receptors sites.

2.4 Mitigation Measures

Mitigation measures have been developed to minimise potential impacts associated with noise and vibration from the Project. The mitigation measures, timing and responsibilities are provided in Table 2—2.

Table 2—2 Mitigation Measures

Mitigation Measure	Timing	Responsibility
Site Induction (Risk Activity 1 – 2)		
Site induction is to include a description of noise and vibration risks across the Project and areas of higher risk (i.e. adjacent to the Aileron Roadhouse).	Site Induction	Safety Officer
Equipment and task specific procedures/work instructions will include noise management, hearing protection training and personal protective equipment instructions.	All project	Operators
Noise Management (Risk Activity 1)		
As per the mobile equipment on the development site likely to cause noise, as per Table 1-6, the majority of work will occur between the hours of 7 am and 7 pm daily. Justification for work on the development site that must be undertaken outside of these times must be approved by the site Safety Officer.	Construction	Safety Officer
Weather conditions and wind direction to be checked the day of blasting to ensure adverse conditions will not increase the impact of noise impacts.	Operation	Area Supervisors
Review available fixed and mobile equipment fleet and if available, select more recent and silenced equipment whenever possible.	Construction	Area Supervisors
Plan to use equipment that is fit for the required tasks in terms of power requirements.	Construction	Area Supervisors
All engine covers should be kept closed while equipment is operating.	Construction and Operation	Area Supervisors
As far as possible, material drop heights into or out of trucks should be minimized and avoid all metal-to-metal contact.	Construction and Operation	Area Supervisors

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Mitigation Measure	Timing	Responsibility
Broadband reversing alarms (audible movement alarms) should be used for all site equipment, subject to meeting occupational health and safety requirements.	Construction	Area Supervisors
All combustion engine plant, such as generators, compressors and welders should be maintained to ensure they produce minimal noise.	Construction	Area Supervisors
Vehicles should be properly serviced. The use of exhaust brakes should be eliminated, where practicable.	Construction	Area Supervisors
Where practical, machines should be operated at low speed or power and should be switched off when not being used rather than left idling for prolonged periods.	Construction and Operation	Area Supervisors
Vibration Management (Risk Activity 2)		
Use of smaller capacity vibratory rollers.	All project	Area Supervisors
Use of static rollers opposed to vibratory roller/compactors where possible.	All project	Area Supervisors
Vibration intensive activities to be undertaken during the least sensitive time periods.	All project	Area Supervisors
Operations sequenced so that vibration intensive activities do not occur simultaneously, where possible.	All project	Area Supervisors
Inspection and Monitoring (Risk Activity 1 – 2)		
Regular visual and audio inspections of work areas to determine if additional noise and vibration suppression measures are required for workers.	As required	Area Supervisors
Biannual assessment of noise and vibration monitoring from blasting activities at closest key receptor of the accommodation village.	As required	Safety Officer

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2.5 Trigger, Action and Response Plan

The Trigger, Action and Response Plan (TARP) outlines remedial actions and responses to the situation. The levels of incidents and TARP are provided in Table 2—3.

Table 2—3 Trigger, Action and Response Plan

Trigger	Action	Response
Noise and/or vibration complaint received but not validated.	OHS department to undertake an investigation of the complaint including an assessment of operations, weather conditions audio and visual observation of impact. Record in the Complaints Register.	Provide feedback to all parties.
Noise and/or vibration complaint received and confirmed as valid.	OHS department to undertake an investigation of the complaint including an assessment of operations, weather conditions, audio and visual observation of impact. Review efficiency of noise and vibration mitigation measures and detail additional mitigation measures and associated monitoring at sensitive receptors (including complainant location where appropriate).	Review and implement additional noise and vibration mitigation measures provided by the OHS department Provide feedback to all parties.

3.0 PERFORMANCE REVIEW

A regular review of performance of this management plan is to coincide with the review process of the Project's MMP.

The review process is to assess performance against objectives of this plan and the stated actions within the MMP, with any relevant outcomes, supporting information, reports and/or data, discussed within the relevant section of the MMP, and supporting information/reports provided within the appendices.

Any outcomes of the performance review that will assist in continually improving this management plan, its objectives, methods or controls, are to be included or reflected in an updated version of this document.

The mitigation objectives and measures outlined in this EMP have been developed to reduce the risk of key project activities to an acceptable level for construction and operation of the Project.