



Appendix O

Noise, Vibration and Light Management Plan

Vista Gold Australia Pty Ltd
Mount Todd Project Area



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1 Introduction

The Mt Todd Project Area (MTPA) is located approximately 55 km northwest of Katherine and 250 km south of Darwin. The area surrounding the mining lease is rural and sparsely populated. The Werenbun community is the closest residential area located approximately 6.5 km from the site. The Werenbun Community (also known as Barnjaru) is an outstation located approximately 60 km by road from Katherine and along the Edith Falls Road. The community lies in the Roper Gulf Shire local government area and has a population of approximately 20-30 people. The outstation consists of permanent and semi-permanent residences with water and power supply. Road access to the outstation is via Edith Falls Road. The Stuart Highway, the main arterial road in the region, is located west of the MTPA.

Mining at the MTPA will be by conventional drill and blast, open-pit truck and shovels & excavator methods, using large haul trucks, hydraulic shovels, excavators and front-end loaders to transport material to the crusher, stockpiles, Run of Mine (ROM) pad and Waste Rock Dump (WRD).

1.1 Purpose

This Plan forms part of the Environmental Management System (EMS) for the MTPA and is considered a working document. It has been updated following formal assessment by Department of Primary Industry and Resources (DPIR) as part of the mining authorisation process.

Mining at the MTPA will generate noise, vibration and light throughout the construction and operational phases. Vista Gold will manage noise, vibration and light throughout the duration of the mine in accordance with this Noise, Vibration and Light Management Plan (NVLMP).

The purpose of the NVLMP is to provide a framework for environmental management. This plan has been developed in accordance with Northern Territory Environmental Protection Authority (NT EPA) requirements and references Australian Standards and international guidelines.

1.2 Objectives

The NVLMP has been established to minimise nuisance causes, health and safety issues, infrastructure damage and impacts to fauna due to noise, vibration and light generated during the construction and operation phase of the mine. It has been designed to achieve this objective through the following process:

- Complying with all regulatory requirements and Australian Standards;
- Identifying, characterising and ranking major noise, vibration and light sources from the construction and operation phases of mining;
- Implementation of mitigation strategies to minimise noise, vibration and light emissions to the maximum possible extent reducing the potential for exceedances to occur; and
- Performance reviews and management requirements against monitoring results to determine if additional mitigation measures are required.

1.3 Legislation and Guidelines

The NVLMP has been developed with reference to several industry standards and guidelines in relation to noise, vibration and light. A summary of applicable guidelines and standards are provided below:

- NT EPA *Noise guidelines for development sites in the Northern Territory* (NT EPA 2013);
- New South Wales Industrial Noise Policy (NSW EPA 2000);
- British Standard 6472-1 – 2008, *Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting*;
- The Australian and New Zealand Environment and Conservation Council (ANZECC) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (ANZECC 1990);
- Australian Standard AS 2436:2010 *Guide to Noise Control on Construction, Maintenance and Demolition Sites*; and
- The Roads and Traffic Authority of New South Wales *Environmental Noise Management Manual* (RTA 2001).

1.4 Previous Investigations

A summary of previous investigations relating to noise, vibration and light at the site is provided in **Table 1-1 Summary of Noise, Vibration and Light Investigations**.

Table 1-1 Summary of Noise, Vibration and Light Investigations

Title	Author	Date	Purpose
Noise and Vibration Assessment (EIS, Appendix U).	GHD	June 2013	<p>The assessment was undertaken to:</p> <ul style="list-style-type: none"> • Determine baseline noise levels. • Assess potential impacts from construction and operation on people and infrastructure at sensitive receptors. • Model the potential levels of noise, vibration and light experienced at receptors. • Specify intended noise, vibration and light management and mitigation measures during construction and operation of the Project to allow compliance with relevant criteria.
Mt Todd Gold Mine Noise and Blasting Impact Assessment on Gouldian Finches.	SLR	August 2015	<p>To address the issues raised by the Australian Government Department of the Environment (DoE) resulting to the potential impact of noise and vibration emissions from the proposed Project on the Gouldian Finch including:</p> <ul style="list-style-type: none"> • Ranking areas most affected by noise and blasting • Establishing variation in effects between dry and Wet Season. • Developing appropriate noise/blasting effect threshold levels. • Identifying impacts to Gouldian Finch population and habitat including from noise and vibration.
Mt Todd Gold Project Gouldian Finch Monitoring and Mitigation Program.	SLR	February 2017	<p>The assessment was undertaken in response to the Department of the Environment and Energy to better understand the dynamics of the local finch population and any potential effects of the Project on this population. In</p>

Title	Author	Date	Purpose
			reference to noise, vibration and light specifically this includes: <ul style="list-style-type: none"> • Extrapolating the potential effects to individual Gouldian Finches from noise, vibration and light. • Defining trigger threshold predictions for noise and vibration to minimise potential future impact. • Detailing the effects of artificial light on the Finch.

2 Existing Environment

The MTPA will mine using conventional drill and blast, open-pit truck and shovels & excavator methods, using large haul trucks, hydraulic shovels, excavators and front-end loaders to transport material to the crusher, stockpiles, Run of Mine (ROM) pad and Waste Rock Dump (WRD).

The Project, based on current known data will have a life of around 20 years inclusive of construction, operations and closure. Construction is anticipated to take two years. The mine is scheduled to operate for an additional 13 to 17 years, and closure and rehabilitation of the mine is expected to take four years.

2.1 Meteorology

The Mt Todd area is susceptible to extreme weather events. Tropical cyclones occur over the Wet Season (October - April) due to low-pressure systems forming offshore over warm tropical waters. As the cyclone, system moves around offshore, wind speeds can reach 270km/h or more within the storm centre. As these systems move inland they down grade to low pressure systems and can bring with it significant wind gusts and periods of torrential rain and numerous lightning strikes resulting in fires in the region.

The area experiences a sub-tropical savannah climate with distinct Wet and Dry Seasons. Daily temperatures in the Dry Season typically range from 24°C - 36°C, occasionally reaching 39°C. Nights in the Dry Season can be quite cool with temperatures falling to 7°C. During the Wet Season, daily temperatures can range from 27°C - 42°C.

High levels of humidity occur within the area, with intensity reaching 80 - 100% between October and March. During this time, the region receives spectacular electrical storms along with vigorous lightning displays. Throughout the Dry Season (April – September), humidity levels can range from 50 - 70%.

The first Automatic Weather Stations (AWS) was installed at the Project site in March 2011 with an additional station commissioned in December 2015. This allows site specific meteorological data to be collected.

Wind speed and direction was monitored on site from the first AWS with the resulting wind rose presented in **Figure 2-1 Average Wind Speed and direction at Mt Todd from 2007 to 2016**. The pattern observed is characteristic of the easterly trade winds experienced at mid-latitudes. There is clear distinction in incident wind direction between the Wet (December to March) and Dry Season. The Australian Monsoon dominates synoptic flows in the Wet Season with the prevailing wind from the northwest, whereas, the Dry Season is characterised by the easterly Trade Winds.

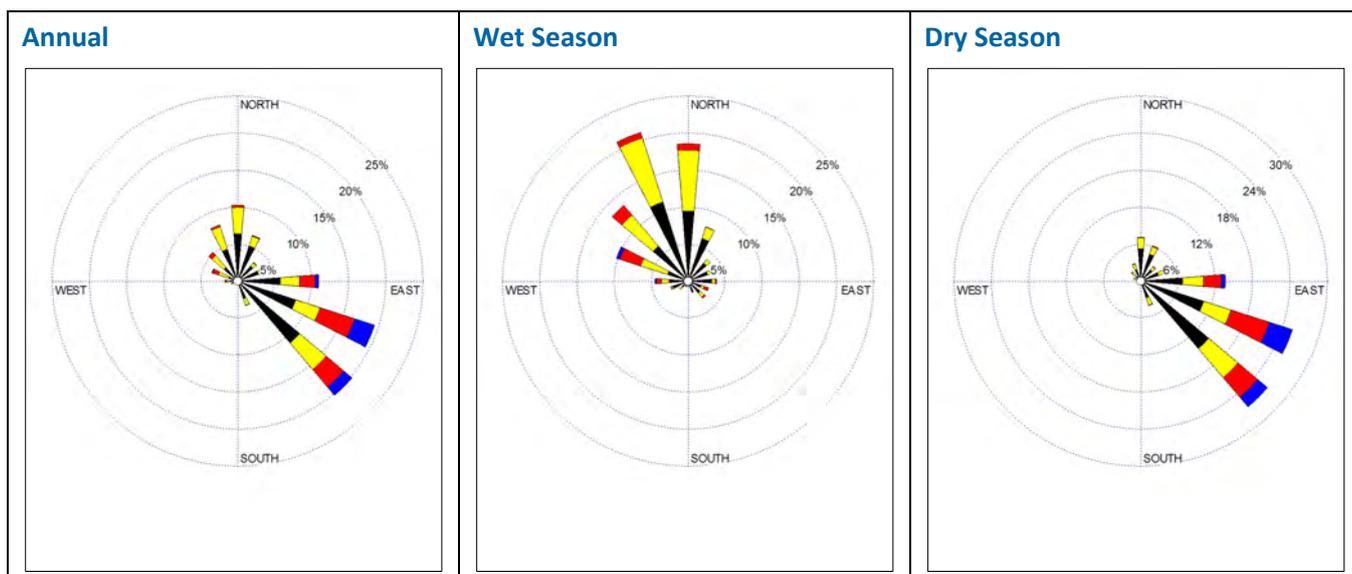


Figure 2-1 Average Wind Speed and direction at Mt Todd from 2007 to 2016

2.2 Noise

Monitoring was conducted in the area surrounding the MTPA to determine the existing noise levels in the area. Monitoring locations included both the MTPA entry point (near Edith Falls Road) and within the MTPA at the Batman Creek crossing. **Table 2-1 Summary of Noise Monitoring Results** summarises noise monitoring results.

Table 2-1 Summary of Noise Monitoring Results

RBL and L_{eq} Overall	Background $L_{A90}dB(A)$			Ambient $L_{Aeq}dB(A)$		
	Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)	Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)
Logger 1	24	25	22	42	41	39
Logger 2	21	22	20	38	45	40
Werebun Community	24	25	22	Information Not Available		

Noise sources in the area include:

- Traffic noise from the Stuart Highway;
- Rail noise from Adelaide-Darwin rail line; and
- Natural noise from wind, insects and other animals.

Heavy rainfall and thunderstorms can generate noise levels in excess of those likely from the MTPA, however, are usually associated with weather events over a short period (i.e. hours) of time.



Atmospheric stability can influence noise propagation. Stable conditions will generally develop at night, under clear skies and weak gradient winds. Such conditions are often coupled with ground based, radiation forced temperature inversions, sometimes with fog, mist or frost. Temperature inversion will cause sound waves to be reflected back towards the ground, thereby increasing noise levels compared to neutral conditions. It is common that stable conditions will result in off-site noise impact at a maximum range.

Category D classifies a neutral atmosphere and E and F slightly and moderately stable atmospheres respectively. The stability characteristics of the mine site:

- Stability class D (neutral) is the most frequently experienced atmospheric condition, present 38% of the time;
- Stable classes E & F combined comprise 34% of atmospheric condition; and
- The highest incidence of E & F conditions is observed from the southeast.

When seasonality is taken into account, the highest incidence of stable conditions corresponds to the change in prevailing wind.

2.3 Sensitive Receptors

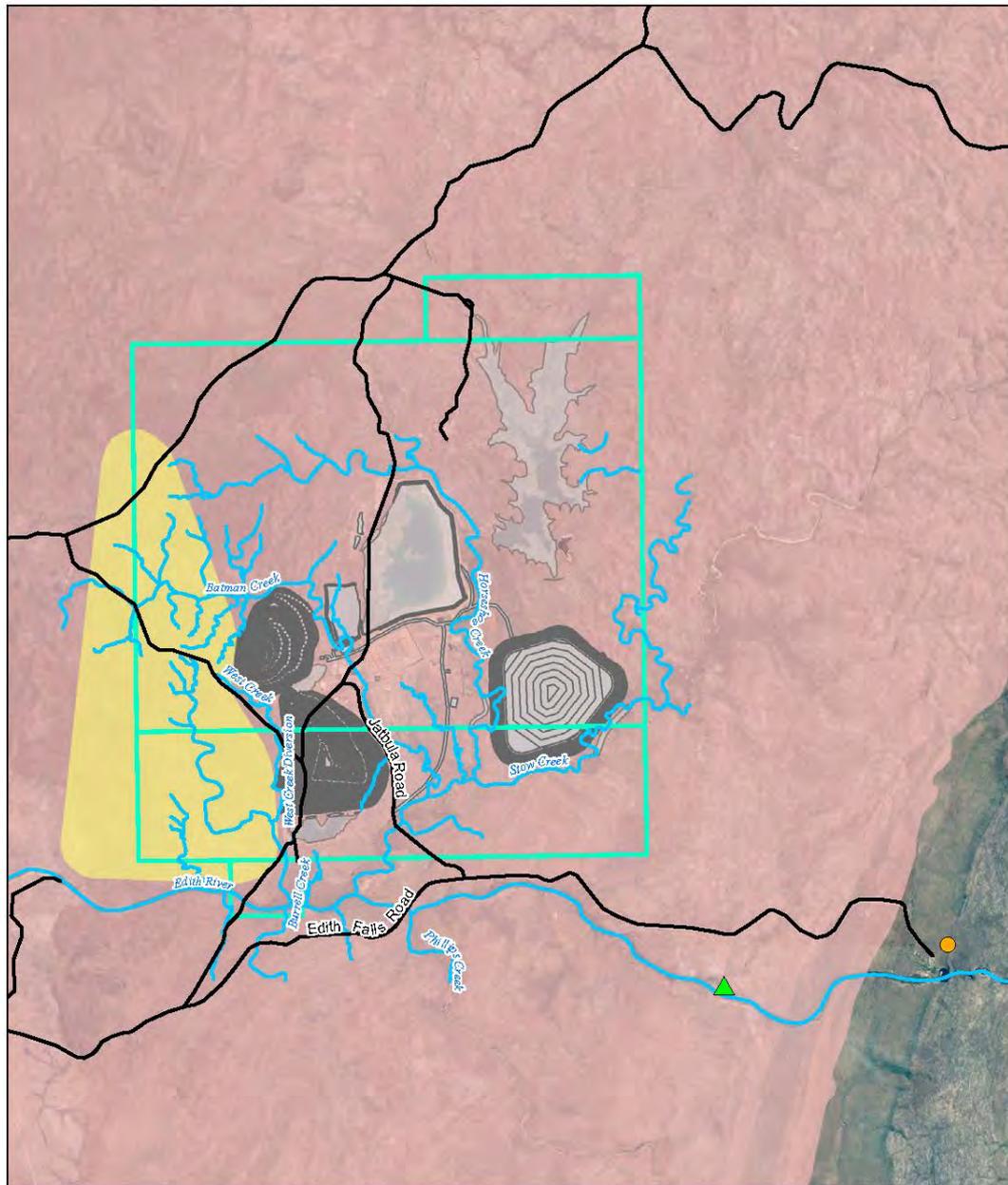
The MTPA is located within a predominantly rural area. The community of Werenbun is the closest human sensitive receptor, located approximately 7 km from the mine site. The community consists of approximately 10 houses, 30 people and an open undercover area used as a community school by the Northern Territory School of the Air. Edith Falls campground is located 9 km to the southeast of the mine with the Stuart Highway, the main arterial road in the region, located 11 km west of the mine site.

The impact of noise on wildlife can be similar to the impacts observed to humans. A total of 216 native terrestrial fauna species have been recorded within the mine site including six threatened species. The Gouldian Finch (*Erythrura gouldiae*) has the potential to be most affected due to habitat and nesting sites in close proximity to the site and its Endangered status under the EPBC Act. **Figure 2-2 Key Sensitive Receptors** contains an overview of all sensitive receptors in the vicinity of the mine site.

Large parts of the core Gouldian Finch habitat are likely to experience some level of impact to noise as a result of emissions from mine activities. The greatest potential for impacts to the Gouldian Finch will be during the Dry Season, where prominent southeast winds will assist in noise propagation over the core Gouldian Finch habitat.

Animals such as birds have been shown to adapt to noise especially if the noise is consistent in both the sound produced and the frequency with which it occurs including noises with a relatively high level (in the order of 70dB(A)). The majority (i.e. > 65%) of the core Gouldian Finch habitat will not be exposed to noise levels that would result in more tangible impacts such as avoidance, flight or alarm responses.

Figure 2-2 Key Sensitive Receptors



LEGEND

- Edith Falls Campground
- ▲ Werenbun
- Roads
- Waterways
- Site Contours
- Site Footprints
- Mineral Lease Boundaries
- Core Gouldian Finch Habitat
- Yinberrie Hills SOCS

1:75 000 @ A4
 0 0.5 1 1.5 2
 Kilometres
 Map Projection: Universal Transverse Mercator
 Horizontal Datum: GDA 1984
 Grid: GDA 1984 MGA Zone 53



Vista Gold Australia Pty Ltd
 Mt Todd Gold Project

Job Number 43-22632
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Key Sensitive Receptors

Figure 2-2

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3 Potential Noise, Vibration and Light Impacts

Due to the staging of the MTPA development and operations, the impact of noise, vibration and light will vary over all the phases of the mine. Year 3 on the MMP has been identified as the year of maximum production and potentially worst-case scenario for noise, vibration and light emissions. The processing facilities and power station will operate 24 hours a day, 365 days per year.

3.1 Construction Noise

Construction works will take place largely between 6 am to 6 pm, with construction workers operating on 12 hour rotating shifts. Occasional night works may be required, for example for concrete pours during hotter months, or to catch up on schedule delays.

Noise generating construction activities include:

- Demolition and disposal of existing process plant and other facilities;
- On site concrete batch plant/s; and
- Construction of mine infrastructure (including roads and utilities).

The mine will use standard construction machinery, general trade equipment and specialised equipment as required. Plant, equipment and construction materials will be transported to the site by road. Transportation vehicles will be a combination of standard and oversize loads.

Construction noise emitted from the mine has been assessed with consideration to the NT EPA *Noise guidelines for development sites in the Northern Territory* (2013). The NT EPA recommends standard hours for construction activity to minimise impacts to sensitive receptors, summarised in **Table 3-1 Standard Hours for Construction**.

Table 3-1 Standard Hours for Construction

Work Type	Standard Hours for Construction
Normal Construction	Monday to Saturday: 6 am to 6 pm. Sunday or Public Holiday 9 am to 6 pm.

The NT EPA noise limit for construction at residential receptors and areas during standard hours for construction are calculated based on the adopted rating background level (RBL) at nearby residential locations. The project specific noise criteria at noise sensitive receptors in Werenbun are provided in **Table 3-2 Noise Criteria for Construction**. Given the location of the mine site and the large distance between sources and receptors, the level of noise and extended working hours during construction are not expected to exceed noise criteria.

Table 3-2 Noise Criteria for Construction

Criterion	Nearest Residential Receptors
-----------	-------------------------------

	Day 7 am to 6 pm	Evening 6 pm to 10 pm	Night 10 pm to 7 am
A: Rating background level	24 L _{A90,day}	25 L _{A90,evening}	22 L _{A90,night}
B: Intrusiveness criteria: Residential areas (A ¹ + 5dB)	35 L _{Aeq,15min}	35 L _{Aeq,15min}	35 L _{Aeq,15min}
C: Rural amenity criteria (NSW EPA 2000 INP)	50 L _{Aeq,day}	45 L _{Aeq,evening}	40 L _{Aeq,night}
Noise criteria for construction	35 L _{Aeq,15min}	35 L _{Aeq,15min}	35 L _{Aeq,15min}

¹ The New South Wales INP states where the rating background level is found to be less than 30dB(A), then it is set to 30dB(A).

3.2 Mining Operations

Mine operations will be 24 hours a day, split across two shifts (6:00 am – 6:00 pm and 6:00 pm – 6:00 am), 365 days per year.

Under NT WorkSafe's Code of Practice 2012 for managing noise, the WHS Regulations set the exposure standard for noise at an L_{Aeq,8h} of 85 dB(A) and a peak noise level at 140 dB(C), which protects most but not all people. Therefore, workplace noise should be kept lower than the exposure standard for noise if reasonably practicable. **Table 3-3 Exposure Standard for Noise (NT WorkSafe 2012)** demonstrates the length of time a person without hearing protectors can be exposed before the standard is exceeded.

Table 3-3 Exposure Standard for Noise (NT WorkSafe 2012)

Noise Level dB(A)	
Exposure Time	Time Frame
80	16 hours ¹
82	12hours ¹
85	8 hours
88	4 hours
91	2 hours
94	1 hour
97	30 minutes
100	15 minutes
103	7.5 minutes
106	3.8 minutes
109	1.9 minutes
112	57 seconds
115	28.8 seconds
118	14.4 seconds

Noise Level dB(A)	
121	7.2 seconds
124	3.6 seconds
127	1.8 seconds
130	0.9 seconds

¹ The adjustment factor for extended workshifts shown in Table 3-4 is to be taken into account.

Shift durations of 10 hours or longer involve a degree of risk greater than that indicated by the 8 hour measurement LAeq,8h. This increase in risk arises because of the additional damaging effect of continuous exposure to noise after 10 hours. The risk may be further increased if there is reduced recovery time between successive shifts. If workers work shifts of 10 hours or more, the adjustment factor for extended shifts as set out in AS/NZS 1269.1 (see Table **3-4 Adjustments to LAeq,8h for Extended Work Shifts (NT WorkSafe 2012)**) should be added to the measured LAeq,8h before comparing it with the 85 dB(A) exposure standard for noise.

Table 3-4 Adjustments to LAeq,8h for Extended Work Shifts (NT WorkSafe 2012)

Extended Work Shifts	
Shift Length	Adjustment Added to Measured LAeq,8h dB(A)
10 hrs or more to less than 14 hrs	+ 1
14 hrs of more to less than 20 hrs	+ 2
20 or more hrs	+ 3

For example, if a worker works 12-hour shifts and the typical LAeq,8h has been determined to be 93 dB(A), an additional one decibel is added to give an adjusted LAeq,8h of 94 dB(A). Hence the worker's LAeq,8h exceeds the exposure standard for noise by 9 dB(A). If workers work more than five days per week, the weekly averaging procedure of AS/NZS 1269.1 should be used.

3.2.1 Mining and Processing

Drilling and blasting, to loosen rock ahead of mining, will be undertaken in order to produce rock sizes that conform to processing requirements. Blasted ore will be loaded into haul trucks for transportation either directly to the primary crusher, ROM pad or the LGO stockpile. Ore will be reclaimed from the ROM pad and LGO by front-end loader and fed to the primary crusher.

The process plant will consist of a gyrator crusher, secondary crushers, coarse screening, coarse ore stockpile, high pressure grinding rolls (HPGR), fine screening, classification, ball mills, pre-leach thickener, CIL circuit, elution circuit, gold room, cyanide detoxification and tailings pumps.

A Rolls Royce Trent 60 Wet Low Emissions single gas turbine generator and two reciprocating engines will meet the electrical demand of the mine.

Acoustic modelling was undertaken using CadnaA V4.3 noise modelling software to predict the effects of industrial noise generated by the mine. Mine site noise was predicted for a worst-case operating scenario whereby all equipment was assumed to be operating all the time under full load under various meteorological conditions. The results of the operational assessment indicate that operational noise is expected to comply with nominated criteria at Werenbun and other sensitive human receptors (**Table 3-5 Percentage of the Core Gouldian Finch Habitat Area Predicted within Specific Noise Effect Thresholds – Operational Phase** and **TABLE 3-1 STANDARD HOURS FOR CONSTRUCTION**).

The noise criteria are based on human response and annoyance factors and are not applicable to livestock or other non-human receptors. While there are no government, policies or widely accepted guidelines with regard to noise criteria for animals it is unlikely that the mine would have an adverse effect on livestock. Given the predicted steady noise levels around the mine are expected to be much less than this level noise is not considered to be a key threat to the Gouldian Finch species.

Table 3-5 Percentage of the Core Gouldian Finch Habitat Area Predicted within Specific Noise Effect Thresholds – Operational Phase

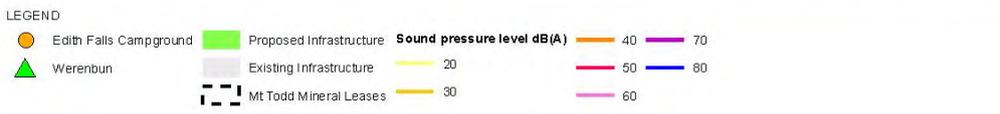
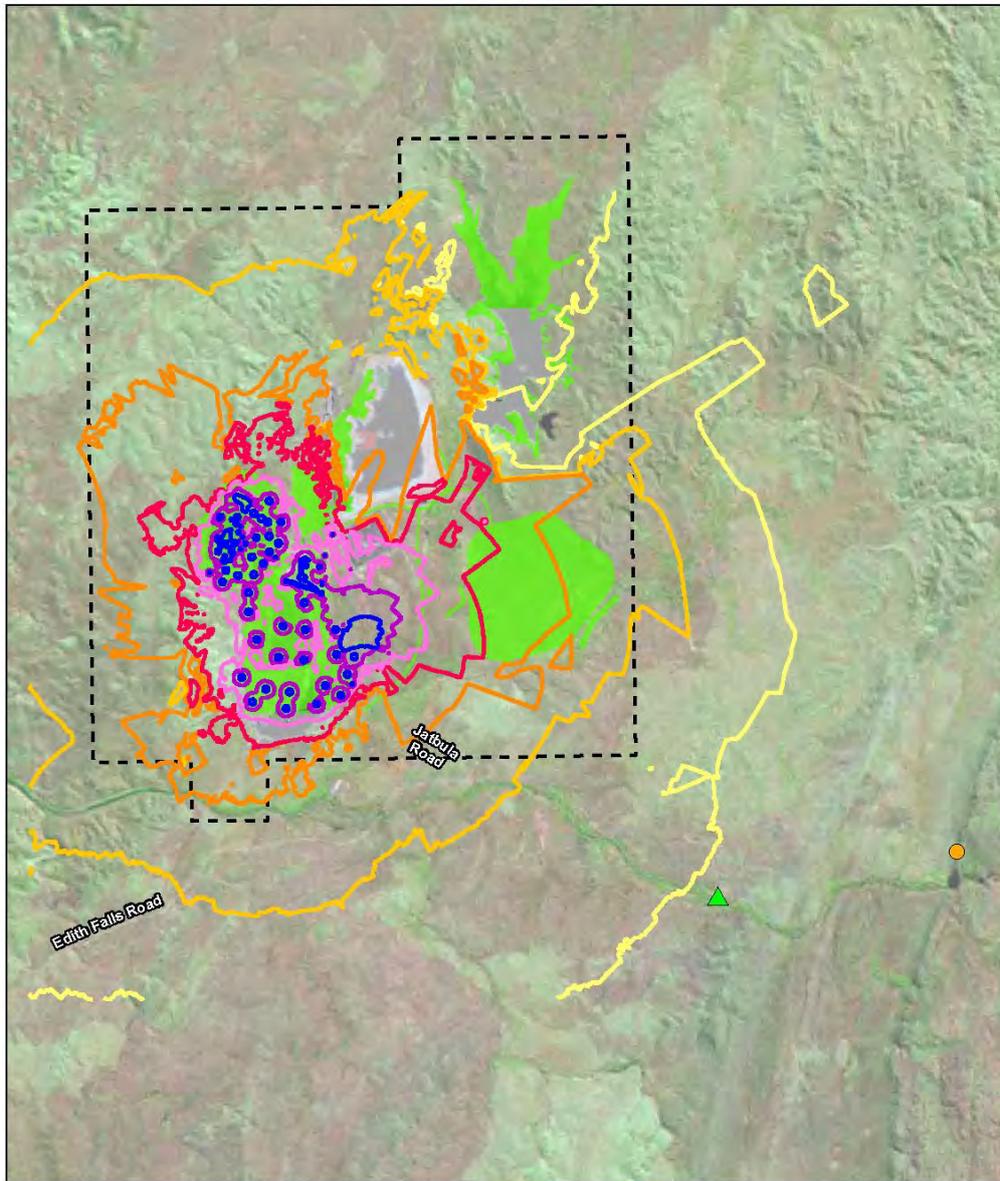
Effect Thresholds (dBA)		Percentage (%) of the Core Habitat Within Specific Effect Threshold Level			
		Neutral weather	Temperature inversion and 3 m/s wind (NW)	Dry Season (3 m/s SE wind)	Wet Season (3 m/s NW wind)
Frequent alarm or flight responses, masking likely	65 – 85 dBA LA _{eq} ^{1,2}	<1	<1	<1	<1
	60 – 80 LA _{max}	4	7	8	4
Occasional alert response, masking possible	50 – 65 dBA LA _{eq} ¹	4	7	8	3
	45 – 60 LA _{max} ³	13	16	32	10
Potential for masking if LA _{ey} noise above ambient	40 - 50dBA LA _{eq}	13	16	32	10
	LA _{max}	n/a	n/a	n/a	n/a
Cumulative Total ³	LA _{eq}	17	24	40	14
	LA _{max}	17	24	40	14

Note 1: The 60 dBA LA_{eq} control band has been used as a conservative band instead of 65 dBA which has been nominated as part of the effect thresholds.

Note 2: The 80 dBA LA_{eq} contour band is the grates band modelled, therefore the area within the 80 dBA band has been considered for this effect threshold.

Note 3: Cumulative total is a sum of the effect threshold percentages to 1 decimal place.

Figure 3-1. Dry season Noise Contours (worst case scenario)



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 Data source: NRETA - Wikimap (2011), Vista Gold - Wikimap (2011), Wikimap (2011), Google Earth Pro - Imagery (2011), GHD - Aerial (2011), Created by: GHD

Dry Season Noise Contours **Figure 3-1**

3.3 Traffic

Vehicle and mobile plant at the mine site will undertake activities such as mining, stockpile management, plant feeding, road maintenance, dust suppression and general personnel movement.

Road access for all traffic will be exclusively via Edith Falls Road and Jatbula Road. The closest noise sensitive receptor to Edith Falls Road (the Edith Falls Road / Jatbula Road intersection) is Werenbun, approximately 4 km away. As such, the estimated increase in traffic noise due to the mine is not expected to be noticeable at Werenbun receptors.

Increased traffic and associated noise may affect the breeding and foraging behaviour of the Gouldian Finches early in the Dry Season, when the sorghum seed at the road verge is more accessible than elsewhere. Due to the location of these roads to the south and south-east of the mine an increase in traffic and any associated increases to noise is not expected to impact the Gouldian Finch nesting area to the west of the site.

3.4 Vibration and Blasting

The nature and level of vibration emitted from the site will vary with the activities conducted. Some construction equipment can generate high vibration levels. Energy from construction equipment is transmitted into the ground and transformed into vibrations, which attenuate with distance. Blasting is required to loosen rock ahead of mining, in order to produce rock sizes that conform to processing requirements. Blasting has the potential to result in both air blast and vibration emissions.

As required in the ANZECC guideline (**Table 3-6 Recommended ANZECC Blasting Limits**), blasting will only occur between 9 am to 5 pm (Monday to Friday) and 9 am to 1 pm (Saturday). The frequency of blasting will be no more than once per day.

Airblast and vibration emissions from blasting activities at the mine are predicted to comply with the mine specific criteria, however, any blast on site should be designed by a qualified contractor and include consideration of the blasting noise and vibration limits outlined in this management plan.

Table 3-6 Recommended ANZECC Blasting Limits

Air blast Overpressure	Ground Vibration
115dB(lin) peak	5 mm/s peak particle velocity
The level of 115dB may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 120dB(lin) peak.	The level of 5 mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 10 mm/s.

Due to the distances between the source of vibration and sensitive receptors, vibration impacts for the Werenbun community are considered to be rare and within acceptable limits for residential receptors during daytime and night-time periods.

Research into the effects of vibration on the Gouldian Finch has been unable to develop trigger values or distances for this species or fauna in general. However, blasting and vibration is not considered to have a significant effect on the species.

Depending on the exceedance allowance and Maximum Instantaneous Charge (MIC) used ground vibration has the potential to impact on core Gouldian Finch Habitat with buffer distances outlined to comply with the effect threshold in **Table 3-7 Ground Vibration Buffer Distance and Core Gouldian Finch Habitat Potentially Impacted**. Airblast buffer distances and percentage of the core Gouldian Finch habitat area predicted to be affected within specific airblast effect thresholds are outlined within **Table 3-8 Air blast Buffer Distance and Percentage of the Core Gouldian Finch Habitat Area Predicted within Specific Air blast Effect Thresholds**.

Table 3-7 Ground Vibration Buffer Distance and Core Gouldian Finch Habitat Potentially Impacted

Exceedance Allowance	MIC	Buffer Distance to Comply with 5 mm/s Effect Threshold	Core Gouldian Finch Habitat Potentially Impacted
5%	50 kg	620 m	4%
	450 kg	1 850 m	40%
20%	50 kg	420 m	2%
	450 kg	1250 m	18%

Table 3-8 Air blast Buffer Distance and Percentage of the Core Gouldian Finch Habitat Area Predicted within Specific Air blast Effect Thresholds

Effect Thresholds (dBL)	Exceedance Allowance	MIC	Buffer Distance to Comply with Specific Threshold	Core Gouldian Finch Habitat Potentially Impacted	
Mortality	>185	5%	50 kg	<10 m	Nil
		20%	450 kg	<10 m	Nil
		5%	50 kg	<10 m	Nil
		20%	450 kg	<10 m	Nil
Increasing Likelihood of Mass Hatching Failure	130 - 170	5%	50 kg	300 m-<10 m	1%
		20%	450 kg	610 m - 13 m	4%
		5%	50 kg	175 m - <10 m	<1%
		20%	450 kg	360 m -< 10 m	1%
Frequent Alarm or Flight	110 - 130	5%	50 kg	2000 m -300 m	46%
		20%	450 kg	4200 m – 610 m	96%
		5%	50 kg	1150 m – 175 m	15%
		20%	450 kg	2400 m -360 m	64%

Effect Thresholds (dBL)		Exceedance Allowance	MIC	Buffer Distance to Comply with Specific Threshold	Core Finch Potentially Impacted	Gouldian Habitat
Low Likelihood of Alert	≤ 110	5%	50 kg	2000 m	47%	
		20%	450 kg	4200 m	100%	
		5%	50 kg	1150 m	16%	
		20%	450 kg	2400 m	65%	

3.5 Light

It is expected that during construction and mining there will be an increase in light sources on site. These will come lighting plants distributed around the site to illuminate work areas, and vehicles and mobile plant moving around the site. The increase of artificial light in the area may cause aesthetic and environmental impacts. These impacts include an increased nuisance factor at sensitive receptors, reduced use of habitat for nearby species such as the Gouldian Finch and attraction/disorientation of other nearby fauna.

Light modelling for the mine indicates that it is highly unlikely that light will encroach into the important Yinberrie Hills nesting sites and habitat of the Gouldian Finch. Therefore, trigger levels for light have not been developed as the assessment on potential light spill from the mine has concluded it is unlikely to be an issue for the Gouldian Finch which would be the most sensitive receptor.

To limit the impact from lighting plants around the site lighting plants will be strategically placed in operations areas so that the emitted light will be directed away from the Yinberrie Hills area as best as possible. In addition, lights on extended lighting plant masts will be directed downwards to reduce the amount of light emitted from the operational areas into the surrounding environment.

4 Noise, Vibration and Light Management

The general approach for management of noise, vibration and light before, during and after mine construction and operations is as follows:

- **Key Activities, Risks and Impacts:** 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 employed 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.

4.1 Key Activities, Risk and Impact

The risk assessment workshop identified noise and vibration from construction and mining (including blasting) to have a low residual risk rating. Risks associated with noise and vibration can be managed by undertaking the following management and mitigation strategies:

- Operate well maintained mining equipment with noise restricting and vibration suppressing controls in place;
- Site employees and/or contractors to wear appropriate hearing protection;
- Health monitoring will be undertaken; and
- Blasting will occur in daylight hours.

A risk assessment was also conducted by SLR 2017 and identified four medium and six low risks at MTPA. Both risk assessment has been combined and are in **Table 4-1 Mt Todd Risk Assessments** below.

Table 4-1 Mt Todd Risk Assessments

Activity	Potential Environmental Impact	Residual Risk Level		
		Consequence	Likelihood	Risk
Noise and vibration from construction and operation including blasting.	Nuisance noise levels at the Werenbun Community.	Significant	Rare	Low
	Reduction in animal species diversity and population sizes.			
	Vibration impacts at the Werenbun Community.			
Increased traffic	Noise effects on breeding and foraging behaviour of the Gouldian Finches early in the Dry Season, when the sorghum seed at the road verge is more accessible than elsewhere	Significant	Rare	Low
	Vibration effects on Gouldian Finch habitat and individuals			
	Light effects on Gouldian Finch individuals			
Noise from construction and operations (including equipment)	Depending on the level effects on the Gouldian Finch including: <ul style="list-style-type: none"> • Acoustic masking of communication • Alert responses • Avoidance behaviours Affects to nesting and roosting	Significant	Unlikely	Medium
	Nuisance noise levels at the Werenbun community			
Artificial lights 24 hour operation	Potential impact of reduced breeding success, reduced appeal/use of habitat	Moderate	Unlikely	Low
	Increased nuisance factor at sensitive receptors			
	Attraction/disorientation of other nearby fauna			
Blasting activities during construction and operations	Sound and vibrations spook nesting birds resulting in abandonment and reduced appeal/use of habitat	Moderate	Unlikely	Low
	Nuisance vibration levels at the Werenbun community			
	Structural effects on-site			
	Indirect disturbance to sites of cultural significance.			

4.2 Management Objectives

The noise and vibration management objectives have been established and are detailed in **TABLE 4-2 NOISE, VIBRATION AND LIGHT MANAGEMENT OBJECTIVES**.

Table 4-2 Noise, Vibration and Light Management Objectives

Objective	Target	Indicator
Avoid, minimise or control the generation of noise, vibration and light emissions and mitigate any potential impacts	No reports of noise or vibration impacts from the mine at Werenbun.	Number of complaints.
	No reports of light impacts from the mine at sensitive receptors.	Number of light impacts/complaints at sensitive receptor sites
	No unplanned exceedance of noise criteria.	Number of unplanned exceedances
	No unplanned exceedance of blasting emission criteria.	Number of unplanned exceedances
	Ensure no significant long-term adverse effects on the Gouldian Finch population from noise, vibration and light emissions.	Number of unplanned exceedances of noise and vibration criteria.

4.3 Mitigation Measures

Mitigation measures have been developed to minimise potential impacts associated to noise, vibration and light, although not expected to cause adverse impacts. A complaint management system will also be implemented including the implementation of management measures adopted should noise complaints be received. The extent and severity of the potential impact to Gouldian Finch populations will be reduced through avoidance and the following mitigation measures.

The mitigation measures, timing and responsibilities are provided in **Table 4-3 Mitigation Measures for Noise, Vibration and Light**.



Table 4-3 Mitigation Measures for Noise, Vibration and Light

ID	Mitigation Measures	Timing	Responsibility
Site Induction			
AD1	<p>All site workers should be aware of the potential for noise impacts and encouraged to take practical and reasonable measures to minimise the impact during the course of their activities, including:</p> <ul style="list-style-type: none"> • Avoiding the use of loud radios; • Avoiding shouting and slamming doors; • Machines should be operated at low speed or power and switched off when not being used; • Informing truck drivers of designated vehicle routes, parking locations and delivery hours; • Minimising reversing; • Avoiding dropping materials from height; • Avoiding metal to metal contact on material; • Closing engine covers while equipment is operating; and • Equipment fit for the required tasks will be used in terms of power requirements. 	Site Induction	Environmental Officer
Construction			
AD2	All work should be kept within the standard working hours prescribed by the NT EPA.	Construction	Area Managers
AD3	Stationary equipment (i.e. crushers, compressors, generators etc.) will be located as far as practicable from sensitive Gouldian Finch breeding habitat.	Construction and Operation	Area Managers
Operational			
AD4	All mobile equipment will be selected to minimise noise emissions with all equipment fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations will be removed from the site or stood down until repairs or modifications can be made.	Construction and operation	Area Managers
	Stationary equipment (i.e. crushers, compressors, generators etc.) will be located as far as practicable from sensitive Gouldian Finch breeding habitat.		



ID	Mitigation Measures	Timing	Responsibility
	Operation of more recent and silenced equipment where possible and maintenance will be regularly undertaken to ensure for good working condition.		
	All new equipment to have sound control devices no less effective than those provided on the original equipment.		
AD5	Haul roads will be kept smooth and free of potholes and bumps as far as practical.		
AD6	Broadband reversing alarms (audible movement alarms) will be used for all site equipment.		
AD7	Whenever feasible, schedule different noisy activities (e.g. blasting and earthmoving) to occur at the same time, since additional sources of noise generally do not add a significant amount of noise (i.e. less frequent noisy activities would be less disruptive than frequent less-noisy activities).		
AD9	Vehicles will be kept properly serviced and fitted with appropriate mufflers. The use of exhaust brakes should be eliminated, where practicable.	As Required	Area Managers
Vibration and Blasting			
AD10	Develop blasting program to limit potential impact on Gouldian Finches nesting sites, including incorporating deck charging (a method of loading blastholes in which the explosive charges in the same blasthole are separated by an inert material. Initiating the blast in the direction away from the closest point to the Gouldian Finch population receiver location, emissions from blasting, using an MIC in accordance with the airblast site law established for the mine.	Operation	Blast Operator
	Avoid blasting during 'sensitive' periods (e.g. breeding and moulting).		
	Control the transmission of vibration by: <ul style="list-style-type: none"> • Increase the distance to sensitive breeding habitat as far as possible; and • Be aware of the geological make-up and terrain separating source with receiver and how this will influence transmission. 		
AD11	Operate or locate high vibration sources as far away from sensitive Gouldian Finch breeding habitat areas as possible.	At All Times	Area Managers
AD12	Sequence operations so that vibration-causing activities do not occur simultaneously.	At All Times	Area Managers



ID	Mitigation Measures	Timing	Responsibility
AD13	Isolate vibration causing equipment on resilient mounts.	At All Times	Area Managers
AD14	Ensure the initial blasts are as small as practicable with maximum instantaneous charges of less than 100 kg.	Every Blast	Blast Operator
AD15	<p>Confined or deck charging blasting techniques (where inert material such as crushed stone is used to seal off or 'stem' the blast holes and contain the energy released by the detonation of the explosives in the blast hole inside the rock) will be used in preference to unconfined methods:</p> <ul style="list-style-type: none"> • Adhere to applicable criteria for blast vibration in ANZECC 1990 including permitted times for blasting to occur; • Identify alternative, lower-impact equipment or methods wherever possible; • Where practical, limit blasting to one (1) per day and after dawn and before dusk (to avoid disturbing roosting and brooding birds); • Route, operate or locate high vibration sources as far away from sensitive breeding habitat areas as possible; • Sequence operations so that vibration-causing activities do not occur simultaneously; • Isolate vibration causing equipment on resilient mounts; • Keep equipment well maintained; and • Ensure the initial blasts are as small as practical. 	At All Times	Area Managers
Light			
AD16	Limiting artificial light to areas actively required and turning off lights when not required.	At All Times	Area Managers
AD17	Ensuring that artificial lighting does not point upwards or laterally i.e. should point towards the ground and avoid the flood of light into natural habitats and should minimise mine lights facing the SOCS area.	At All Times	Area Managers
AD18	Use of lower wavelengths of light wherever possible i.e. red/yellow lights and low light intensities that are as low as possible without reducing safety or efficiency.	At All Times	Area Managers



ID	Mitigation Measures	Timing	Responsibility
AD19	<ul style="list-style-type: none"> • Avoid painting large structures bright colours. • Limit artificial light to areas actively required and turn off lights when not required so as to avoid flooding natural habitats with light; • Ensure that artificial lighting does not point upwards or laterally i.e. should point towards the ground. Otherwise, lighting guards/shutters should be installed to direct light to road/working surfaces and away from adjacent vegetation; • Preference should be given to lower rather than higher lighting installations so as to reduce the spread of the light cast; • Use lower wavelengths of light wherever possible i.e. red/yellow lights and low light intensities that are as low as possible without reducing safety or efficiency; • Avoid adverse offsite lighting impacts by implementing work procedures related to the use of mobile lighting plants; • Where possible, conduct operations behind light barriers, especially at night to avoid adverse offsite lighting impacts; • Consider including reinforcement of screen plantings around areas where lighting plant are used extensively at night in offsite treatments; and • Conduct a lighting survey. Ensure optimal placement of all lighting plants. 	At All Times	Area Managers
Monitoring			
AD20	Regular monitoring of meteorological conditions will confirm conditions suitable for blasting without causing or exceeding thresholds.	As Required	Environmental Officer
AD21	Review the fixed and mobile equipment fleet and prefer more recent and silenced equipment whenever possible.	As Required	Area Managers
AD22	All combustion engine plant, such as generators, compressors and welders should be checked to ensure they produce minimal noise with particular attention to residential grade exhaust silencers.	As Required	Area Managers
AD23	Monthly review and compilation of the complaints register in relation to vibration, noise and light.	Monthly	HSEC Manager

4.4 Trigger, Action and Response Plan

The trigger, Action and Response Plan (TARP) provides an outline of remedial actions and responses to the situation. The TARP is outlined in **Table 4-4 Trigger Action Response Plan**.

Table 4-4 Trigger Action Response Plan

Responsibility	Situation		
	Standard	Level 1	Level 2
Noise			
	At all four monitoring stations: <ul style="list-style-type: none"> Noise monitoring station 1: ≤85 dBA LAeq (Blasts <130 Dbl). Noise monitoring station 2: ≤65 dBL LAeq (Blasts <110 dBL). Noise monitoring station 3: ≤50 dBA LAeq. 	Trigger: At a minimum one of four monitoring stations as per: <ul style="list-style-type: none"> Noise monitoring station 1: >85 dBA LAeq (Blasts >130 dBL). Noise monitoring station 2: 65-85 dBA LAeq (Blasts >110dBL). Noise monitoring station 3: 50-65 dBA LAeq. 	Trigger: At a minimum one of four monitoring stations: <ul style="list-style-type: none"> Noise monitoring station 2: >85 dBA LAeq (Blasts >130dBL). Noise monitoring station 3: >65 dBA LAeq (Blasts >110 dBL).
Site Personnel	Comply with site inductions and mitigation measures outlined in Table 4-3.		
Environmental Officer and Area Supervisors	<ul style="list-style-type: none"> Regular inspections across the mine to determine if additional measures are required. Monthly inspection and reporting of all noise control measures. Undertake regular monitoring as per management plant. 	<ul style="list-style-type: none"> Undertake an investigation including an assessment of operations, weather conditions and noise loggers. Consideration given to designing and installing a suitably high and long bund wall along the western edge of the eastern Rock Dump if deemed necessary. 	<ul style="list-style-type: none"> Relocation or temporary suspension of noise producing activities until meteorological condition become more favourable. Establishment of a vegetation buffer between the core breeding and foraging areas and key emissions sources to reduce noise levels. <p>Undertake alternative actions as agreed with the NT EPA, or others.</p>
Blasting			
	At both monitoring stations: <ul style="list-style-type: none"> Blast monitoring station 1: < 130 dBL. Blast monitoring station 1: < 110 dBL. 	One exceedance at any of the following monitoring stations: <ul style="list-style-type: none"> Blast monitoring station 1: >130 dBL. Blast monitoring station 2: >110 dBL. 	Multiple exceedances at any of the following monitoring stations: <ul style="list-style-type: none"> Blast monitoring station 1: >130 dBL. Blast monitoring station 2: >110 dBL.

Responsibility	Situation		
	Standard	Level 1	Level 2
		<ul style="list-style-type: none"> Consider refining the blasting processes If possible Consider additional vibration impact assessments including quantification, qualification, modelling and assessment of acceptability of impacts. Reschedule blasting activities if meteorological conditions have the potential to increase air blast levels over the core Gouldian Finch habitat. Refining the blast deign parameters so the initial blasts are as small as practical and uses low MIC where possible. 	<p>Temporarily halt blasting activities until the following is achieved:</p> <ul style="list-style-type: none"> Reschedule blasting activities if meteorological conditions have the potential to increase air blast levels over the core Gouldian Finch habitat Refining the blast design parameters so the initial blasts are as small as practical and uses low MIC where possible. Undertake alternative actions as agreed with the NT EPA or others.
Community			
	Noise, vibration and light activities from the mine do not affect sensitive receptors.	Trigger: Complaint for noise, vibration or light received but not validated.	Trigger: Complaint for noise, vibration or light received and confirmed as valid.
Site Personnel	Comply with site inductions and mitigation measures outlined in Table 4-3.		
	<ul style="list-style-type: none"> Monitoring of all noise, vibration and light control measures. Regular monitoring of noise and blast loggers. 	<ul style="list-style-type: none"> Undertake an investigation of the complaint of operations, weather conditions and equipment. Record within the complaints register. 	<ul style="list-style-type: none"> Undertake an investigation of the complaint of operations, weather conditions and equipment. Revie efficiency of mitigation measures and detail additional monitoring at sensitive receptors (including complainant location where appropriate).

5 Noise, Vibration and Light Monitoring

A comprehensive environmental monitoring program will be undertaken during the construction and operational phases of the MTPA. In conjunction with water, soil, flora and fauna, weather and waste etc; noise, vibration and light monitoring will be a big component of environmental monitoring for the site.

5.1 Noise

Four noise loggers will be placed within the Yinberrie Hills. One will be situated on the western edge of the WRD, and one on the western edge of the Batman Pit (on the eastern edge of the Yinberrie Hills). Sampling will be undertaken until blasting ceases, or until such time that it is considered that noise levels are such that no adverse effects to Gouldian Finches are anticipated.

5.2 Vibration and Blasting

Two blast monitoring monitors will be located within the mine site. Monitoring will be conducted at the location where the progressively updated (5% exceedance) blast emission site laws predict a level of 130 dB Linear air blast or 5 mm/s ground vibration, whichever is the closer, as well as the distance at which the air blast level of 110 dB Linear is predicted. Monitoring data from blast emissions will be used to refine subsequent blast designs in order to control blast emission (ground vibration and air blast) levels.

A program of blast emissions monitoring (air blast and ground vibration) will be developed with reference to the procedures described in AS 2187.2-1993, and with reference to the ANZECC's "*Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*", September 1990.

5.3 Light

Light levels to be tested in finch habitats using a lux meter with location and timing to be confirmed following final lighting specification developed during the detailed design phase. There is expected to be low residual predicted risks of mine-related light to the Gouldian Finch, however, final design, installation, inspections and monitoring of light in the Yinberrie Hills will be undertaken.

5.4 Meteorology

Data from the three recently installed Automatic Weather Stations will be used to forecast potential risk of noise and vibration impacts especially in sensitive areas. Monitoring will be used to assess changes and trends in the operations of the mine and noise and vibration readings. The automatic anemometer and wind station located at the mine will be considered representative of wind propagation conditions in relation to blast emissions throughout the blast monitoring program.

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