Mt Gibson Gold Project

Acoustic Assessment

Tetris Environmental Pty Ltd

19 May 2025

→ The Power of Commitment

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Executive summary

Crimson Metals Pty Ltd (a wholly owned subsidiary of Capricorn Metals Ltd) propose the development of the Mt Gibson Gold Project (the Project) in the Murchison region. The Project will expand on a decommissioned mine site, and will include mining pits, processing plant, integrated waste landform (IWL) and run of mine (ROM). It is expected to mine 30 million tonnes per annum (Mtpa) of ore and waste. The processing plant is expected to process 5 Mtpa of ore for approximately 10 years.

Tetris Environmental Pty Ltd is managing the environmental approvals for the Project and have engaged GHD Pty Ltd to undertake an acoustic assessment for the Project. The purpose of this report is to evaluate and present predicted acoustic impacts associated with the operation of the proposed Project, and to consider these impacts in the context of noise criteria set by the *Environmental Protection (Noise) Regulations 1997.*

A review of the proposed operations was undertaken to identify noise generating equipment that would be required for the construction and operational stages of the Project. Equipment noise levels were modelled in CadnaA to predict noise levels at the sensitive receptors identified near the Project site.

Three key sensitive receptors relating to human health were identified near the Project site. In addition to these receptors, the impacts due to noise and vibration on Malleefowl (*Leipoa ocellata*) and the Lake Goorly Shield-Backed trapdoor spider (*Idiosoma kopejtkaorum*) were also assessed.

The site is scheduled to operate for 24 hours, 7 days a week. Operational noise was assessed against the night-time assigned noise level as this was identified as the most stringent time period. Predicted operational noise levels are below the night-time assigned noise levels at the nearest sensitive receptors, therefore noise impacts are not anticipated due to mining and processing operations.

Blasting is expected to occur up to three times per week. A conservative maximum charge mass of 750 kg per detonation hole has been assumed. The sensitive receptors are not anticipated to be impacted by blasting.

Equipment that would likely be required for construction were identified and modelled to predict construction noise levels at the nearest sensitive receptor. Noise levels exceeding the daytime L_{A1} assigned level of 55 dBA are not predicted at the nearest sensitive receptor.

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Glossary of terms and abbreviations

Term	Description
AS	Australian Standard
CadnaA	Computer Aided Noise Abatement software used for calculating predicted noise emissions
CONCAWE	Conservation of Clean Air and Water in Europe
dB(A)	Decibel (A-weighted)
EPA	Environmental Protection Authority
GHD	GHD Pty Ltd
IF	Influencing factor
ISO	International Organisation for Standardization
IWL	Integrated waste landform
SPL	Sound pressure level
SWL	Sound power level
L_{Aeq}	Equivalent sound pressure level over A-weighted spectra
m	Metre
km	Kilometre
PP	Processing Plant equipment
D&B	Drill and Blast equipment
L&H	Load and Haul equipment
Support	Support vehicles and equipment
TSF	Tailing storage facility
ROM	Run-off-mine equipment
CP	Construction of processing plant equipment
PPV	Peak particle velocity
Mt	Million tonnes
t	Tonne
WRD	Waste rock dump

1. Introduction

1.1 Background

Crimson Metals Pty Ltd (a wholly owned subsidiary of Capricorn Metals Ltd) propose the development of their second mining tenure in Western Australia, the Mt Gibson Gold Project (the Project).

Gold production was historically in operation from 1986 to 1999, where the deepest open pit was only 100 m below the surface and the average depth of mining was between 60-80 m below the surface (Capricorn Metals, 2023).

The Project will expand on the decommissioned mine site, aiming to achieve 30 million tonnes per annum (Mtpa) of ore and waste. The Project is expected to mine over 229 million tonnes (Mt) of waste and 49 Mt of ore over 12 years. The processing plant expected to process 5 Mtpa for approximately 10 years. The process plant will operate on three types of ores with the predominate ore being fresh (>70 percent). A Mineral Resource Estimate (MRE) completed for the Project by Capricorn, estimates a gold grade of 0.8 g/t.

1.2 Purpose of this report

Tetris Environmental Pty Ltd (Tetris Environmental) is managing the environmental approvals for the Project and has engaged GHD Pty Ltd (GHD) to undertake an acoustic assessment for the Project. The purpose of this report is to evaluate and present predicted acoustic impacts associated with the operation of the proposed Project, and to consider these impacts in the context of noise criteria set by the *Environmental Protection (Noise) Regulations 1997.*

1.3 Scope of works

The scope of works for this assessment is as follows:

– Determine the relevant noise criteria under the *Environment Protection (Noise) Regulations 1997* and other relevant noise guidelines.
– Develop representative noise emissions from the proposed mining area, including mine vehicles, excavators and haul trucks, for the worst case operational year and power station (as required).
– Conduct noise modelling for two operational scenarios, using CadnaA noise modelling software.
– Include a qualitative assessment for the likely impacts to local fauna and nearby nature reserves resulting from noise and vibration associated with operation of the Project.
– Outline in principle mitigation measures for consideration.
– Include a qualitative construction noise assessment outlining typical noise impacts associated with expected construction activities.
– Provide a report (this document) outlining development of the noise model and findings of the subsequent noise impact assessment.

1.4 Limitations

This report has been prepared by GHD for Tetris Environmental Pty Ltd and may only be used and relied on by Tetris Environmental Pty Ltd for the purpose agreed between GHD and Tetris Environmental Pty Ltd as set out in Section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Tetris Environmental Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer Section(s) 1.5 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Tetris Environmental Pty Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.5 Assumptions

- All information provided by Tetris Environmental on behalf of Crimson Metals, including operational parameters and mine site layout is correct.
- All parameters used in the model and other relevant data are based on best estimates using information provided by Tetris Environmental and other relevant sources.
- The mine plan, outputs and timeline are indicative at the time of writing and has been used for noise modelling purposes.
- All noise sources will be modelled as operational over a 24/7 period.
- Two operational scenarios have been taken as worst case, both assumed during periods of TSF lifts and periods of peak production at the processing plant.
- The TSF and ROM IWL have been considered at natural ground level in the geographical landscape to ignore any geo-graphic mitigation impact.
- Pits and surrounding terrain have been modelled according to latest geospatial data considering the pit depth per modelling year.

2. Project overview

2.1 Project details

Crimson Metals propose the development of the Mt Gibson Gold Mine Project on the tenements that are located at the southwest portion of the Yalgoo-Singleton Greenstone Belt in the Murchison Province of the Yilgarn Craton.

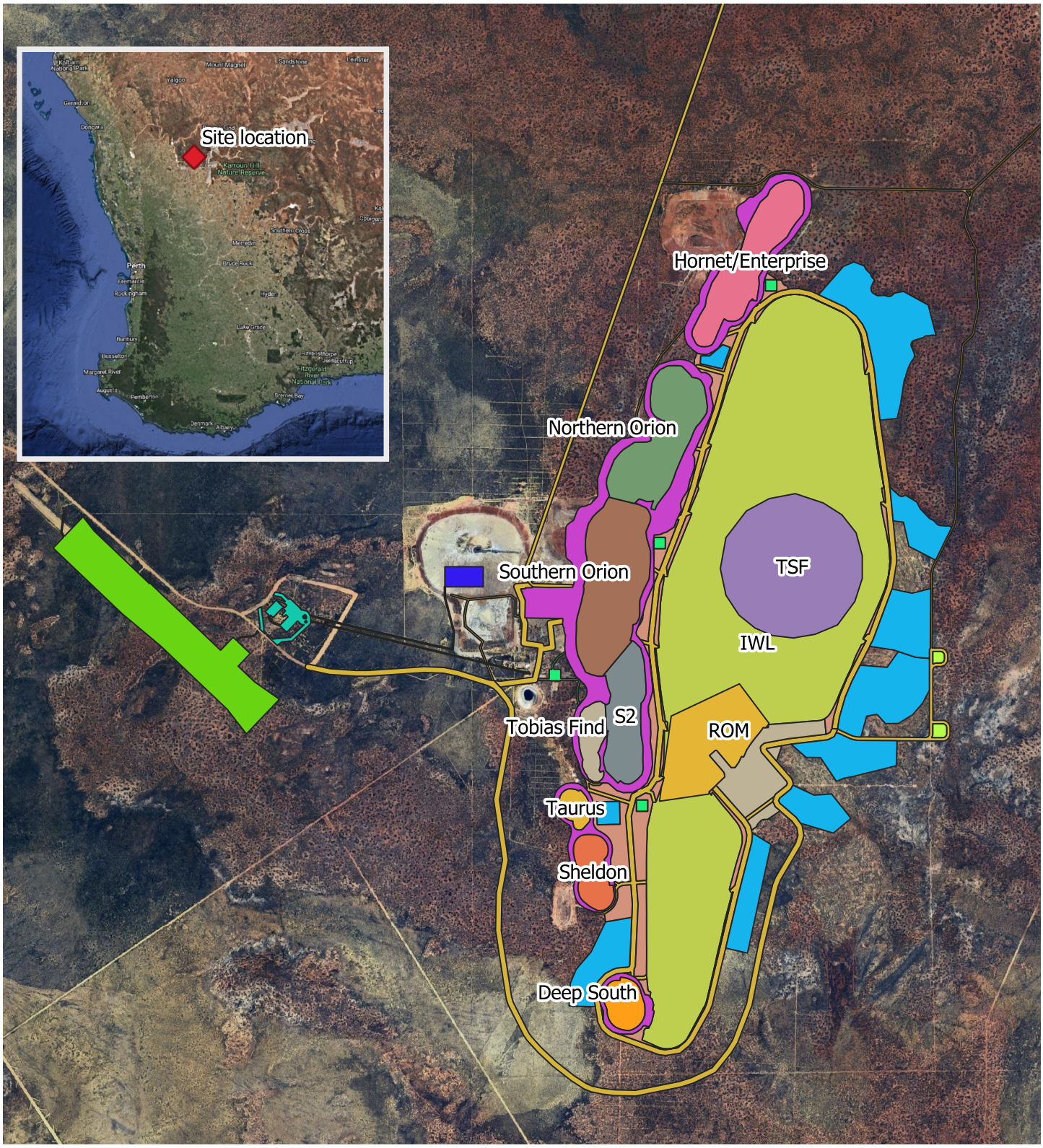
The combined area of tenure covers approximately 139 km^2 and is more than 15 km of strike. The proposed deposit design encompasses historic pits over an 8 km strike within the tenement. This design has further been defined to be between 200 m to 250 m below surface. This contrasts with the historically mined average depth of 60-80 m (Capricorn Metals, 2023). The mining site and layout is shown in Figure 2.1.

Upon the completion of a Joint Ore Reserves Committee (2012) compliant MRE for the Project, the estimated gold grade is 0.8 g/t from the Project. The gold ore output is expected to be at approximately 5 Mtpa with three types of ores (oxidised, transitional and fresh), with the Project to be run for a period of 10 years following two years of pre-production. There will be construction of a run of mine (ROM), three-stage processing plant, integrated waste landform (IWL) and tailings storage facility (TSF).

2.2 Mining process

Miming operations will comprise of the following processes:

– Ore and waste are mined from the mining pits at an estimated average rate of 30 Mtpa.
– Ore from all pits will be taken via haul trucks and unloaded at the ROM, located in the IWL. Waste will be hauled to the waste rock dump (WRD) in the IWL (pending a pre-production waste movement of 29 Mt).
– Ore will be processed at three-stage crushing plant and milling circuit at a rate of approximately 5 Mtpa.
– Residue material from the processing of ore will be deposited into the TSF.
– Every one to two years the TSF will undergo a lift stage to ensure adequate storage at the TSF. The lift stage is estimated to be conducted over a three-month period.



Legend

- Plant Area
- Roads
- IWL
- ROM
- TSF

Mine pits

- Hornet/Enterprize
- Northern Orion
- Southern Orion
- S2
- Tobias Find
- Taurus
- Sheldon
- Deep South
- Airstrip
- Magazine
- Misc Mining
- Spare TSS
- TK Nest
- TSS
- Village
- WWTP

Paper Size ISO A4

0 0.25 0.5 0.75 1 km

Map Projection: Transverse Mercator
Horizontal Datum: GDA94
Grid: GDA94 / MGA zone 50

N

Tetris Environmental Pty Ltd

Mt Gibson Acoustic Assessment

Mine location and layout

Project No. **12606145**
Revision No. **2**
Date. **9/08/2023**

FIGURE 2.1

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Data Source:Google Earth Imagery 2023.
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2.3 Key project elements

2.3.1 Mining area

The mining will comprise of the following:

– Mining pits including Deep South, Sheldon Taurus, Tobias, S2, Southern Orion, Northern Orion and Enterprise/Hornet.
– Load and haul mining fleet which consists of up to four excavators and 26 haul trucks of various capacities.
– Complementing the load and haul is drilling and blasting equipment including up to eight drill rigs and one mobile mining unit.
– Support equipment for the mining operations including up to three watercarts, two dozers, two graders, two loaders, two trucks, three bus, two service trucks and a rock breaker.
– IWL which consists of the following components.
    - ROM stockpile
    - TSF stockpile
    - WRD
– ROM stockpile with one wheeled loader for occasional ROM feed.
– The TSF area requires a lift with the help of four haul trucks, one watercart, one dozer, one excavator, one grader and one loader for approximately three months every one to two years.
– Haul and mining roads for pit and IWL inspection.
– Light vehicle roads for general travel.

Mining will occur 24 hours a day, seven days a week.

2.3.2 Processing plant area

The processing plant will comprise of the following:

– Three-stage crushing plant and milling circuit with the following major components:
    - One primary jaw crusher
    - One secondary cone crusher
    - Two tertiary cone crushers
    - Crushed ore stockpile
    - Two vibrating screens or one double deck screen
    - Six major conveyors that are enclosed with chutes and skirts with dust suppression sprays. To be operated at 1.5 m per second (s) and maximum incline of 15 degrees.
– Power station with nine 2 MW generators fuelled by natural gas.
– Support infrastructure.

The crushing circuit will have 70 percent availability and the processing circuit is expected to have 95 percent availability over 24 hours a day, seven days a week.

2.4 Project timeline

The total mined output including waste and ore is expected to be around 30 Mtpa. Note that during production, the project has an approximate 4.7:1 waste to ore ratio.

Over ten years of operation, close to 229 Mt of waste and 49 Mt of ore is expected to be mined. Majority of this will be sourced from Orion North, South and Hornet/Enterprise and with the highest throughput occurring in the third, fourth, and fifth years as highlighted in Figure 2.2.

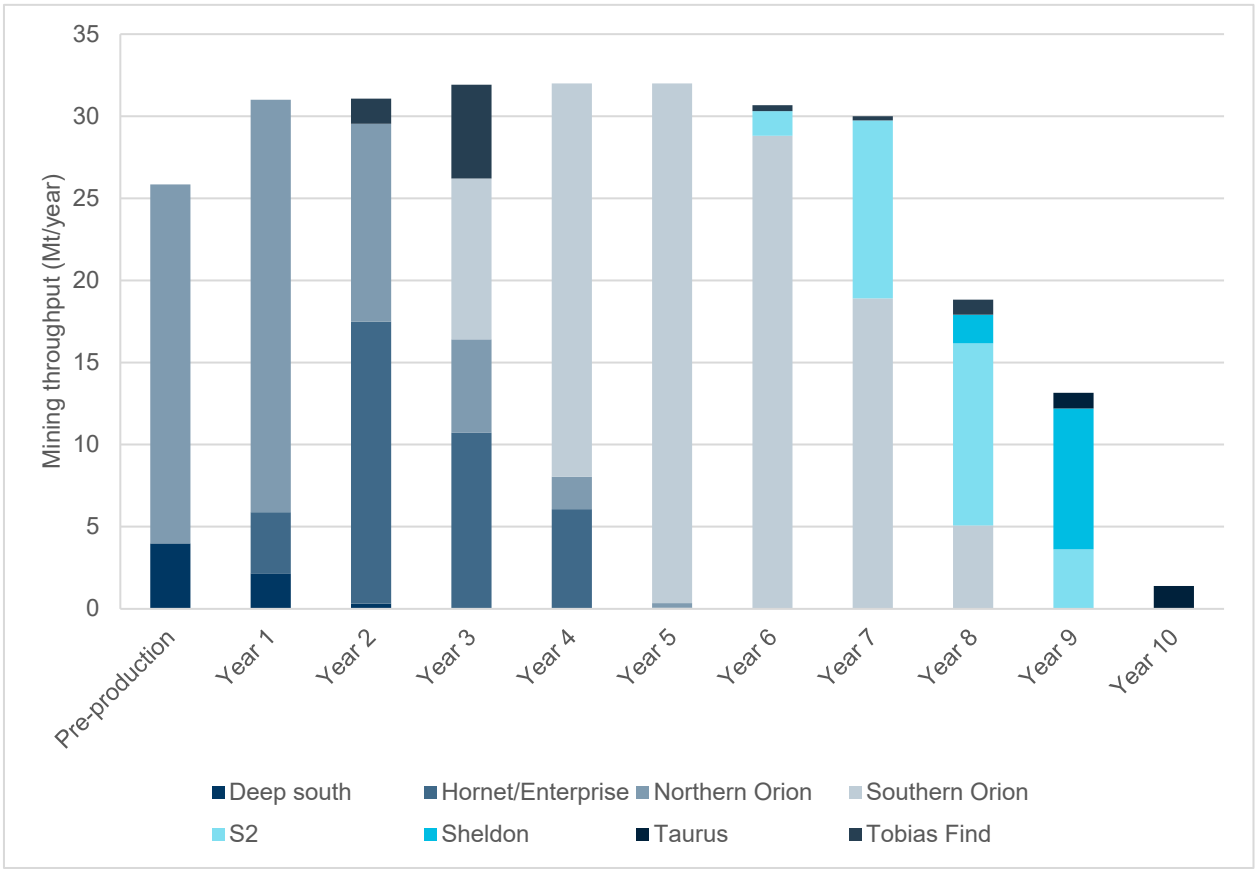


Figure 2.2 Mining schedule

3. Noise and vibration criteria

3.1 Operational noise

The Regulations specify maximum allowable external noise levels at noise sensitive, commercial and industrial premises. The Regulations (Regulation 7) define prescribed standards for noise emissions as follows:

7. (1) Noise emitted from any premises or public place when received at other premises –

> *1. Must not cause or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind*
>
> *2. Must be free of –*
>
> > *(i) Tonality (e.g. whining or droning)*
> >
> > *(ii) Impulsiveness (e.g. sirens)*
> >
> > *(iii) Modulation (e.g. banging or thumping)*

Furthermore, a *…noise emission is taken to significantly contribute to a level of noise if the noise emission exceeds a value which is 5 dB below the assigned level…*

The assigned levels (Regulation 8) are shown in Table 3.1.

Table 3.1 Assigned noise levels, dBA

Type of premise receiving noise	Time of day	Assigned level (dBA)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area[2]	7.00 am to 7.00 pm Monday to Saturday (Day)	45 + IF	55 + IF	65 + IF
	9.00 am to 7.00 pm Sunday and public holidays (Sunday)	40 + IF	50 + IF	65 + IF
	7.00 pm to 10.00 pm all days (Evening)	40 + IF	50 + IF	55 + IF
	10.00 pm on any day to 7.00 am Monday to Saturday and 9.00 am Sunday and public holidays (Night)	35 + IF	45 + IF	55 + IF
Noise sensitive premises[3]	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises other than those in the Kwinana Industrial Area	All hours	65	80	90

Notes:

1. IF = influencing factor
2. Noise sensitive areas that are classified as highly sensitive areas include a building, or a part of a building, on the premises that is used for a noise sensitive purpose and any other part of the premises within 15 m of that building or that part of the building.
3. Any other areas located further than 15 m from a building and directly associated with a noise sensitive use.

Tonality, impulsiveness and modulation are defined in Regulation 9. Noise is to be taken to be free of these characteristics if:

> *(a) The characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission.*
>
> *(b) The noise emission complies with the standard after the adjustments of* Table 3.2 *are made to the noise emission as measured at the point of reception.*

Table 3.2 Adjustment for intrusive or dominant noise characteristics (dB)[1]

Tonality[2]	Impulsiveness[3]	Modulation[3]
+5	+5	+5

Notes:

1. Adjustment applies where noise emission is not music
2. Adjustments are cumulative to a maximum of 15 dB
3. Any area other than highly sensitive area

Assigned noise levels in Table 3.1 have been set differently for noise sensitive, commercial and industrial and utility premises. For noise sensitive premises an influencing factor (IF) is incorporated into the assigned noise levels. IF depends on land use zonings within circles of 100 m and 450 m radius from the noise receiver, including:

– Proportion of industrial land use zonings
– Proportion of commercial zonings, and
– Presence of major (more than 15,000 vehicles per day) or secondary (6000 to 15,000 vehicles per day) roads.

For this assessment it has been assumed that IF will be zero for all noise sensitive premises surrounding the Project, as they are more than 450 m from any industrial or commercial premises or major road. For noise sensitive residences, the time of day also affects the assigned levels. The Regulations define three types of assigned noise levels:

– L_{A10} assigned noise level which is not to be exceeded for more than 10 percent of the time
– L_{A1} assigned noise level which is not to be exceeded for more than one percent of the time, and
– L_{Amax} assigned noise level means a noise level which is not to be exceeded at any time.

The L_{A10} noise limit is the most significant for this assessment as this is most representative of continuous noise emissions.

3.2 Construction noise

In Western Australia, construction activities should be performed in accordance with the Regulations. Under the Regulations, various construction noise requirements apply for daytime construction and out of hours construction. These times and construction noise requirements as outlined in the Regulations are summarised in Table 3.3.

Table 3.3 Construction noise criteria

Time period	Time	Construction noise requirements
Day time construction	7:00 am and 7:00 pm on any day which is not a Sunday or a public holiday	No specific construction noise criteria. However, construction noise should be kept as low as practicable.
Out of hours construction	7:00 pm and 7:00 am on any day which is not a Sunday or a public holiday	Construction noise should, as far as practicable, meet the assigned noise levels outlined in Regulation 8 in the Regulations. Alternatively, out of hours construction works may occur if the following are undertaken: – The contractor must advise all nearby occupants of the work to be done at least 24 hours before it commences. – The contractor must show that it was reasonably necessary for the work to be done out of hours. – The contractor must submit to the CEO a noise management plan at least seven days before the work starts, and the plan must be approved by the CEO. – The noise management plan must include details of: • Need for the work to be done out of hours • Types of activity which could be noisy • Predictions of noise levels • Control measures for noise and vibration

Time period	Time	Construction noise requirements
		• Monitoring of noise and vibration • Complaint response

Furthermore, the Regulations give guidance on peak sound levels dB $L_{Linear, peak}$ for blasting noise, whereby:

– Monday to Friday Day time level: 125 dB $L_{Linear, peak}$
– Sunday and public holiday Day time level: 120 dB $L_{Linear, peak}$

3.3 Blasting noise

The Regulations state that airblast levels resulting from blasting on any premises or public place received at any other premises must not exceed the following limits.

Table 3.4 Blasting noise guide values

Time period	Time	Construction noise requirements
Day time	7:00 am to 6:00 pm on any day which is not a Sunday or a public holiday	– 125 dB $L_{Linear, peak}$ for any blast, and – 120 dB $L_{Linear, peak}$ for nine in any ten consecutive blasts, regardless of the interval between blasts.
Sunday and public holidays	7:00 am to 6:00 pm on Sunday or a public holiday	– 120 dB $L_{Linear, peak}$ for any blast, and – 115 dB $L_{Linear, peak}$ for nine in any ten consecutive blasts, regardless of the interval between blasts.
Out of hours	6:00 pm to 7:00 am on any day which is not a Sunday or a public holiday	– 90 dB $L_{Linear, peak}$ at any other premises, and – The only exception is that explosives which have previously been placed and primed may be fired if necessary to meet a safety requirement of the Department of Minerals and Energy (DME), in which case the levels must meet those given above for daytime and weekend blasting, for the time when the blast was scheduled to be fired.

3.4 Blasting vibration

For blasting vibration, the following limits minimise risk to any premises nearby.

Table 3.5 Blasting vibration guide values

Time period	Time	Blasting requirements
Day time	7:00 am to 6:00 pm on any day which is not a Sunday or a public holiday	– No vibration level resulting from blasting on any premises or public place, when received at any other premises, may exceed a peak particle velocity of 10 mm/s. – The vibration levels for 9 in any 10 consecutive blasts (regardless of the interval between blasts) on any premises or public place, when received at any other premises, must not exceed 5.0 mm/s.
Out of hours	6:00 pm and 7:00 am on any day which is not a Sunday or a public holiday	– No vibration level resulting from blasting on any premises or public place, when received at any other premises, may exceed a peak particle velocity of 1.0 mm/s. – The vibration levels for 9 in any 10 consecutive blasts (regardless of the interval between blasts) on any premises or public place, when received at any other premises, must not exceed 0.5 mm/s.

4. Existing environment

This section provides a summary of the existing environment in terms a site description, land use and sensitive receptors.

4.1 Site description and surrounding land use

The Project site is situated within the mid-west region of Western Australia. The site is situated approximately 70 km southeast of former gold rush settlement Paynes Find, and approximately 70 km northwest of wheatbelt town Wubin. The land around the site varies between 300 m and 400 m above mean sea level.

4.2 Existing noise environment

There is currently no onsite noise monitoring data to analyse the existing ambient noise at the Project site. Therefore, a quantitative description of the site is not possible.

Due to the relatively open terrain and low density of vegetation, it is expected that conditions are favourable for airborne noise propagation. This is because there is an absence of shielding infrastructure as well as a low amount of ground absorption.

4.3 Sensitive receptors

4.3.1 Human health

DWER defines sensitive receptors as places people live or regularly spend time (DWER, 2021).The locations identified were a prospecting campground, the Mummaloo mine site, Mummaloo accommodation camp and the Mt Gibson accommodation camp. The location of the Project site is considered regional, as it is not located within close proximity to a city or town. The closest towns are Paynes Find and Wubin, located approximately 70 km northeast and southwest respectively.

4.3.2 Ecosystem health

The impact of noise on flora is not well studied and is not known to be of major impact. Hence the noise assessment aims to only adopt the study of noise impact from the Project on fauna in the area.

The local fauna dataset included active and inactive mounds for the Leipoa ocellata (Malleefowl). Some sightings were located over the planned mining pits and infrastructure. These were not considered sensitive receptors as the birds will be have moved from the area before mining activities occur. Only active mounds outside the Project activities were considered as sensitive receptors in this assessment.

A sighting of Falco peregrinus (peregrine falcon) was recorded on the fauna survey. The peregrine falcon is found in a wide range of habitats and is listed as a specially protected fauna in Western Australia (DPAW, 2019). As the peregrine falcon can have a home range of over 30 km (Jenkins, 1998) it was not considered a sensitive receptor.

Idiosoma kopejtkaorum is a WA listed endangered species of shield-backed trapdoor spiders found close to the Project site. The spider is found around Lake Goorly and Lake Moore catchments and the distribution appears to be strongly correlated with annual rainfall between 250 and 300 mm, in areas with red clay soils (Rix, 2018). The spiders rely on leaf litter, so it is unlikely they will be found in areas cleared of vegetation where mining activities will occur. Limited research on the spiders has identified changes in soil moisture content as a key stressor (Main, 2010). As vibration is a major impact on ground dwelling creatures, such as these spiders, the surveyed areas where burrows were sighted have been considered sensitive receptors.

Nyctophilus major tor (central long-eared bat) is currently listed as a Priority 3 species in WA (DPAW, 2019). As the bats roost in tree hollows and amongst foliage (Andrew, 2015), the locations of bat sightings were not considered as specific sensitive receptors for this assessment.

Egernia stokesii badia (Western spiny-tailed skink) were not sighted during the surveys but is considered likely to live in the area. As there were no sighting locations they could not be included as sensitive receptors.

Table 4.1 Local fauna species as provided by Tetris Environmental (received 7/6/2023).

Species name	Conservation status
Leipoa ocellata	Vulnerable (State and Commonwealth listed)
Falco peregrinus	Other specifically protected fauna (State listed)
Idiosoma kopejtkaorum	Endangered species (State listed)
Nyctophilus major tor	Priority three (State listed)
Egernia stokesii badia	Vulnerable species (State listed) Endangered (Commonwealth listed)

4.3.3 Adopted sensitive receptors

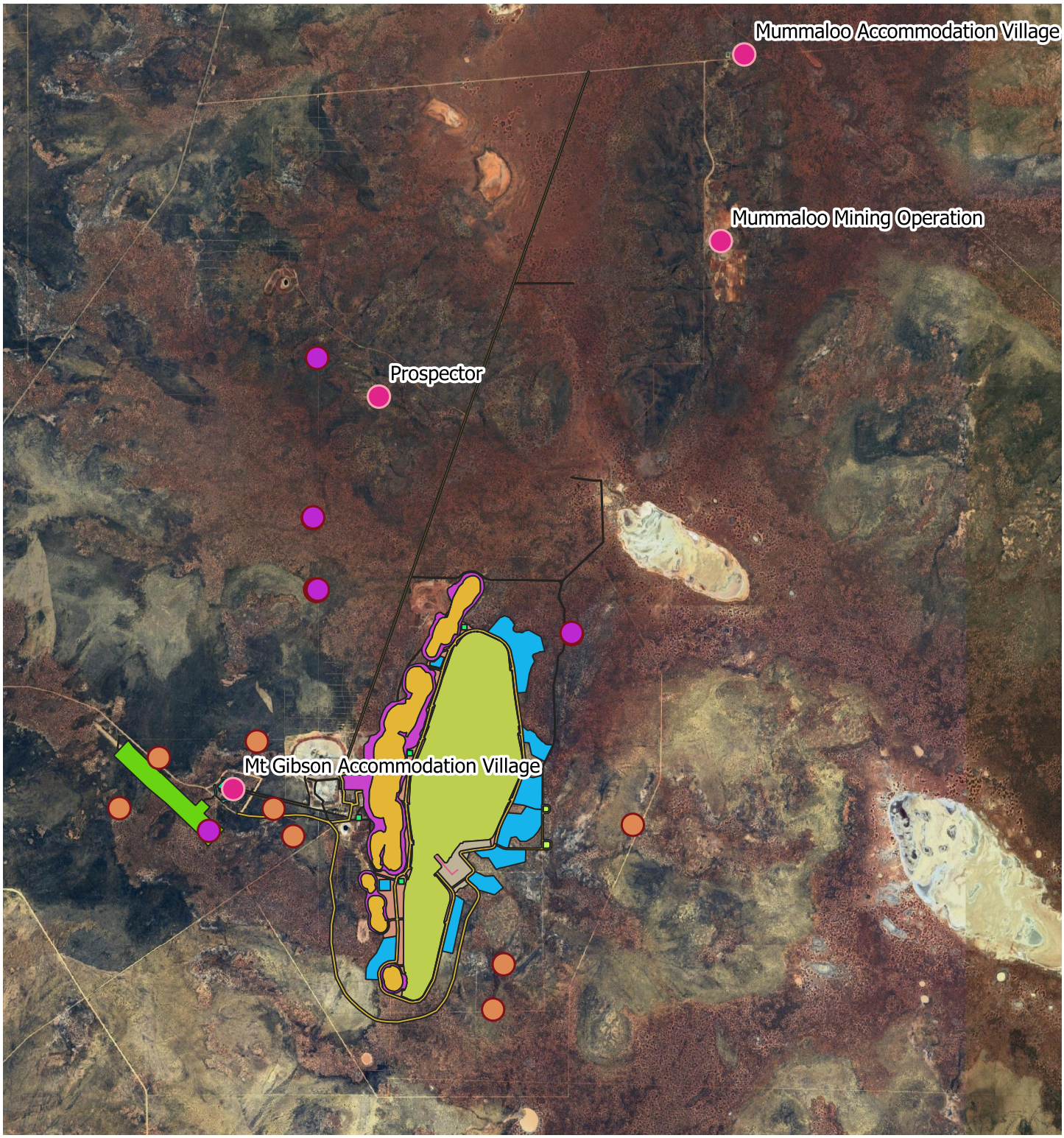
Sensitive receptors in proximity to the Project site is where people regularly spend time, Malleefowl mounds are active and Trapdoor spiders have been sighted.

Table 4.2 Sensitive receptors

ID	Category	Detail	Easting	Northing	Distance from Project boundary (km)	Assigned night time L_{A10} noise level , dBA
R01	Human	Mt Gibson accommodation village	513417	6708687	2.42 W	35
R02	Human	Prospector	516016	6715686	3.74 N	35
R03	Human	Mummaloo mining operation	522115	6718459	8.04 NE	35
R04	Human	Mummaloo accommodation village	522532	6721786	10.84 NE	35
R05	Fauna	Active mound - *Leipoa ocellata*	514489	6707849	0.87 W	-
R06	Fauna	Active mound - *Leipoa ocellata*	514138	6708335	1.22 W	-
R07	Fauna	Active mound - *Leipoa ocellata*	513839	6709536	1.67 W	-
R08	Fauna	Active mound - *Leipoa ocellata*	512091	6709246	3.34 W	-
R09	Fauna	Active mound - *Leipoa ocellata*	511387	6708348	3.97 W	-
R10	Fauna	Active mound - *Leipoa ocellata*	518053	6704757	1.10 SE	-
R11	Fauna	Active mound - *Leipoa ocellata*	518242	6705563	0.79 SE	-
R12	Fauna	Active mound - *Leipoa ocellata*	520545	6708050	2.00 E	-
R13	Fauna	Idiosoma kopejtkaorum	519459	6711447	1.07 NE	-
R14	Fauna	Idiosoma kopejtkaorum	519453	6711471	1.07 NE	-
R15	Fauna	Idiosoma kopejtkaorum	514875	6712245	2.18 NW	-
R16	Fauna	Idiosoma kopejtkaorum	514891	6712221	2.18 NW	-
R17	Fauna	Idiosoma kopejtkaorum	514922	6712224	2.18 NW	-
R18	Fauna	Idiosoma kopejtkaorum	514924	6712242	2.18 NW	-
R19	Fauna	Idiosoma kopejtkaorum	514913	6716375	4.45 NW	-
R20	Fauna	Idiosoma kopejtkaorum	514833	6713513	2.85 NW	-
R21	Fauna	Idiosoma kopejtkaorum	514843	6713531	2.85 NW	-
R22	Fauna	Idiosoma kopejtkaorum	512983	6707941	2.82 W	-

It is worth noting that the Mt Gibson accommodation village, whilst not classified as a sensitive receptor from a regulatory perspective, will eventually house and accommodate employees of the mine site and can be impacted from a health and safety perspective. Therefore, it will be assessed as a sensitive receptor with the same noise criteria.

The Malleefowl (*Leipoa ocellata*) and the Lake Goorly Shield-Backed trapdoor spider (*Idiosoma kopejtkaorum*) will be qualitatively assessed in terms of impact due to noise and vibration. The recorded locations of these fauna along with human sensitive receptors are presented in Figure 4-1.



Legend

- Plant area
- Mining area
- Roads
- IWL Footprint
- Airstrip
- Magazine
- Misc Mining
- Spare TSS
- TK Nest
- TSS
- Village
- WWTP
- Active mounds - Leipoa ocellata
- Idiosoma kopejtkaorum
- Sensitive receptors - human

Paper Size ISO A4

0 0.5 1 1.5 2 km

Map Projection: Transverse Mercator
Horizontal Datum: GDA94
Grid: GDA94 / MGA zone 50

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Mt Gibson Acoustic Assessment

Sensitive receptors

Project No. **12606145**
Revision No. **2**
Date. **9/08/2023**

FIGURE 4.1

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Print Date: 26/07/2023

Data Source:Google Earth Imagery 2023.
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5. Noise and vibration assessment

5.1 Noise and vibration sources

5.1.1 Operational sources

The noise sources for the operational period of the Project come from two main areas as follows:

1. Fixed noise and vibration from the processing plant
2. Mining noise
    a. Airborne noise and ground-borne vibration from blasting
    b. Noise from mobile equipment operating within the mine pits
    c. Haul noise along the roads from the mine pits to the IWL
    d. Noise from mobile equipment operating within the IWL

5.1.2 Construction sources

The noise sources for the construction period of the Project come from two main areas as follows:

1. Mobile equipment for construction of processing plant
2. Mobile equipment for pre-production clearing and constructing IWL:
    a. Airborne noise and ground-borne vibration from blasting
    b. Noise and vibration from mobile equipment within the mine pits
    c. Haul noise and vibration along the roads from the mine pits to the IWL

5.1.3 Noise and vibration inventory

The noise source inventory was supplied by Tetris Environmental (received 23/05/23). Noise sources from the supplied list that were used in the model are presented in Table 5.1. Only major noise sources have been considered, as minor sources are not expected to have a significant contribution to overall noise emissions. Sound power levels were determined from one of the following, with missing data points in the spectrum amended as necessary:

– Sound power levels from UK Department for Environment, Food and Rural Affairs (DEFRA) database
– Sound power levels from Engineering Noise Control 4th Edition (Hanson, 2009)
– Sound power levels from on-site measurements and databases by other acoustic consultants

An over-estimation of noise level spectra was made when equipment data was not sourced exactly for the client's specification, as indicated in red.

Table 5.1 Noise sources inventory

Number	Equipment ID	Equipment name	Description	SWL ID	Height (m)	Quantity
1	CP	Concrete truck	Typical concrete truck	VEH3	2	3
2	CP	Grader	Caterpillar 14M	GRA1	3	1
3	CP	Handheld power tools	Typical handheld power tools	POW0	1.5	1
4	CP	Large crane	Typical large crane 500t (specified 200t)	CRA0	1.5	1
5	CP	Small crane	25ft Franna MAC 25-3	CRA1	3	3
6	CP	Roller	16t Bomag BE216	ROL0	3	1
7	CP	Scissor lift	Typical scissor lift	VEH4	1.5	2
8	CP	Service truck	Typical tipper truck	VEH1	1.5	1
9	CP	Telehandler	Typical telehandler	CRA0	3	1
10	CP	Skid steer loader	Typical skid steer loader	VEH4	1.5	4
11	CP	Excavator	30t Komatsu PC300	DOZ0	2	1
12	CP	Watercart	Typical watercart	WAT0	3	1
13	D&B	Drill rig	Atlas Copco T45	DRI0	4	8
14	D&B	MMU	Volvo FM9	VEH0	1.5	1
15	L&H	Haul truck	90t Komatsu HD785-7	DUM0	3	6
16	L&H	Excavator	100t Komatsu PC1250-8	EXC0	2	1
17	L&H	Haul truck	193t CAT789 (specified 180t Hitachi EH3500AC-3)	DUM2	3	20
18	L&H	Excavator	200t Liebherr R9200	EXC1	4	3
19	PP	Agitator	Typical agitator	AGI0	2	9
20	PP	Ball mill	Typical 14 MW	MIL0	3	1
21	PP	Carbon safety screen	Derrick 1.4x4.7m	SCR0	3	1
22	PP	Conveyor	Typical conveyor per 100m length (overland)	CON0	2	6
23	PP	Conveyor drive	Typical conveyor driver	CON1	2	6
24	PP	Natural gas generator	Typical 9 MW generator	GEN0	3	9
25	PP	Primary crusher and vibrating grizzly	Metso C160 with 1.4x4.8m Grizzly Scalper	CRU1	4	1
26	PP	Pump	Typical pump (discharge)	PMP0	1.5	2

Number	Equipment ID	Equipment name	Description	SWL ID	Height (m)	Quantity
27	PP	Rotary kiln (Carbon regeneration)	Typical rotary kiln	ROT0	2	1
28	PP	Scalping screen	Multislope/Bannana ~4m x 8m	SCR0	3	1
29	PP	Secondary crusher	Sandvik 860i	CRU0	3	1
30	PP	Sizing screen	Multislope/Bannana ~4m x 8m	SCR0	3	1
31	PP	Tertiary crusher	Sandvik 865i	CRU0	2	2
32	PP	Trash screens	Derrick 1.4x4.7m	SCR0	3	2
33	ROM	Wheeled loader	Komatsu WA900	LOD2	3	1
34	Support	Bus 2WD	2WD Toyota Coaster	VEH2	1.5	1
35	Support	Bus 4WD	4WD Isuzu Abbel	VEH2	1.5	2
36	Support	Crane	25ft Franna MAC 25-3	CRA0	2	1
37	Support	Dozer	Caterpillar D10T	DOZ0	2	3
38	Support	EWP (elevated work platform)	40ft JLG 600AJ	VEH4	1.5	1
39	Support	Grader	Caterpillar 16M	GRA0	3.5	2
40	Support	Loader	IT/Stemming Caterpillar IT930	LOD0	3	2
41	Support	Loader	Tyre Handler Caterpillar 988K	LOD1	3	1
42	Support	Rock breaker	30t Caterpillar 336DL	BRE0	3	1
43	Support	Roller	16t Bomag BE216	ROL0	3	1
44	Support	Service truck	Scania G410	VEH1	1.5	2
45	Support	Truck	2WD Isuzu NPS300	VEH2	1.5	2
46	Support	Watercart	85kL Komatsu HD785-7	WAT0	3	3
47	TSF	Dozer	Caterpillar D9T	DOZ1	2	1
48	TSF	Haul truck	40t Bell B40D	DUM1	3	4
49	TSF	Excavator	30t Komatsu PC300	CRA0	3	1
50	TSF	Grader	Caterpillar 14M	GRA1	3.5	1
51	TSF	Loader	Komatsu WA600	LOD1	3	1
52	TSF	Roller	16t Bomag BE216	ROL0	3	1
53	TSF	Watercart	35kL Bell B40D	WAT0	3	1

Note:

1. PP = Processing Plant equipment
2. D&B = Drill and Blast equipment
3. L&H = Load and Haul equipment
4. Support = Support vehicles and equipment
5. TSF = Tailing storage facilities equipment
6. ROM = Run-off-mine equipment
7. CP = Construction of processing plant equipment

Table 5.2 Sound power levels

SWL ID	Sound power level, Hz (dB)									Overall L_{Aeq} (dB)	Reference
	31.5	63	125	250	500	1000	2000	4000	8000		
AGI0	87	88	89	91	91	94	91	87	81	92	Engineering Noise Control 4th Edition (1500 RPM small electric turbine)
BRE0	110	109	108	108	111	110	107	104	101	118	DEFRA database
CON0	101	103	105	100	101	97	93	85	79	110	Global Acoustics in-situ measurements
CON1	100	100	100	98	101	99	95	90	84	110	Global Acoustics in-situ measurements
CRA0	102	101	99	96	98	94	91	82	77	107	DEFRA database (crawler crane)
CRA1	109	108	107	101	102	101	101	92	83	112	DEFRA database (500t crane)
CRU0	107	111	113	112	116	115	111	103	100	121	Lloyd George Acoustics (LGA) in-situ measurements
CRU1	115	117	121	118	120	115	110	106	101	126	LGA in-situ measurements
DOZ0	103	101	107	104	106	102	98	92	90	112	LGA in-situ measurements
DOZ1	111	110	109	107	106	104	104	102	101	117	Environmental Resources Management Australia Pty Ltd database
DRI0	105	107	116	114	108	107	107	99	97	120	LGA in-situ measurements (drill rig typical)
DUM0	89	86	89	88	88	86	83	76	70	96	DEFRA database
DUM1	103	100	97	88	84	82	80	77	68	106	DEFRA database
DUM2	115	123	123	121	115	113	112	108	104	128	LGA in-situ measurements (CAT 789D)
EXC0	92	98	109	105	109	100	93	89	87	113	LGA In-situ measurements (Komatsu PC1250)
EXC1	112	113	119	116	111	111	108	104	100	123	LGA in-situ measurements (Komatsu PC1800-6)
GEN0	116	118	125	120	107	101	96	94	89	127	Engineering Noise Control 4th Edition
GRA0	113	111	109	107	107	106	102	93	87	118	Coalpac Pty Ltd database
GRA1	105	115	110	107	109	108	106	101	97	118	LGA in-situ measurements
LOD0	104	102	94	92	92	91	88	87	78	107	DEFRA database
LOD1	96	97	105	108	103	104	99	93	89	112	Spectrum Acoustics database (CAT 988H)
LOD2	111	113	115	106	100	110	106	100	93	119	LGA In-situ measurements (CAT990)
MIL0	62	64	74	86	97	101	101	96	94	106	VDM consultant on site measurements
PMP0	56	57	58	60	60	63	60	56	50	60	Engineering Noise Control 4th Edition (450 RPM, 0.2 kW small electric motor)

SWL ID	Sound power level, Hz (dB)									Overall L_{Aeq} (dB)	Reference
	31.5	63	125	250	500	1000	2000	4000	8000		
POW0	80	76	74	80	85	97	95	100	96	104	Jacobs database
ROL0	86	90	99	105	110	112	111	104	95	117	VDM consulting database (dozer)
ROT0	93	96	99	99	99	99	99	99	99	100	Engineering Noise Control 4th Edition (800 kW, 3 RPM rotary kiln)
SCR0	110	101	101	93	93	93	93	88	86	111	LGA in-situ measurements
VEH0	52	54	58	62	65	68	66	61	56	72	VDM consulting database (accelerating truck)
VEH1	84	82	80	78	75	76	78	75	69	89	DEFRA database
VEH2	52	54	58	62	65	68	66	61	56	72	VDM consulting database (accelerating truck)
VEH3	114	111	102	94	97	98	106	88	83	113	DEFRA database
VEH4	102	100	97	94	92	88	87	86	84	106	Jacobs database
WAT0	106	111	120	119	110	108	105	102	96	123	Global Acoustics in-situ measurements

5.2 Construction noise and vibration assessment

5.2.1 Construction noise

The following relationship between distance and attenuation were considered as the basis for the construction noise assessment:

$$SPL = SWL - 20\log(d) + 10\log(Q) - 11$$

where: d = Distance between the source and receptor (m)

Q = Directivity index (2 for a flat surface)

SPL = Sound pressure level at the distance from the source (dBA)

SWL = Sound power level of the source (dBA)

Typical noise levels produced by construction equipment were sourced from Table 5.1.

Propagation calculations only take into account losses due to spherical spreading, with additional minor losses such as atmospheric absorption, directivity and ground absorption ignored. As a result, predicted received noise levels are conservative.

Noise produced at distances relevant to the Project by anticipated activities during the construction are shown in Table 5.3, with no noise barriers or acoustic shielding in place and with each item assumed to be operating at full power.

The magnitude of noise impact associated with construction will be dependent upon a number of factors:

– The intensity and location of construction activities.
– The type of equipment used.
– Existing local noise sources.
– Intervening terrain.
– The prevailing weather conditions.

Construction machinery will move about the site area, altering the directivity of the noise source with respect to individual receptors. During any given period of time, the machinery items to be used in the area will operate at maximum sound power levels for only brief stages. At other times the machinery may produce lower sound levels while carrying out activities not requiring full power. It is unlikely that all construction equipment would be operating at their maximum sound power levels at any one time. All sources present in Table 5.3 is equipment that will be present at both construction and operational stages of the Project and are the noisiest sources from the complete noise inventory.

Table 5.3 Noisiest sources for the Project

Equipment	L_{Aeq} (dBA)	Estimated SPL (dBA) - at distance (m)							
		10	100	1000	2000	4000	6000	8000	10000
Concrete truck	100	80	60	40	34	28	25	22	20
Large crane	98	78	58	38	32	26	23	20	18
Scissor lift	87	67	47	27	21	15	12	9	7
Small crane	91	71	51	31	25	19	16	13	11
Telehandler	87	67	47	27	21	15	12	9	7
Skid steer loader	99	79	59	39	33	27	24	21	19
Drill rig	105	85	65	45	39	33	30	27	25
Haul truck	112	92	72	52	45	39	36	33	32
Excavator	108	88	68	48	42	36	32	30	28

Equipment	L_{Aeq} (dBA)	Estimated SPL (dBA) - at distance (m)							
		10	100	1000	2000	4000	6000	8000	10000
Agitator	90	70	50	30	24	18	14	12	10
Wheeled loader	105	85	65	45	39	33	29	27	25
Crane	91	71	51	31	25	19	16	13	11
EWP	87	67	47	27	21	15	12	9	7
Loader	100	80	60	40	34	28	24	22	20
Rock breaker	107	87	67	47	40	34	31	28	27
Roller	108	88	68	48	42	36	33	30	28
Watercart	107	87	67	47	41	35	31	29	27
Dozer	103	83	63	43	37	31	27	25	23
Grader	105	85	65	45	39	33	29	27	25

The closest sensitive receptors to any potential noise source during construction of the Project and associated infrastructure is R01, located approximately 2420 m from the mine footprint. From Table 5.3, noise levels exceeding the daytime L_{A1} assigned level of 55 dBA are not predicted at such distances.

5.2.2 Construction vibration

Vibration impacts discussed essentially focus on potential structural damage to properties in close proximity of the site area. It is possible that construction vibration will be perceived at times by local sensitive receptors. However, the level of annoyance will depend on individuals.

There is a large separation distance of 2420 m between the potentially most impacted receptor (R01) and site construction activities.

The nature and levels of vibration emitted by the site will vary with the activities being carried out on site. Table 5.4 outlines typical vibration levels for different activities that may be generated on site, sourced from the NSW Roads and Traffic Authority (RTA) *Environmental Noise Management Manual* (RTA, 2001).

Table 5.4 Typical vibration levels for construction equipment

Plant item	Peak particle velocity at 10 m (mm/s)
Dozer	2.5-4.0
Front end loader	6.0-8.0
Roller (16t)	7.0-8.0

Construction activity may result in varying degrees of ground vibration depending on the equipment used and methods employed. Operation of construction equipment causes ground vibration which spread through the ground and diminish in strength with distance. Buildings founded on the soil in the vicinity of the construction site respond to these vibrations with varying results, ranging from no perceptible effects at the lowest levels, low rumbling and perceptible vibrations at moderate levels and slight building damage at the highest levels.

From Table 5.3, equipment proposed for site preparation and construction of the site will generate low levels of vibration which are unlikely to result in any vibration risks to structures. The lower limit for vibrations resulting in building damage of 5 mm/s is normally not exceeded by general construction activities at distances greater than 20 m from the nearest sensitive receptor.

Given the distances involved between site works and the nearest receptors, vibrations affecting human comfort and building integrity are not expected to be an issue.

5.3 Blasting noise and vibration assessment

5.3.1 Blasting noise

An assessment of blasting noise levels at sensitive receptors has been made for Project blasting activities. Blasting will occur regularly as part of mining operations.

A conservative maximum charge mass of 750 kg per detonation hole has been assumed. It is assumed that two holes will be detonated at once from the total 350-400 hole pattern, using 8 millisecond delay. Due to the short pulse length of hole detonation, compared with the time between pulses, the maximum instantaneous charge expected to detonate per blast is approximately 1500 kg. Noise levels from blasting using unconfined or confined charges are estimated using the following equations. The formulas return a conservative estimate of blast noise levels and would tend to overestimate the actual impact from blasting.

Unconfined charge

$$Airblast\ Level\ dB\ L_{Linear\ Peak} = 20log\left(\frac{P_A}{P_O}\right)$$

Confined charge

$$Airblast\ Level\ dB\ L_{Linear\ Peak} = 20log\left(\frac{P_B}{P_O}\right)$$

where:

$$P_A = 185\left(\frac{R}{\sqrt[3]{Q}}\right)^{-1.2}$$

$$P_B = 3.3\left(\frac{R}{\sqrt[3]{Q}}\right)^{-1.2}$$

$P_O = 2\ x\ 10^{-8}$
$R = Distance\ from\ blast\ (m)$
$Q = Maximum\ charge\ mass\ (kg)$

In order to calculate site specific values for the two constants in the above equations, the airblast levels should be recorded at various distances during the first series of blasts to validate the predictions.

Unconfined blasting is not proposed except for unusual situations such as large rock removal from machinery or access paths after blasting. However, the blasts will be restricted to small (<10 kg) quantities of explosive. Based on the distance between the closest point of the mine pit and noise sensitive receptors and assuming a maximum charge mass of 1500 kg for two detonation holes, estimated confined air blast levels are provided in Table 5.5.

Table 5.5 Estimated blasting noise levels assuming confined blasts, dB $L_{inear,\ peak}$

Receptor name	Distance from pits (m)	Estimated level $L_{Linear\ Peak}$ (dBA)
R01	2420	109
R02	3740	104
R03	8040	96
R04	10,400	93

From Table 5.5, it can be seen that estimated blasting noise levels are considerably below the Monday to Saturday day time level of 125 dB $L_{Linear,\ peak}$ and the Sunday and public holiday day time level of 120 dB $_{Linear,\ peak}$, as prescribed in the Regulations at all receptors.

5.3.2 Blasting vibration

In the absence of specific blast vibration measurements at this site, the ground vibration attenuation estimation formula derived from AS 2187.2-2006 provides vibration level predictions:

$$PPV = 1140\left(\frac{R}{\sqrt{Q}}\right)^{-1.6}$$

where: $PPV = Peak\ particle\ velocity$

$R = Distance\ from\ blast\ (m)$

$Q = Maximum\ charge\ mass\ (kg)$

For ground vibration, it is assumed that the blasting conditions are for 'fresh' rock formation, owing to the being the most predominate ore. Based on the distance between the closest point of the mine pit and noise sensitive receptors and assuming a maximum charge mass of 1500 kg for two detonation holes, estimated ground vibration levels from blasting are provided in Table 5.6. The resulting values at the sensitive receptors are well below criteria of 10 mm/s for daytime and marginally compliant for out of hours blasts.

Table 5.6 Estimated blasting ground vibration PPV

Receptor name	Distance from pits (m)	Estimated level (mm/s)
R01	2420	1.93
R02	3740	0.96
R03	8040	0.28
R04	10,400	0.19

Note: * indicates marginal compliance with criteria for less than 9 out of 10 blasting events out of hours

5.4 Operational noise assessment

5.4.1 Software package

CadnaA, by Datakustik, is a computer program for the calculation, assessment and prognosis of noise exposure. CadnaA calculates environmental noise propagation according to *ISO 9613-2 Attenuation of Sound During Propagation Outdoors Part 2: General Method of Calculation* (ISO Standards 1996). CadnaA considers local topography, weather conditions, reflection, ground absorption, relevant building structures, site sources and the location of the receptor areas to predicted received noise levels. The method specified in ISO 9613-2 consists specifically of octave-band algorithms (with nominal mid band frequencies from 31.5 Hz to 8 kHz) for calculating the attenuation of sound.

The algorithms used in this model account for the following physical features:

– Geometrical divergence
– Atmospheric absorption
– Ground effect
– Reflection from surfaces
– Screening by obstacles

5.4.2 Meteorological conditions

In assessing meteorological conditions, the CONCAWE method has been applied instead of ISO 9613-2 weather correction. Modelling results are based on available information provided and should only be used as a guide for comparative purposes. The noise model inputs and assumptions for the operational assessment of the Project are provided in Table 5.7.

Table 5.7 Noise modelling software parameters

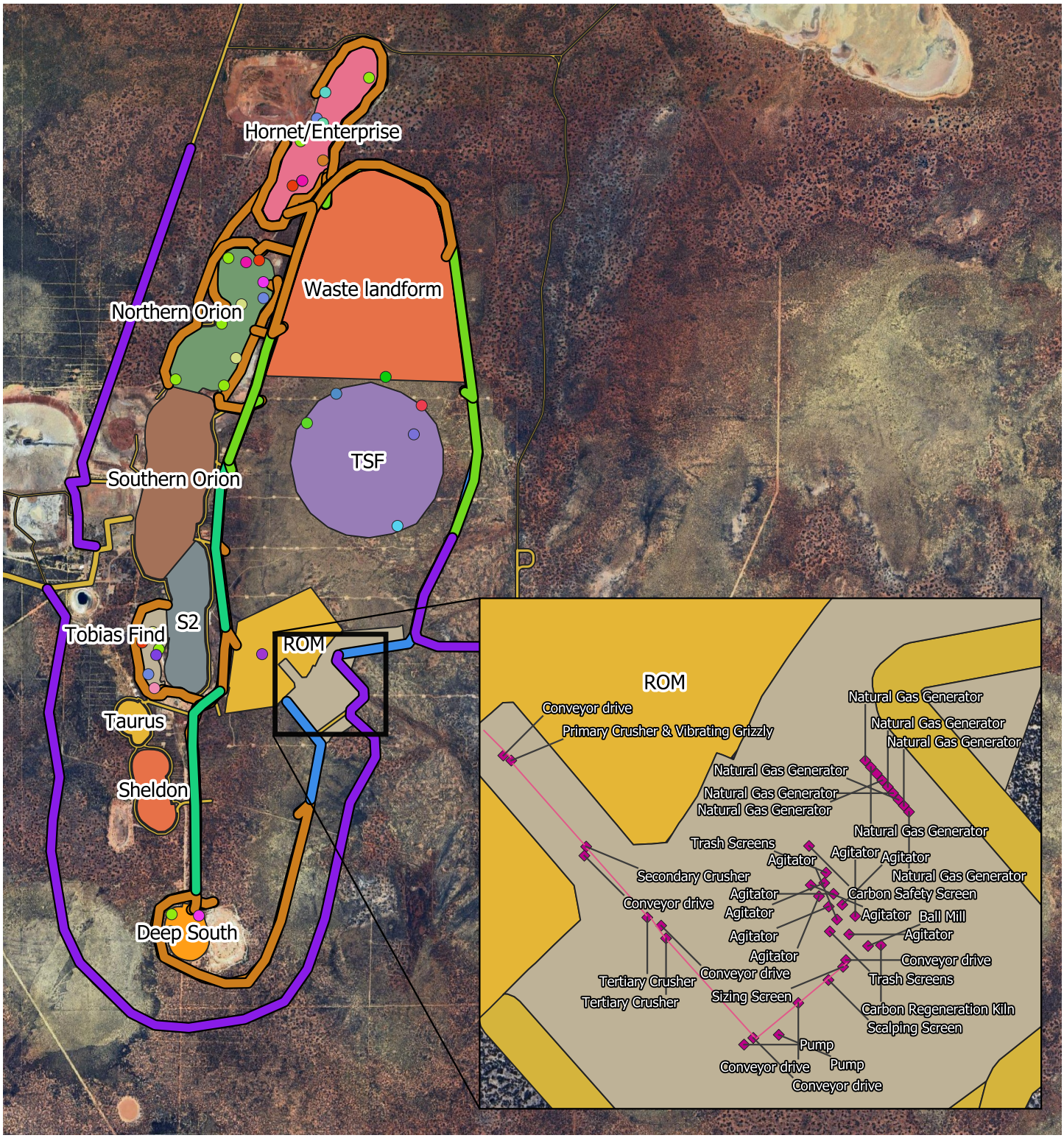
Variable	Parameter used
Prediction algorithm	CONCAWE prediction algorithm
Modelling period	Typical period of operation where all noise sources are running simultaneously at full power.
Ground absorption coefficient G=0 is hard, reflective ground G=1 is soft, porous ground	G = 0.5 (based on largely flat desert-like environment with low laying vegetation)
Receiver heights	1.5 m above ground.
Terrain	Three dimensional terrain has been used in the model with 10 m ground contours.
Shielding	Shielding from site structures, such as buildings and noise walls have not been considered in the model due to open nature of environment.
Order of reflection	0 – Reflections not considered due to open nature of environment near source and receivers.
Proposed layout	The noise model developed for this assessment was based on the layout drawings as provided by the client.

5.4.3 Modelling scenarios

Two operational years were chosen as worst case for the operational period based on shallowest pit depths (Year 1) and largest amount of mining operations closest to the sensitive receptors (Year 3). The noise source distribution for Year 1 and Year 3 are shown in Figure 5-1 and Figure 5-2 respectively.

Table 5.8 Operational noise modelling scenarios

Scenario	Pits mined
Year 1 – Y1	Hornet/Enterprise N Orion Tobias Find Deep South
Year 3 – Y3	Hornet/Enterprise N Orion S Orion



Legend

- Plant area
- Roads
- Processing plant
- Plant conveyors
- L&H - Dump Truck
- Support Bus
- Support Service Truck
- Support Truck
- TSF - Dump Truck
- D&B - Drill Rig
- D&B - MMU
- L&H - Excavator
- L&H - Excavator
- ROM - Wheel loader
- Support Crane
- Support Dozer
- Support EWP
- Support Grader
- Support Loader
- Support Rockbreaker
- Support Roller
- Support Watercart
- TSF - Watercart
- TSF - Dozer
- TSF - Excavator
- TSF - Grader
- TSF - Loader
- TSF - Roller

Paper Size ISO A4

0 0.5 1 1.5 2 km

Map Projection: Transverse Mercator
Horizontal Datum: GDA94
Grid: GDA94 / MGA zone 50

N

GHD

Tetris Environmental Pty Ltd

Mt Gibson Acoustic Assessment

Noise sources for Year 1 operational modelling scenario

Project No. **12606145**
Revision No. **2**
Date. **9/08/2023**

FIGURE 5.1

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Print Date: 07/08/2023

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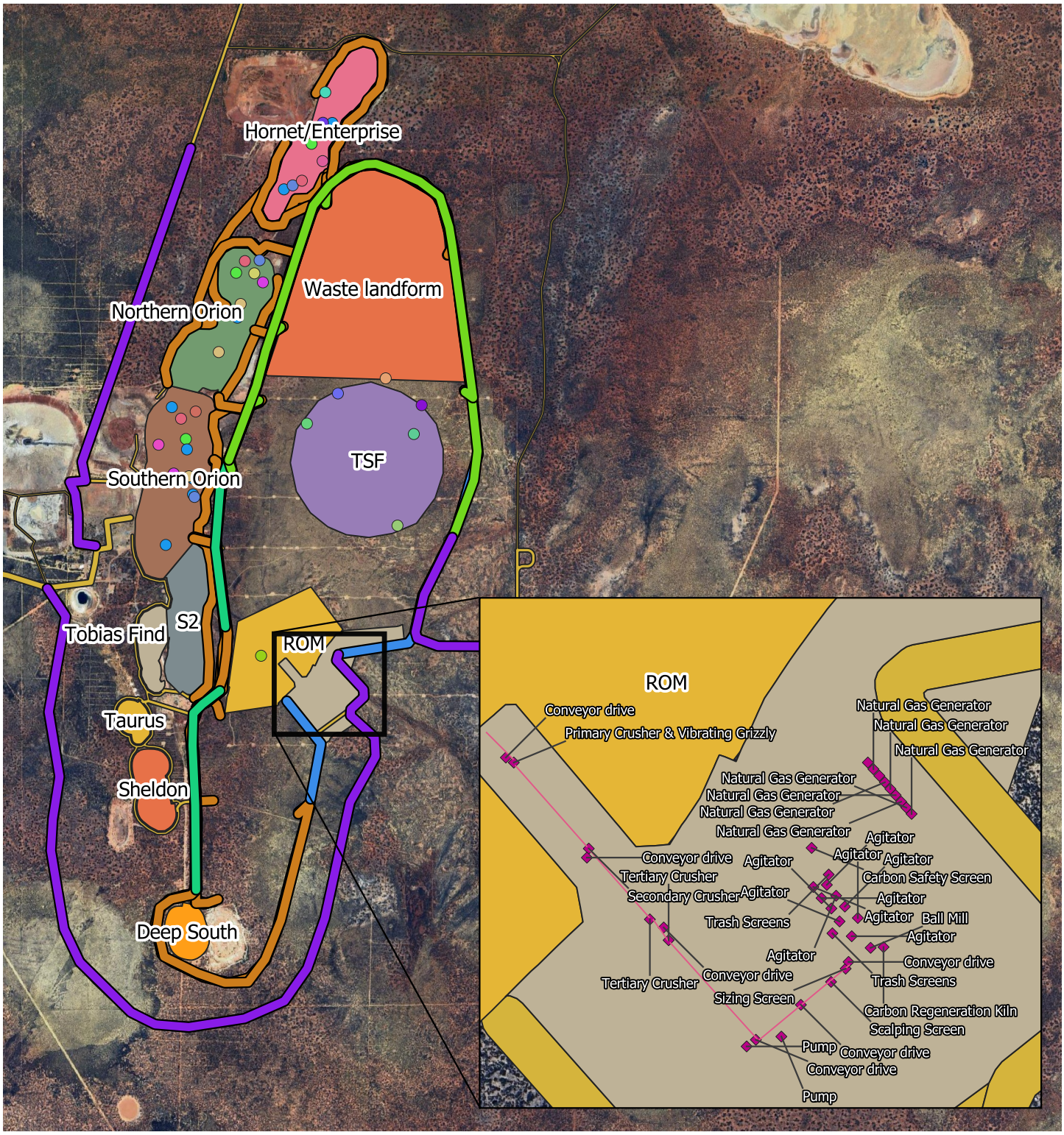

Legend

- Plant area
- Roads
- Processing plant
- Plant conveyors
- L&H - Dump Truck
- Support Bus
- Support Service Truck
- Support Truck
- TSF - Dump Truck
- D&B - Drill Rig
- D&B - MMU
- L&H - Excavator
- L&H - Excavator
- ROM - Wheel loader
- Support Crane
- Support Dozer
- Support EWP
- Support Grader
- Support Loader
- Support Rockbreaker
- Support Roller
- Support Watercart
- TSF - Watercart
- TSF - Dozer
- TSF - Excavator
- TSF - Grader
- TSF - Loader
- TSF - Roller

Paper Size ISO A4

0 0.5 1 1.5 2 km

Map Projection: Transverse Mercator
Horizontal Datum: GDA94
Grid: GDA94 / MGA zone 50

N

GHD

Tetris Environmental Pty Ltd

Mt Gibson Acoustic Assessment

Noise sources for Year 3 operational modelling scenario

Project No. **12606145**
Revision No. **2**
Date. **9/08/2023**

FIGURE 5.2

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Print Date: 07/08/2023

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Created By: afarhath

5.4.4 Geographical conditions

The modelling scenarios selected for this assessment require that the pit conditions are representative of the production year. The provided topographical shapefile data was modified to represent the amount of material moved at the beginning of the modelling year to account for noise mitigation off the pit walls.

This was achieved by first simplifying the shapefile to smooth out the contour lines. Following this, the full depth was adjusted by a percentage according to the yearly material movement data as stated in Table 5.9.

Table 5.9 Pit-depth percentage at the start of modelling year with per year mining volume

Mine pits (North to South)	Y1		Y3	
	Percentage of pit depth at start of year	Amount of mining for the year	Percentage of pit depth at start of year	Amount of mining for the year
Hornet/Enterprise	9%	High	84%	Medium
N Orion	70%	High	96%	Low
S Orion	0%	None	8%	Very High
S2	0%	None	0%	None
Tobias Find	0%	Low	17%	None
Sheldon	0%	None	0%	None
Taurus	0%	None	0%	None
Deep South	95%	Low	100%	None

Notes:

– Low: 0 – 5 Mt mined
– Medium: 6 – 15 Mt mined
– High: 16 – 22 Mt mined
– Very High: 23 – 30 Mt mined

Since the strike of the mining pits are spread over a large distance geographically (~8 km), the sensitive receptors that are primarily located at the northern end would be most impacted by the mining work. This is captured by both scenarios having majority of the mine operations at the northern pits.

Y1 represents shallowest mining depth in proximity to the sensitive receptors and Y3 represents the highest mining activity in terms of mining volume in the pits closest to the sensitive receptors.

Generally, the noise source height has been positioned between 2 and 4 metres above ground level depending on the equipment type as shown in Table 5.1.

The predicted noise level at receiver locations is at a height of 1.5 metres above the natural ground level and is assumed to be on a flat open natural terrain.

5.4.5 Noise modelling results

Noise modelling was conducted under worst case meteorological conditions assuming mining operations and processing plant were all at full production rates. Predicted night time noise levels are presented, demonstrating predicted compliance at all sensitive receptors.

Night time L_{A10} noise level contour plots under worst case meteorological conditions (wind blowing towards receptors) are shown in Figure 5-3 and Figure 5-4.

Receptor	L_{A10} night time noise level		Assigned L_{A10} night time level	Compliance Y1 / Y3
	Y1	Y3		
R01	41	41	35	No[1] / No[1]
R02	34	31	35	Yes / Yes
R03	25	23	35	Yes / Yes
R04	12	9	35	Yes / Yes

Notes:

1. Regulatory compliance is not required under the approval process.

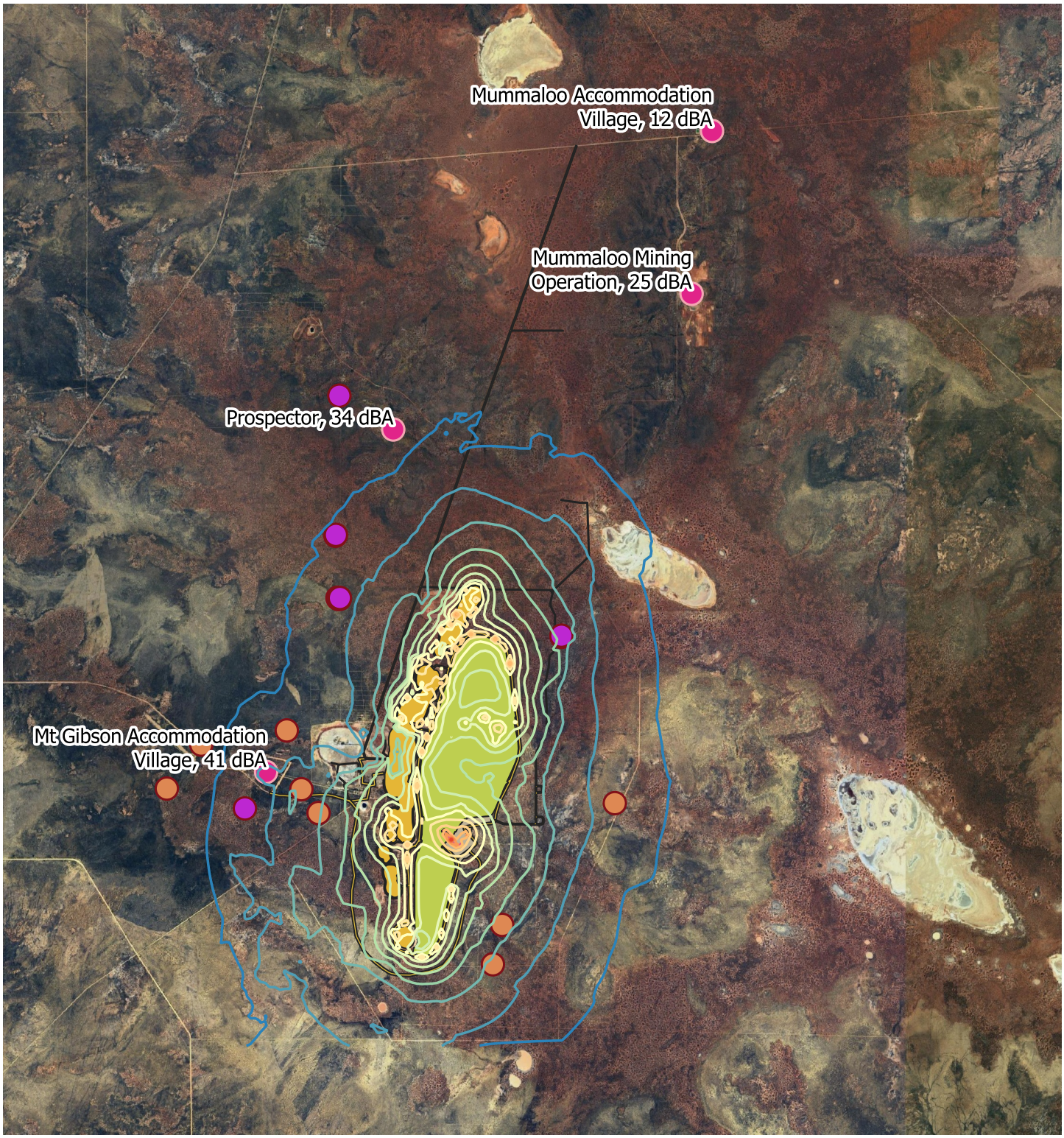
Although the noise level at R01 does not meet regulatory compliance as outlined in Section 4.3.3, there is conformance to the AS 2107-2016 standard of indoor based design sound level for sleeping areas in mining camps. According to Regulations (Regulation 19) the difference in sound from an outdoor space to an indoor space is a L_{A10} reduction of 15 dBA:

(4) Where a measurement is made inside a building —

(a) external windows and doors must be shut and the measurement must be adjusted by adding 15 dB;

Hence the noise level present inside the sleeping area is predicted to be 26 dBA for both Y1 and Y3.

This is below the maximum recommended limit of 30 dBA as presented in the AS 2107-2016 standard.



Legend

- Sensitive receptors - human
- Plant area
- Mining area
- Roads
- IWL Footprint
- Active mounds - Leipoa ocellata
- Idiosoma kopejtkaorum

Sound pressure level LA10, dBA

- 30
- 35
- 40
- 45
- 50
- 55
- 60
- 65
- 70
- 75
- 80
- 85
- 90
- 95

Paper Size ISO A4

0 0.5 1 1.5 2 km

Map Projection: Transverse Mercator
Horizontal Datum: GDA94
Grid: GDA94 / MGA zone 50

N

Tetris Environmental Pty Ltd

Mt Gibson Acoustic Assessment

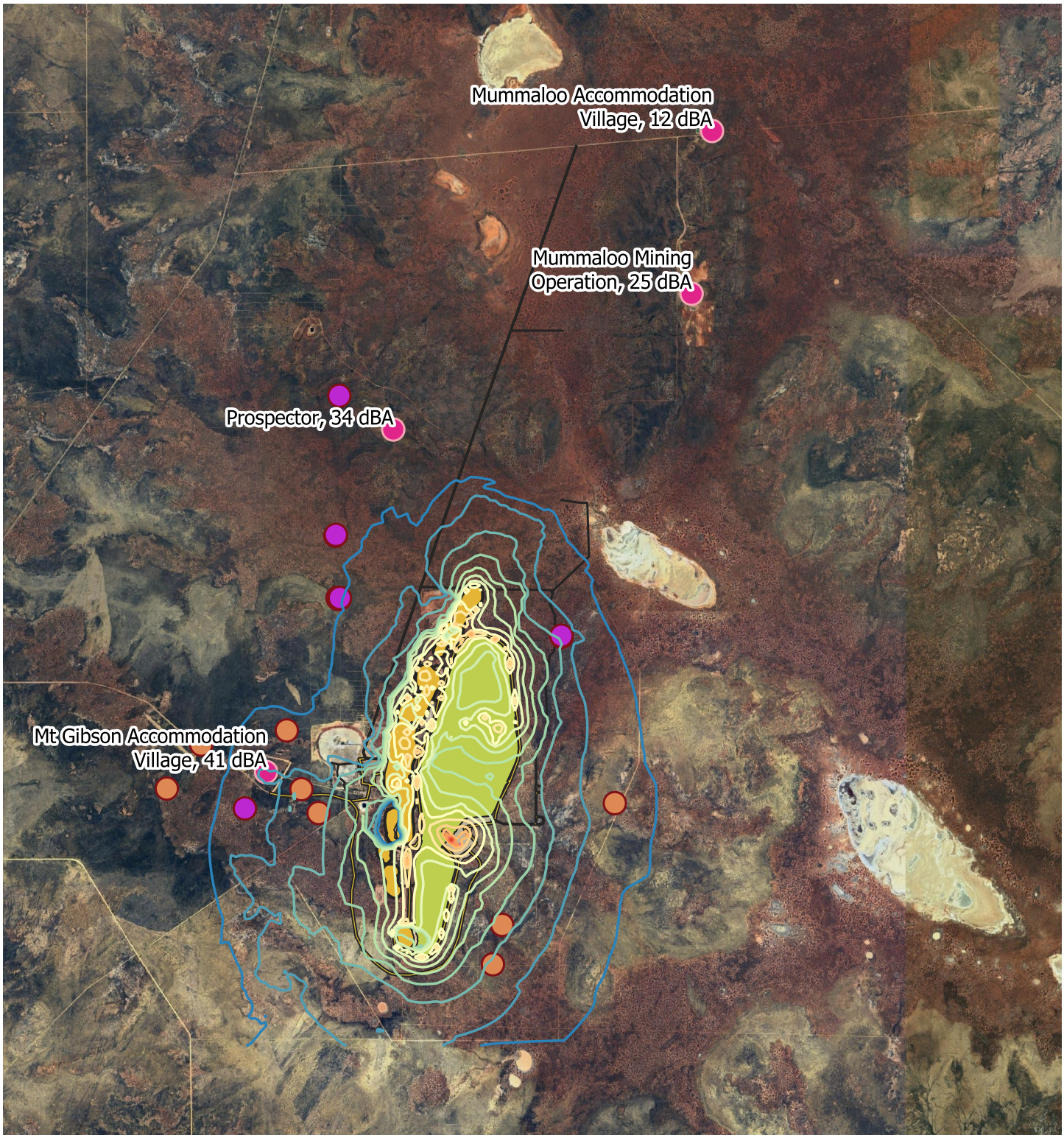
Predicted night time noise contours for Year 1 operational scenario

Project No. **12606145**
Revision No. **2**
Date. **9/8/2023**

FIGURE 5.3

Document Path: \\ghdnet\ghd\AU\Perth\Projects\61\12606145\GIS\Maps\Working\12606145_Noise_working.qgz
Print Date: 26/07/2023

Data Source:Google Earth Imagery 2023.
Created By: afarhath



Legend

- Sensitive receptors - human
- Plant area
- Mining area
- Roads
- IWL Footprint
- Active mounds - Leipoa ocellata
- Idiosoma kopejtkaorum

Sound pressure level LA10, dBA

- 30
- 35
- 40
- 45
- 50
- 55
- 60
- 65
- 70
- 75
- 80
- 85
- 90
- 95

Paper Size ISO A4

0 0.5 1 1.5 2 km

Map Projection: Transverse Mercator
Horizontal Datum: GDA94
Grid: GDA94 / MGA zone 50

N

Tetris Environmental Pty Ltd

Mt Gibson Acoustic Assessment

Predicted night time noise contours for Year 3 operational scenario

Project No. **12606145**
Revision No. **2**
Date. **9/08/2023**

FIGURE 5.4

Document Path: \\ghdnet\ghd\AU\Perth\Projects\61\12606145\GIS\Maps\Working\12606145_Noise_working.qgz
Print Date: 26/07/2023

Data Source:Google Earth Imagery 2023.
Created By: afarhath

5.5 Noise and vibration impacts on fauna

5.5.1 Shield-Backed trapdoor spider

Exploration conducted at Jack Hills and Weld Range, located approximately 300 km north of the Project location, reported trapdoor spiders (*Idiosoma nigrum*) fleeing 50 m of the drill pad (Phoenix Environmental, 2010). As trapdoor spiders dwell underground, ground-based noise (or vibration) is the predominant area of interest. Typical ground vibrations are 7-8 mm/s peak-particle velocity (at 10 m) for the typical equipment found at a drill pad as referenced from the *NSW Roads and Traffic Authority (RTA) Environmental Noise Management Manual (RTA 2001).*

It has been suggested that vibrations from vehicles and exploration drilling have the potential to affect nearby trapdoor spider populations, however, no immediate or short term effects of vibrations on the survival of *Idiosoma nigrum* have been found (Bennelongia (2024)).

Blasting, which is to occur every few days during both pre-production and production phases, also have the potential for impact on the trapdoor spiders. With charge masses of 1500 kg for two detonation holes, it is predicted that the trapdoor spiders could be adversely impacted if in close vicinity to the blasting.

Detailed data and fauna impact assessments later undertaken by fauna specialists Bennelongia Environmental Consultants determined that the impact of noise and vibrations on trapdoor spiders is considered minor. At a local scale, impacts are expected to be moderate and affecting those individuals in the Development Envelope that were not taken during the construction or exploration stages. At a regional scale, impacts are likely to be minor, with noise and vibration not expected to have impacts at a regional scale (Bennelongia 2024).

5.5.2 Malleefowl

There is a comprehensive discussion on the impact on wild birds from construction sites as presented in the Internoise 2015 catalogue: *Effect of Noise Generated by Construction Sites on Birds* (Spoglianti, 2015). This paper has been used as a reference to understand impact on Malleefowl density-loss based on distances at which either permanent or temporary impacts may occur due to airborne noise.

It has been stated that permanent impacts such as hearing loss, threshold shift and significant behavioural impacts are found at SPLs (L_{Aeq}) above 110 dBA. At lower SPLs, between 110 dBA and 93 dBA, some temporary impacts could arise, including masking of communication signals. At even lower SPLs, the impacts are difficult to estimate based on lack of evidence for the Malleefowl, but it is expected that some level of masking of communication signals could occur.

Furthermore, anecdotal evidence suggests that Malleefowl are very tolerant of disturbance, with the ability to move into different territory if required (Benshemesh, 2007).

Assessing against evidence found, the most significant impacts on Malleefowl would be from noise levels that cause permanent to temporary damage. From the loudest of the mining equipment that operate continuously (see Table 5.3), neither the 93 dBA nor the 110 dBA thresholds are exceeded at any distance greater than 10 m from the mining equipment. Although there is no apparent permanent or temporary damage predicted, communication signal masking could still potentially take place temporarily.

Additionally, airborne noise from blasting does create noise levels that have peak pressure levels that could be potentially damaging to the Malleefowl. It is not expected that masking of communication signals or other temporary shifts will occur due to irregularity of blasts.

Detailed data and fauna impact assessments later undertaken by fauna specialists Bamford Consulting Ecologists determined that the risk of impact to Malleefowl from noise is considered negligible.

Malleefowl at other mine sites have been observed to continue working on a mound, and subsequently returning to a mound <50 m from a major haul road. One male continued to work a mound within <50 m of clearing being carried out and continued to maintain that mound until the end of the season (Bamford 2024).

6. Recommended mitigation measures

The assessment of predicted noise impacts from the Mt Gibson Gold Mine indicates there is regulatory compliance of assigned day and night L_{A10} noise levels at all sensitive receptors that fall under regulatory guidelines. The Mt Gibson accommodation camp, whilst not requiring regulatory compliance, does meet AS 2107-2016 recommended levels of design sound levels for sleeping areas. This section outlines general mitigation measures which should be considered during design, construction and operation of the Project.

6.1 Operational noise and vibration

To ameliorate noise, the following design strategies can be considered and incorporated into the detailed design of the Project:

– Selection of mine equipment and vehicles to limit noise emission where possible. All equipment and vehicles on site to be kept properly serviced and fitted with appropriate mufflers.
– Mine equipment and vehicles found to produce excessive noise to be removed from the site or stood down until repairs or modifications can be made.
– Haul roads should be kept smooth and free of holes and bumps.
– Broadband reversing alarms (audible movement alarms) should be used for all site equipment, subject to meeting occupational health and safety requirements.
– Purpose built acoustic enclosures will be provided where required for large plant items in order to achieve noise levels of less than 85 dBA at 1 m, consistent with occupational health and safety requirements.
– Selection of equipment to limit noise emissions. Where practical and feasible, selected to achieve a noise level of less than 85 dBA at 1 m.
– By keeping vehicles serviced, fitted with mufflers and eliminating exhaust brake usage, noise due to trucking activity associated with the operation and construction can be significantly mitigated.

6.2 Fauna impacts

As outlined in Section 5.5, fauna specialists Bennelongia Environmental Consultants determined that the impact of noise and vibrations on trapdoor spiders is considered minor.

If disturbed, Malleefowl are known to be able to move and relocate mounds often. It is expected that they will utilise the large land area outside the mining area when the clearing of the proposed area takes place. This is evidenced by behaviour in Malleefowl moving breeding areas by as much as several square kilometres when disturbed (Benshemesh, 2007). As discussed in Section 5.5, detailed data and fauna impact assessments undertaken by fauna specialists Bamford Consulting Ecologists determined that the risk of impact to Malleefowl from noise is considered negligible.

The following procedures are recommended to minimise impacts on fauna:

– Clearing be undertaken in stages along one front to give fauna the opportunity to escape.
– All vehicles to stay on clearly designated roads and tracks and adhere to speed limits for the duration of preproduction and operational stages.
– Implement and maintain a Fauna Register (including encounters, injuries, and deaths) for the entirety of the Project and ensure it is regularly updated.

7. Conclusions

Noise modelling has demonstrated that under worst case meteorological conditions, night time assigned L_{A10} noise levels are predicted to be compliant at all surrounding sensitive receptors that fall under the regulatory guidelines. The Mt Gibson accommodation camp, whilst not requiring regulatory compliance, does meet AS 2107-2016 recommended levels of design sound levels for sleeping areas. It is recommended that mitigation measures are implemented to ensure full compliance for the entirety of the Project.

Assessment of blasting noise and vibration levels indicates that levels are below the relevant blasting noise and vibration criteria.

With regards to the fauna, it is predicted that there is little to no impact on both species in the area outside the mine footprint, provided that recommended mitigation measures are implemented.

8. References

Intergovernmental Committee on Surveying and Mapping (ICSM). (2023).

Bamford Consulting Ecologists. (2024). *Mount Gibson Gold Project Targeted Investigations into Significant Fauna.*

Bennelongia Environmental Consultants. (2024). *Impact assessment of the Mt. Gibson Gold Project in relation to the Lake Goorly Shield-Backed Trapdoor Spider (Idiosoma kopejtkaorum).*

Benshemesh, J. (2007). *National Recovery Plan for Malleefowl Leipoa ocellata .*

Bureau of Meteorology (BoM). (2022). *Climate classification maps, Burea of Meteorology*. Retrieved June 21, 2022, from http://www.bom.gov.au/jsp/ncc/climate_averages/climate-classifications/index.jsp?maptype=kpn#maps

Capricorn Metals. (2023). *Mount Gibson Gold*. Retrieved from https://capmetals.com.au/projects/mount-gibson-gold/

DPAW. (2019). *Threatened and Priority Fauna List, s.l.: Department of Parks and Wildlife.*

DWER. (2021). *Guideline: Dust emissions, s.l.: Department of Water and Environmental Regulation, Government of Western Australia.*

EPA. (1997). *Environmental Protection (Noise) Regulation.*

Hanson, B. (2009). *Engineering Noise Control.*

Jenkins, A. R. (1998). *Home range size and habitat requirements of peregrine falcons on the Cape Peninsula, South Africa. The Raptor Research Foundation Inc., 32(2), pp. 90 - 97.*

Main, B. Y. (2010). *Interactions of Water, Plants and Ground-Dwelling Fauna: Water Harvesting and Tapping by Trapdoor Spiders. Landscapes: the Journal of the International Centre for Landscape and Language, 4(1), pp. 1-18.*

Phoenix Environmental. (2010). *Form to nominate a Western Australian species for listing as threatened, change of category or delisting 2010.* unpublished data - Anonymous.

Rix, G. M. (2018). *Conservation systematics of the shieldbacked trapdoor spiders of the nigrum-group (Mygalomorphae, Idiopidae, Idiosoma): integrative taxonomy reveals a diverse and threatened fauna from south-western Australia. ZooKeys, Volume 756,.*

RTA. (2001). *NSW Roads and Traffic Authority (RTA) Environmental Noise Management Manual.*

Spoglianti, B. (2015). *Effect of Noise Generated by Construction Sites on Birds.*

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