VECCO CRITICAL MINERALS PROJECT

Julia Creek, North-West Queensland

Noise Assessment

Vecco Group

Date
16 October 2023

Report
227401.0093.R01V03

DOCUMENT CONTROL

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Reference	Date	Description	Prepared	Checked
227401.0093.R01V01	26/06/2023	Final	Burak Ayva	Cedric Roberts
227401.0093.R01V02	13/09/2023	Project name update	Burak Ayva	Andrew Martin
227401.0093.R01V03	16/10/2023	Figure 3.1 and associated text update	Burak Ayva	Andrew Martin

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APPENDICES

1. INTRODUCTION

1.1 Overview

Trinity Consultants Australia (Trinity) was commissioned by Vecco Group Pty. Ltd. to provide noise and vibration assessment of the proposed Vecco Critical Minerals Project (the Project).

The deposit is located in north-western Queensland 70 kilometres north of the township of Julia Creek and approximately 515 kilometres west of Townsville in Northwest Queensland. Access to the project site is via Mt Isa, the nearest major centre and regional airport.

The Project area will be defined by three proposed mining lease applications (MLA) being an MLA for the mine, an MLA for infrastructure and an MLA for the access road, which will occupy a total area of 3,536 ha. The land within and surrounding the Project area is designated as 'Rural' zone under the McKinlay Shire Planning Scheme 2019. The existing land use of the Project area is low intensity cattle grazing.

The Project location is shown in **Figure 1.1**.

1.2 Scope

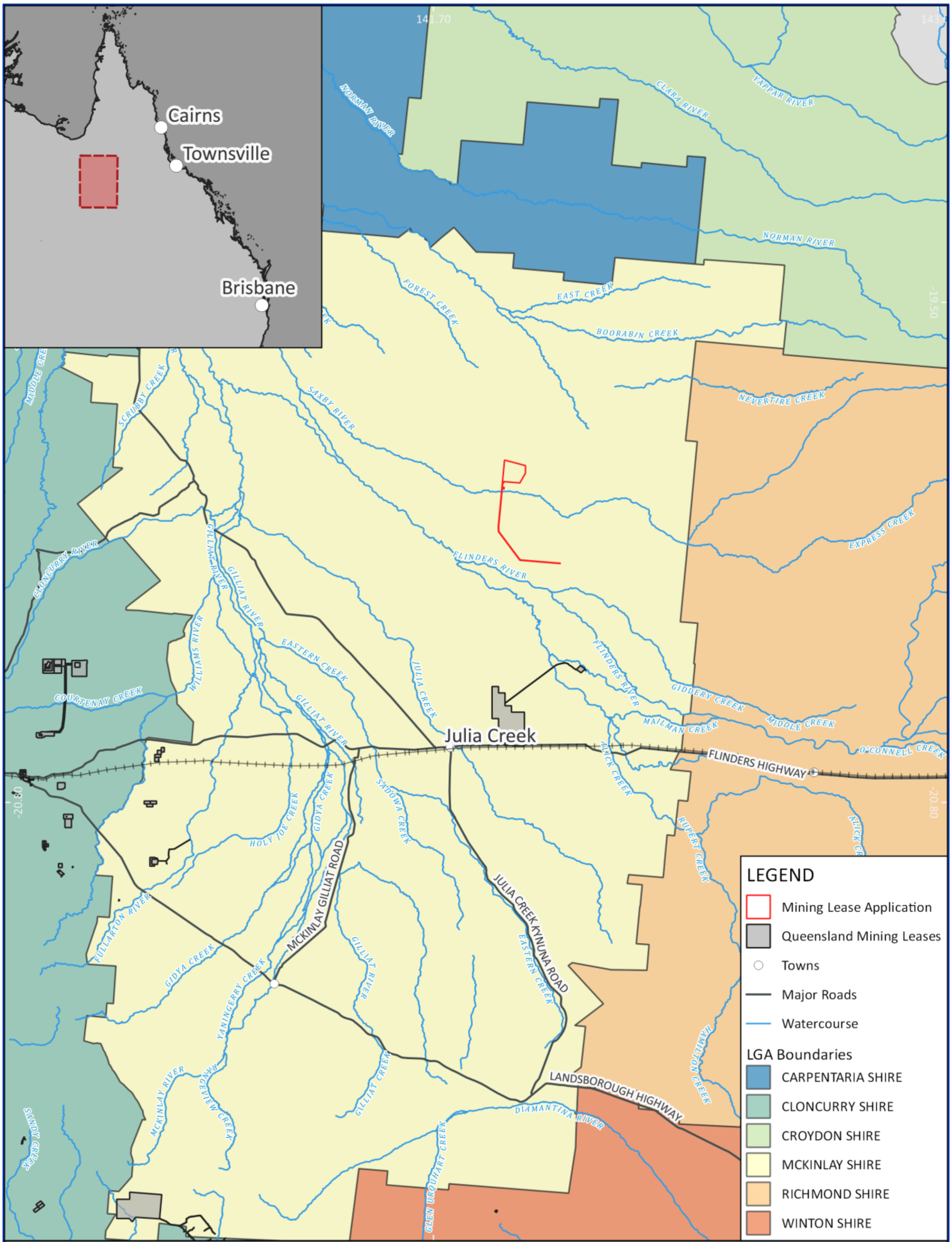
This report presents an assessment of the noise and vibration impacts associated with the Project. It is to form an appendix to the application for a site-specific Environmental Authority (EA) for assessment by the Queensland Department of Environment and Science (DES).

This report is based on the following tasks:

- Review the Project and the associated potential noise emissions.
- Present review of baseline noise levels.
- Model the noise emissions, propagation and immissions based on proposed activities to calculate noise levels at sensitive receptors and develop contours over the modelling area.
- Analyse the results of noise modelling and compare modelling results with the relevant noise criteria selected to protect the acoustic environment.
- Provide recommendations on control measures, where required.

To aid in the understanding of the terms in this report a glossary is included in **Appendix A**.

Figure 1.1: Vecco Critical Minerals Project Location and Approved Mining Leases



Project Locality

Vecco Critical Minerals Project

Client	Vecco Industrial Pty Ltd
Date	31-08-2023
Author	L.Morgan
Projection	GDA2020 / MGA zone 54
Scale	1:1300000

0 10 20 30 40 km

ARC ENVIRONMENTAL SOLUTIONS

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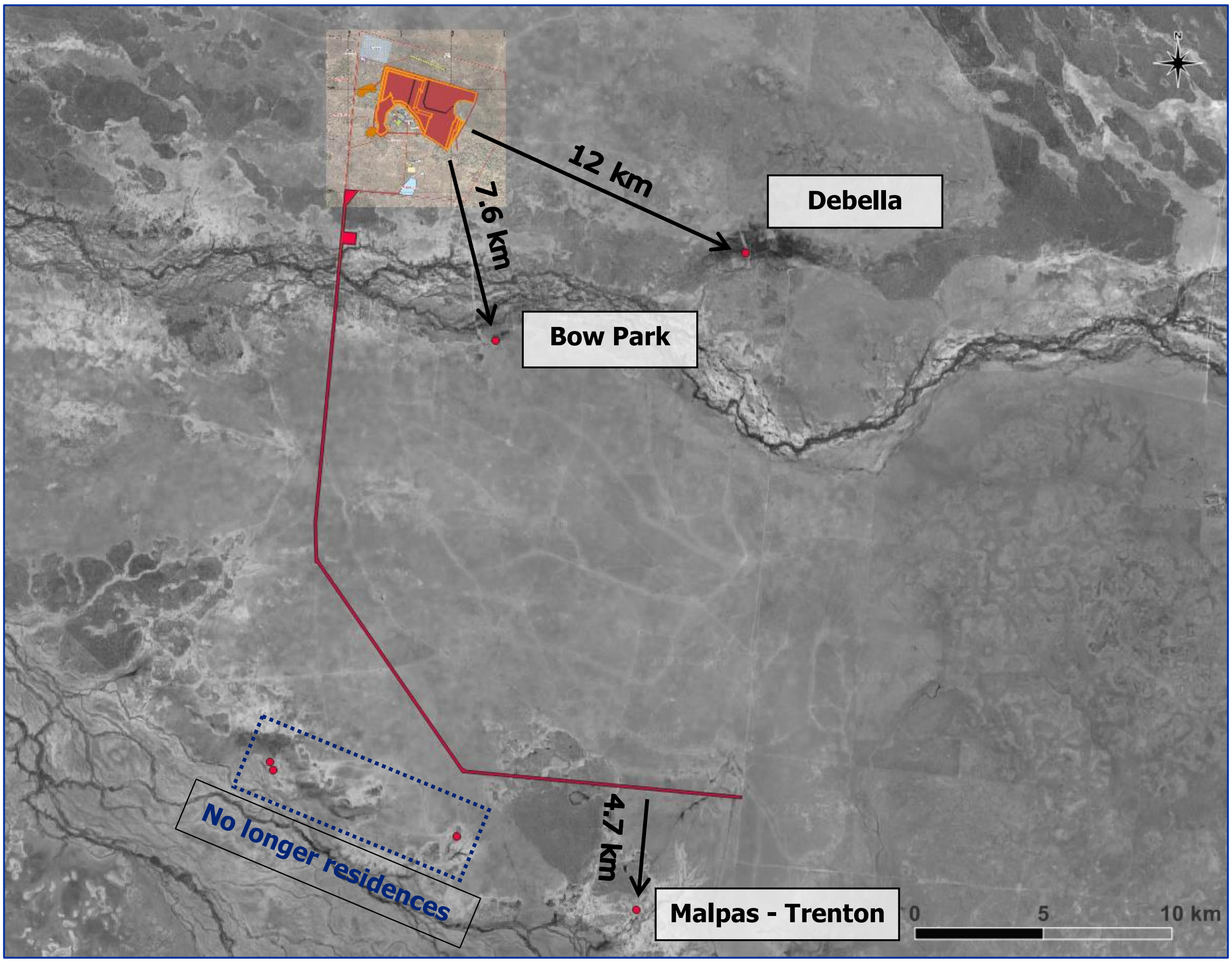
2. STUDY AREA DESCRIPTION

2.1 Overview

The Project site is located in a remote area approximately 70 kilometres north of Julia Creek in mid-northern Queensland. The nearest potential residential noise sensitive receptor is approximately 7.6 kilometres to the southeast of the mining area. The Project location and the proposed infrastructure are shown in **Figure 2.1**.

Figure 2.1: Location of the Site and Sensitive Receptors (Image from Queensland Globe Overlay)



2.2 Identification of Sensitive Receptors

The definition of a sensitive receptor required to be considered by operators of environmentally relevant activities is provided by the Department of Environment and Science (DES 2019). This definition is an area or place where noise is measured, and includes:

- residence, which includes a building, or part of building, capable of being used as a dwelling
- library and educational institution (including a school, college and university)
- childcare centre or kindergarten
- hospital, surgery or other medical institution
- commercial and retail activity
- protected area or critical area

- marine park
- park or garden that is open to the public (whether or not on payment of an amount) for use other than for sport or organised entertainment.

Six potential noise sensitive receptors were identified near the Project area; however, it is understood that three of them are no longer residential receptors, i.e., flooded or abandoned. The other three noise sensitive receptors considered for the noise impact assessment are listed in **Table 2.1**. These receptor locations are also shown in **Figure 2.1**.

Table 2.1: Potential Sensitive Receptors

Receptor ID	Receptor Description	Latitude	Longitude	Distance from Closest Mining Area and Direction
R1 – Bow Park	Residential	-20.018064	141.933653	7.6 km S
R2 – Debella	Residential	-19.987765	142.028363	12 km SE
R3 – Malpas Trenton	Residential	-20.218263	141.988227	4.7 km S*

Distance from mine access road. Please refer **Figure 2.1 for locations of potential sensitive receptors.*

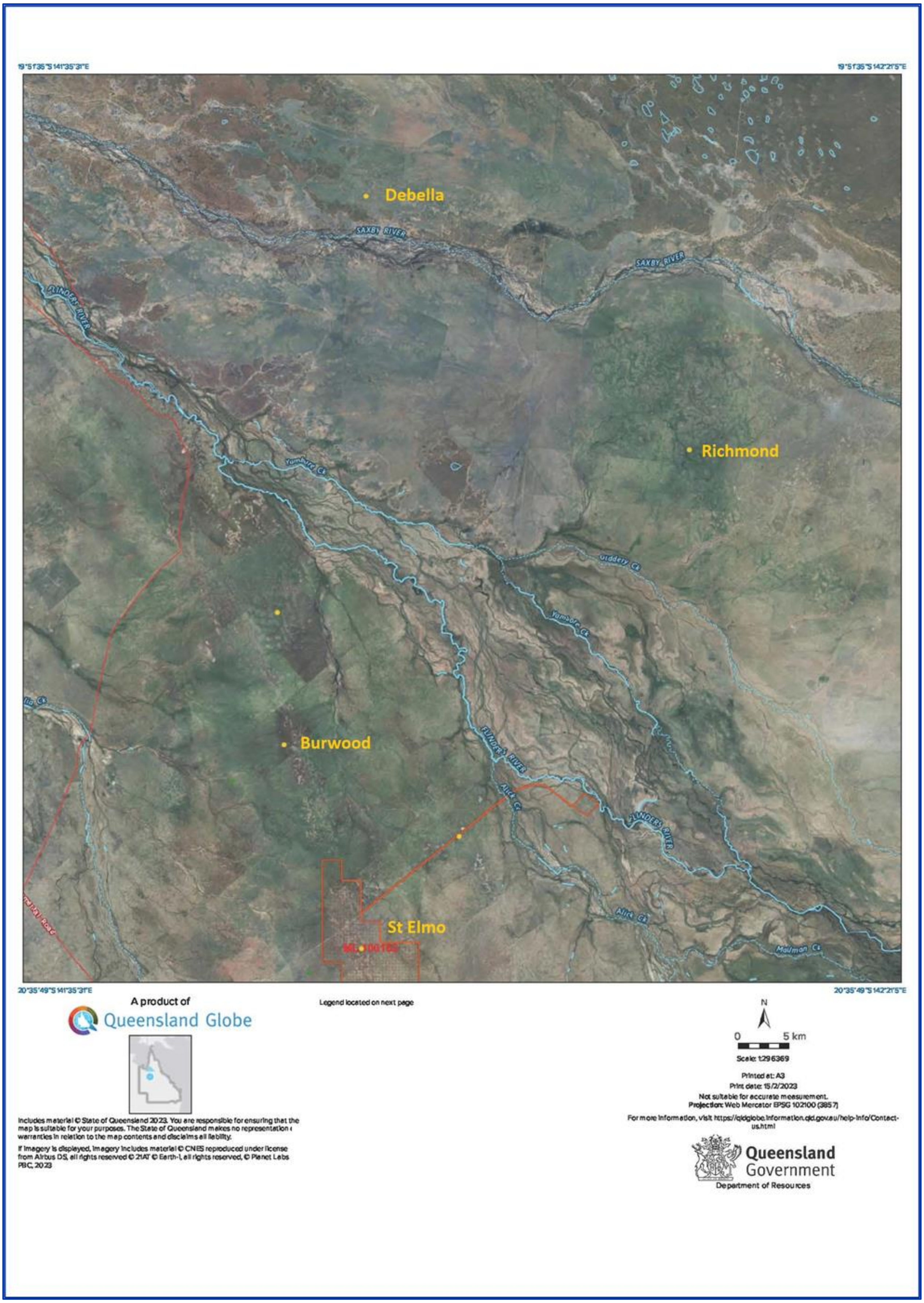
2.3 Description of Existing Noise Environment

A survey of the surrounding area was conducted with no other existing noise emission sources found, with the exception of grazing operations and their associated activities.

There are no other mining lease production permits. There are several other exploration permits in the vicinity of the sensitive receptors held by Red OX Copper Pty Ltd, Currie Rose Vanadium, CMG_3 Pty Ltd, and Yappar Resources Pty Ltd. However, at the time of publication Trinity and AARC are not aware of any other operations proposed in the foreseeable future. At this time, there are no potential cumulative impacts from other future mines. At the time of publication Trinity and AARC are not aware of any other nearby mining operations proposed in the foreseeable future. Proposed mines and mineral resource development projects in the vicinity on Queensland Globe include Richmond, Manfred and Burwood, all potential future vanadium mines as shown in **Figure 2.2**. The approved St Elmo mine is further south. The Richmond – Julia Creek Vanadium Project is on the Queensland Coordinated Projects map of proposed mines.

However, St Elmo and Richmond - Julia Creek are more than 60 kilometres distant and no cumulative noise impacts are expected from these mines at the noise sensitive receptors being assessed here. Hence there will be no cumulative impacts from these mines.

Figure 2.2: Potential Vanadium Mines in Vicinity



3. PROJECT DESCRIPTION

3.1 Overview

The information in this section has been provided to Trinity.

The proponent of the Vecco Critical Minerals Project is Vecco Industrial Pty. Ltd. (Vecco), a wholly owned subsidiary of Vecco Group Pty. Ltd. (Vecco Group).

Vecco is seeking to develop the Project to mine and process the vanadium deposit. The Project will target vanadium pentoxide (V_2O_5) and High Purity Alumina (HPA), along with minor quantities of Rare Earth Elements (REEs) also found within the ML area. The life of mine (LOM) is expected to be approximately 36 years, which includes construction, operation, and rehabilitation. A conceptual Project layout is presented in **Figure 3.1**. The Project is a proposed greenfield operation that will consist of a shallow, open-cut mine that will process up to 1.9 Mtpa ROM feed to produce up to approximately 5,500 to 6,000 tpa V_2O_5 and approximately 3,000 to 4,000 tpa HPA over an operational life of 26 years.

Ore will be mined to an approximate depth of up to 35 metres. Processing will occur following on site crushing and screening of the ore. Mineral products will be packed in containers and transported by truck to Townsville, for secondary processing into battery electrolyte or exported from the Port of Townsville to international markets.

The following sections specify details of the project that are relevant to the environmental noise assessment.

3.2 Infrastructure

Project infrastructure will include the following key components:

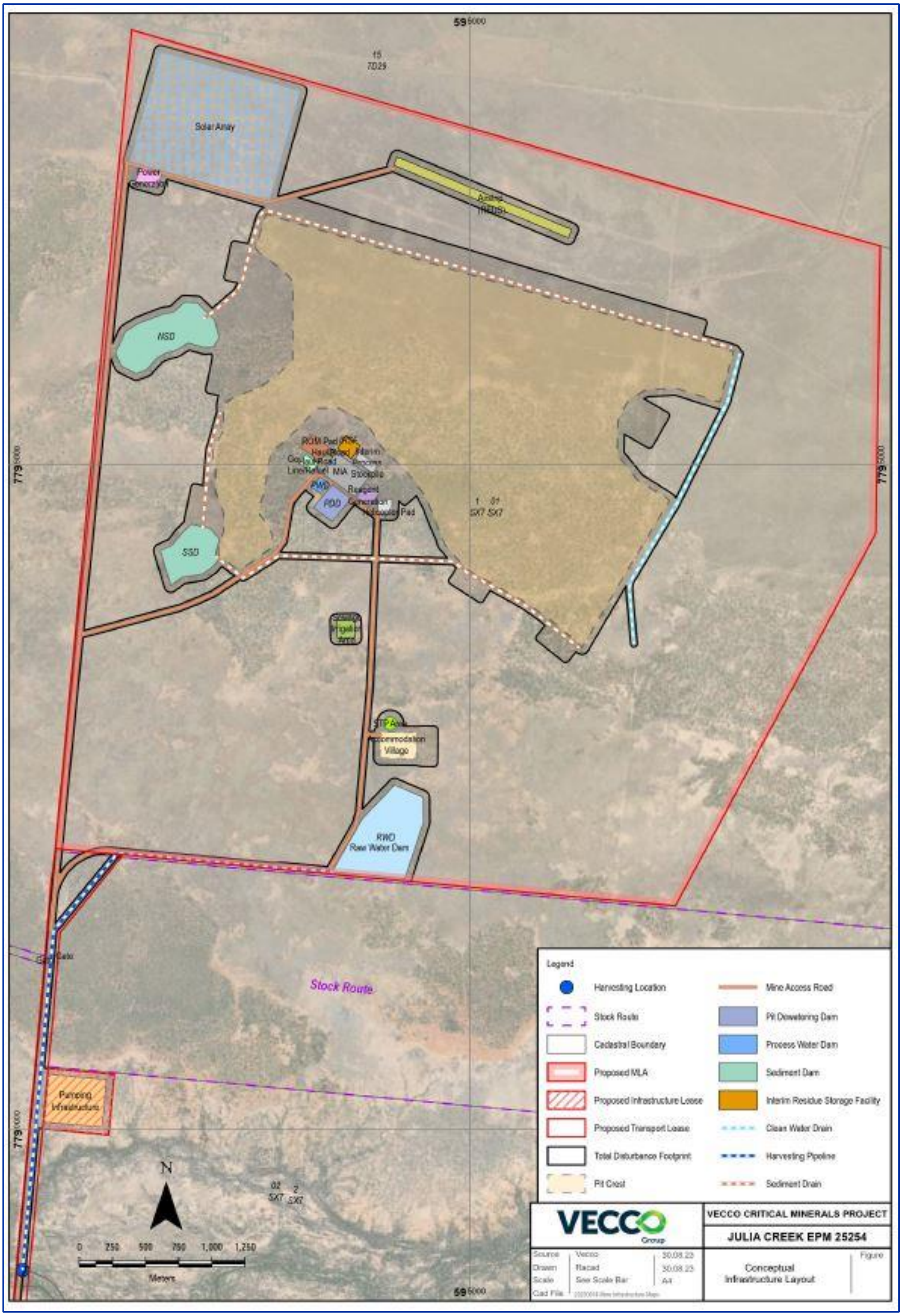
- Open-cut mining of up to 1.9 Mtpa ROM ore over an operational period of 26 years;
- development of a mine infrastructure area (MIA) including, administration buildings, bathhouse, crib rooms, storage warehouse, workshop, fuel storage, refuelling facilities, wash bay, laydown area, and a helipad;
- development of mine areas (open cut pits) and out-of-pit waste rock emplacements. This includes vegetation and soil stripping;
- development of out-of-pit and in-pit waste rock emplacements;
- construction and operation of a Mineral Processing Plant (MPP) and ore handling facilities adjacent to the MIA (including ROM ore and product stockpiles and rejects);
- construction and use of an access road from Punchbowl Road to the MIA;
- construction of an airstrip to provide access for the Royal Flying Doctors Service;
- construction of a 10 MW solar farm and associated energy storage system;
- installation of a raw water supply pumping system and pipeline to connect the Raw Water Dam to the Saxby River for water harvesting;
- construction of an on-site workers village and associated facilities, including an adjacent sewage treatment plant (STP);
- other associated minor infrastructure, plant, equipment and activities;
- progressive establishment of soil stockpiles, laydown area and borrow pits (for road base and civil works). Material will be sourced from local quarries where required;
- mine operations using conventional surface mining equipment (excavators, front end loaders, rear dump trucks, dozers);
- strategic disposal of neutralised process rejects within the backfilled mining void;
- continued exploration and resource definition drilling on the MLA's;

- progressive development of internal roads and haul roads including a causeway over the Saxby River (designed for minimum impact on flow events) to enable access and product haulage;
- development of water storage dams and sediment dams, and the installation of pumps, pipelines, and other water management equipment and structures including temporary levees, diversions and drains;
- a crossing of the Saxby River, designed for minimum impact on flow events; and
- Rehabilitation occurring at defined milestones through the operational life. All voids will be backfilled to natural surface, ensuring all rehabilitated landforms achieve a sustainable post-mining land use on closure.

Existing regional infrastructure, facilities and services may be used to support the project activities. These include the Townsville Port, the Aurizon rail network, Ergon's electricity network and the Flinders Highway.

The project layout is shown in **Figure 3.1**.

Figure 3.1: Project Layout



3.3 Mining Activities

3.3.1 Overview

The Project is based on typical truck and excavator operations. Mining will be carried out sequentially from mining panels. Once material is removed the exposed pit floor will be covered with neutralised, filtered, process residue (trucked from the MIA) before being backfilled to surface level or above with waste rock. The back-filled overburden will then be sheeted with topsoil for revegetation. Progressive rehabilitation will then be undertaken.

The mining operations are summarised as follows:

- Vegetation will be cleared.
- Topsoil will be removed, temporarily stockpiled and used to progressively rehabilitate other areas.
- A single box cut will be excavated with waste rock initially dumped in a single out-of-pit dump.

  As the mining face advances, neutralised residue will be trucked from the MIA to cover the pit floor and waste rock from the advancing face will be dumped in-pit, returning the mined land to natural surface level or above.
- Dozers will push material to back-fill the areas that have been previously mined.
- Excavators will side cast the rehandled overburden wedge.
- Excavators will load the mined ore into haul trucks to be transported from the pits to the run-of-mine (ROM) pad.
- Haul trucks will unload ROM ore at the ROM pad. All the ore from the ROM stockpiles will be rehandled to feed the processing plant using a front end loader to feed the ore onto a conveyor via a hopper.
- MPP residue will be dried blended, neutralised, stockpiled, loaded and hauled back to the open pit where it will be used to cover the exposed pit floor.
- Ore will be processed in the on-site plant incorporating beneficiation, roasting, leaching, filtration, solvent extraction, precipitation refining, HPA and REEs processes.
- Product will be transported out through the mine access road by road trucks such as B-double and A-triple.
- Maintenance and servicing of plant and equipment will be undertaken at the MIA.

3.3.2 Mine Sequencing

The mining sequencing plan is to target the lowest strip ratio area first. **Figure 3.2** presents a layout of the mining sequencing plan. Predicted material handling quantities over the 26 year operational life of the Project are provided in **Table 3.1**.

The life of the open cut mine is estimated to be 36 years, including construction, operation, 26 operational years and rehabilitation.

Figure 3.2: Mine Sequencing Plan (Period Progress Plot – Ore)

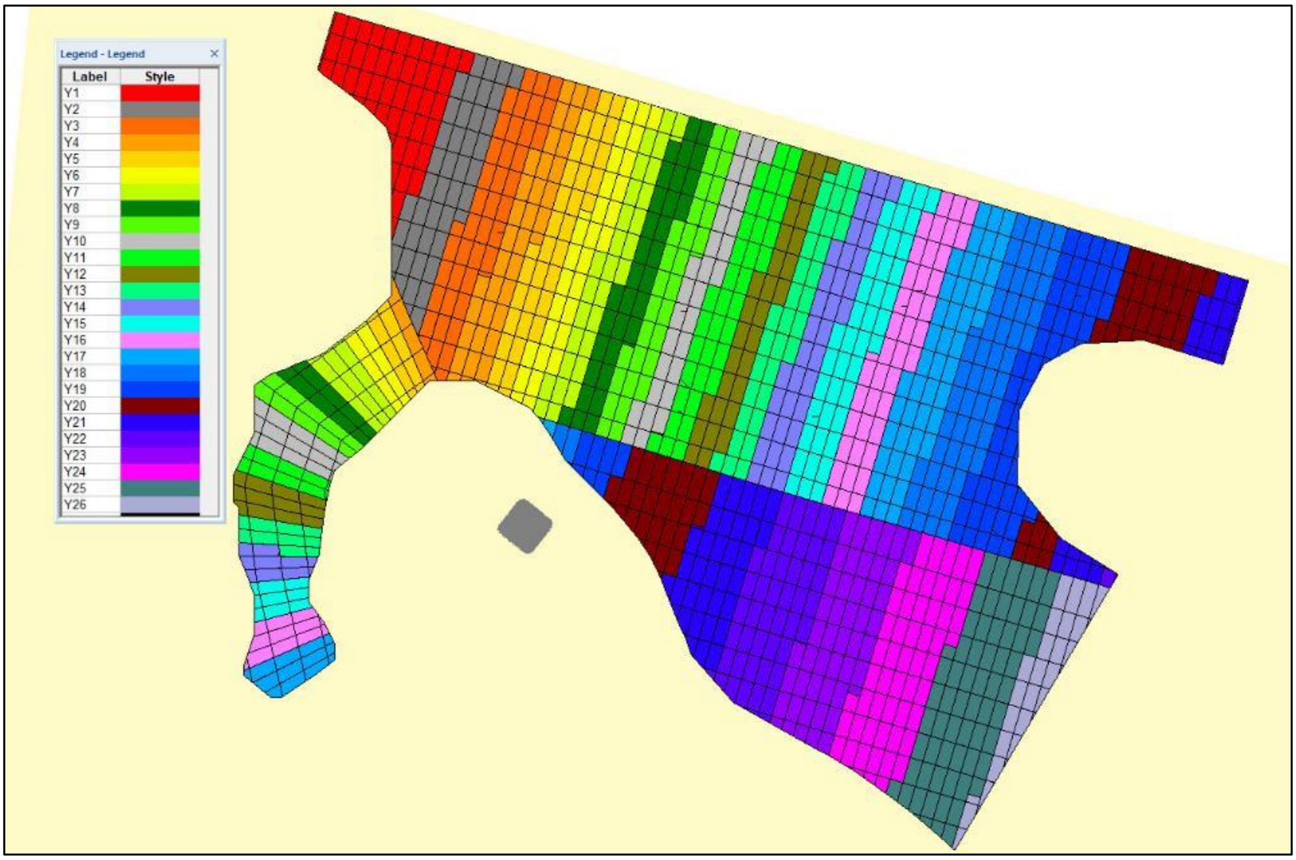


Table 3.1 presents the proposed schedule of materials to be handled over the life of the mine.

Table 3.1: Indicative material handling quantities over the 26 years of operating mine

Year	Topsoil removal (bank cubic meter)	Overburden (bank cubic meter)	Ore – ROM (ton/period)	Rejects (ton/period)
0	162,000	2,200,000	1,900,000	1,892,270
1	62,000	2,122,000	1,900,000	1,892,270
2	58,000	1,930,000	1,900,000	1,892,270
3	63,000	1,980,000	1,900,000	1,892,270
4	59,000	1,929,000	1,900,000	1,892,270
5	61,000	1,996,000	1,900,000	1,892,270
6	60,000	2,001,000	1,900,000	1,892,270
7	57,000	1,966,000	1,900,000	1,892,270
8	62,000	2,072,000	1,900,000	1,892,270
9	65,000	2,002,000	1,900,000	1,892,270
10	54,000	2,154,000	1,900,000	1,892,270
11	67,000	2,129,000	1,900,000	1,892,270
12	59,000	2,181,000	1,900,000	1,892,270
13	63,000	2,387,000	1,900,000	1,892,270
14	65,000	2,475,000	1,900,000	1,892,270
15	67,000	2,758,000	1,900,000	1,892,270
16	79,000	3,040,000	1,900,000	1,892,270
17	83,000	3,181,000	1,900,000	1,892,270
18	85,000	3,403,000	1,900,000	1,892,270

Year	Topsoil removal (bank cubic meter)	Overburden (bank cubic meter)	Ore – ROM (ton/period)	Rejects (ton/period)
19	75,000	3,341,000	1,900,000	1,892,270
20	90,000	3,552,000	1,900,000	1,892,270
21	79,000	3,628,000	1,900,000	1,892,270
22	69,000	3,749,000	1,900,000	1,892,270
23	73,000	3,829,000	1,900,000	1,892,270
24	81,000	3,613,000	1,900,000	1,892,270
25	94,000	3,604,000	1,900,000	1,892,270
26	12,000	921,000	524,000	516,270

3.3.3 Choice of Modelling Scenario

The major determinant of noise impacts over the lifetime of the mine is the number of stationary and mobile plant noise sources and the location of noise sources relative to the noise sensitive receptors. Number of plant are related to material handling quantities. Estimated material handling quantities over the life of the mine are provided in **Table 3.1**.

Considering the remote location of the mine and the distance to the nearest sensitive receivers, only one mine scenario has been modelled, as follows:

- Year 26 mine site layout as shown in **Figure 3.2** with Year 25 production rate.

The scenario was chosen to represent the likely worst-case impact at the nearest noise sensitive receptors, i.e., Bow Park and Debella. The noise sources are anticipated to be closest to the nearest noise sensitive receptors during year 26 (EOM) of the mine. As the quantities of materials for year 26 are relatively low (based on a partial year) in comparison to other years within 25 years of the life of the mine, the quantities of materials handled for year 25, which are typical but erring on the higher side of the quantities of materials, were used. The combination of year 26 source locations with year 25 materials handled provides a worst-case scenario with a good balance between the proximity of noise sources to the sensitive receptors and amount of materials handled.

3.4 Operational Plant

3.4.1 Mobile Plant

The proposed fleet for the open cut mining operations during Year 25 is presented in **Table 3.2**.

Table 3.2: Proposed Production Fleet

Equipment Model	Scenario Quantity	Application
Komatsu PC1250 Excavator	2	Overburden removal
Komatsu HD605-7 Dump Truck	5	Hauling/unloading of Overburden
Komatsu PC700 Excavator	1	Loading of Ore
Komatsu HD325-7 Rock Truck	3	Hauling/unloading of Ore
Face Dozer	2	Ore on run-of-mine (ROM) pad/product
Stockpile Dozer/Dump Dozer	2	Pit and haul road establishment and maintenance
Grader	2	Overburden removal
Rubber Tyre Dozer	1	Rejects loading and general use
Water Truck	2	Dust control
Service Truck	1	Maintenance
Lighting Plant	3	Lighting

3.4.2 Processing Plant

The Project has a hydrometallurgical processing plant designed to extract and refine vanadium, HPA and produce a REE concentrate. The vanadium extraction process is based on the capacity of sulphuric acid required to dissolve the vanadium contained within the iron oxides and clays within the orebody. Vanadium will be refined through selective solvent extraction. The basis for refinement of HPA is the utilisation of HCl (hydrochloric acid) to leach and precipitate an alumina chloride hexahydrate (ACH) through multiple purification stages.

Ore will be crushed to a nominal size for a reverse flotation process, utilising frothing agents to differentially float the calcite from the ore. This calcite-rich concentrate proceeds to drying and roasting in a rotary kiln. Concentrate is then cooled and conveyed to the leaching circuit. Leaching will be undertaken at 95° C via process heating (most likely steam injection) and the addition of sulphuric acid. The barren residue will be filtered and washed to recover vanadium and sulphuric acid. This recovered leachate will then be partially neutralised before solvent extraction. A series of mixer settlers will extract the vanadium from the solution into an organic phase (with other impurities) and then a stripping solution will be utilised to selectively concentrate the vanadium into an aqueous phase for precipitation. Precipitation of ammonium metavanadate (AMV) involves crystallisation in stirred tanks with recycling as seed to enhance the recovery of AMV. A filtered product will be then calcined to generate a high purity V_2O_5 powder while recovering ammonia to generate AMV. Rare earth metals are beneficiated, leached and concentrated into a mixed carbonate product.

As outlined above, the processing plant has numerous components and machinery as noise sources. However, due to the large distance between noise sensitive receptors and the plant's location, it was determined that modelling the processing plant as a single noise source would be a practical and accurate approach. This approach avoids the need to consider each subcomponent individually.

3.5 Upset Conditions

Potential upset conditions and their effect on noise immissions (noise levels received at a sensitive receptor) are discussed as follows:

- If a piece of equipment malfunctions, this could result in an increased noise level for that item of equipment, although the overall effect on noise emissions from the whole site would likely be minor and of short duration. When equipment malfunctions, it should be quickly taken out of operation, and adverse noise impacts are not expected to occur. In addition, all equipment will be maintained routinely, and malfunctions that increase noise levels are expected to be rare.
- Severe weather conditions causing poor visibility such as a dust storm and heavy rain could cause mining activity to reduce or cease. This would result in lower noise immission levels. Strong winds blowing from the mine towards sensitive receptors could increase the mining noise levels but would also likely increase the background noise levels significantly such that mining noise would be masked.

Overall, it is not expected that upset conditions pose a risk of additional noise impact, and further assessment of such cases is not considered to be warranted.

3.6 Construction and Commissioning

Prior to the operation of the Project, ancillary facilities will be constructed predominantly at the MIA which will include (but not be limited to) the processing plant, offices, solar farm, tailings facility and evaporation pond. Construction activities within the mining area have similar or less emissions than the mining operations and would be undertaken for a relatively short period of time. Commissioning should include testing of processing plant. Construction and commissioning activities within the Project would likely have less impact than operational activities. Therefore, no detailed noise assessment of construction and commissioning activities has been conducted.

3.7 Decommissioning and Closure

Decommissioning and closure of the mine will have less immissions, and similar immission at worst, than the construction and mining operations. Impacts from these activities will be minimal at the sensitive receptors. Therefore, no detailed noise assessment of decommissioning activities has been conducted.

3.8 On-site Water Storage Facility

An on-site water storage facility (Raw Water Dam) will be constructed approximately 7 kilometres to the north-east of receptor 1. **Figure 3.1** shows the location of the raw water dam. A pump station will transfer the water to the raw water dam at a rate of up to 112,320 ML per day during flow harvesting conditions. The pump station energy will be supplied by a 500 kW diesel generator approximately 7 kilometres from the nearest sensitive receptor.

The main noise emission sources of the raw water dam operation will be the 4 x 1 MW pump generators. These emissions are not likely to cause discernible changes to the immissions at the nearest sensitive receptor 7 kilometres away. Hence, these emissions have not been considered further in this assessment.

4. EXISTING NOISE ENVIRONMENT

4.1 Overview

Baseline noise monitoring at the noise sensitive receptors was not considered necessary for this Project since the closest noise sensitive receptor is located greater than 7 kilometres away from the proposed mine. Background noise conditions would be equivalent to a remote, rural setting, being typically low levels with the exception of natural sources such as wind, birds, insects and the occasional equipment noise from agricultural land uses.

Furthermore, the proposed noise limits are fixed numbers, and establishing the background noise level would not provide this report with information that would assist with the assessment and management of noise.

Reference is made to the published baseline monitoring data (Trinity Consultants 2020), for nearby sensitive receptors of the Saint Elmo Vanadium mine to provide some indication of background noise.

4.2 Monitoring Locations

Acoustic measurements of Saint Elmo Vanadium Mine consisted of attended noise measurements and noise logging. The noise measurement locations are described as follows:

- Location A – Saint Elmo: Located in an open field, approximately 4 kilometres away from the St. Elmo homestead, at the request of the landowner. (Lat -20.61669, Long 141.892961)
- Location B – Argyle: Located in an open field, approximately 90 metres away from the homestead. (Lat -20.580634, Long 141.810327)
- Location C – Burwood: Located in an open field, approximately 65 metres behind the unoccupied homestead. A wind vane at a distance of 150m away was still audible at nighttime at the logging position. (Lat -20.437298, Long 141.849926)

The purpose of these measurement locations was to be representative of the nearby homesteads.

4.3 Background Noise Levels

Noise logging was undertaken using field and laboratory calibrated Bruel & Kjaer 2250 based environmental noise loggers. Noise logging was undertaken in the free field at each location.

The rating background noise levels (RBLs), calculated using the lowest 10th percentile method, are shown in **Table 4.1**.

Table 4.1 Background Noise Levels at Location A, B and C

Period	Background Noise Level L_{A90} dBA		
	A – St Elmo	B – Argyle	C – Burwood
Day (7am to 6pm)	22	22	20*
Evening (6pm to 10pm)	21	25	21*
Night (10pm to 7am)	18	19	17*

Note: * The background noise level was affected by insect noise. As the insect noise is likely a variable influence, the noise level data has been filtered to remove the insect noise.

From the results above it is apparent that the existing background noise environment is very quiet, as expected of a rural area. The background noise levels at night tend to be dominated by natural noises (e.g. insects, wind rustling leaves and grass), livestock or the occasional distant vehicle.

5. ACOUSTIC CRITERIA

5.1 Overview

Noise criteria are required to assess the potential impacts of the proposed mining operations on potential noise sensitive receptors.

The relevant Department of Environment and Science (DES) noise and vibration criteria have been considered and are listed in the following documents:

- Environmental Protection Act 1994
- Environmental Protection (Noise) Policy 2019
- Guideline "Planning for Noise Control", Department of Environment and Science, 20 July 2004
- Guideline "Model Mining Conditions", Department of Environment and Science, 07 March 2017
- Guideline "Application requirements for activities with noise impacts", Department of Environment and Science, v3.05, 21 September 2021

5.2 Environmental Protection Act

In Queensland, the environment is protected under the Environmental Protection Act (EP Act) 1994.

Section 3 of the EP Act states that the object of the Act is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development).

Section 12 of the EP Act defines noise as including "vibration of any frequency, whether emitted through air or another medium" and thus includes underwater noise.

Section 319 of the EP Act relates to General Environmental Duty and states that a person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm.

Section 14(1) of the EP Act defines environmental harm as any adverse effect, or potential adverse effect (whether temporary or permanent and of whatever magnitude, duration or frequency) on an environmental value, and includes environmental nuisance.

Section 15 of the EP Act defines environmental nuisance as an unreasonable interference or likely interference with an environmental value caused by (a) ... noise. The EP Act refers to the Environmental Protection Policies as being subordinate legislation to the Act.

5.3 Environmental Protection (Noise) Policy

5.3.1 Overview

In respect of the acoustic environment, the object of the Act is achieved by the Environmental Protection (Noise) Policy 2019 (EPP (Noise)). This policy identifies environmental values to be enhanced or protected, states acoustic quality objectives, and provides a framework for making decisions about the acoustic environment.

5.3.2 Acoustic Quality Objectives

The EPP (Noise) contains a range of acoustic quality objectives for a range of receptors. The objectives are in the form of noise levels, and are defined for various periods of the day, and use several acoustic parameters. The objectives are not target levels but rather maximum levels. The reasonableness of the objectives should also consider the existing noise environment.

Schedule 1 of the EPP(Noise) includes the following acoustic quality objectives which must be satisfied:

- Residence:
  - Outdoors
    - Daytime and Evening: 50 dBA $L_{Aeq,adj,1hr}$, 55 dBA $L_{A10,adj,1hr}$ and 65 dBA $L_{A1,adj,1hr}$
  - Indoors
    - Daytime and Evening: 35 dBA $L_{Aeq,adj,1hr}$, 40 dBA $L_{A10,adj,1hr}$ and 45 dBA $L_{A1,adj,1hr}$
    - Night: 30 dBA $L_{Aeq,adj,1hr}$, 35 dBA $L_{A10,adj,1hr}$ and 40 dBA $L_{A1,adj,1hr}$

In the DEHP EcoAccess Guideline "Planning For Noise Control" documentation it is proposed that the noise reduction provided by a typical residential building façade is 7 dBA assuming open windows. As a conservative approach considering poor building quality of outback Queensland houses, a façade reduction of 5 dBA in noise levels from outside a house to inside a house when windows are fully open was adopted, the indoor noise objectives noted above could be converted to the following external objectives (with windows open) for monitoring:

- Daytime and Evening: 40 dBA $L_{Aeq,adj,1hr}$, 45 dBA $L_{A10,adj,1hr}$ and 50 dBA $L_{A1,adj,1hr}$
- Night: 35 dBA $L_{Aeq,adj,1hr}$, 40 dBA $L_{A10,adj,1hr}$ and 45 dBA $L_{A1,adj,1hr}$

5.3.3 Background Creep

The current 2019 version of the EPP (Noise) no longer contains criteria for background creep, but states that background creep should be prevented or minimised, to the extent that it is reasonable to do so.

Background creep is defined as "a gradual increase in the total amount of background noise in the area or place as measured applying the document called the 'Noise Measurement Manual' published on the department's website" (Section 9(4) of EPP Noise). This is understood to require consideration of cumulative impacts, including other developments.

5.4 Guideline – Planning for Noise Control

DES had previously published a guideline titled "Planning for Noise Control". The Planning for Noise Control guideline is currently listed as being "under review" according to the DES website. As such, it is not proposed to utilise the noise criteria contained within the document.

The document contains a method for determining the minimum background noise level using the lowest tenth percentile methodology.

5.5 Guideline – Assessment of Low Frequency Noise

The DES Guideline "Assessment of Low Frequency Noise" contains methods and procedures that are applicable to low frequency noise emitted from industrial premises and mining operations for planning purposes. Items such as boilers, pumps, transformers, cooling fans, compressors, oil and gas burners, foundries, wind farms, electrical installations, diesel engines, ventilation and air-conditioning equipment, wind turbulence and large chimney resonance may comprise sources of high-level noise having frequency content less than 200 Hz.

These sources may exhibit a spectrum that characteristically shows a general increase in sound pressure level with decrease in frequency. Annoyance due to low frequency noise can be high even though the dBA level measured is relatively low. Typically, annoyance is experienced in the otherwise quiet environments of residences, offices and factories adjacent to or near low frequency noise sources. Generally, low level/low frequency noise becomes annoying when the masking effect of higher frequencies is absent. This loss of high frequency components may occur as a result of transmission through the fabric of a building, or in propagation over long distances.

Where a noise immission (noise level received at a sensitive receptor) occurs exhibiting an unbalanced frequency spectrum, the overall sound pressure level inside residences should not exceed 50 dBZ to avoid complaints of low frequency noise annoyance. A spectrum is considered unbalanced when the unweighted overall noise level is more than 15 dB higher than the A-weighted overall noise level.

5.6 Guideline – Noise and Vibration from Blasting

The DES Guideline "Noise and vibration from blasting" contains criteria and procedures that are applicable to noise and vibration emitted from blasting. It applies to activities such as mining, quarries, construction and other operations which involve the use of explosives for fragmenting rock.

The criteria are presented in **Table 5.1**. These criteria address human comfort and apply at residential and commercial receptors.

Table 5.1: Blasting Vibration and Airblast Criteria

Issue	
Airblast	Airblast overpressure of 115 dB (Z peak) for nine (9) out of ten (10) consecutive blasts initiated and not greater than 120 dB (Z peak) at any time.
Vibration	5 mm/s peak particle velocity for nine (9) out of ten (10) consecutive blasts and not greater than 10 mm/s peak particle velocity at any time.

It should be noted that higher limits would typically be used for prevention of structural damage.

5.7 Proposed Criteria

5.7.1 Noise Emissions

In accordance with the EPP (Noise) and based on the calculated external limits as discussed in **Section 5.3.2**, the resulting noise objectives for the site to protect the acoustic environment and to be proposed as noise limits for the operation are presented in **Table 5.2**.

Table 5.2: Proposed Noise Limits for Sensitive Receptors

Period	Noise Limit $L_{Aeq,adj,1hr}$ dBA
Day (7am to 6pm)	Outdoor 40 dBA $L_{Aeq,adj,1hr}$ and Indoor 50 dBZ $L_{eq,adj,1hr}$ (and dBZ-dBA > 15 dB)
Evening (6pm to 10pm)	Outdoor 40 dBA $L_{Aeq,adj,1hr}$ and Indoor 50 dBZ $L_{eq,adj,1hr}$ (and dBZ-dBA > 15 dB)
Night (10pm to 7am)	Outdoor 35 dBA $L_{Aeq,adj,1hr}$ and Indoor 50 dBZ $L_{eq,adj,1hr}$ (and dBZ-dBA > 15 dB)

5.7.2 Blasting

It is proposed to adopt the blasting criteria from the Guideline "Noise and vibration from blasting". The criteria are presented in **Table 5.3**.

Table 5.3: Proposed Noise Limits for Sensitive Receptors

Issue	Criteria
Airblast	Airblast overpressure of 115 dB (Z peak) for nine (9) out of ten (10) consecutive blasts initiated and not greater than 120 dB (Z peak) at any time.
Vibration	5 mm/s peak particle velocity for nine (9) out of ten (10) consecutive blasts and not greater than 10 mm/s peak particle velocity at any time.

6. NOISE ASSESSMENT

6.1 Overview

The main contributors of noise emissions for the Project would be the mobile mining equipment (i.e. excavators, haul trucks, loaders and dozers), processing plant and generators. It is understood that the helipad and airstrip will only be used during emergencies, and so these have not been considered further in this assessment.

Construction activities within the mine site would have similar or less emissions than the mining operations and would be undertaken for a relatively short period of time. Hence, construction activities within the mine site would likely have less impact than operational activities. Therefore, only the operational mine activities have been represented in the model.

6.2 Model Description

Noise modelling was carried out using the CONCAWE method, which is widely used and accepted for noise modelling and is approved by DES. The CONCAWE method allows for modelling a number of discrete meteorological scenarios.

The SoundPLAN V8.2 program was used to develop a three-dimensional digital terrain noise model of the project area and the surrounding area including the location of sensitive receptors. The model incorporates terrain data for the proposed Project and the existing surrounding topography.

6.3 Meteorology

The mining noise levels at potential sensitive receptors can vary significantly depending upon the meteorological conditions and the mining activities. Meteorological conditions have a significant effect on the noise levels, particularly due to wind speed and direction and vertical temperature gradients, which include temperature inversions.

It is possible to measure noise variations of the order of 15 to 20 dBA due to changes in meteorological conditions. Assessment is required under typical worst-case meteorological conditions according to the DES Planning for Noise Control guideline.

The SoundPLAN model was set up to predict noise levels under neutral and adverse meteorological conditions. The conditions used in the noise model are shown in **Table 6.1**.

Table 6.1: Meteorological Scenarios

Parameter	Day Meteorological Scenario		Night Meteorological Scenario	
	Scenario D1-Neutral	Scenario D2-Adverse	Scenario N1-Neutral	Scenario N2-Adverse
Pasquill Stability Class	D	D	F	F
Temperature (°C)	25	25	10	10
Wind Speed (m/s)	0	2	0	2
Wind direction	No wind	Towards receptor	No wind	Towards receptor
Relative Humidity (%)	40	40	70	70

These meteorological scenarios are presented to give an indication of the range of noise levels from neutral to adverse conditions and are assessed against the criteria corresponding to the periods when they are most likely to occur. The most critical predictions are the night scenarios since this assesses the highest predicted noise levels against the most stringent night-time criteria.

The SoundPLAN model assumes the wind direction is from the source to each receptor and thus modelling for multiple wind directions is not required.

6.4 Noise Source Data

The model uses the sound power level (L_W) of each noise source to predict noise emissions. The sound power levels used in the model were based on noise source data obtained from previous mining projects and are inclusive of tonality and impulsiveness penalties. The sound power levels for the proposed equipment for the Project are presented in **Table 6.2**.

Table 6.2: Noise Source Sound Power Levels

Equipment	Data Source	Octave Band Sound Power Level $L_{w,eq}$ dBZ								Overall $L_{w,eq}$	
		63	125	250	500	1k	2k	4k	8k	dBZ	dBA
Excavator (PC700/LC-8)	1,2	119	113	104	108	101	95	93	89	120	108
Truck (HD325-7)	1,2	118	118	111	106	105	101	98	95	121	110
Excavator (PC1250)	1,2	123	117	108	112	105	99	97	93	124	112
Truck (HD605-7)	1,2	118	118	111	106	105	101	98	95	121	110
Dozer	3	85	103	108	116	113	115	106	92	120	119
Grader	4	108	115	112	104	104	102	98	90	118	110
Water Cart	4	110	112	110	111	111	109	101	96	119	115
Rubber tyre dozer	1,2	77	95	100	108	105	107	98	84	112	111
Processing Plant	5	123	122	121	122	119	118	110	108	129	124
Lighting Plant	6	80	81	81	81	79	77	74	69	88	84
500kW Water Pump	2	98	112	104	104	101	102	98	98	114	108
90kW Water Pump	6	79	93	85	85	82	83	79	79	95	89
75kW Water Pump	6	78	92	84	84	81	82	78	78	94	88
55kW Water Pump	6	76	90	82	82	79	80	76	76	92	86
Road Trucks (A-Triple)	6	109	107	105	104	105	103	96	84	114	109
A/C Unit (Room Type)	6	71	68	67	65	58	52	47	42	75	65

The sources of data used to compile the sound power level data in **Table 6.2** are presented in **Table 6.3**.

Table 6.3: Source of Data for Equipment Sound Power Levels

Source #	Data Source
1	Data based on measurements undertaken by Trinity at a coal mine.
2	Manufacturer's noise data.
3	Trinity database, based on sound power level calculated from measurements at a coal mine for the same/similar equipment.
4	Data for these sources was extracted from a coal mine project. Generally, this data is similar to noise data for similar equipment at other mine sites and is considered suitable for noise modelling purposes.
5	Data for this source was adopted from the following sources: Overall dBA value from: Kintyre Uranium Project (The Pilbara) Environmental Noise Assessment Report (ref 13970-4-11174), Prepared by Herring Storer Acoustic, Prepared for Cameco Australia, on December 2011.

Source #	Data Source
	Spectrum adjusted from: Saint Elmo Vanadium Project Noise and Vibration Technical Report (Trinity Consultants 2020).
6	Data based on Trinity Database

The equipment numbers and location for the modelled Project years are presented in **Table 6.4** based on information provided by the Proponent.

Table 6.4: Equipment Number and Locations for Modelled Project Years

Equipment	Number of Items and Locations
Excavator (PC700/LC-8)	1 in mining area
Truck (HD325-7)	3 between mining area and MIA
Excavator (PC1250)	2 in mining area
Truck (HD605-7)	5 in mining area
Dozer	4 in mining areas
Grader	2 in internal roads
Water Cart	2 in internal roads
Rubber Tyre Dozer	1 in MIA
Processing Plant	1 in MIA
A/C units	100 in camp area
Delivery and product trucks on access road	2 per hour at 60 km/h (peak hour condition, A-Triple)
Lightning Plant	3 in mining area
500kW Water Pump	1 in pumping infrastructure
90kW Water Pump	1 in mining area
75kW Water Pump	1 in MIA
55kW Water Pump	1 in raw water dam

The equipment modelled has been chosen to closely reflect the anticipated mining fleet. However, there is potential for alternate makes and models of equipment to be used in the operating mine. If the equipment model is changed, the sound power level of the alternative model could be reviewed to determine if noise level increases are expected. Furthermore, a BESS (battery energy storage system) will be considered for use with the proposed solar array in the future. Although BESSs are noise sources that must be considered in most cases, given that the sound power levels of mining equipment studied in this assessment are significantly higher than typical noise emissions from a BESS, no increase in overall noise impact from the proposed mine operation would be expected due to a possible BESS application in the future.

6.5 Modelling Scenario

Mining noise emissions from the Project have been predicted for Year 26 mine site layout with Year 25 production rate of the Project, as this is considered the typical worst-case scenario for noise sensitive receptors to the southeast.

Modelling has included ground elevations, equipment numbers and equipment locations as presented in **Table 6.4** and **Figure B.1** in **Appendix B**. Modelling has excluded aircraft noise since the proposed infrastructure is intended to facilitate access for the Royal Flying Doctors Service during emergency situations, and only rare air traffic is expected.

The overall sound power levels of the equipment modelled in the day and evening, and night scenarios are presented in **Table 6.5**. The tabulated values are a combination of the sound power levels of all mining equipment operating.

Table 6.5: Overall Mine Noise Source Sound Power Levels

Period	Octave Band Sound Power Level $L_{w,eq}$ dBZ								Overall $L_{w,eq}$	
	63	125	250	500	1k	2k	4k	8k	dBZ	dBA
Day, evening and night	131	130	125	126	124	124	116	111	135	129

6.6 Predicted A-weighted Noise Levels and Assessment

The predicted mining noise levels at nearby sensitive receptors are presented in **Table 6.6**. These tabulated noise levels (or component noise levels) do not include ambient noise level, indicating noise impact of the proposed mining activities only. Ambient noise levels at the noise sensitive receptors may be higher than the level predicted here due to local noise sources such as insects, local traffic, and other extraneous noise sources.

Table 6.6: Predicted A-weighted Noise Immission Level.

Receptor ID	Predicted Noise Immissions Level, $L_{eq,adj,T}$ dBA			
	D1	D2	N1	N2
1 – Bow Park	15	21	26	22
2 – Debella	8	14	18	14
3 – Malpas Trenton	-1 (Inaudible)	6	10	8

Predicted noise levels are also shown graphically as noise contours in **Appendix C** for the modelled scenario and day and night meteorological conditions, as follows:

- **Figure C.1** Day Scenario D1-Neutral
- **Figure C.2** Day Scenario D2-Adverse
- **Figure C.3** Night Scenario N1-Neutral
- **Figure C.4** Night Scenario N2-Adverse

6.7 Predicted Low Frequency Noise Immission Levels & Assessment

An assessment of low frequency noise immission levels at residential receptors has been included in accordance with the guideline "Assessment of Low Frequency Noise criteria".

The internal noise limit at a residence is an unweighted noise level of 50 dBZ which is considered to correlate with an external noise limit of 55 dBZ, reduction from outside to inside through a residential building with open windows. If the external noise level exceeds 55 dBZ and the difference between the unweighted and A-weighted noise levels exceeds 15 dB at the same time, then the noise is considered to have unacceptable low frequency content and further assessment is required.

The predicted unweighted (Z-weighted) noise levels at the residential receptors are shown in **Table 6.7**.

From the results in **Table 6.7** it can be seen that there are no results exceeding 55 dBZ. Therefore, the predicted low frequency noise levels are acceptable.

Table 6.7: Predicted Z-weighted Noise Immission Levels

Receptor ID	Predicted Noise Immission Levels, $L_{eq,adj,T}$ dBZ / (dBZ-dBA difference)			
	D1	D2	N1	N2
1 – Bow Park	31 / 16	36 / 15	38 / 12	36 / 14
2 – Debella	25 / 17	30 / 16	33 / 15	31 / 17
3 – Malpas Trenton	14 / 15	18 / 12	20 / 10	19 / 11

7. BLASTING ASSESSMENT

7.1 Overview

It is anticipated that the existing vibration levels around the Project and at the location of sensitive receptors will generally be negligible, except at locations which are close (e.g. within 100 metres) to haul roads, mobile plant or near major items of fixed plant. No sensitive receptors for the Project are within this range.

The only vibration source of significance from the proposed mining activities would be blasting. Although blasting activities are not anticipated for the Project, a vibration assessment was still undertaken. Possible blasting activities within the pits have been assessed for both ground vibration and airblast. The relevant criteria for ground vibration and airblast have been presented and discussed in **Section 5.6** and **Table 5.1**.

7.2 Predictions

Ground vibration and airblast levels caused by blasting activities have been predicted based on the formulas and methodology of Australian Standard AS2187.2 "Explosives - Storage Transport and Use - Use of Explosives", which predicts the peak particle velocity (PPV) in mm/s and the airblast over pressure (peak pressure level) in dBZ.

7.2.1 Ground Vibration

In accordance with the criteria presented in **Section 5.6**, ground vibration levels are to achieve 5mm/s PPV for nine out of ten blasts and not greater than 10mm/s PPV at any time. Ground vibration can be calculated at various distances from a blast using the following formula from AS2187.2:

$$V = K\,(R / Q^{1/2})^{-ß}$$

Where: V = ground vibration as peak particle velocity (PPV) (mm/s)

K = site constant

R = distance between charge and point of measurement (m)

Q = effective charge mass per delay or maximum instantaneous charge (kg)

ß = site exponent or attenuation rate

Ground vibration from blasting generally increases with an increase in charge mass and reduces with increase in distance.

A site exponent (ß) (attenuation rate) of 1.6 has been estimated for the site based on Trinity's experience with similar mining projects. The site constant (K) was assumed to be in the range 800 to 1600. The maximum instantaneous charge mass was planned to be 94 kilograms. **Table 7.1** contains the calculated ground vibration levels (mm/s) at various distances from the blast.

Table 7.1: Ground Vibration Levels at Various Distances from the Blast

Distance from Blast, km	Vibration Level mm/s	
	K = 800	K = 1600
1.0 - Campsite	0.48	0.96
2.0	0.16	0.32
4.0	0.05	0.10
6.0	0.03	0.05
7.6 - Bow Park	0.02	0.04
8.0	0.02	0.03

Distance from Blast, km	Vibration Level mm/s	
	K = 800	K = 1600
10.0	0.01	0.02
12.0 - Debella	0.01	0.02

Table 7.1 shows that the 5 mm/s PPV criterion would not be exceeded at distances greater than 1.0 kilometre from the blast.

The nearest sensitive receptor is approximately 7.6 kilometres away from the nearest pit within the proposed Project area. Therefore, ground vibration due to blasting is predicted to be compliant with the nominated criteria at all sensitive receptors.

It should be noted that the distance between mining camp site and nearest blasting area is assumed to be 1.0 kilometres and ground vibration due to blasting at the camp site is also predicted to be compliant with the 5 mm/s PPV criterion.

7.2.2 Airblast

In accordance with the criteria presented in **Section 5.6**, airblast pressure levels are to achieve 115 dBZ for nine out of ten blasts and not greater than 120 dBZ at any time. For blasting in an open-cut mine, the distance to the 120 dBZ Lpeak contour line from the blast can be calculated using the following formula[1]:

$$D_{120} = (k * h / \text{maximum}(B, S))^{2.5} * m^{1/3}$$

Where: D_{120} = distance to the 120 dBZ Lpeak contour (m)

k = a site constant determined from the ratio S/B and S/h which requires local calibration

h = hole diameter (mm)

B = burden (mm)

S = stemming height (mm)

m = charge mass (kg)

The site constant, k, has been assumed to be equal to 180 based on Trinity's experience with other mining projects.

The following blast information has been provided:

- h = 150 mm
- S = 4000 mm
- B = 6750 mm
- m = 94 kg

Table 7.2 contains the separation distances and the reduction of noise levels due to distance.

Table 7.2: Airblast Noise Levels at Various Distances from the Blast

Distance from Blast, km	Airblast Level. dBZ
0.145	120.0
0.21	115.0
1.0 - Campsite	95.0
2.0	86.0

[1] Reference: Richards, A B and Moore A J (2002), Airblast Design Concepts in Open Pit Mines, presented at The 7th International Symposium on Rock Fragmentation by Blasting (FRAGBLAST 7).

Distance from Blast, km	Airblast Level. dBZ
4.0	77.0
6.0	71.7
7.6 - Bow Park	68.6
8.0	68.0
10.0	65.1
12.0 - Debella	62.7

The distance to the 120 dBZ contour line is calculated to be 145 metres. The distance to the 115 dBZ contour line is calculated to be 210 metres.

The nearest sensitive receptor is approximately 7.6 kilometres away from the nearest pit within the proposed mining area. Therefore, airblast overpressure due to blasting is predicted to be compliant with the nominated criteria at all sensitive receptors.

It should be noted that the distance between the mining camp site and nearest blasting area is assumed to be 1.0 kilometres, and airblast overpressure due to blasting is also predicted to be compliant with the nominated criteria at the camp site.

8. OPERATIONAL VIBRATION ASSESSMENT

8.1 Existing Vibration Levels

It is anticipated that the existing vibration levels around the mine site and at the location of sensitive receptors will generally be negligible, with the exception of locations that are close to existing roads, rail lines or near major items of fixed plant (e.g. farm machinery, light vehicles, pumps and generators).

Site specific vibration measurements have not been undertaken, as is normal practice, but we would expect vibration levels below 0.1 mm/s (PPV) except near aforementioned vibration sources where higher levels may be expected. Some typical vibration levels at different setback distances are provided in **Section 8.2.4**, with indications of vibration levels below 0.1 mm/s (PPV) when there is no notable vibration source nearby.

8.2 Vibration from Proposed Activities

8.2.1 Background

The only vibration source of significance in a mining project is blasting, and therefore blasting would be the only vibration source that would typically be assessed. The vibration criteria proposed in **Section 5.6** only relate to blasting vibration.

It has previously been noted that rather than blasting, other vibration sources would not be expected to cause impacts beyond 100 metres. As there are no sensitive receptors within 100 metres of the mine (the nearest receptor, Bow Park, is approximately 8 kilometres from the mine), no vibration impacts would be expected.

In this instance, more detailed vibration assessment has been requested by DES and has been provided in this section.

8.2.2 Criteria

The extent of any impact from vibratory works will vary depending on the geological conditions, the type of works being carried out and the type and condition of the structures located near the works. The effects of ground-borne vibrations will generally be perceived (heard and felt) at levels much lower than those that would cause structural damage. Vibration perceptibility levels are listed in **Table 8.1**.

Table 8.1: Vibration Perceptibility

Approximate Vibration Level (mm/s) (PPV)	Degree of Perception
0.10	Not felt
0.15	Threshold of perception
0.35	Barely noticeable
1.0	Noticeable
2.2	Easily noticeable
5.0	Very noticeable – construction activity limit (unlikely to cause damage)
6.0	Strongly noticeable
Reference:	DIN 4150-2 Structural vibration - Human exposure to vibration in buildings.

8.2.3 Minor Vibration Sources

Potential minor vibration sources are assessed in the following sections and could include:

- Construction equipment
- Mining and earthmoving equipment.

8.2.4 Typical Vibration Levels – Construction, Mining and Earth Moving Equipment

The approximate vibration levels generated by these minor sources are as follows in **Table 8.2**.

Table 8.2: Typical Vibration Levels of Construction, Mining and Earth Moving Plant Items

Equipment	Approximate Vibration Level (PPV, mm/s) at 10 metres
Piling	12 to 30
Roller (15 tonne)	7 to 8
Dozer	2.5 to 4
Compactor (7 tonne)	5 to 7
Backhoe	1

Reference : Roads and Maritime Services Environmental Noise Management Manual 2001.

The rate of vibration attenuation can be calculated using the following formula:

$V = kD^{(-n)}$, where

V = vibration velocity (PPV, mm/s)

k = vibration velocity (PPV, mm/s) at 1 unit of distance (metres)

D = distance (metres)

n = attenuation exponent, which generally lies between 0.8 and 1.6 with a relatively common value of 1.5 used.

The vibration levels can thus be calculated as per **Table 8.3**.

Table 8.3: Typical[2] Vibration Levels at Distance from Construction Plant Items

Equipment	Approximate Vibration Level (PPV, mm/s)		
	10 metres	250 metres	500 metres
Piling	12 to 30	0.1 to 0.2	< 0.1
Roller (15 tonne)	7 to 8	0.1	< 0.1
Dozer	2.5 to 4	< 0.1	< 0.1
Compactor (7 tonne)	5 to 7	< 0.1	< 0.1
Backhoe	1	< 0.1	< 0.1

The nearest sensitive receptor (Bow Park) to the project is approximately 8 kilometres from the mining site and the next nearest sensitive receptor (Debella) is 12 kilometres from the site.

From **Table 8.3** it can be seen that vibration levels of all sources would be 0.1 mm/s or lower at the nearest residence and would not be felt (refer **Table 8.1**). Therefore, no associated vibration conditions are proposed for the project.

[2] As determined from Trinity's library of data.

9. NOISE MANAGEMENT PLAN

9.1 Overview

Noise modelling results indicate that exceedances of the nominated noise criteria at the residential sensitive receptors are unlikely. Therefore, it is unlikely that a noise and vibration management plan will be required to be enacted for the mine. Nevertheless, the following information is provided for assistance in the event of a noise or vibration complaint.

9.2 Monitoring

In the event of a noise and/or vibration complaint it is recommended that noise and/or vibration level compliance be confirmed by monitoring at the most noise affected receptor/s and/or complainants' location. The monitoring and assessment report should be conducted in accordance with the Noise Measurement Manual (DES, 2020). Should the short-term monitoring assessment indicate exceedances of the limits within the EA conditions, then a long-term monitoring system should be considered.

9.3 Summary

Noise and vibration complaints are not expected as a result of the Project. Regardless, in the event of a justifiable noise or vibration complaint, monitoring is generally recommended. In the event of monitoring indicating an exceedance of EA (Environmental Authority) limits from mining noise, then noise and/or vibration management measures should be developed and implemented until such time as complaints and/or exceedances have been resolved.

10. CONCLUSION

A noise and vibration impact assessment has been conducted for the Project. A noise model has been developed for proposed mining activities for the worst-case mining scenario, i.e., Year 26 mine site layout with Year 25 production rate, to predict noise immission levels at nearby noise sensitive receptors.

From this assessment, the following conclusions are made:

- Noise criteria for the mine have been proposed in **Section 5.7.1**. The outdoor noise limits at sensitive residential receptors are 40 dBA $L_{Aeq,adj,1hr}$ in the day, 40 $L_{Aeq,adj,1hr}$ in the evening and 35 dBA $L_{Aeq,adj,1hr}$ in the night; and an indoor noise limit at sensitive receptors of 50 dBZ $L_{eq,adj,1hr}$ (and dBZ-dBA < 15 dB).
- Noise levels are assessed under several meteorological conditions in **Section 6**. Noise modelling has determined that under all conditions:
  - An assessment of A-weighted noise impacts in **Section 6.6** indicates that potential noise sensitive receptors, i.e., Bow Park, Debella and Malpas-Trenton, are compliant with relevant $L_{Aeq,adj,1hr}$ noise limits.
  - An assessment of low frequency noise impacts in **Section 6.7** indicates that the low frequency noise criterion is compliant at all noise sensitive receptors.
- Noise and vibration levels are predicted to be compliant at sensitive receptors identified in **Section 2.2**. However, although the proposed mining camp accommodation is not considered a sensitive receptor, we note that noise levels from mining activities may cause sleep disturbance unless appropriate acoustic control treatments are included in accommodation building specifications.
- A noise and vibration management plan has been recommended when necessary and prepared in accordance with **Section 9**.
- Although, there are no other significant vibration sources, operational vibration is assessed in **Section 8**. No exceedances were predicted.
- No noise and vibration exceedances were predicted due to construction activities.

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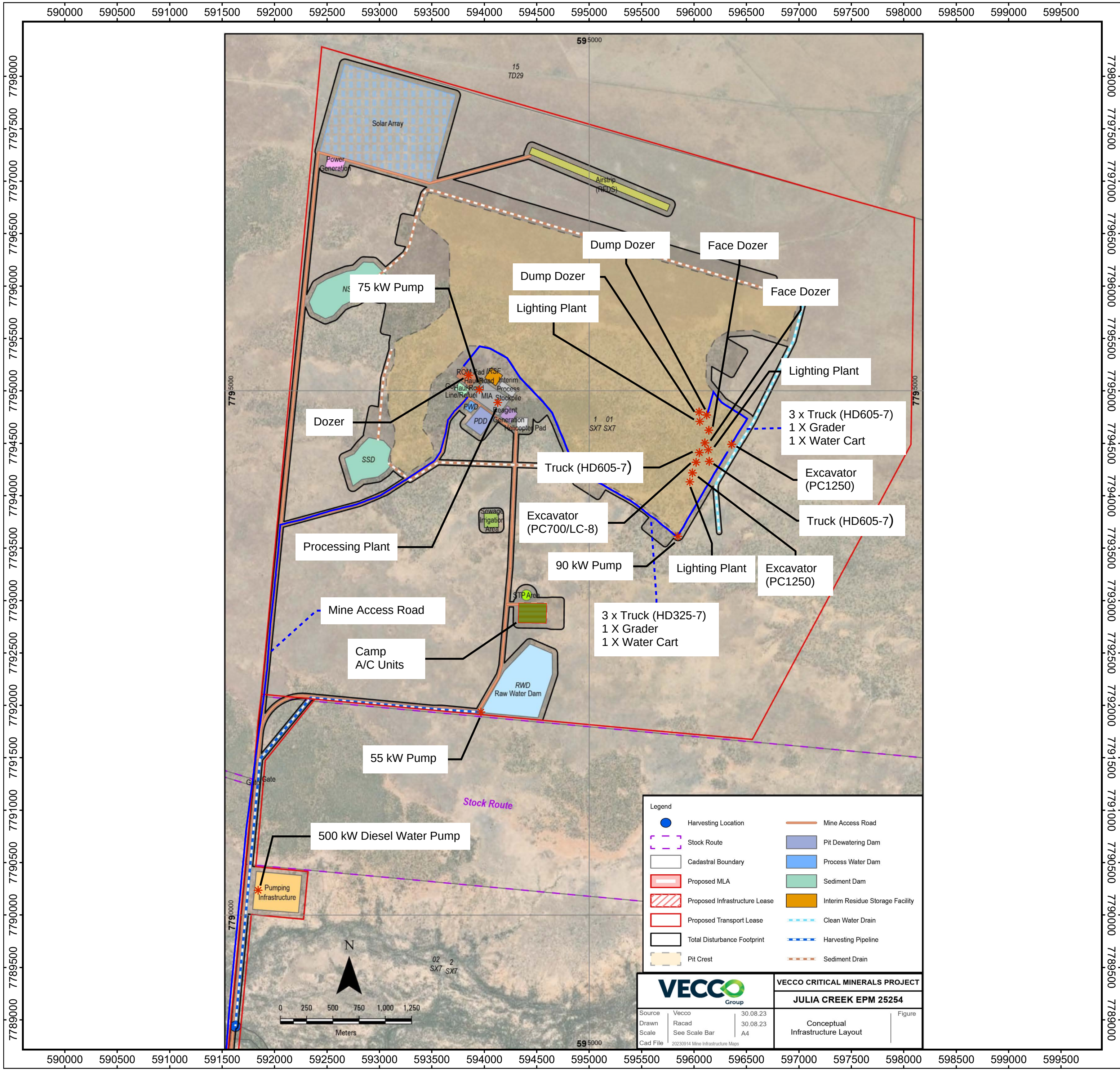
APPENDIX A GLOSSARY

Parameter or Term	Description
dB	The decibel (dB) is the unit measure of sound. Most noises occur in a range of 20 dB (quiet rural area at night) to 120 dB (nightclub dance floor or concert).
dBA	Noise levels are most commonly expressed in terms of the 'A' weighted decibel scale, dBA. This scale closely approximates the response of the human ear, thus providing a measure of the subjective loudness of noise and enabling the intensity of noises with different frequency characteristics (e.g. pitch and tone) to be compared.
Day	The period between 7am and 6pm.
Evening	The period between 6pm and 10pm.
Night	The period between 10pm and 7am.
Free-field	The description of a noise receptor or source location which is away from any significantly reflective objects (e.g. buildings, walls).
Frequency	The fluctuation of oscillating sound waves measured by the number of wave cycles per second. Frequency is quantified using a unit of measurement known as Hertz (abbreviated Hz), which defines the number of repeating cycles per second.
L_1	The noise level exceeded for 1% of the measurement period.
L_{10}	The noise level exceeded for 10% of the measurement period. It is sometimes referred to as the average maximum noise level.
L_{90}	The noise level exceeded for 90% of the measurement period. This is commonly referred to as the background noise level.
L_{eq}	The equivalent continuous sound pressure level, which is the constant sound pressure level over a given time period, which is equivalent in total sound energy to the time-varying sound pressure level, measured over the same time period.
$L_{eq,\ 1hour}$	As for Leq except the measurement intervals are defined as 1 hour duration.
$L_{eq,\ 24\ hour}$	The average Leq noise level over the 24-hour period from midnight to midnight.
Low frequency noise	Noise with low frequency components containing significant acoustic energy within a frequency range defined by one-third octave bands 10 Hz to 200 Hz.
Noise immission	noise level received at a sensitive receptor
ROM	Run of mine, referring to the ore removed from the pit.
tpa	tonnes per annum
Z-frequency weighting	Means the sound pressure level when no frequency weighting is applied, as specified in Australian standard AS IEC 61672.1-2019.

APPENDIX B NOISE SOURCE LOCATIONS USED IN MODELLING



VECCO CRITICAL MINERALS PROJECT
Project Number: 227401.0093

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Figure B.1

End Of Year Noise Source Locations

Date: 8/09/2023
Drawn By: BA
Prepared For: Vecco /c- AARC

Signs and Symbols

- Point receiver
- Point source
- Line source
- Area source

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VISION ENVIRONMENT

Air Noise Environment

C:\Users\burak.ayva\Trinity Consultants, Inc\Vecco Group - 227401.0093 - Debella Vanadium Mine\Model (Noise)\22.0093 Model\Figure B2.sgs

APPENDIX C PREDICTED NOISE CONTOURS

VECCO CRITICAL MINERALS PROJECT
Project Number: 227401.0093

N

Figure

C.1

Year EOM Noise Contours
Day - Scenario D1

Date: 8/06/2023
Drawn By: BA
Prepared For: Vecco /c- AARC

Free Field Noise Levels $L_{eq(1\ hour)}$ dBA
Ground Contour Calculation Height = 1.8m

25 <		<=	35
35 <		<=	45
45 <		<=	55
55 <		<=	65
65 <		<=	75
75 <			

Signs and Symbols
- Point receiver
- Point source
- Line source
- Area source

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C:\Users\burak.ayva\Trinity Consultants, Inc\Vecco Group - 227401.0093 - Debella Vanadium Mine\Model (Noise)\22.0093 Model\Figure C1.sgs

VECCO CRITICAL MINERALS PROJECT
Project Number: 227401.0093

N

Figure

C.2

Year EOM Noise Contours
Day - Scenario D2

Date: 8/06/2023
Drawn By: BA
Prepared For: Vecco /c- AARC

Free Field Noise Levels $L_{eq(1\ hour)}$ dBA
Ground Contour Calculation Height = 1.8m

25 <	(green)	<=	35
35 <	(yellow-green)	<=	45
45 <	(orange)	<=	55
55 <	(red)	<=	65
65 <	(dark red)	<=	75
75 <	(dark blue)		

Signs and Symbols

- Point receiver
- Point source
- Line source
- Area source

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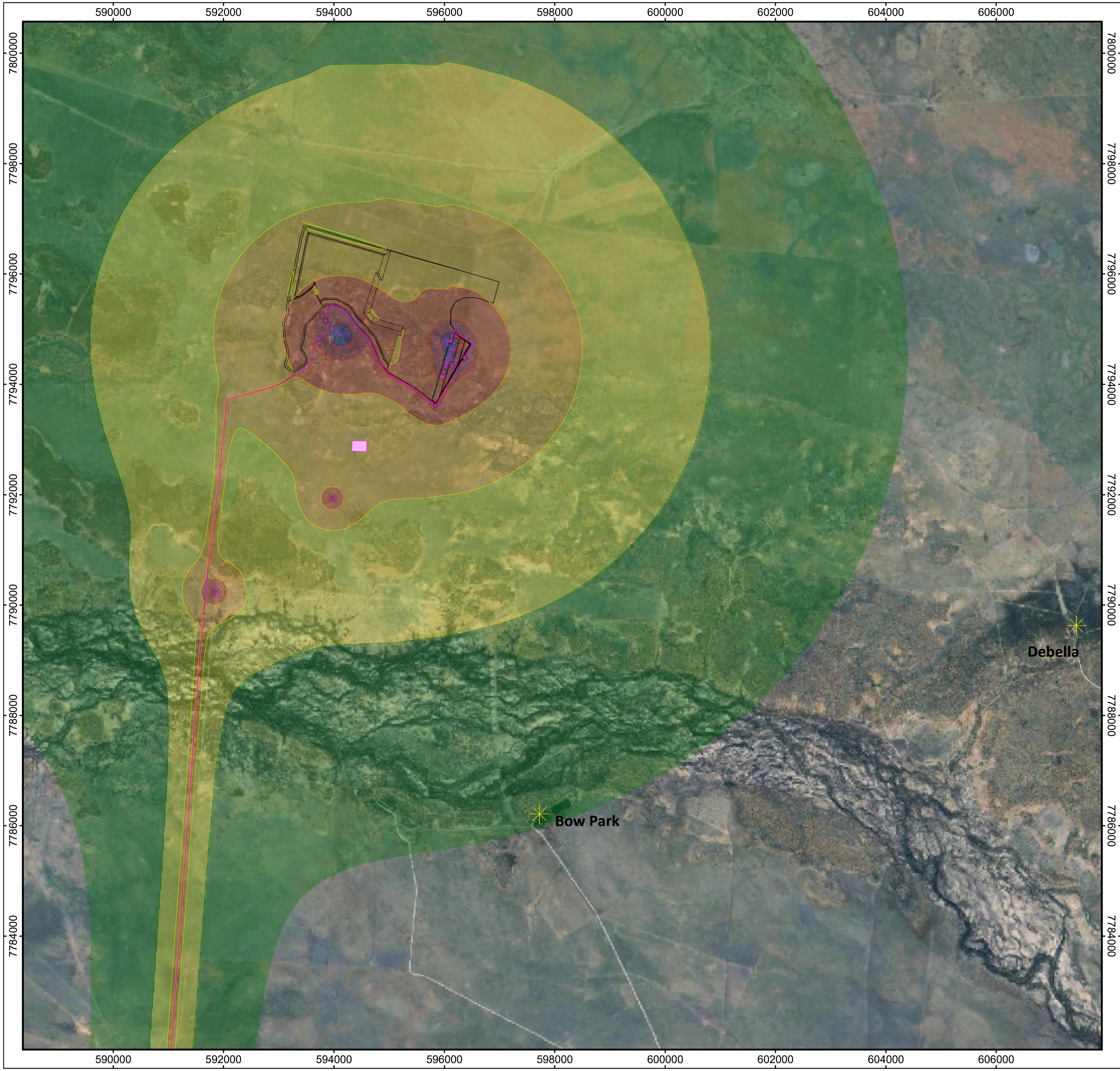
C:\Users\burak.ayva\Trinity Consultants, Inc\Vecco Group - 227401.0093 - Debella Vanadium Mine\Model (Noise)\22.0093 Model\Figure C2.sgs



VECCO CRITICAL MINERALS PROJECT
Project Number: 227401.0093

N

Figure C.3

Year EOM Noise Contours
Night - Scenario N1

Date: 8/06/2023
Drawn By: BA
Prepared For: Vecco /c- AARC

Free Field Noise Levels $L_{eq(1\ hour)}$ dBA
Ground Contour Calculation Height = 1.8m

25 <	(green)	<=	35
35 <	(yellow)	<=	45
45 <	(orange)	<=	55
55 <	(red)	<=	65
65 <	(dark red)	<=	75
75 <	(dark blue)		

Signs and Symbols
- Point receiver
- Point source
- Line source
- Area source

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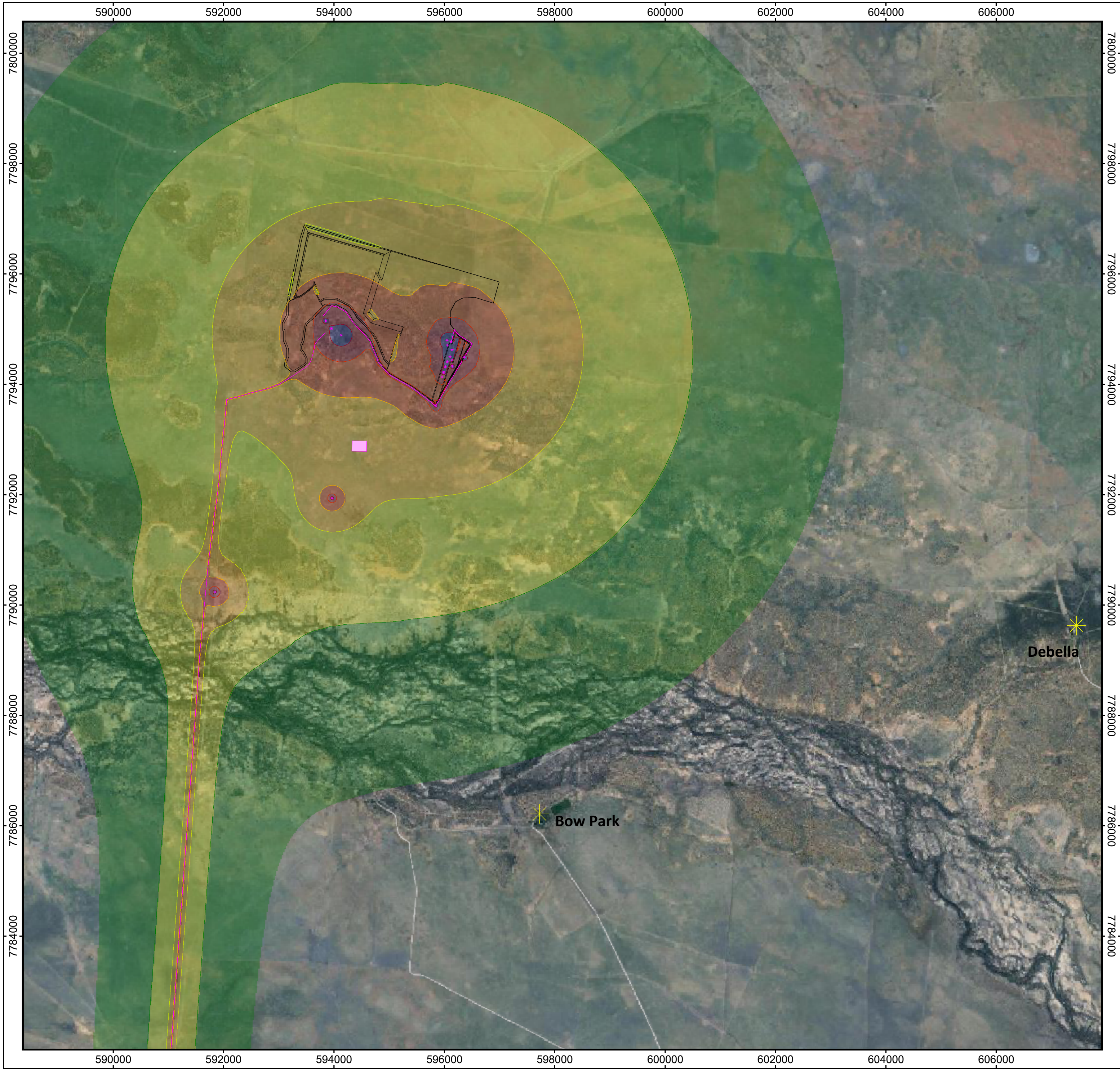

VECCO CRITICAL MINERALS PROJECT
Project Number: 227401.0093

N

Figure C.4

Year EOM Noise Contours
Night - Scenario N2

Date: 8/06/2023
Drawn By: BA
Prepared For: Vecco /c- AARC

Free Field Noise Levels $L_{eq(1\ hour)}$ dBA
Ground Contour Calculation Height = 1.8m

25 <	(green)	<=	35
35 <	(yellow-green)	<=	45
45 <	(orange)	<=	55
55 <	(red)	<=	65
65 <	(dark red)	<=	75
75 <	(dark blue)		

Signs and Symbols
- Point receiver
- Point source
- Line source
- Area source

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