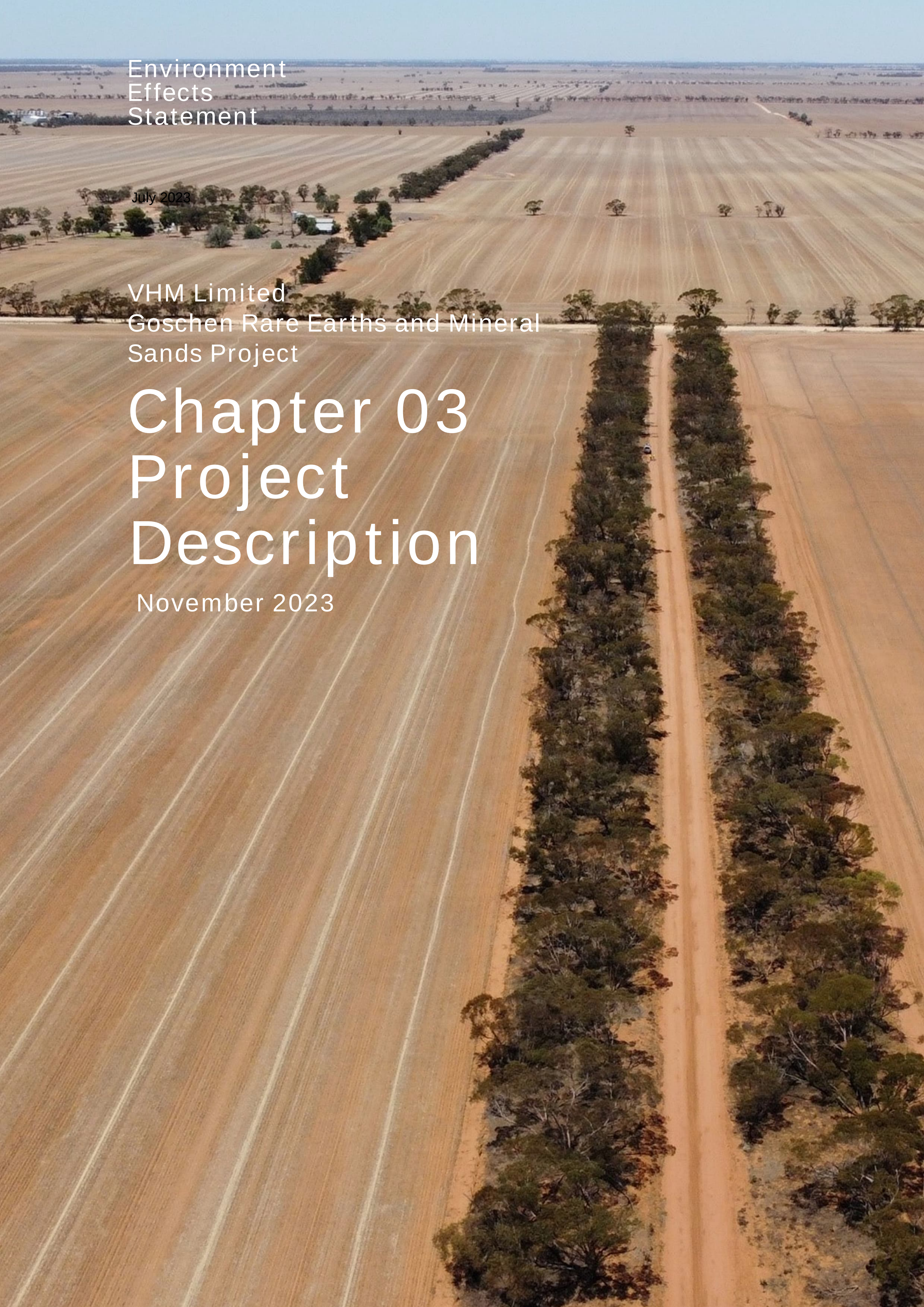
Environment Effects Statement

July 2023

VHM Limited
Goschen Rare Earths and Mineral Sands Project

Chapter 03 Project Description

November 2023



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3. Introduction

This chapter provides an overview of the construction, operation and rehabilitation of the proposed Goschen Rare Earths and Mineral Sands and Project (the Project). The purpose of this chapter is to describe the Project and its components, and to provide a clear understanding of the scope of works that are assessed in this Environment Effects Statement (EES).

3.1 Overview

VHM Limited (VHM) is proposing to develop the Goschen Rare Earths and Mineral Sands Project (the Project) in the Loddon Mallee Region of Victoria, approximately 35 kilometres (km) south of Swan Hill. The Project would involve the mining and processing of rare earths and heavy mineral sands.

VHM is an Australian company established in 2014 to develop rare earths and heavy mineral sands projects located in Victoria and provide feedstock to downstream customers.

VHM hold over 2,860 km^2 of near-contiguous tenements in Victoria. This has provided VHM with access to significant historical exploration data, which formed the basis of VHM's exploration program to generate its own data for estimating mineral resources and ore reserve estimates within its tenements. The exploration undertaken to date has discovered one of the world's largest, highest-grade zircon, rutile and rare earth mineral deposits, comprising a mineralisation resource in and surrounding the Project in excess of 300 million tonnes, located near Lalbert in the Murray Basin, Victoria (refer to Figure 3-1 and Figure 3-2).

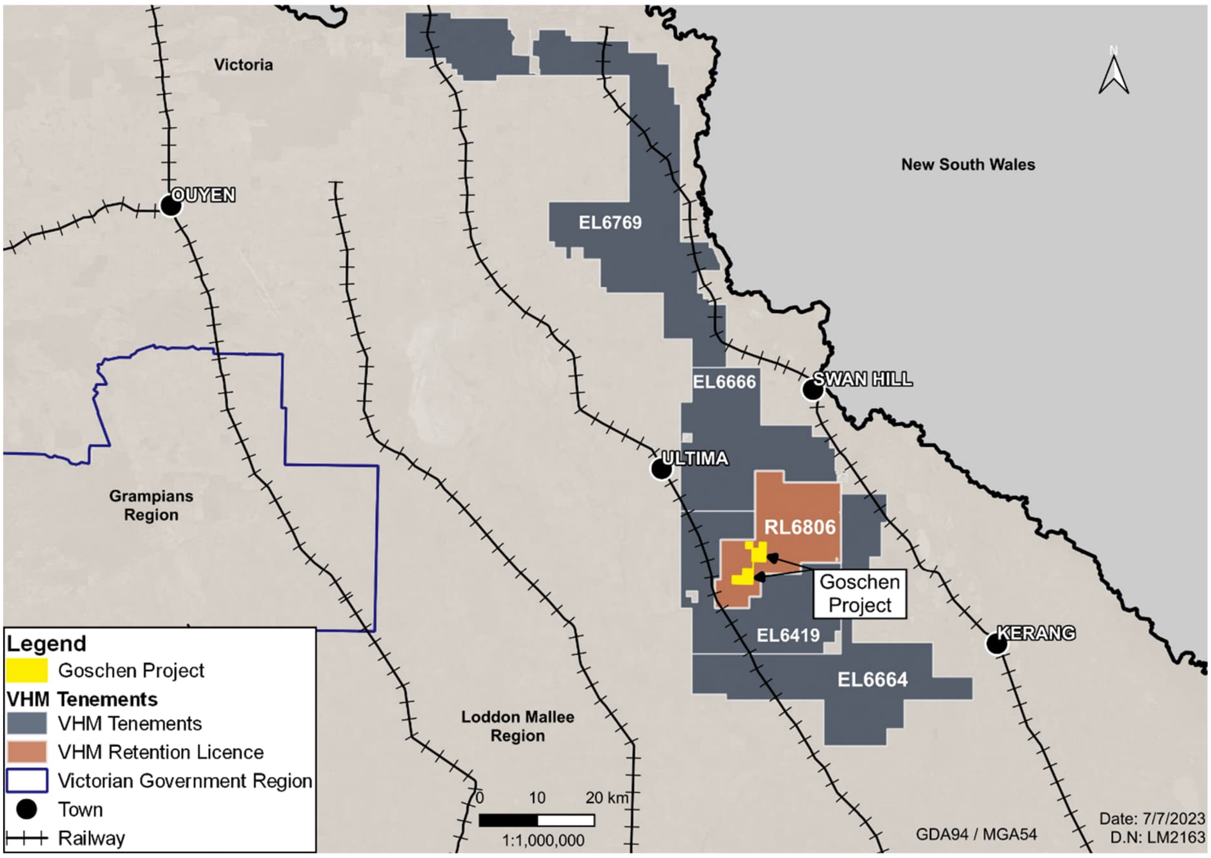


Figure 3-1 Project location

The Project would involve the mining and processing of heavy mineral sands and rare earths at a throughput rate of approximately 5 million tonnes per annum (Mtpa) of ore to produce mixed heavy mineral concentrate (HMC) comprising zircon concentrate, rutile product, leucoxene products, ilmenite product and rare earth mineral products, over a 20 to 25 year mine life. The products would then be transported via road and rail for export overseas.

The on-site mineral processing would be implemented over various phases which are summarised in Table 3-1 below.

Table 3-1 Summary of proposed mineral products from on-site processing

	Processing		
Phase	1	1A	2
Timing	At commencement of operations.	Construction planned to commence during Phase 1 construction to allow commissioning around 6 to 12 months after project commencement.	Construction planned to commence around 2 to 3 years after project commencement.
Processing plant or circuit	Mining unit plant (MUP) Wet concentrator plant (WCP) Rare earth mineral concentrate (REMC) flotation plant	MUP WCP REMC flotation plant Hydrometallurgical circuit	MUP WCP REMC flotation plant Hydrometallurgical circuit Mineral separation plant (MSP)
Products	Zircon/titania HMC REMC	Zircon/titania HMC REMC Mixed rare earth carbonate (MREC)	Zircon/titania HMC REMC MREC Premium zircon Zircon concentrate HiTi/rutile HiTi leucoxene Low chromium ilmenite

3.1.1 Background

The Project, as described in this EES, was developed through an iterative process that was undertaken to assess a range of alternatives, with the aim of creating a project that provides long term local socioeconomic benefits whilst avoiding and minimising adverse environmental and social impacts.

The design process has incorporated specialist input from engineers, environmental consultants, geologists and construction and mining contractors. Investigations and studies completed to inform the EES have assessed the identified options and helped to refine the design to maximise recovery of the resource and address the environmental, social and economic impacts of the proposed mine to achieve a sustainable development.

The key components of the Project include:

- Mining – Mining would operate 24 hours a day over approximately 20 to 25 years to generate 5 Mtpa ore for feed to the on-site process plant. Mining would occur above the regional groundwater table within the proposed mining licence area (MIN) across approximately 750 hectares (ha) of farmland (~49% of 1,534 ha which makes up Area 1 and 3 – Figure 3-2) using conventional open cut mining methods of excavation, load and haul. Extracted ore would be slurried in the mining unit plant (MUP) and conveyed via pipeline to the processing plant.
- Processing – The mineral processing would operate 24 hours a day with heavy mineral sands and rare earths ore separated via an on-site MUP, WCP and MSP to generate a rare earth mineral concentrate (REMC). Refining of the REMC on-site (Phase 1A processing) is limited to hydrometallurgical extraction to produce a mixed rare earth carbonate (MREC). Tailings from the various mineral processes would be homogenised at the plant and placed back into cells within the mine voids via pipeline.
- Rehabilitation – The mined areas would be progressively backfilled in a staged manner with homogenised tailings being placed in the pit first and then overlaid with overburden, subsoil and topsoil so that the profile reinstates the background soil structure and returns the land to agricultural land uses within three to five years of it being mined. No remnant stockpiles or above ground structures would remain post closure.
- Water – An off-site water source is required for construction earthworks, processing, dust suppression and rehabilitation with demand peaking at 4.5 gigalitres per year (GL/y) for the start-up and 3.1 GL/y for operations (Phase 2 Processing). The off-site water would be sourced from Goulburn Murray Water (GMW) through the open water market and be delivered via a new pumpstation adjacent to Kangaroo Lake and a 38 km underground pipeline to be constructed beneath existing local roads (Figure 3-6).

- Power – All electrical power needed for mining and processing would be produced from an on-site power plant able to be fuelled by diesel, liquefied natural gas (LNG) and/or liquefied petroleum gas (LPG). A transition is expected within five years to renewables, hydrogen and/or battery - this is expected to occur as technologies and commercial viability increase and/or with the future connection to grid. Heat energy for the on-site gas fired appliances would be provided from an extension of the distribution network from the main LNG storage and regasification system.
- Transport – Final products from Phase 1, 1A and 2 processing would be containerised in 20 foot sealed sea containers on site and exported via the preferred route of road (daytime hours only) to an intermodal terminal at Ultima and then rail to the Port of Melbourne (Figure 3-14 and Figure 3-15). An alternative route for the sealed sea containers to be transported by road all the way to the Port of Melbourne is included for times when the rail line is shut down for maintenance or there are other unplanned events (e.g. flooding).

3.1.2 Objectives

The purpose of the Project is to mine and process heavy mineral sands and rare earths within two areas:

- Area 1 has an expected life of mine of approximately eight to 10 years at 5 Mtpa Run of Mine (ROM) throughput capability. The processing plant for ore extracted from Area 1 and Area 3 is also proposed to be located in Area 1, north of Bennett Road for the duration of the Project; and
- Area 3 has an expected mine life of approximately 12 to 15 years at 5 Mtpa ROM throughput capability, once mining of ore within Area 1 has ceased.

The Project has been designed to minimise environmental impacts as much as practicable and will be operated in accordance with regulatory requirements, and in so doing aims to deliver long-term benefits to the community and local, state and federal governments.

The mine site area will be progressively rehabilitated to enable the continuation of agricultural activities consistent with the previous use at the end of mining. All roads closed during mining will be reinstated together with native vegetation corridors, leaving a positive mining legacy for local landowners and the surrounding community.

The Project provides a significant opportunity to further enhance the critical mineral sands and rare earths industry in Victoria and to grow the Victorian economy by creating new opportunities for employment. Rare earth elements are the building blocks of sustainable technologies, including renewable energy, electric vehicles, and e-mobility alternatives. VHM intends to establish the Project to mine ore and process it to produce the range of products described in Table 3-1 to national and international consumers.

3.1.3 Project mining footprint

The proposed Project mining area is within Retention Licence (RL) 6806 and comprises:

- Area 1, which is approximately 722 ha and has an estimated mineral resource[1] of 82.2 million tonnes (Mt).
- Area 3, which is approximately 754 ha and has an estimated mineral resource of 140 Mt.
- Connecting services corridor (<3ha) between Area 1 and 3 within Shepherd Road.

These areas, shown in Figure 3-2 below, form the proposed MIN area and the general layout of Area 1 and Area 3 is presented in Figure 3-4 and Figure 3-5. The active areas within Area 1 and 3 (mining, processing and ancillary) total approximately 750 ha (~49% of total proposed MIN area).

VHM outlined in its 2018 Referral a larger mineralisation zone footprint but ultimately selected just Areas 1 and 3 for development and assessment in this EES after assessing the available mineral resource and considering potential environmental impacts associated with design alternatives. Further information about the iterative process that informed the design of the Project is provided in Chapter 4.

1 measured + indicated (Mineralisation report, VHM 2023)

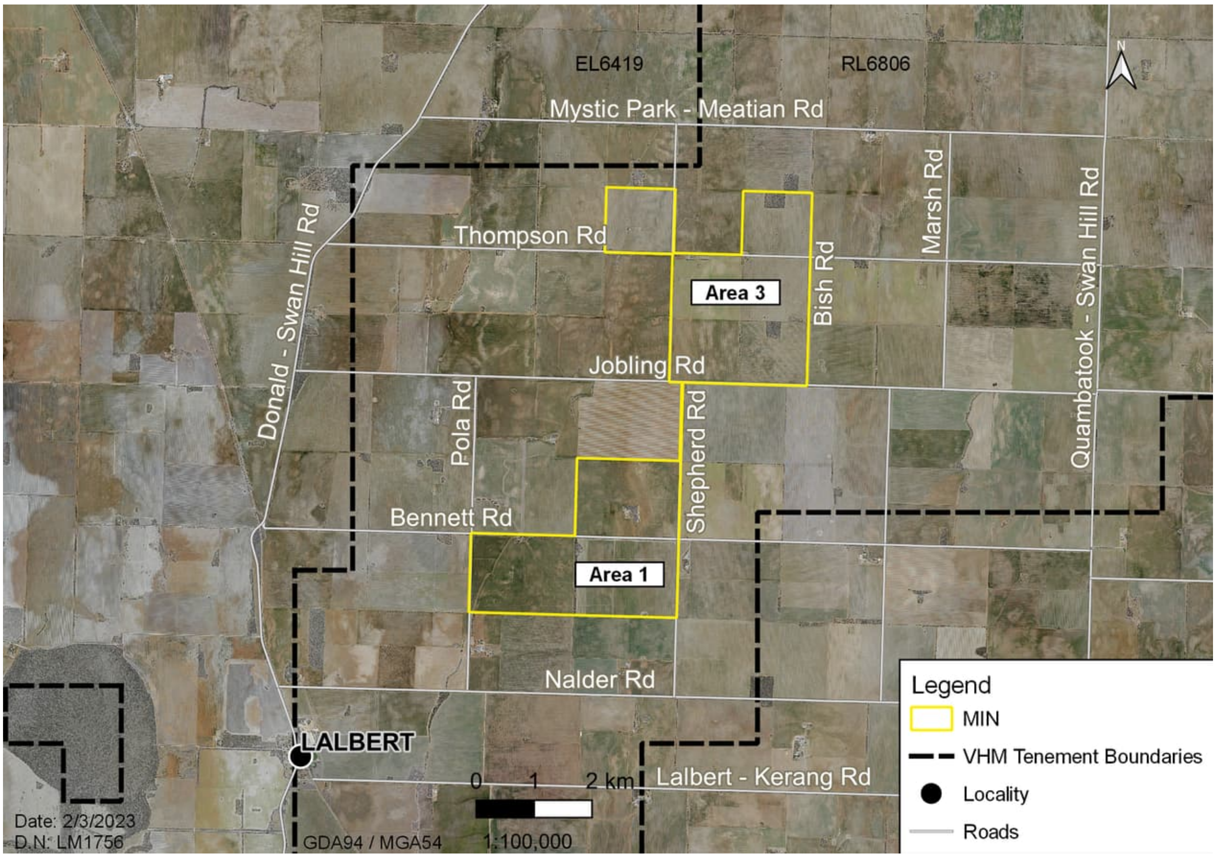


Figure 3-2 Mine Site Area – and Proposed MIN Boundary (yellow)

3.1.4 Infrastructure required for the Project outside the proposed MIN boundary

A water pipeline and pump station are proposed to be constructed to deliver water required for the Project from Kangaroo Lake, which is located approximately 30 km to the east of the Project mining area. The pump station would be located adjacent to existing GMW water pumping infrastructure at Kangaroo Lake, with the water pipeline proposed to be constructed primarily within road reserves as shown in Figure 3-5 below.

In addition, a number of local roads outside the proposed MIN boundary are proposed to be upgraded to facilitate the safe movement of vehicles to and from the Project mining area, as described in Table 3-6 and Figure 3-13 below.

3.1.5 Existing land use and sensitive receptors

Areas 1 and 3 are generally used for broadacre farming consisting of dryland cropping and the production of wheat, barley, pulses, legumes, and sheep grazing.

The Project area falls within the Murray and Western Plains surface water segment, which comprises river and stream reaches of lowlands (generally below 200 metres (m) in altitude), including the Avoca basin.

Potential sensitive receptors[2] identified within 2 km of the Project mining area include:

- five (5) dwellings, excluding two dwellings VHM has entered into contract for the freehold
- eleven (11) council roads
- Powerlines in the south-western block of Area 1 and north-west block of Area 3
- Telecommunications cables.

[2] As defined by Earth Resources Regulation in the *Preparation of Work Plans and Work Plan Variations - Guideline for Mining Projects* (December 2020, version 1.3): any member of the public, or land, property or infrastructure in the vicinity of the proposed work

The following potential sensitive receptors have found not to be present within 2 km of the Project mining area:

- registered waterways
- registered groundwater bores.

Potential sensitive receptors identified within 150m of the Kangaroo Lake pumpstation, and pipeline alignment include:

- ten (10) dwellings
- eight (8) council roads
- Powerlines, Telecommunications cables.

3.1.6 Timeframes and workforce

The timeframes for planning, design, construction and operation of the Project are shown in Figure 3-3.

Figure 3-3 Project timeline

The mine process plant would operate 24 hours per day, 365 days per year. Mining operations would also be undertaken 24 hours per day, (excepted in designated areas). Work shifts would be made up of two 12-hour shifts commencing at 7am and 7pm.

VHM anticipate that the construction workforce would consist of up to 260 people. Workforce numbers would vary throughout the different stages of construction. The mining operations workforce is likely to consist of up to 400 full time jobs, varying throughout the various phases of operation. Where possible, workers would be employed from the local area, however it is noted that a number of specialist jobs would likely be sourced from outside the local area.

It is assumed that workers who already live in the region would travel to the Project site each day. Additional workers from outside of the region may relocate for the duration of Project construction and/or operation, with a range of incentives being considered to increase housing numbers in the region. Specialised contractors used for construction and/or key maintenance periods who would work a rotation would use a range of appropriate dedicated existing or upgraded seasonal accommodation facilities.

3.2 Site preparation and construction

The construction of the Phase 1 process plant (Table 3-1) and the preliminary works to allow mining within Area 1 would take approximately a year to complete. This has been broken into five separate stages, from the establishment of site access to Project commissioning.

Site preparation for mining in Area 3 would not commence until approximately eight to 10 years after the commencement of operations in Area 1.

3.2.1 Site establishment

The first phase in the construction sequence would be the establishment of site access to Area 1 from Bennett Road.

Once site access is gained, the site would be established with permanent security fencing around Area 1 and temporary construction services such as demountable site offices, communications hub, site ablutions, workshops, stores and lay down areas. The initial mobilisation would consist of key project management staff and select trade skills to establish the site. The temporary site offices, communications hub and ablutions would be set-up on the western side of Area 1, to the north of Bennett Road.

As part of initial site establishment for Area 1, the following would be either temporarily closed or permanently removed:

- Farm dams will be decommissioned
- Bennett Road to be closed – to be reinstated at the end of mining
- Powerlines to be retained but moved to avoid mining areas.

As part of site establishment for when mining progresses into Area 3 (~Year 8), the following would be either temporarily closed or permanently removed as part of site establishment:

- Farm dams will be decommissioned
- GWMWater pump station and pipeline would be moved out of mining path
- Thompson Road to be closed – to be reinstated at the end of mining
- Powerlines to be retained but moved to avoid mining areas.

3.2.2 Earthworks

The second phase of construction would occur in two areas, being the process plant and the pump station and water pipeline.

Process Plant

Earthworks would involve the clearing and stripping of subsoil and topsoil layers and bulk filling of the plant site in Area 1 to design level. Area 1 earthworks would overlap with concrete works. The primary focus during this phase would be on the feed preparation plant (FPP) and wet concentrator plant (WCP) pads to allow work to continue in these areas. Earth and concrete work would then progress to the hydromet circuit and mineral separation plant (MSP), rare earth mineral concentrate (REMC) flotation plant and reagent area.

Process Water Pond (PWP), stormwater diversions/ponds, roads, carparks and other ancillary areas would follow after earth and civil work have been undertaken in key plant locations, unless resources allow for parallel construction.

Pump Station and Water Pipeline

Earthworks would involve the pad preparation for the pump station at Kangaroo Lake and trenching and pipe laying for the pipeline.

3.2.3 Structural, mechanical and piping construction

Structural and piping construction would occur at the same time following the earthworks. The mining unit plant (MUP) would not require any civil works and so its installation would occur while civil construction is underway in the main processing area. Once civil work is complete in the processing plant area on Area 1, the overland piping required to convey slurried ore (from the mining areas to the processing plant) and tailings (from the processing plant back to the mine voids) would be installed, and the structural and mechanical construction of the REMC plant would be undertaken.

The mechanical installation of the processing plant would then commence, with work beginning at the ground floor before progressing to upper levels. As progress permits, pipework would be installed in each plant commencing with large bore piping.

The installation of high voltage cabling to the mining areas from the power plant would occur during this phase.

3.2.4 Electrical and instrumentation construction

Following the structural and mechanical construction of the lower floors of the WCP and MSP, electrical and instrumentation construction would commence. This would involve the installation of cabling, trays, switch rooms and instruments, allowing for the plant to be construction verified and commencement of commissioning.

3.2.5 Commissioning

The commissioning phase would commence from the handover of the construction verified processing plant. The following would be made available prior to the commencement of commissioning:

- Power to the process plant
- Raw water supply (from Kangaroo Lake).

Sufficient feed material (ore) would be required for continuous operation during commissioning, which would be provided by the commencement of the first mining blocks within Area 1.

The plant would be energised first and then dry commissioned. Dry commissioning is a subsequent phase of pre-commissioning and includes the loading of the control system, first fill lubrication, "bump testing" of drives, initial instrument calibration, testing of critical safety systems and the running of rotating machinery without water and without feed.

Subsequent commissioning phases would consist of:

- A water run to initially flush out construction debris followed by the circulation of water through water circuits on a system-by-system basis. These water runs prove the integrity of the plant under water; and
- The dry run of those items that do not carry fluids such as conveyors, feeders, and screens with the purpose of tracking, aligning, and adjusting these items of plant.

Figure 3-4 below presents the proposed layout of Area 1 and Figure 3-5 below presents the proposed layout of Area 3, noting that the MUP will be moved as mining operations progress so indicative locations at various points in time are shown.

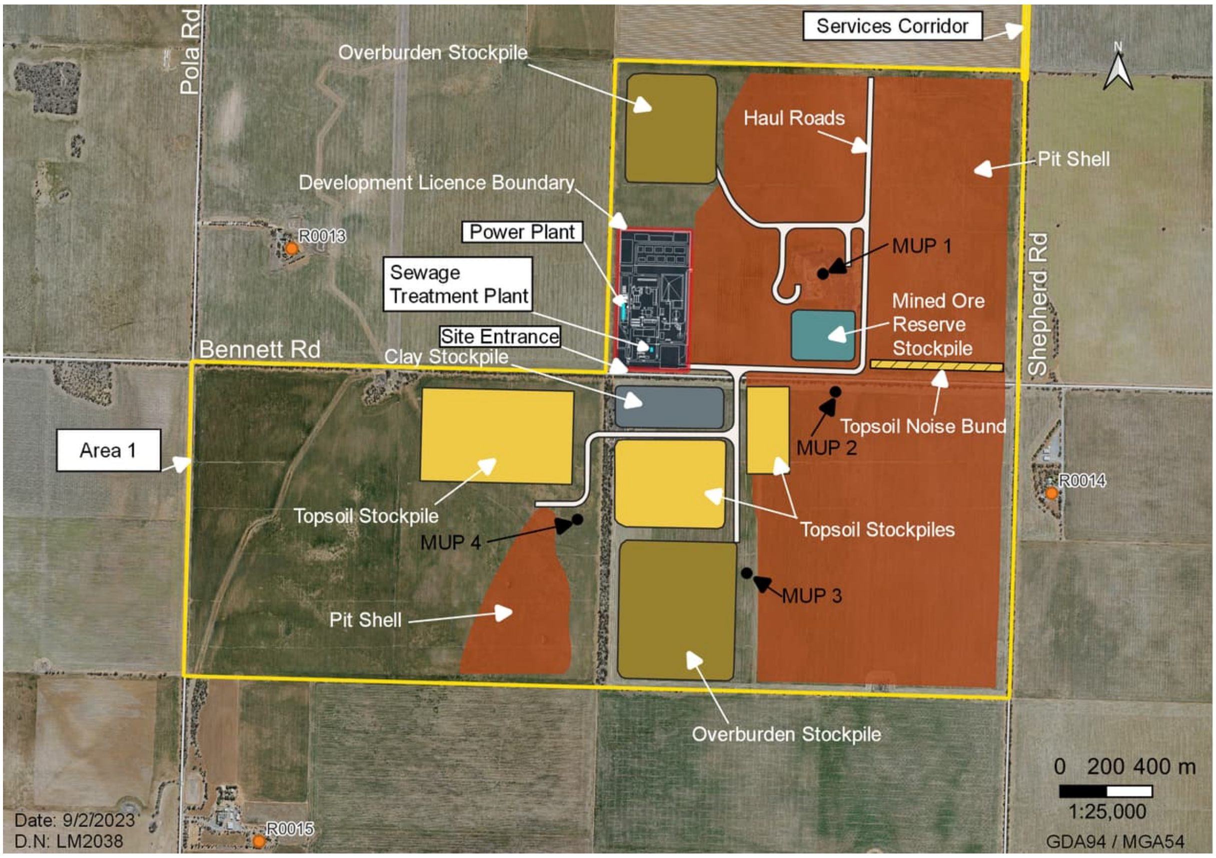


Figure 3-4 Area 1 proposed layout

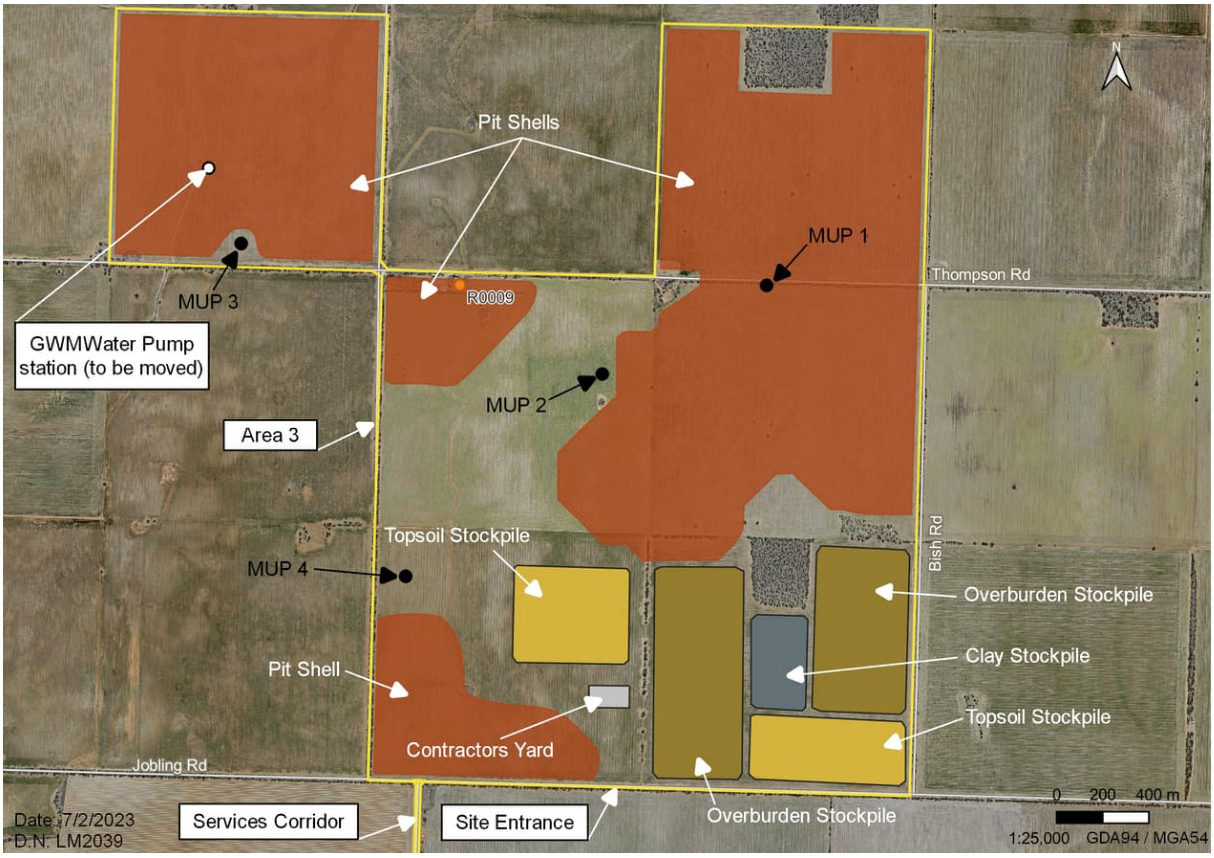


Figure 3-5 Area 3 proposed layout

3.2.6 Ancillary construction and utilities

Power

As part of the Project a power station will be needed, with a connected load capacity of 10.2 megawatt (MW) and would be installed within the processing plant in Area 1 (refer to Figure 3-4).

The proposed power supply is based on an off-grid solution using on-site generators to provide a reliable continuous source of electrical energy to operate the mine and would be progressively installed to meet the power requirements of the various processing plant stages (Phases 1, 1A and 2).

Key features of the proposed power station include:

- an indicative configuration of 12 installed 850 kilowatt (kW), 11kilovolt (kV) tri-fuel generating sets with two additional generator sets in an engine shed that is fitted with an overhead crane for maintenance
- 11 kV switch room with provision for alternative renewable energy inputs and future expansion
- fuel storage for diesel, LNG and LPG with sufficient storage capacity for 10 days operation, and
- power station controls and communications for remote monitoring of the power station.

It is expected that 12 of the 14 generators would operate under normal conditions to provide power to the Project's processing facility. The remaining two generators would either be serviced or in standby mode waiting for connection to the other generators. Operators would need to place the generators in standby mode after the regular service. The automated system would manage the entire generator system, switching off individual units when demand for power is low. This would maximise fuel efficiency and operate the generators in a normal operating loading range.

During overhauls or downtime of generator units, power would still be delivered by using the two standby generators. This would ensure reliable power supply is provided for continued 24/7 mining operations.

The power station and reticulation network around the process plant and mine site would have the capability for renewable energy inputs. This would ensure that when renewable energy is readily available and feasible to use for the Project, it can be efficiently integrated into the site grid as part of Project power supply.

During the construction phase, temporary power would be provided by mobile generator units, assumed to be running on diesel.

Water

Mine water would be supplied to the processing plant through a pipeline from Kangaroo Lake, approximately 30 km to the east of Areas 1 and 3 and will be pumped into a 60 megalitre (ML) on site Process Water Pond (PWP). Located adjacent to the processing plant, The PWP would be approximately 100 m by 80 m and lined with high density polyethylene to minimise any losses.

The mine water supply system would include a new intake pump station at Kangaroo Lake adjacent to existing GMW water pumping infrastructure, and a 38 km underground pipeline along road corridors to the PWP at the mine site.

The concept design for the pump station anticipates two bank-mounted, skid-mounted 400 kW horizontal pumps each with an electric motor. Each 400-volt (V) motor will be controlled by a variable speed drive (VSD) powered from a common switchboard. The switchboard will be connected to the Powercorp electricity grid but would also be able to be powered by a 1.5 MW dual-fuel generator.

The preferred route for the 38 km underground pipeline and the location of the pump station is presented in Figure 3-6 below.

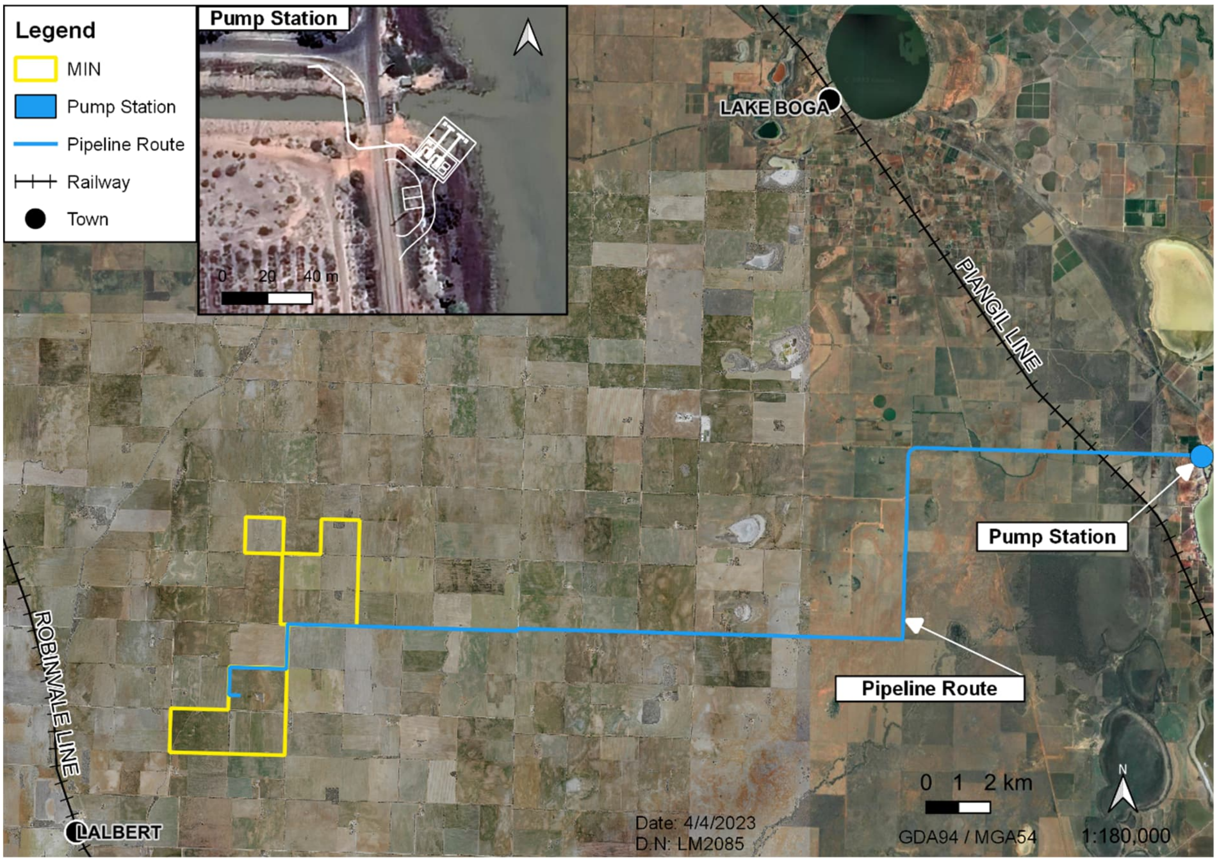


Figure 3-6 Pipeline route

The water pipeline would travel west from Kangaroo Lake along Mystic Park East Road and Mystic Park-Beauchamp Road, beneath the trafficked roadway rather than in the roadside so as to minimise impacts to native vegetation within the road reserve.

The water pipeline would then follow Lookout Road south and Teagues Road west, before joining Mystic Park-Beauchamp Road. Open trenching is the preferred method of construction, although trenchless construction methods may be needed at the following crossings, subject to further investigation:

- Swan Hill railway line at Mystic Park
- Avoca siphon channel crossing
- Channel crossings along Mystic Park-Beauchamp Road.

The notional diameter of the pipe for the water supply is 450 mm and would be installed in a nominal 1 m wide trench (to a maximum depth of 1.5 m depending on ground conditions and topography). Construction access will be required along a 6 m wide corridor within the existing road reserves to install the pipeline. The soil would typically be removed from the trench and temporarily placed on one side of the trench, with the pipe to be installed on the opposite side of the trench. Nominally, 6 m is required for this access.

Potable water would be provided by a water treatment plant with a nominal capacity of 20,000 litres per day treating Kangaroo Lake water. Water recycling systems would be used within the process water circuit as far as is practicable.

A packaged wastewater containment system would be installed as part of construction and would collect and store wastewater from showers, toilets and sinks. The wastewater system would have a nominal capacity to store up to four days of wastewater at an estimated generation of 20,000 litres per day, prior to collection and disposal at a licenced facility off-site.

Transport

As part of the Project, local roads surrounding and within the Project area would be upgraded where required to support expected vehicle movements resulting from the construction and operation of the mine.

Road works will include widening, re-surfacing, acceleration, deceleration and turning lanes and expanding intersections for increased turning circles (refer to Section 3.3.4).

Appropriate signage and road markings would also be installed as required.

Offices and amenities

Site buildings would be prefabricated and modular, and include:

- administration building
- stores warehouse with laydown area for heavy equipment
- on-site laboratory
- maintenance workshop
- security guardhouse with boom gates for access to the process plant.

All these buildings would be located within the processing plant of Area 1 (refer to Figure 3-4).

Offsite construction and operational support facilities have been established in Kerang and will continue to be utilised for the following:

- Secure yard for temporary storage of weather resistant construction and operation goods
- Undercover storage for weather sensitive goods
- Administration offices
- Office facilities as overflow to the site-based construction and operation facilities
- Community centre and project display.

Information and communication

During construction, temporary site-cellular mobile coverage would be received from a donor signal or from the nearest macro site (Lalbert town) with WiFi access provided via Starlink or equivalent service that will aim to off-set impact on existing users.

Longer term, all data communications/management requirements for operations is proposed to be provided by microwave point-to-point link. This will be achieved with a directional antenna constructed at each end, which for the Project will be a 1 m diameter antenna mounted on one of the process plant buildings (for example the MSP building), and a similar unit mounted at the other end of the link on the existing tower at Lalbert. A suitable frame to mount the antenna to the MSP building is sufficient and no additional height will be required.

Security and lighting

Perimeter security fencing would be installed as part of site establishment – initially just surrounding Area 1, until Area 3 is also fenced in around Year 7 or 8. Secondary security would be installed around secure areas, such as the process plant which would be regularly visited by reagent / fuel tankers and product shipments Figure 3-4).

Perimeter fencing would consist of a 1.8 m high chain mesh (or similar) with regular signage warning public to not enter. The perimeter fencing would be erected to discourage unwanted intrusions to the mine and process plant site, including people, sheep and wild fauna.

All roads constructed within the mine site area would be maintained by the operations team and not be open to the public.

Process building areas would be constructed of reinforced concrete-bunded aprons allowing for the containment of spills and all processing areas would have bunded concrete floors.

The lighting proposed within the Project area will consist of two types of light sources: fixed/permanent lights and stationary work lights and will be in place during all phases of the Project.

- Fixed and permanent lights comprise lighting installed as part of the permanent infrastructure, such as process and power plants, administration buildings, contractor facilities, equipment storage compounds and product stockpile areas. Lights would be installed on each level of buildings and exit lighting with battery backup to allow for power outages. Fixed lighting may also be required at the intersection of the main access road.
- Stationary work lights are associated with mining activities in the area in which mining, and tailings disposal, is occurring. These may be connected to mine grid system or with trailer-mounted lights and would comprise a number of directional, shielded lights mounted on a post. In many cases, these lights would be obscured from view within mine voids or behind stockpiles.

Chemicals and hydrocarbon storage

All reagents, oils and fuels would be stored in accordance with the appropriate regulatory requirements and within the process plant area of Area 1.

All hazardous waste (oils, waste chemicals), including from the on-site laboratory, would be stored using the appropriate regulatory requirements and be removed by a suitable licenced contracted waste management service.

Vehicle washdown and weighbridge

A vehicle washdown and weighbridge (if required) will be installed at an appropriate location near the entrance to the process plant area. Washdown would be required for all vehicles that have operated within the mine or process plant areas, before exiting operations areas back onto the public road system.

3.3 Mine operation

Mine operations, as distinct from mineral processing, includes the following key activities:

- Topsoil, subsoil and overburden stripping and stockpiling
- mining of ore and haulage to MUP
- tailings movement and deposition
- Overburden, subsoil and topsoil placement (backfilling above tailings)
- ancillary activities to allow the above to occur, such as water management, haul road construction and maintenance.

Mining is proposed to commence in Area 1, located to the immediate north and south of Bennett Road and west of Shepherd Road. Mining would be undertaken in Area 1 for around 8-10 years, before moving into Area 3, located to the north of Area 1, adjacent to Jobling and Thompson Roads. The mining approach of Area 3 would closely follow that of Area 1.

3.3.1 Mining description

The proposed mining method for the operation of the Project would be strip-mining. Strip mining refers to the removal of soil and rock, known as overburden, before the removal of underlying ore deposits. Each mined segment (mining block) would be approximately 500 m along-strike and would be variable in width to suit prevailing ground conditions.

Mining operations are designed to take place above the regional groundwater water table, with the depth of mining proposed to be approximately 20 to 40 m below ground level (m bgl). At present, there is no indication that drilling and/or blasting would be required as part of mine operations.

The proposed mining blocks for Area 1 and Area 3 are presented in Figure 3-7 and Figure 3-8. The indicative sequence is that mining operations would begin in the north-east paddock of Area 1 and would continue to the south before moving back north. Once Area 1 has been mined, mining operations are proposed to begin in the north-eastern paddocks of Area 3 before heading west.

Figure 3-7 Area 1 proposed mining blocks

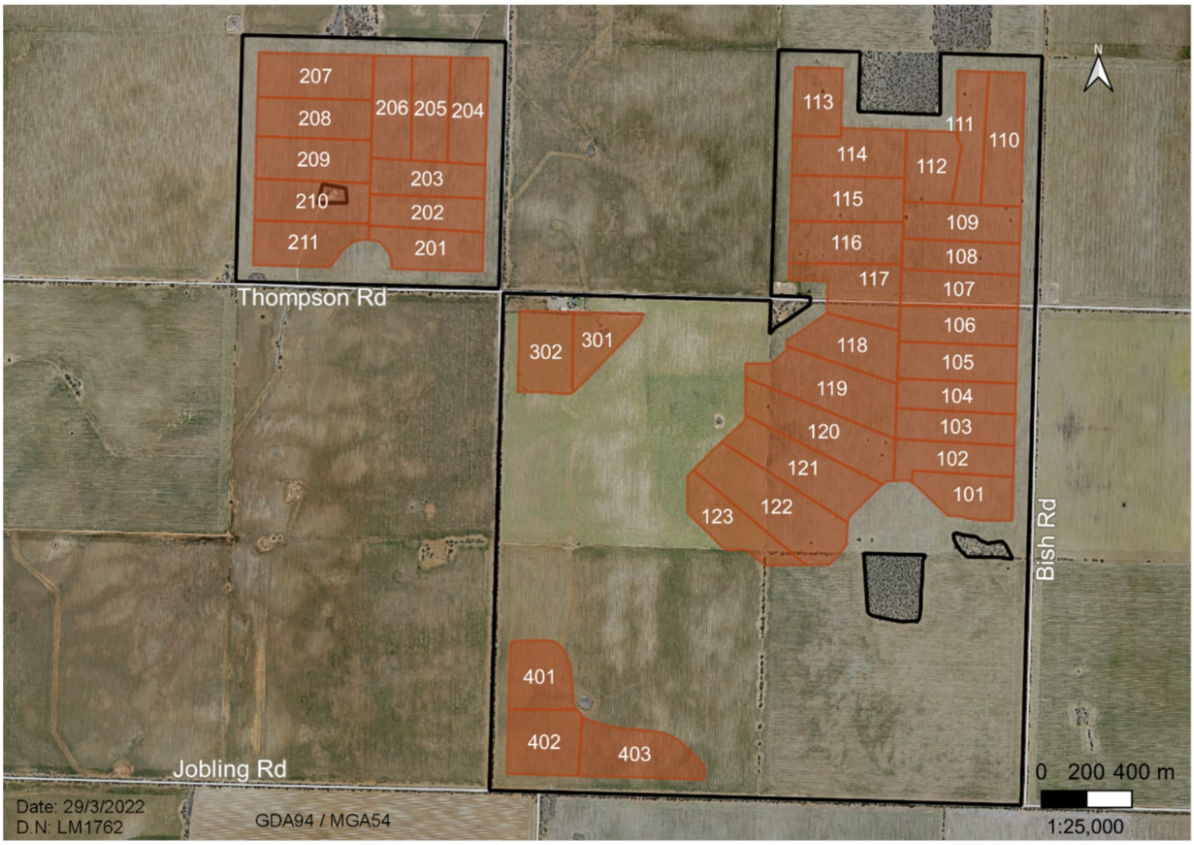


Figure 3-8 Area 3 proposed mining blocks

Mining would be primarily undertaken using excavators and trucks. Trucks (with a capacity of around 130 tonnes) would be used to transport the majority of the overburden from its in-situ location to the surface. It is proposed that (nominally) 200 tonne excavators (see Photograph 3-1) would be used to excavate and stockpile overburden, whereas smaller excavators (nominally 100 tonnes) would be used for ore mining. Rigid body trucks (see Photograph 3-2) would be used to transport ore to the MUP and other overburden material within the mine area.

Photograph 3-1 200 tonne excavator (Source: Lectura specs)

Haul road conditions within the mining area and pit will be designed to provide good trafficability for large, rigid body trucks. If in-pit trafficability conditions are challenging, equipment such as articulated dump trucks, or a heavier reliance on track mounted equipment, would be utilised.

Photograph 3-2 A 130 tonne rigid body truck (Source: Cat)

Primary mining operations would be supported by dozers and front-end loaders (FELs) which would be used for activities such as cross-ripping, pushing up bunds and contouring waste dumps. Dozers, graders and scrapers may also be used to accurately remove topsoils, subsoils and the overburden immediately above ore zones in order to minimise dilution of the ore. FELs and dozers may also be used for feeding the MUP and to assist in cleaning the pit floor to improve mining recovery.

Mining would occur in blocks, with excavation (topsoil, overburden and ore), tailings deposition (within tailings cells comprising a number of mining blocks) and rehabilitation being undertaken in a progressive sequence. It is expected that a nominal area (comprising up to 8 blocks) would be open for an estimated maximum 12 to 18 months. This mining sequence allows for the deposition of tailings without the need for an aboveground tailings storage facility (TSF).

At the beginning of mining operations, overburden and ore extracted from the first mining blocks would be stored at the surface in temporary stockpiles as indicated in Figure 3-4. Once the first mining blocks have been mined, overburden either been stockpiled or taken from an adjacent mining block would be used to make tailings embankment within the void of the mined blocks to create tailing cells. Processing of stockpiled ore would then begin, and tailings would be deposited behind the constructed embankments (i.e. within the tailings cells) located within the mined blocks. Once sufficiently dried, the tailing cells would then be covered by more overburden as mining progresses to the next block. This sequence is presented in Figure 3-9 below.

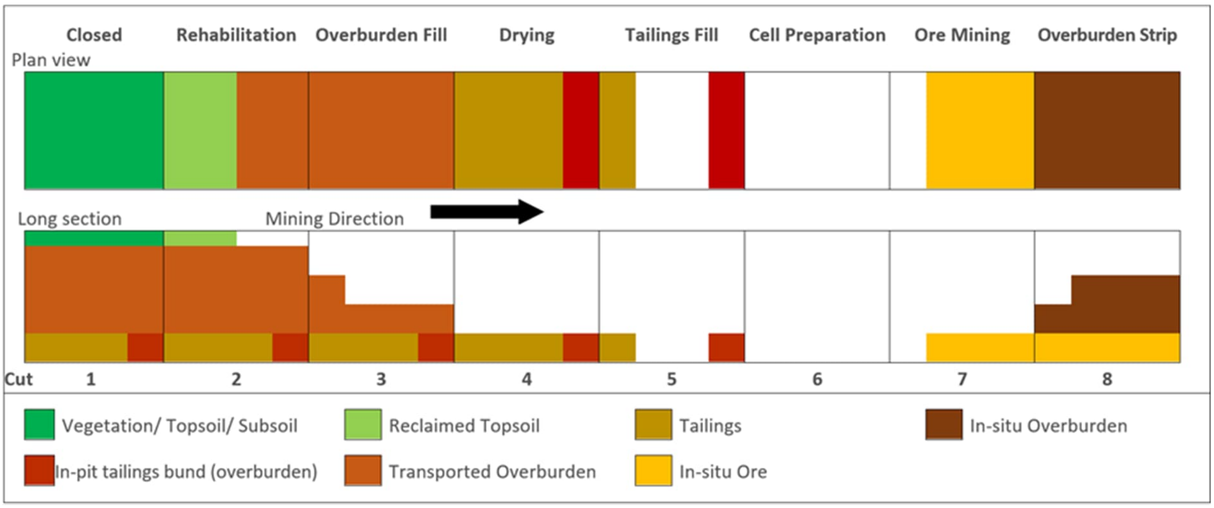


Figure 3-9 Mining sequence

Further information on materials handling is presented in Section 3.3.6.

Slope and pit design

An indicative subsurface profile has been developed based on geological logging from visual inspections, chip tray samples, core samples and laboratory analysis and is presented in Table 3-2 below.

Table 3-2 Generalised subsurface profile

Description	Typical depth range (m)	Typical layer thickness (m)	Thickness for design (m)
Topsoil, silty clay	0	1.0 to 1.5	1.5
Silty clay, becoming clayey sand with depth	1 to 6; locally up to 10 m in Area 3	4.5 to 8.6	4.5
Dense silty sand	6 to 20	10 to 16	14
Silty sand	16 to 20	20	18
Geera Clay	40 to 50	Not determined	Not determined

Common terminology used in pit slope design is presented below and in Figure 3-10:

- Bench slope angle: the angle from the horizontal of an individual bench slope. Also called a batter slope.
- Overall slope angle: the angle of the complete slope from toe to crest.
- Berm width: the horizontal width of a bench that remains between individual bench slopes. Also called catch bench/berm or safety bench/berm.
- Bench height: the vertical distance between individual berms.

- Inter-ramp angle: the slope angle between haul road locations. This is required for larger slopes and would not be necessary to consider for this project.
- Inter ramp slope height: the vertical distance from the angle of the toe of one bench to the toe of the next bench, exclusive of any ramp system.

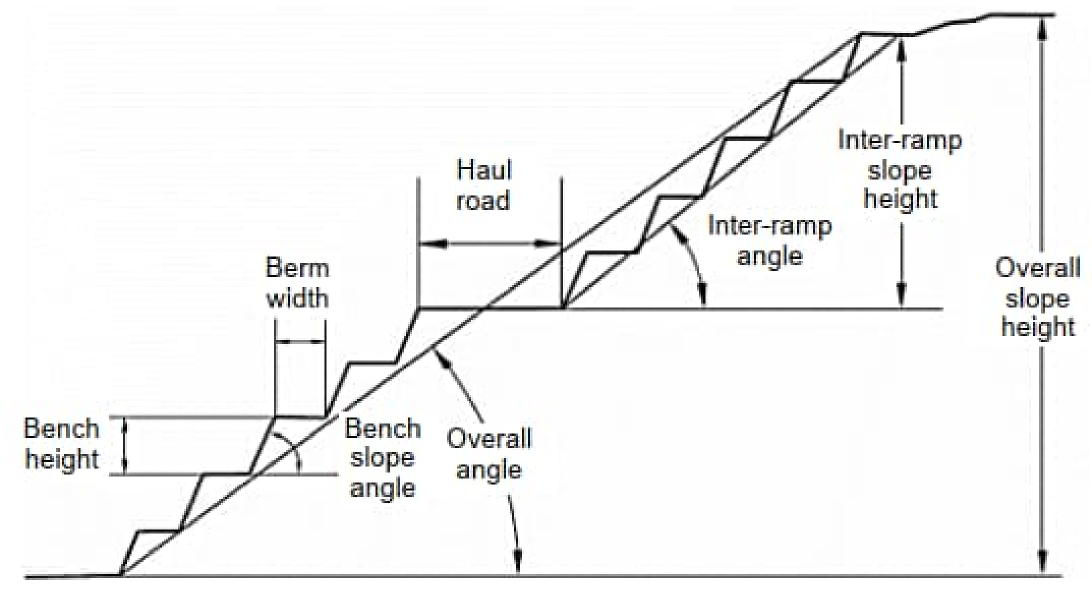


Figure 3-10 Schematic diagram of pit wall with slope design definitions

The indicative pit slope parameters proposed for the Project are presented in Table 3-3 below.

Table 3-3 Proposed pit slope parameters

Pit depth (m)	Clay layer thickness (m)	Buffer width (m)	Bench Slope Angle (Inter-ramp) (degrees)	Overall Angle (degrees)
30	4.5	21.9	35	32
40	4.5	28.6	33	31

The depth of mining will not be more than 30 m bgl in Area 1. However, in Area 3, there are some zones with thicker overburden and as such, it is proposed that the pits (mining blocks) would be up to 43 m deep.

Buffers between mine pits and the closest sensitive receptors (remnant native vegetation and/or public roads) would be 22 m for 30 m deep pits and 29 m for 40 m deep pits. The buffer distance between soil stockpiles and mine pits would be 22 m for 30 m deep pits and 31 m for 40 m deep pits.

Further information is provided in EES Technical Report J: Geotechnical impact assessment.

3.3.2 Mineral processing description

As described in Section 3.1, Phase 1 of the mining process circuit would consist of a mining unit plant (MUP), wet concentrator plant (WCP) and a rare earth mineral concentrate (REMC) flotation plant and within 6 to 12 months, Phase 1A would be commissioned and operational to introduce a hydrometallurgical circuit. Phase 2 is expected to commence construction approximately 24 months post Phase 1 production commencement and consist of an additional mineral separation plant (MSP), hot acid leach (HAL) and chrome removal circuit.

The various products generated from Phase 1, 1A and 2 would be stored in covered sheds, in segregated bays, with packaging and loading into sea containers occurring under cover.

An overview of the proposed mining process circuit is presented in Figure 3-11, Figure 3-12 and Figure 3-13, which includes the points at which tailings is generated, noting that the various tailings streams are homogenised prior to deposition in pit (Section 3.3.6).

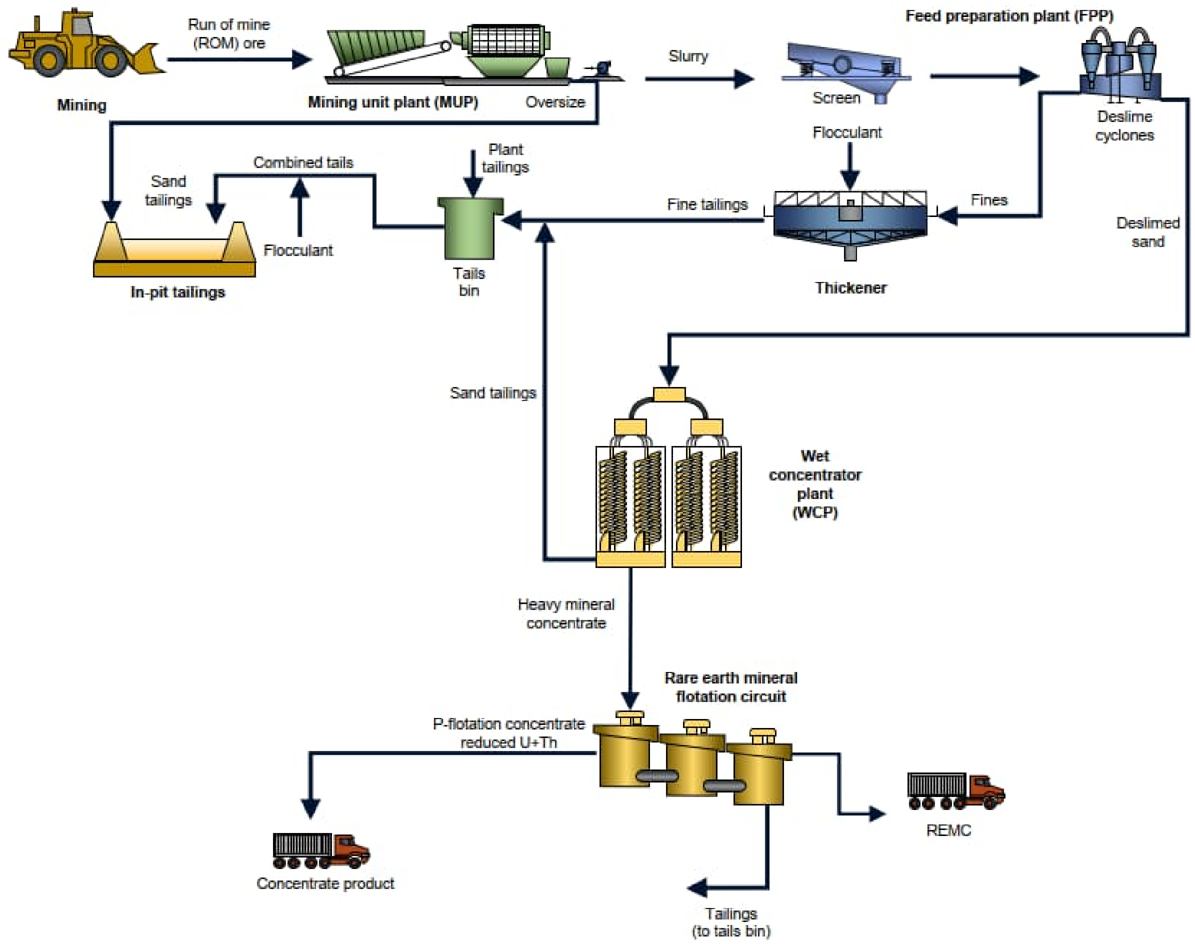


Figure 3-11 Phase 1 mining and process flow sheet

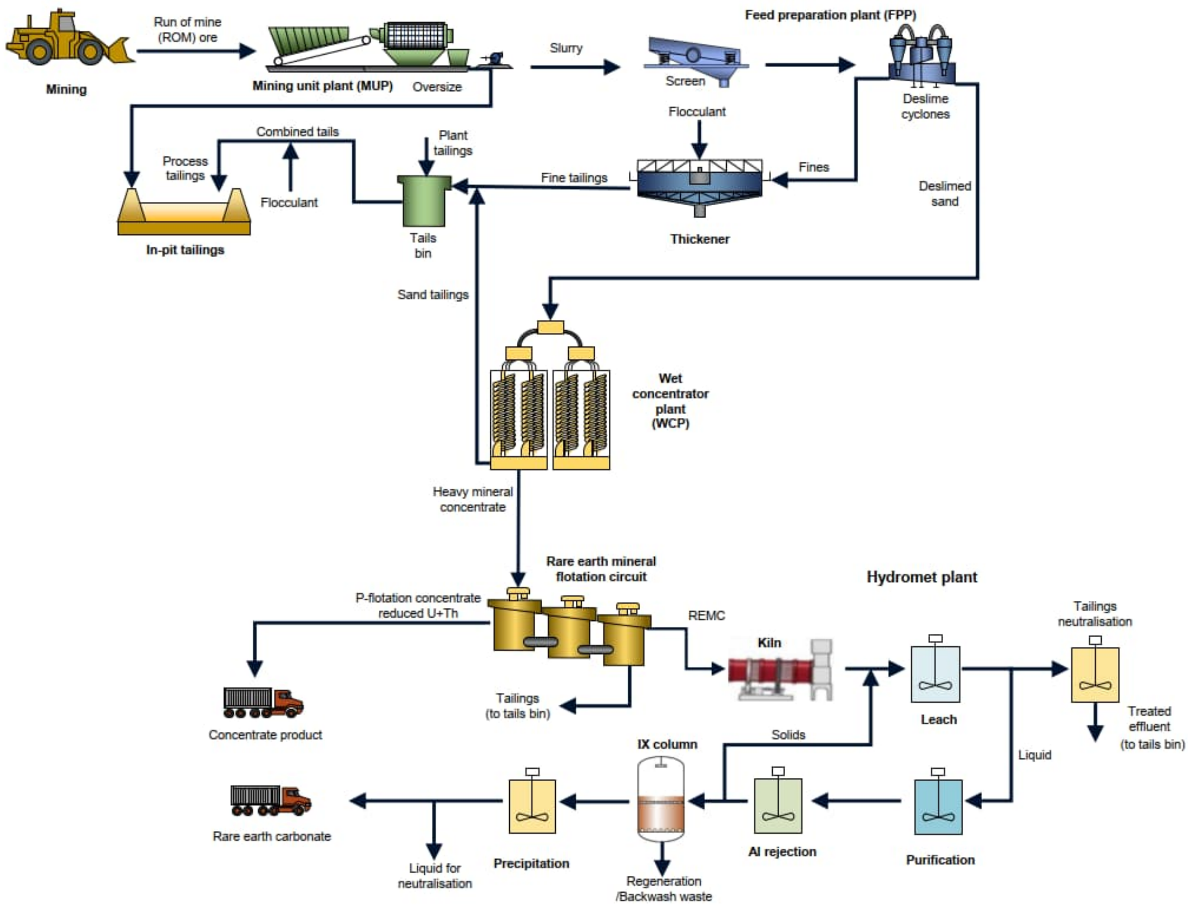


Figure 3-12 Phase 1A mining process circuit

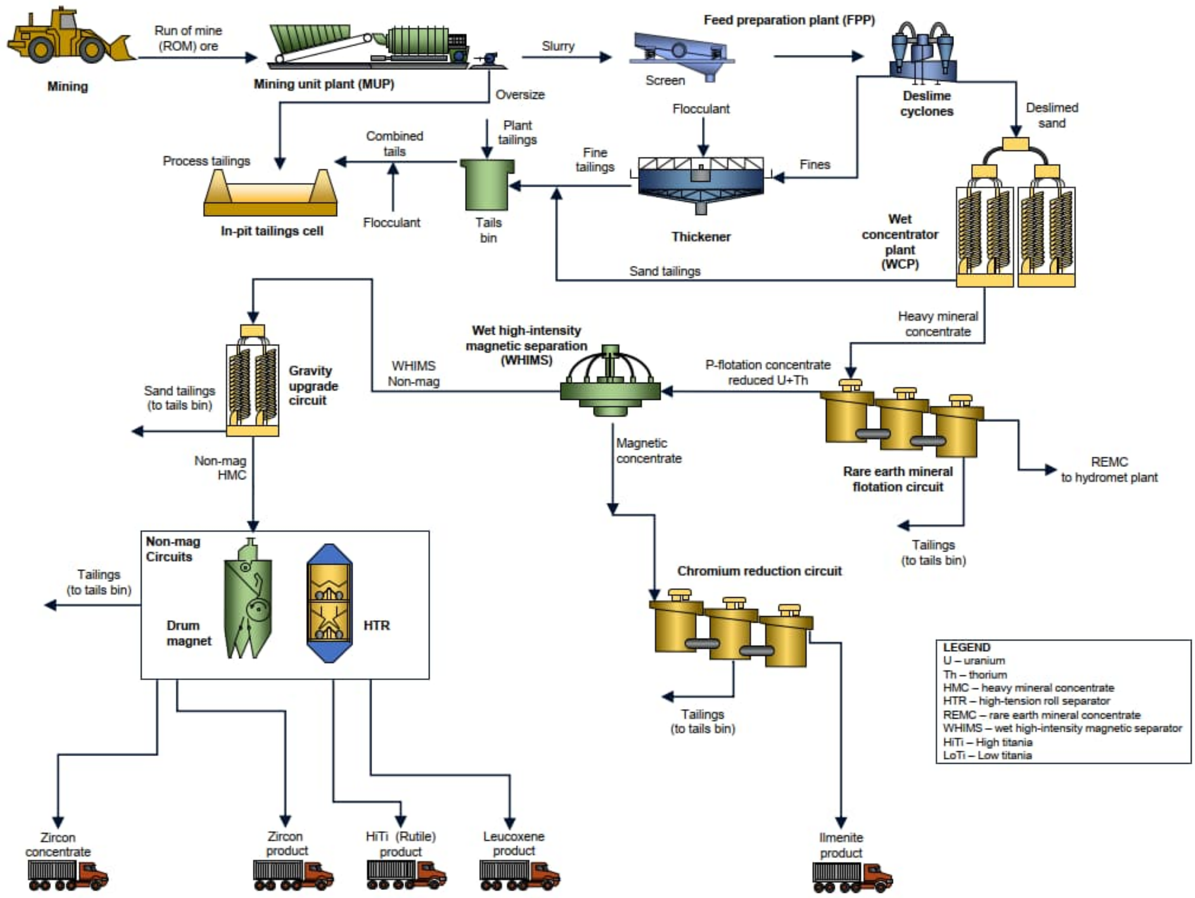


Figure 3-13 Phase 2 mining process circuit

Mining unit plant

Mineral processing would begin with the mining unit plant (MUP). The MUP would have a processing capacity of 5 Mtpa. The general concept is for the MUP to be located outside the mining footprint at surface (refer to Visualisation 3-1). However, where and whenever practicable based on detailed mine scheduling, it will be moved to sit at a bench level of 12 m below ground level to further minimise noise and light emissions at ground level or located adjacent to a stockpile to provide additional noise and visual screening.

Visualisation 3-1 Mining Unit Plant

The MUP would be moved to different locations as mining operations progress, so that it is always proximate to the active mine face. Figure 3-4 presents the indicative locations of the MUP in Area 1 and Figure 3-5 presents the indicative locations for Area 3. The MUP prepares the ore for further processing by liberating minerals from clays, reducing the ore to a pumpable size. Ore would be pumped from the MUP to the feed preparation plant (FPP) situated within the processing plant for fine tailings removal.

Feed preparation plant and wet concentrator plant

The FPP would be located at the main processing plant and would consist of coarse screening, fine screening, desliming cyclones and scavenging cyclones.

Material removed from the ore by the initial coarse screen would be deposited back within the void of a mined block. The finer cyclone overflow would be pumped to a thickener for further treatment, while underflow, coarser material, would be pumped to the surge bin, prior to pumping to WCP.

Material is proposed to be pumped from the surge bin to the wet concentrator plant (WCP), which contains spirals and a further screening stage. The spirals separate heavy minerals from light minerals based on their specific gravity. The screen removes recirculating larger gangue material, otherwise known as valueless ore, and prevents it from building up in the process.

Material removed from the WCP would be combined with the thickened overflow from the FPP and deposited in a tailings cell within a mined block.

Rare earth mineral concentrate plant

Heavy mineral concentrate (HMC) would be collected from the WCP and pumped to the rare earth mineral concentrate (REMC) flotation plant. Throughout mining operations, the utilisation rates of the WCP and REMC floatation plant may differ and stockpiling HMC material would allow for throughput to be maximised.

Rare earth mineral (REM) present in the HMC would be separated from other heavy minerals by flotation and gravity separation. Attritioning[3] and conditioning cells would scrub the surface of HMC particles in preparation for flotation. A multi-stage float circuit maximises REM recovery, floating off a monazite and xenotime stream which undergoes gravity separation to remove residual heavy minerals.

[3] wearing or grinding down by friction

The REMC flotation plant (Phase 1) produces a REMC that would be further processed (Phase 1A) at the hydrometallurgical circuit and a zircon titania concentrate produced which would be dewatered and processed at a mineral separation plant (MSP) as part of Phase 2 mining operations.

Hydrometallurgical circuit

The hydrometallurgical circuit proposed to be constructed as part of Phase 1A of the Project to produce a mixed rare earth carbonate (MREC) would be made up of a number of processes. It would include a sulphation bake, water leach tanks, purification, aluminium rejection, ion exchange and uranium removal and mixed rare earth carbonate (MREC) precipitation.

The feed-stock to the circuit is REMC, which would be dewatered in an indirectly heated electric dryer and then discharged to a paddle mixer where concentrated sulphuric acid is added to make a paste in preparation for baking in a gas-fired kiln. The sulphation process involves the conversion of the monazite and xenotime rare earth phosphate minerals into water soluble sulphate compounds.

Product from the sulphation bake kiln would then be discharged into a water leach tank where contact with recycled process water results in the solubilisation of the rare earth sulphate species generated in the sulphation bake.

The slurry leaving the water leach tanks would then be sent to a thickener, where the solid residue is diverted to a higher density underflow stream. This underflow would then be sent to a filter for further dewatering and washing, with the aim to produce a high-density cake with minimal rare earth species for disposal.

The thickener overflow is primarily a liquor stream containing most of the dissolved rare earth elements. This stream would be sent to purification for further refinement.

The primary goal of the purification stage would be to separate soluble phosphate from the rare earth liquor stream. In addition to phosphate removal, co-precipitation of other species also occurs. The slurry leaving the purification tanks is sent to a thickener. The thickener overflow is primarily a liquor stream and is sent to aluminium rejection for further refinement.

The aluminium rejection circuit involves the addition of magnesium oxide to achieve a target pH of 5. Under these conditions, the majority of any aluminium, iron and thorium metals would precipitate as hydroxides. Uranium would then be removed from the liquor via ion exchange and the rare earth elements would then be precipitated using sodium carbonate. This would create a high grade, high purity rare earth carbonate precipitate. This precipitate is then dewatered in a thickener, with a portion of the underflow directed to a final product filter, where the rare earth carbonate product is washed and dewatered prior to being dried.

Any residual water collected is added to the process water circuit and re-used in the various plants.

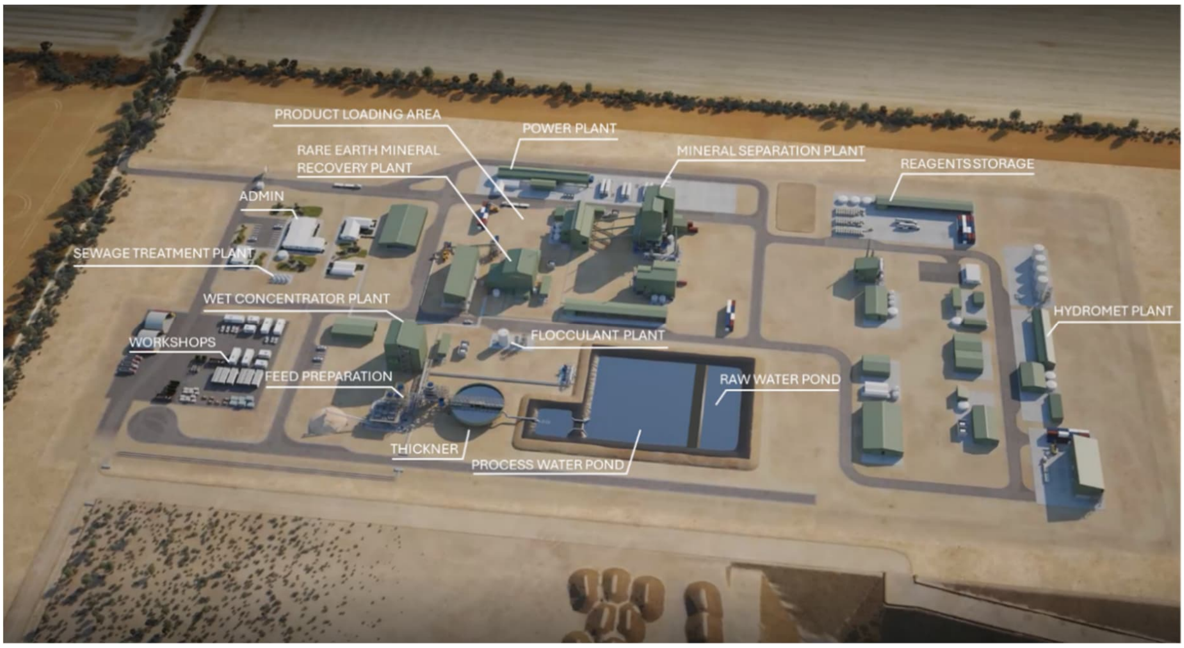
Wet high intensity magnetic separation circuit

Phase 2 processing operations would use a mineral separation circuit to separate REMC into a magnetic ilmenite (TiO_2) HMC product and a non-magnetic HMC product consisting mostly of zircon and various titania minerals. Separation would occur through a wet high intensity magnetic separation (WHIMS) and gravity clean up.

The non-magnetic stream largely rejects quartz to a tails stream during gravity separation, resulting in a zircon rich non-magnetic HMC with high TiO_2 minerals leucoxene and rutile.

The magnetic HMC product would be further processed by flotation to produce a low chrome ilmenite.

Visualisation 3-2 provides a conceptualised layout of the processing plant (Phase 2 located to the right) within Area 1.



Visualisation 3-2 Process Plant General Layout

Non-magnetic HMC upgrade circuit

A further processing circuit for non-magnetic HMC is also proposed as part of Phase 2. This would involve several processes including dry magnetic separators and high tension (electrostatic) rolls to create high quality products of zircon. These include HiTi rutile, HiTi leucoxene and LowTi leucoxene.

The zircon rich stream would undergo a further hot acid leaching stage (HAL) to improve the quality of the final zircon product.

Rejected materials would be collected and combined to produce a zircon/rutile rich HMC.

Chemicals and reagents

Table 3-4 summarises the reagents that will be used as part of the processing Phase 1, 1A and 2, with any breakdown products ending up in the homogenised tailings stream which has been chemically characterised[4].

During processing, flocculants (anionic polyacrylamide) are also added to assist with separation of solids (by clumping) from water and aid water recovery.

Table 3-4 Indicative chemicals and reagents required in the processing circuits

	Processing		
Phase	1	1A	2
Processing plant or circuit	Mining unit plant (MUP) Wet concentrator plant (WCP) Rare earth mineral concentrate (REMC) flotation plant	MUP WCP REMC flotation plant Hydrometallurgical circuit	MUP WCP REMC flotation plant Hydrometallurgical circuit Mineral separation plant (MSP)
Regents	Quebracho[5] Sodium Silicate Starch Sodium Hydroxide Floatation Reagents (NaF, Aristonate)	Additional: Sulfuric Acid	Additional: Nitric Acid Hexafluoro silicic Acid Sodium Fluoride

[4] Refer to Groundwater Impact Assessment (Technical Report I) which provides a summary and analytical report (Appendix C of technical report) on the geochemical characteristics of the various tailings streams that are homogenised.
[5] Chemically, quebracho is made up of carbon, oxygen, and hydrogen atoms and form phenol and carboxylic groups

3.3.3 Mining production rate

The rate of throughput for the Project is proposed to be 5 Mtpa (+/-10%) of ore for the approximate 20 to 25-year life of the mine. As the ratio of overburden to mineralised ore will vary across the areas to be mined, the annualised material movement rates (I.e. movement of overburden, ore and tailings) would vary accordingly between 10 Mtpa and 27.5 Mtpa to maintain a throughput of 5 Mtpa of ore at the MUP.

3.3.4 Logistics

The transport of various products from the mine site would incorporate the following:

- All packaged in either one or two tonne bulker bags and transported in 20 ft standard shipping containers
- Shipping container packing and sealing would take place undercover within the process plant
- Shipping containers will be transported via road and rail to the Port of Melbourne for export.

The preferred route to the Port of Melbourne is for containers to be transported by road to the Ultima intermodal terminal and then rail to port. An alternative for solely road transport to Port of Melbourne has also been assessed.

The Ultima intermodal terminal would require minimal changes in order to accept and transport Goschen products to the Port of Melbourne, given the following existing infrastructure:

- The Ultima intermodal terminal opened in 2019 and is primarily used for exporting Victorian hay to Asia, with the facility removing the need for approximately 4,000 truck trips annually from Victoria roads
- A broad-gauge rail line currently operates between Ultima and the Port of Melbourne precinct
- The Ultima intermodal terminal has approved high productivity freight vehicle (HPFV) access for A-Double trucks to the facility via Swan Hill-Sea Lake Road.

In terms of delivery of material into the site, Figure 3-14 below presents the local B-Double approved road network[6] and the proposed transport routes for site vehicles entering and exiting the mine site at Area 1 and Area 3. The primary transport route into and out of the mine will be through the mine site entrance on the southern boundary of the Process Plant area, via Bennett Road to Donald Swan Hill Road.

Jobling Road and Mystic Park-Meatian Road are the proposed alternate connections to the mine site from Donald-Swan Hill Road.

[6] Victoria's Gazetted B-Double road network

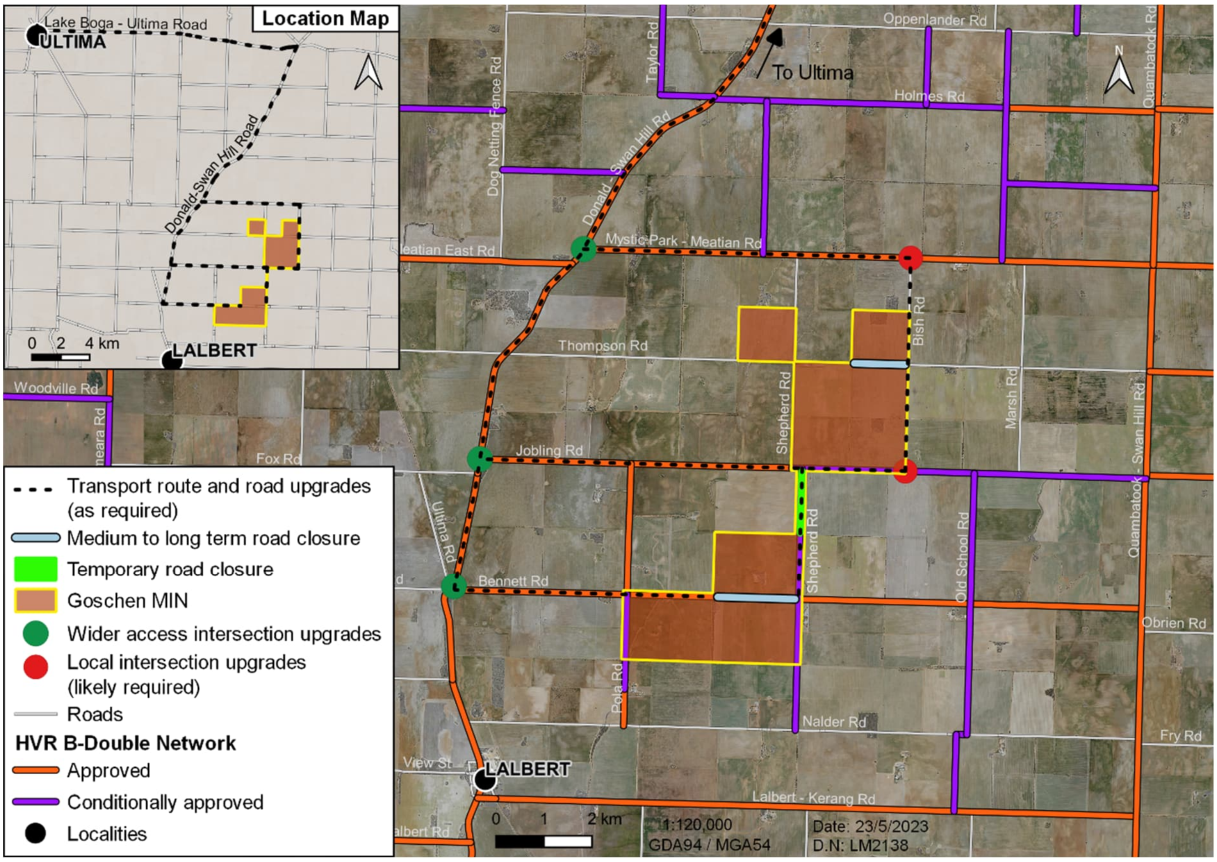


Figure 3-14 Proposed road transport routes, upgrades and closures

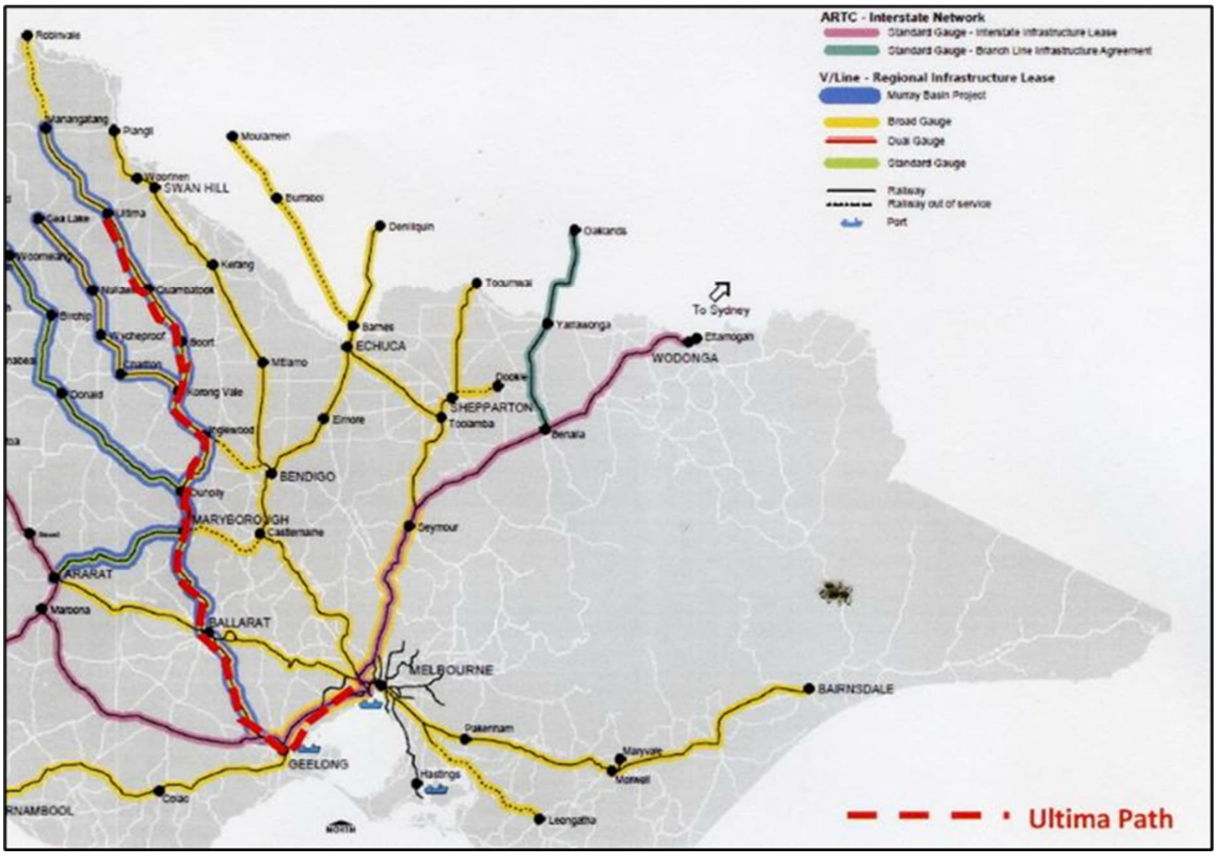


Figure 3-15 Proposed rail route

Road closures

As part of the construction and operation of the Project, sections of the roads within the proposed Project footprint would need to be closed at different points in time. An overview of the proposed road closures is presented in Table 3-5 and Figure 3-14. Potential impacts of the road closures have been considered and are discussed in Technical Report E: Traffic and transport impact assessment.

Table 3-5 Proposed Road Closures

Area	Road Closure	Indicative time periods of road closures	
		Closure	Reinstatement
Area 1	Bennett Road	Year 1 - ~2024	End of mining - ~2044
Area 3	Thompson Road	Year 8 - ~2031	End of mining - ~2044
Service Corridor	Shepherd Road	Year 1 - ~2024 Limited period of closure to allow construction of services.	~2024

Road upgrades

A number of key local access roads proposed to be used during construction and operation of the Project may require upgrades to facilitate the safe movement of vehicles to and from the Project site.

The preferred option is to use Bennett Road as the principal entrance and exit for construction and operation. Based on this, an overview of the road section upgrades required are presented in Table 3-6 below and Figure 3-14. The various options for local road access have been discussed as part of EES Technical Report E: Traffic and transport impact assessment.

Table 3-6 Proposed road section upgrades

Road	Length	Condition	Width	Potential upgrade requirements
Bennett Road	6.3 km	Existing: Gravel Proposed: Sealed	Existing: 5 -6.5 m Proposed: 6.2 – 7 m with 1.5 m unsealed shoulders (TBC)	• Sealing road surface • Localised shoulder widening and shoulder sealing in the vicinity of the intersection with local roads including Donald Swan Hill Road to provide a wider turning lane • One culvert present along length of road
Mystic Park – Meatian Road	6.8 km	Existing: Gravel Proposed: Gravel	Existing: 5 – 7 m Proposed: 6.2 – 7 m with 1.5 m unsealed shoulders (TBC)	• Localised road widening to allow for bidirectional heavy vehicle movements • Localised shoulder widening and shoulder sealing in the vicinity of the intersection with local roads to provide a wider turning lane • Three culverts present along length of road
Bish Road	4.5 km	Existing: Gravel/ dirt Proposed: Gravel	Existing: 4 – 5 m Proposed: 6.2 – 7 m with 1.5 m unsealed shoulders (TBC)	• Localised road widening to allow for bidirectional heavy vehicle movements • Localised shoulder widening in the vicinity of the intersection with local roads to provide a wider turning lane • One culvert present along length of road
Jobling Road	9 km	Existing: Gravel/ dirt Proposed: Gravel	Existing: 5 – 6 m Proposed: 6.2 – 7 m with 1.5 m unsealed shoulders (TBC)	• Localised road widening to allow for bidirectional heavy vehicle movements • Localised shoulder widening in the vicinity of the intersection with local roads to provide a wider turning lane • Three culverts present along length of road
Shepherd Road	2.8 km	Existing: Gravel/ dirt Proposed: Sealed	Existing: 5 – 5.5 m Proposed: 6.2 – 7 m with 1.5 m unsealed shoulders (TBC)	• Localised road widening to allow for bidirectional heavy vehicle movements • Localised shoulder widening in the vicinity of the intersection with local roads to provide a wider turning lane • One culverts present along length of road

3.3.5 Site layout

The mineral processing plant is located within Area 1, north of Bennett Road (refer to Visualisation 3-2 Process Plant Generalised Layout). The processing plant would include the FPP, WCP, REMC flotation plant, MSP and reagent storage, tailings thickener, process water dam, workshop, laboratory, administration and ancillary buildings and hydrometallurgical circuit and p-flotation stockpiles. The HMP would be located adjacent to mineral processing plant.

The Process Water Pond (PWP), power station and fuel storage area would be located across from the process plant itself to separate it from high traffic areas. The plant workshop would be split into two, with a smaller workshop located near the plant entrance. This would service small scale works and storage of components for the WCP. A larger workshop would be located near the MSP and would service larger deliveries, such as equipment and bulk reagents. The plant access road would be a one-way ring road around the process plant. A separate mine access road would be provided for off-road vehicles for haulage from the mining void.

The pumping distances between the MUP and the FPP/WCP would typically be 1 to 1.5 km with the MUP located at surface unless able to be positioned in pit approximately 12 m bgl based on mine schedule.

A service corridor between Area 1 and Area 3 would be established along Shepherd Road, or in an adjacent paddock, which would also provide access between Area 1 and Area 3. The service corridor would include a pipeline under the roadway to transport ore slurry from Area 3 to the processing plant in Area 1, and would be established in readiness for the commencement of mining in Area 3.

The indicative layout for Area 1 and Area 3 is presented in Figure 3-4 and Figure 3-5.

3.3.6 Material handling

To facilitate the sequence of depositing homogenised tailings as described in Section 3.3.1, stockpiles of topsoil, subsoil, clay and overburden would be located to the west of the mined extent of Area 1.

Topsoil stockpiles would not exceed a height of 2m and will be carefully managed to ensure soil biota and nutrients are maintained. Topsoil and subsoil stockpiles would be created by material removed from the surface of mining blocks and stockpile areas. As the mining of the blocks progresses, topsoil, overburden from the initial mining voids will backfill the mined voids, reducing haulage and double handling. The stockpiled material on the surface will ultimately be rehandled to the final mine void as part of rehabilitation and closure phases.

All soils removed during construction and operation will be placed in designated stockpile areas. Freshly stripped and placed topsoil retains seed that is more viable and a greater number of micro-organisms and nutrients, than does stockpiled sub soil. Vegetation establishment is generally improved by the direct return of topsoil and is considered ‘best practice’ topsoil management. Should longer term storage of stockpiles be proposed (six months or greater) accurate records will indicate stockpile volumes and areas to be covered by each stockpile upon rehabilitation and closure.

A clay stockpile would be created from subsoil material to ensure the availability of clay around the site throughout the life of the Project, including rehabilitation. This material, with its expected lower permeability, may be used in the construction of water storage dams and/or tailings embankments within mined blocks.

Overburden would also be used to make tailings bunds and barriers as close to the mining location as possible. Overburden would then be used to cover deposited tails as the mining sequence progresses, with any excess overburden stockpiled on the surface. Overburden stockpiles have been designed to a height of 35m above the highest point of the surrounding topography, with the capacity to hold the majority of waste mined in the initial 12 to 18 months of production and approximately 50% of the waste mined in the subsequent 12 to 18 months, up to a total of approximately 9 million bank cubic metres. A bank cubic metre (bcm) is a cubic metre of material *in-situ* before it is extracted. Over the life of the mine, waste movement to backfill mined voids would be prioritised whenever possible, with surface stockpiling occurring when there is insufficient capacity in the mined voids.

During extraction of ore from the first mining blocks, an ore stockpile would be positioned adjacent to the initial MUP location. This stockpile will be used to balance overall production rates as it is expected that the ore mining rate for the first 12 to 18 months of processing would be below the 5 Mtpa capacity of the MUP. The initial ore stockpile is expected to be depleted within 12 months of mining operations.

Tailings management

Tailings are the material waste that remains once the valuable mineral material is extracted and recovered from mineral processing. While classified as a waste under the *Environment Protection Act 2017*, tailings are an important resource that are used in the mine rehabilitation process.

As described in Section 3.3.1, once a block(s) has been mined, overburden would be used to construct in-pit bund (embankment) so as to create tailings cell(s). This would allow for tailings to be confined and drained in-pit and without the need of a temporary above ground tailings storage facility.

The general methodology selected for the Project to achieve this strategy is summarised as follows:

- thickening the various tailings streams (clay, silt) at the process plant in a thickener and using a flocculant to release additional water;
- homogenising the dominant WCP coarse material (approximately 80% comprising fine to medium sand), with FPP oversize (approximately 6% comprising medium to coarse sand) and the clay and silt slimes (approximately 15%) and pumping to cells within mined blocks at approximately 47% w/w[7] solids content;
- use pipe head flocculation with a secondary flocculant to achieve early release of water; and
- hydraulic deposition into in-pit cells, with upstream toe drainage and removal of tailings decant water using pump(s).

This means all tailings from the processing of ore would be homogenised into a single tailings slurry at the process plant. The homogenised tailings would be placed above the pre-mining water table elevation cross the same interval as the extracted ore zone. During later stages of filling, a second tailings feed pipeline would be installed along the crest of the tailings bund to optimise fill volumes (Figure 3-16).

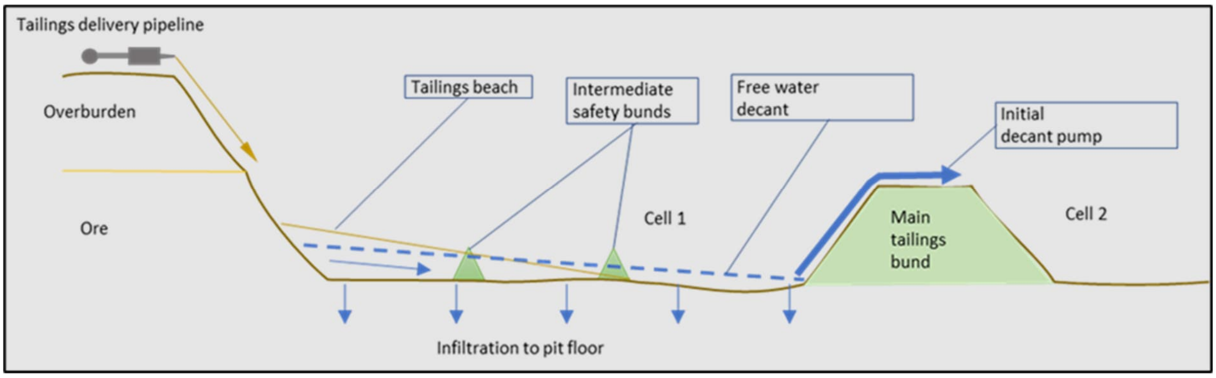


Figure 3-16 Tailings management – conceptual outline of in-pit tailings

Laboratory testing has been conducted on the various tailings and leachate quality generated from the tailings that is ultimately homogenised together. This testing of the tailings and leach water was on processed material and includes any residual breakdown products from reagents used in the mineral processing. The exception to this is the secondary addition of flocculants both in the thicker and at the point of discharge (in-pit).

Water would be recovered from the tailings deposited in-pit via submersible pump lines located down the face of the block wall or down the face of the main tailings bund/embankment. The pump lines would be oversized ducts to allow for optimal water recovery, and the pump could be raised or lowered as required. Tailings would dewater under gravity as well as via the pump and some seepage would occur into the base of the pit (Figure 3-17).

[7] Weight per weight - means for every 100 kilogram (kg) of slurry tailings 47 kg is solid and 53 kg is water.

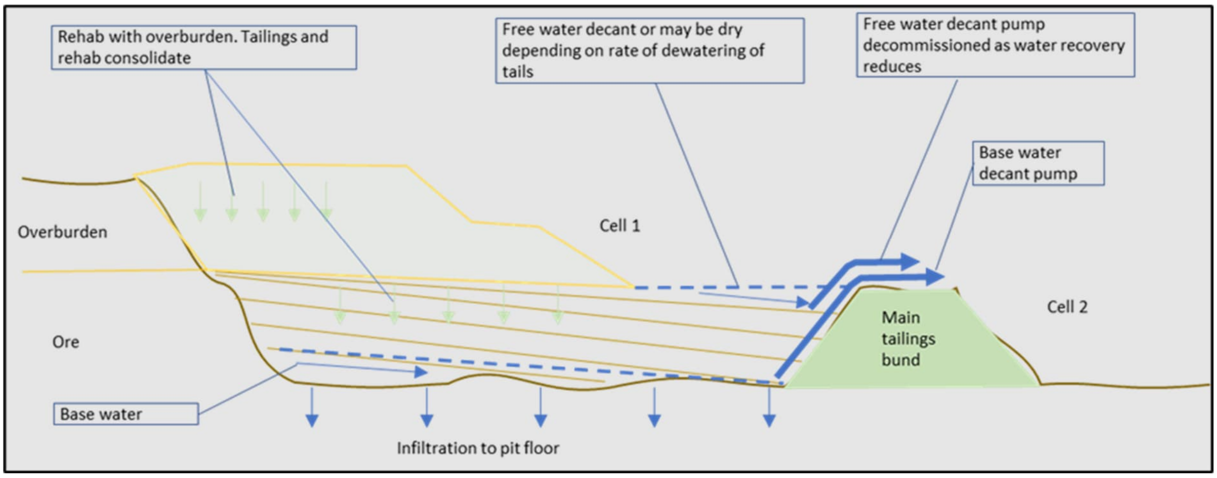


Figure 3-17 Tailings management - water recovery

Once tailings decant pond is dewatered, the decant pipeline would be connected to subsequent pits or decommissioned. Water recovered from the tailings slurry would be pumped to the above ground process dam (Figure 3-18). As mentioned in Section 3.3.1, once buried within the void of a mined block, the deposited tailings would continue to dewater. Further information is provided in EES Chapter 5 Legislation and Approvals and EES Chapter 14 Groundwater.

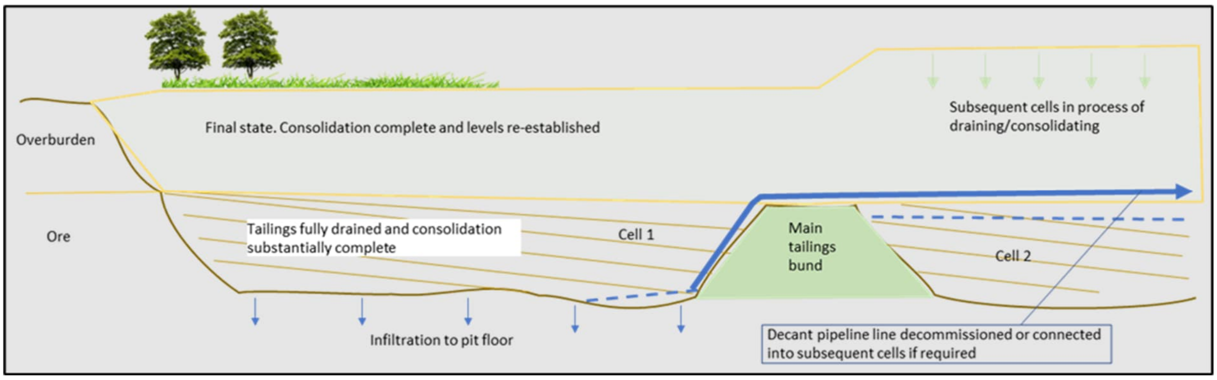


Figure 3-18 Tailings management - tailings drained

Water management

It is estimated that the general annual water demand for Phase 1 and 2 would be approximately 2.9 and 3.1 GL/year respectively. During start-up and commissioning, the water demand would be up to a maximum of 4.5 GL/year, for approximately 3 months.

The following table provides a summary of the estimated annual water demand.

Table 3-7 Annual water demand summary (Phase 1 and 2)

Stream	Mass in (t/hr)	Water In (m3/hr)	Mass Out (t/hr)	Water Out (m
Kangaroo Lake (process water)		261.15		
Water recovered from Tails		514.24		
Water Lost to sprays				
ROM Feed	672.00	74.67		
+300mm oversize			0.00	0.00
+40mm oversize			6.72	1.68
+2mm oversize			12.86	1.43
Thickener U/F			108.80	309.66
Sand tails (Coarse Tails+ REMC Tails)			517.10	334
Combined Tails			625.90	643.66
Reagents	0.01		0.01	
Flocculant	0.00		0.00	200.35
REMC			1.16	0.10
P-Float Concentrate			25.54	2.84
Total (per hour)	**672.01**	**850.06**	**672.20**	**850.06**
Total (per day) @85% Utilisation	**13712.82**	**17341.20**	**13712.82**	**17341.20**
Solids Balance				0.00
Water Balance				0.00
PER DAY				
Washdown				120.00
Evaporation-Rainfall				50.39
Dust Suppression (Stockpile)				603.60
Dust Suppression (Roads)				1944.00
Personal Water				0.70
Kangaroo Lake (other water)		2718.69		
Total		**2718.69**		**2718.69**

Daily Water Requirement	**8046.1**	**m^3/day**
Annual Water Requirement	**2.937**	**GL**

Stream	Mass in	Water In	Mass Out	Water Out
Kangaroo Lake (process water)		280.21		
Water recovered from Tails		542.12		
Water Lost to sprays				
ROM Feed	672.00	74.67		
+300mm oversize			0.00	0.00
+40mm oversize			6.72	1.68
+2mm oversize			12.86	1.43
Thickener U/F			108.80	309.66
Hydromet Tails (TBC)			5.34	32.90
MSP Tails			4.70	25.00
Hydromet Reagents (estimated)	5.40	13.43		
Sand (coarse) tails			521.80	359
Combined Tails			635.94	701.56
Reagents	0.01			
Flocculant	0.00			203.56
REMC			-	-
Illmenite			6.32	0.00
Illmenite Dryer Exhaust			0.00	0.55
NM Dryer Exhaust			0.00	0.87
HiTi Leuc Product			0.36	0.00
HiTi Rutile Dryer Exhaust			0.00	0.16
HiTi Rutile Product			1.83	0.00
Zircon Dryer Exhaust			0.00	0.62
Zircon Concentrate			1.20	0.00
Zircon Product			6.30	0.00
Rare Earth Carbonate (estimate)			1.20	
HAL Fume Scrubber Exhaust			0.00	0.00
Total (per hour)	**677.41**	**910.43**	**677.44**	**910.43**
Total (per day)	**13819.26**	**18572.77**	**13819.71**	**18572.77**
Solids Balance				0.02
Water Balance				0.00
PER DAY				
Washdown				120.00
Evaporation				50.39
Dust Suppression (Stockpile)				603.60
Dust Suppression (Roads)				1944.00
Personal Water				0.70
Kangaroo Lake (other water)		2718.69		
Total		**2718.69**		**2718.69**

Daily Water Requirement	**8709.0**	**m^3/day**
Annual Water Requirement	**3.179**	**GL**

The Process Water Pond (PWP) would serve as the primary storage to support the overall water demand of the Project, which has been sized to hold approximately four days of water usage (~60ML). This water would be reticulated to various areas for dust suppression and storage for use in the various mineral processes, whereafter it would be referred to (and managed) as process water.

Process water would be used in a closed circuit and would only be used within the processing plant and mining areas.

Process water circuits would be designed to optimise the re-use of water recovered from the various process circuits, which would draw water from the PWP as required.

Potable water would be required for consumption and washing during operation. Water from Kangaroo Lake pipeline would be transferred to an on-site water treatment plant for treatment and then stored in potable water tanks. Potable water would be trucked from the potable water tanks to remote mining facilities as required.

Non-hazardous waste management

Non-hazardous waste generated from mining operations would be stored in dedicated areas and removed by an appropriately licenced waste management contractor for offsite disposal or recycling.

Hazardous waste management

The final sources and characterisation of hazardous waste (and chemicals) would be confirmed during detailed design of various Project component. However, the overall waste collection, storage and transport on and off site would be managed by an appropriately licenced contractor.

In summary, the principal waste types are:

Solid waste

All solid waste including any spent packaging materials would be collected and stored on-site in suitable containers and transported off-site by licensed contractor(s) in accordance with EPA requirements. Recyclable materials will also be collected and sent to a licensed recycler by a licensed waste contractor.

Waste hydrocarbons

Hydrocarbon waste including any waste lubricants, oils, fuels and fuel filters, would be collected using appropriate equipment and specialised storage vessels local to potential discharge points and would be stored in bunded and double skinned storage vessels as required. Hydrocarbon waste would be collected, transported, treated and/or disposed by appropriately licenced contractors.

Wastewater

All wastewater (greywater and blackwater) from ablutions and the administrative offices within the Process Plant area will be treated with a sequencing batch reactor (SBR) that has a design capacity of 20,000 L/day that will discharge Class C recycled water. The treated effluent would be collected and used in process water circuit. Excess biosolids from the SBR will be pumped out to a 10 cubic metres sludge holding tank for thickening and ultimately be disposed of off-site by an EPA licenced contractor.

Hazardous material management

Any chemicals, reagents and hazardous substances used as part of the Project would be appropriately stored with relevant material safety data sheets (MSDS) close to respective end-users. To ensure the proper handling and storage of hazardous substances, including diesel and LNG, the dangerous goods would be managed in accordance with the following:

- Dangerous Goods Act 1985 (Vic);
- Dangerous Goods (Storage and Handling) Regulations 2012;
- Code of Practice for the Storage and Handling of Dangerous Goods 2013; and
- Relevant guidelines, including EPA Publication 1698: Liquid storage and handling guidelines.

Naturally occurring radioactive material that may occur at the Project is discussed in EES Technical Report N: Radiation impact assessment.

Dust Management

The main sources of dust during operation would include mining activities, haulage and stockpiling of material. Management of dust generated during the operation of the mine would primarily consist of water spray from rigid or articulated all-wheel drive water tankers. Additionally, material would only be excavated, transported and stockpiled as necessary to limit the potential for dust generation.

3.4 Closure and rehabilitation

3.4.1 Rehabilitation objective

The proposed Project area is currently used for broadacre farming consisting of dryland cropping and the production of grains, pulses and cereals such as wheat, canola, chickpeas, pastures for hay production and some sheep grazing. The whole-of-site rehabilitation objective must meet the following key guideline (ERR 2021[8]):

To rehabilitate the mined area and associated disturbance footprint to its original agricultural capacity or better.

In order to achieve this rehabilitation objective, VHM has committed to the following:

- Mining pits would be backfilled to the surface

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[8]Earth Resources Regulation (ERR) 2021, *Preparation of Rehabilitation Plans – Guideline for Mining & Prospecting Plans*, Department of Jobs, Precincts & Regions, Government of Victoria, Melbourne, Australia, p 74

- No stockpiles or aboveground structures would remain on the surface following closure
- The Project area would be graded to pre-mining contours or better (with respect to farming)
- The soil profile would be re-established and subsoil clay units that influence the water retention of the surface soil would be replaced
- Topsoil would be rehabilitated to pre-mining fertility or better
- Crop yields would be returned to comparable pre-mining levels of production
- Crops and soils would not contain any pollution or increase in elements associated with mining above pre-mining levels
- Where desirable and agreed by relevant stakeholders, mining infrastructure, such as upgraded roads and power connections, water pipeline and fences, would remain for use by landholders. If not needed, this infrastructure would be decommissioned and rehabilitated consistent with the above objectives.

It is expected that a return to pre-mining crop yields would take approximately 3 to 5 years to return post-rehabilitation, assuming similar climatic conditions. Where topsoil, clay and overburden removed is of insufficient volume to backfill the mining pits to surface, additional topsoil or clean fill would be used where necessary and with consideration to relevant regulations. Further information is provided in EES Technical Report P: Draft Rehabilitation Plan.

3.4.2 Rehabilitation activities

The conceptual plan for mining and progressive backfilling and rehabilitation of mined areas is shown in Figure 3-9. This rehabilitation would take place during operation in the sequence described in Section 3.3.1 and would include the following activities:

- Removal of mine infrastructure and services
- Controlled backfill with overburden, clay and topsoil following tailings dewatering
- Soil preparation and revegetation
- Reinstatement of public roads and other infrastructure (e.g. fences)
- Removal of temporary environmental and drainage controls.

The decommissioning of plant areas would require a contamination assessment with any necessary remediation taking place prior to closure. In plant and infrastructure areas, the following activities would be undertaken as part of decommissioning:

- Plant and ancillary facilities would be dismantled, with material removed from site
- Full decommissioning of the water pipeline would occur unless it could be used by the local community
- Materials may be sold for scrap to local merchants, taken off-site for recycling or transported to an appropriate disposal facility licenced to receive the waste
- Soil testing would be undertaken to identify any potential soil contamination and determine appropriate management
- Building materials, foundations and contaminated soil would be remediated and/or removed from site and disposed of at an appropriate facility licenced to receive the waste; and
- All exposed soil would be graded to approximately pre-project contours, ripped to reduce compaction (if necessary), spread with topsoil and revegetated.

Further information is provided in EES Technical Report P: Rehabilitation and Closure.