pitt&sherry

# Goschen Rare Earths and Mineral Sands Project

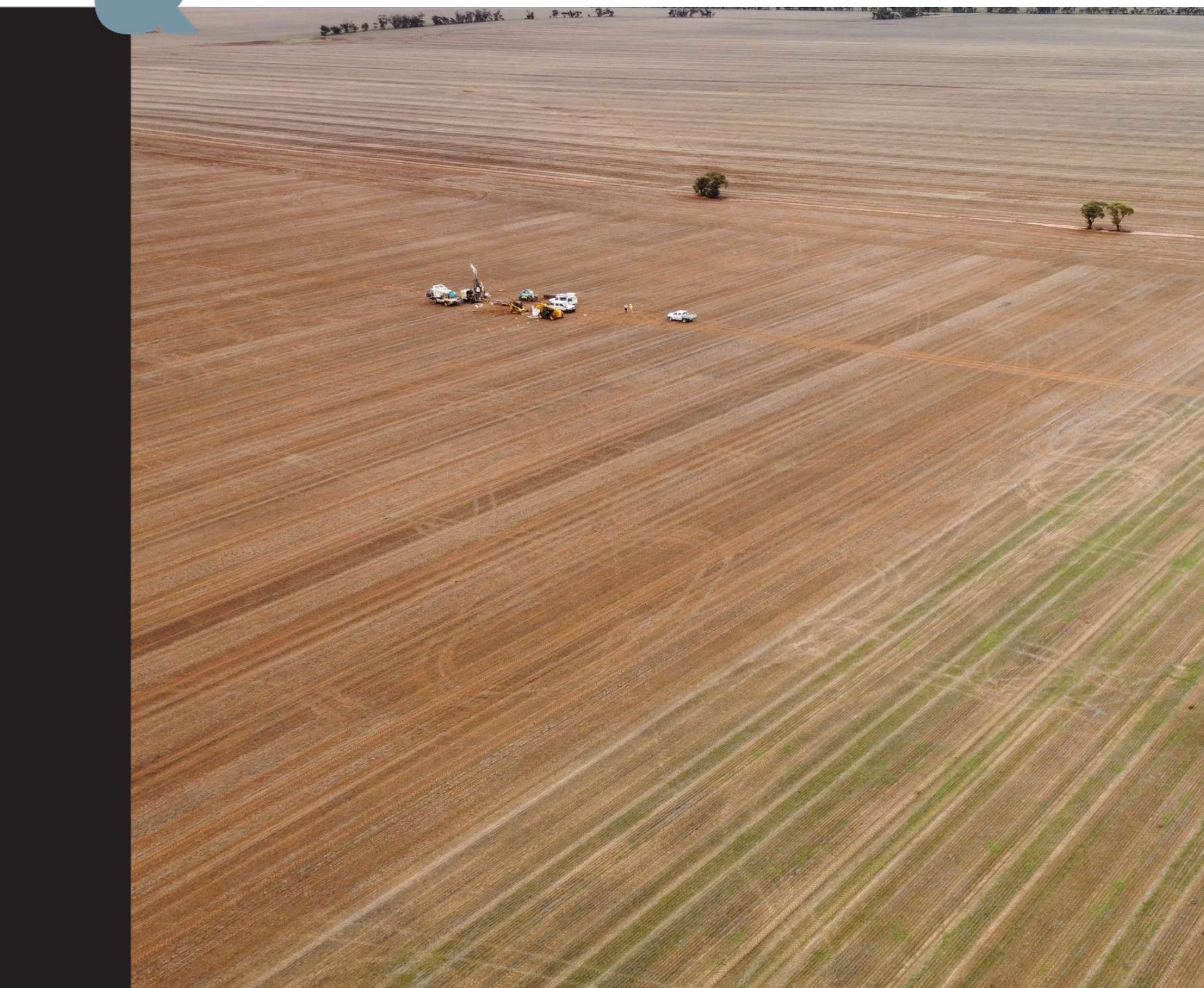
Environment Effects Statement

Mine Site Surface Water Impact Assessment

Prepared for
**VHM Limited**

Date
**1 November 2023**

Rev 0



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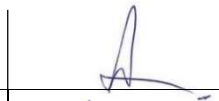
| **Prepared by – Adrian Moon** |  | Date – 1 November 2023 |
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# Executive Summary

## Overview

This technical report is an attachment to VHM Limited's Goschen Rare Earth and Mineral Sands Project (the Project) Environment Effects Statement (EES). It has been used to inform the EES required for the Project.

The Project intends to contain all water from disturbed catchments onsite and not permit offsite release until the catchment is rehabilitated. A separate regional surface water assessment considered the impacts associated with removal of water from the regional catchment. This report examines surface water impacts on environmental values within the mining lease.

## Existing environment

The proposed mine site is located in an agricultural setting and is characterised by low rainfall, high evaporation and flat topography, with a north-south oriented ridgeline (Cannie Ridge) running through the centre. The ridgeline forms the top of catchment in the area and the site is not near any waterways. Surface water from the proposed mine site catchment does not interact with any designated waterways.

The original 2017 referral area was much larger and included the Murray and Avoca Rivers and Kerang Wetlands catchments. The Site Area in this impact assessment comprises a significantly reduced footprint, is not located in or near these catchments, and the probability of interaction Is very low.

Surface water runoff within the proposed mine site largely forms isolated pools in shallow depressions and quickly evaporates or infiltrates and is either consumed by vegetation or directed to groundwater.

The proposed mine site has a relatively deep water-table with no known permanent surface expressions of groundwater within 10km. Groundwater depths on site vary between 30m below ground to greater than 50m below ground. Ground water is highly saline and groundwater recharge due to infiltration from rainwater is low due low permeability at depth and the relatively deep ground water level.

Soils and subsoils are moderately to strongly alkaline and contain sodic / dispersive materials. Potential for acid formation is unlikely. Soil erosion hazard risk is very low.

Water supply channels that crossed the proposed mine site have been decommissioned and are no longer in use. One environmental value, a farm dam, exists within the proposed mine site and would need to be removed as part of the mining process.

For the purpose of this assessment, the Study Area referred to in this document relates to the mine site. The two terms will be used interchangeably.

## Impact assessment findings

Given the semi-arid site conditions, high water demand from the mining process and the desire to eliminate potential for pollutants to be transported offsite in surface water, the project intends to capture and retain all surface water from disturbed catchments onsite. The surface water strategy includes capturing surface water at the source for storm events up to the 5% AEP (1 in 20 year ARI) and to direct excess water from more extreme events to the open pit.

Assessment of the surface water strategy found that collection and storage of surface water from disturbed catchments is feasible and practical, however due to the low rainfall, and high evaporation rates, harvesting of rainwater for use in process would not be economically viable. Instead, collected surface water could be used opportunistically to support site activities such as dust suppression.

The impact assessment found that four areas of protected vegetation (two in Area 1 and two in Area 3) exist within the Project area and could be impacted by surface water flows.

Impacts due to change surface water quality could be adequately addressed through Isolation of the area from disturbed catchments.

The assessment found that isolation of the vegetation altered catchments and reduced surface water availability. Further investigation of protected vegetation in the Project footprint will be required to determine the sensitivity of vegetation to reduced surface water supply and if mitigation and contingency measures are required.

## Mitigation and contingency measures

Potential impacts on mine site surface water due to the project would be avoided, minimised or managed through the recommended mitigation measures below.

- Bunds will be installed to contain all disturbed surface water flows to within the mine site area,
- Protective bunds will be installed to redirect disturbed surface water flows away from sensitive receptors, and
- Disturbed areas will be progressively rehabilitated to catchment hydrology as soon as practicable.

## Glossary and abbreviations

| Term | Definition | Abbreviation |
|---|---|---|
| Action/Activity | Part of the project, such as installing infrastructure in a certain manner, that may have an impact on receptors. | |
| Annual Exceedance Probability | The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year. | AEP |
| Australian Height Datum | The vertical height of 0.000m established within the Australian National Levelling Network. | AHD |
| Acid Mine Drainage | The outflow of acidic water from metal mines or coal mines. | AMD |
| Assess | To consider an action and the likely effects of that action. | - |
| Australian Government Bureau of Meteorology | The Australian Government agency responsible for providing weather services to Australia and surrounding areas. | BoM |
| Beneficial Uses | Specific environmental values/receptors/assets protected by legislation. These may include environmental matters such as natural resources or ecosystems. *SEPP (Waters)* refers to Beneficial Uses which has been updated to Environmental Values in the Environment Reference Standard. | - |
| Best Practice Erosion and Sediment Control | Technical publication detailing best practice principles for planning, design, and operation of erosion and sediment control systems. | BPESC |
| *Catchment and Land Protection Act 1994* | The following are the purposes of this Act:<br>a) to set up a framework for the integrated management and protection of catchments,<br>b) to encourage community participation in the management of land and water resources,<br>c) to set up a system of controls on noxious weeds and pest animals, and<br>d) to repeal and amend various Acts concerning catchment and land management. | *CaLP Act* |
| Contaminants of Concern | Pollutants that have been detected in water bodies that may cause ecological or human health impacts. | CoC |
| Commonwealth Scientific and Industrial Research Organisation | Australian Government agency responsible for scientific research. | CSIRO |
| Default Guideline Values | Provides a generic starting point for assessing water quality. | DGV |
| Department of Energy, Environment, and Climate Action | Department of Energy, Environment, and Climate Action (formerly DELWP - Department of Environment, Land, Water and Planning.) | DEECA |
| Design Flood | A probabilistic or statistical estimate of hypothetical flood events, being generally based on some form of probability analysis of flood or rainfall data. | - |

| Term | Definition | Abbreviation |
|---|---|---|
| Discharge | The rate of flow of water measured in terms of volume over time. It is to be distinguished from the speed or velocity of flow, which is a measure of how fast the water is moving rather than how much is moving. | - |
| Disturbed Catchment | Landform within the Study Area that has been altered in the process of constructing, operating &/or decommissioning the mining activities and has an elevated risk of transporting sediments or contaminants in surface water.<br>Landform that has been rehabilitated post mining activities is not considered disturbed catchment | |
| DRAINS | Stormwater Drainage System design and analysis software. | - |
| Effect | The outcome of an event or a circumstance that is likely to occur. It may be caused directly or indirectly by an action. It can also be termed a consequence. The significance of the effect may vary. | - |
| Environment Effects Statement | Statement required under the *Environment Effects Act (1978)*. | EES |
| Environmental Value | Particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health and which require protection from the effects of pollution, waste discharges and deposits. | - |
| Environmental Management Framework | A transparent framework to manage the environmental effects of the Project to meet statutory requirements, protect environmental values and sustain stakeholder confidence. | EMF |
| Erosion and Sediment Control | Control measures aimed to prevent or reduce soil erosion caused by raindrop impact and sheet flow and to trap and retain sediment displaced by up-slope erosion processes. | ESC |
| Front End Engineering Design | Basic Engineering which is conducted after completion of Conceptual Design or Feasibility Study to determine technical issues and estimate rough investment cost. | FEED |
| Flood | Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or overland runoff before entering a watercourse and/or coastal inundation resulting from super elevated sea levels and/or waves overtopping coastline defences. | - |
| General Environmental Duty | A duty under section 25(1) of the *Environmental Protection Amendment Act 2018*<br>The general environment duty requires people to undertake reasonably practicable steps to eliminate, or otherwise reduce risks of harm to human health and the environment from pollution and waste<br>Reasonably practicable includes having regard to the likelihood of the risk of harm eventuating, degree of harm that would result if the risk eventuated, actual and reasonable knowledge on that risk of harm and availability, suitability and cost of ways to eliminate or reduce the risk of harm. | GED |
| Hydrology | The term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs. | - |

| Term | Definition | Abbreviation |
|---|---|---|
| Impact | A marked effect or influence on something, either positive or negative. | - |
| Intensity Frequency Duration | An intensity-duration-frequency curve is a mathematical function that relates the rainfall intensity with its duration and frequency of occurrence. | IFD |
| International Erosion Control Association, Australasia | International organisation and subject matter expert on erosion and sediment control procedures. | IECA |
| Mine Affected Water | Surface water within active mining areas that has potential to contain contaminants at levels that could impact external environmental receptors. | MAW |
| *Mineral Resources (Sustainable Development) Act 1990* | The purpose of this Act is to encourage mineral exploration and economically viable mining and extractive industries which make the best use of, and extract the value from, resources in a way that is compatible with the economic, social and environmental objectives of the State. | MRSD Act |
| Rainfall Erosivity | A multi-annual average index that measures rainfall's kinetic energy and intensity to describe the effect of rainfall on sheet and rill erosion. | R-factor |
| Revised Universal Soil Loss Equation | Assesses land degradation through soil related measures. | RUSLE |
| Study Area | The Study Area for mine site surface water impact assessment covers surface water within mine operational areas 1 and 3, shown in Figure 6-2. | - |
| Surface Water Management Plan | The management of surface water through the operational life of the mine and provide a management framework to mitigate potential impacts over the life of mine. | SWMP |
| Receptors | Entities of value that may be harmed by a water affecting activity, such as ground dependant ecosystems or people. Also termed values or assets. | - |
| Trigger Action Response Plan | A tool to manage known hazards, that defines the minimum set of actions required in response to a deviation from normal working conditions. | TARP |
| Water Management Basin | Stormwater collection basin designed to capture all surface water flows within active mine areas, prevent surface water from leaving site and support harvesting of stormwater for use in operational activities. | - |
| Water Quality Objectives | The desired physical and chemical characteristics of waters. | WQO |

# 1. Introduction

The key purpose of this document is to address the Goschen Mineral Sands and Rare Earths Project Environment Effects Statement (EES) Scoping Requirements related to potential effects of the surface water management controls within the mine site area and its relationship to the external environment. The scoping requirements for the Project are presented in Section 3.

The work undertaken has involved:

- Identification of policy and legislation relevant to surface water use, water quality and the protection of natural waterways and wetlands in proximity to the Project area,
- Characterisation of surface water in the Project area, including compilation of the available surface water information, identification of sensitive receptors and environmental values of surface water,
- Determination of design and mitigation measures that could substantially avoid, reduce and/or mitigate the significance of the effects/impact e.g. through reducing their extent, duration or likelihood, and
- Assessment of the likely residual impact of the Project on the existing environment and evaluate their significance assuming implementation of design and mitigation measures.

## 1.1 Requirement for an EES

The Project was referred to the Minister for Planning to seek advice on the need for an EES under the *Environment Effects Act 1978 (Vic)* (EE Act).

On 10 October 2018, the Minister for Planning decided that an EES was required on the basis that the Project has the potential for a range of significant environmental effects.

On 19 December 2018 under delegated authority from the Minister for the Environment, the Department of the Environment and Energy (now referred to as the Department of Climate Change, Energy, the Environment and Water (DCCEEW) made a decision that the Project is a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and would require assessment and a decision about whether approval should be given under the *EPBC Act*. DCCEEW also confirmed the Victorian Government's advice that the Project will be assessed under a bilateral agreement under the *EE Act*.

The EES allows stakeholders to understand the likely environmental impacts of the Project and how they are proposed to be managed. The Minister's assessment of the EES will also inform statutory decisions that need to be made on the Project.

The EES was developed in consultation with the community and stakeholders.

# 2. Project description

## 2.1 Project overview

The Goschen Project is an approximately 20 to 25-year rare earth and mineral sands mine and processing facility. VHM has been developing the Project in the context of a rapidly growing global demand for rare earths. One of the world's largest, highest-grade zircon, rutile and rare earth mineral deposits is in the Loddon Mallee region of Victoria in Australia. VHM intends to establish the Project to mine these deposits and process to produce and market a range of products to national and international consumers.

The mine site area has been designed to avoid intersection with groundwater and significant areas of remnant native vegetation. VHM will commence mining in Area 1 and subsequently progress to Area 3 (Figure 2-3 and Figure 2-4). Processing of ore will be implemented in the following phases:

- Phase 1 would involve a mining unit plant (MUP), wet concentrator plant (WCP), feed preparation plant (FPP) and a rare earth mineral concentrate (REMC) flotation plant. The product suite for Phase 1 consists of zircon. titania heavy mineral concentrate (HMC) and REMC products.
- Phase 1A would add a hydrometallurgical plant (HMP) downstream of the REMC flotation plant. The HMP would commence operations approximately 18 months post first production. The product suite for Phase 1A consists of mixed rare earth carbonate (MREC) products and zircon/ titania HMC.
- Phase 2 would commence either at the same time as Phase 1 or some 24 months post-production depending on prevailing market circumstances and consist of an additional mineral separation plant (MSP), hot acid leach (HAL) and chrome removal circuit. The additional plant would allow for the production of premium zircon, zircon concentrate, high titanium (HiTi) rutile, HiTi leucoxene and low chromium ilmenite.

The Goschen Project is located approximately 35 km south of Swan Hill within Gannawarra Shire (Figure 2-1).

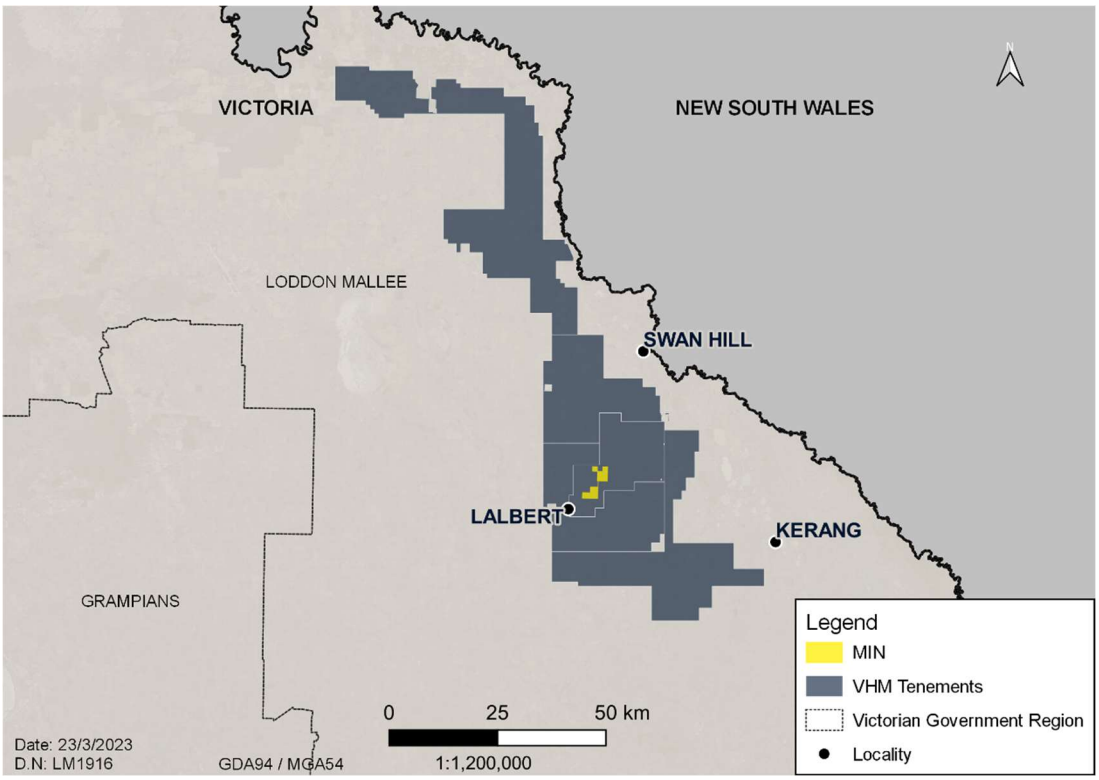


*Figure 2-1: Goschen project location*

## 2.2 Project development

It is recognised that there are opportunities to avoid and minimise environmental impacts during the many stages of project development. During project inception and early design development stages of the project, decisions on the location of the project and its design and construction techniques have enabled impacts to be significantly avoided and minimised in accordance with the hierarchy presented in Figure 2-2.

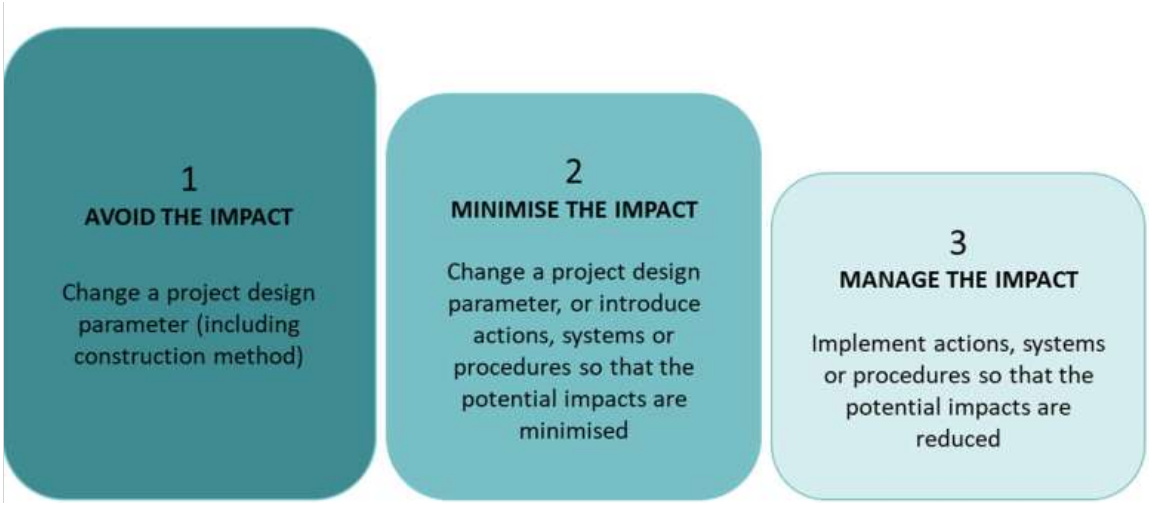


*Figure 2-2: Mitigation hierarchy*

Avoidance and minimisation of social and environmental impacts is central to the project's decision making and as such, the project will continue to be refined in response to technical requirements and potential environmental and social impacts identified during the development phase.

This was considered in the preparation of a project description which is found at Chapter 4: Project description. A description of how avoidance of impact has informed the design in relation to mine site surface water can be found in Section 6.4.

Examples of avoidance and minimisation include the decision to create vegetation protection zones within the project (mining area), restricting mining operations to daylight hours only to avoid noise related impacts to certain receptors, and restricting mining to depths above the water table to avoid impacts to the groundwater table.

After opportunities to avoid impact were incorporated into the project, minimisation and rehabilitation measures were developed. These are described in the construction and operation impact assessment sections below.

## 2.3 Key project components

The Project site consists of a heavy mineral sand mining and processing operation that will produce several heavy mineral concentrates (HMC) and a range of critical rare earth minerals across two defined mining areas known as Area 1 and Area 3 (Figure 2-3 and Figure 2-4).

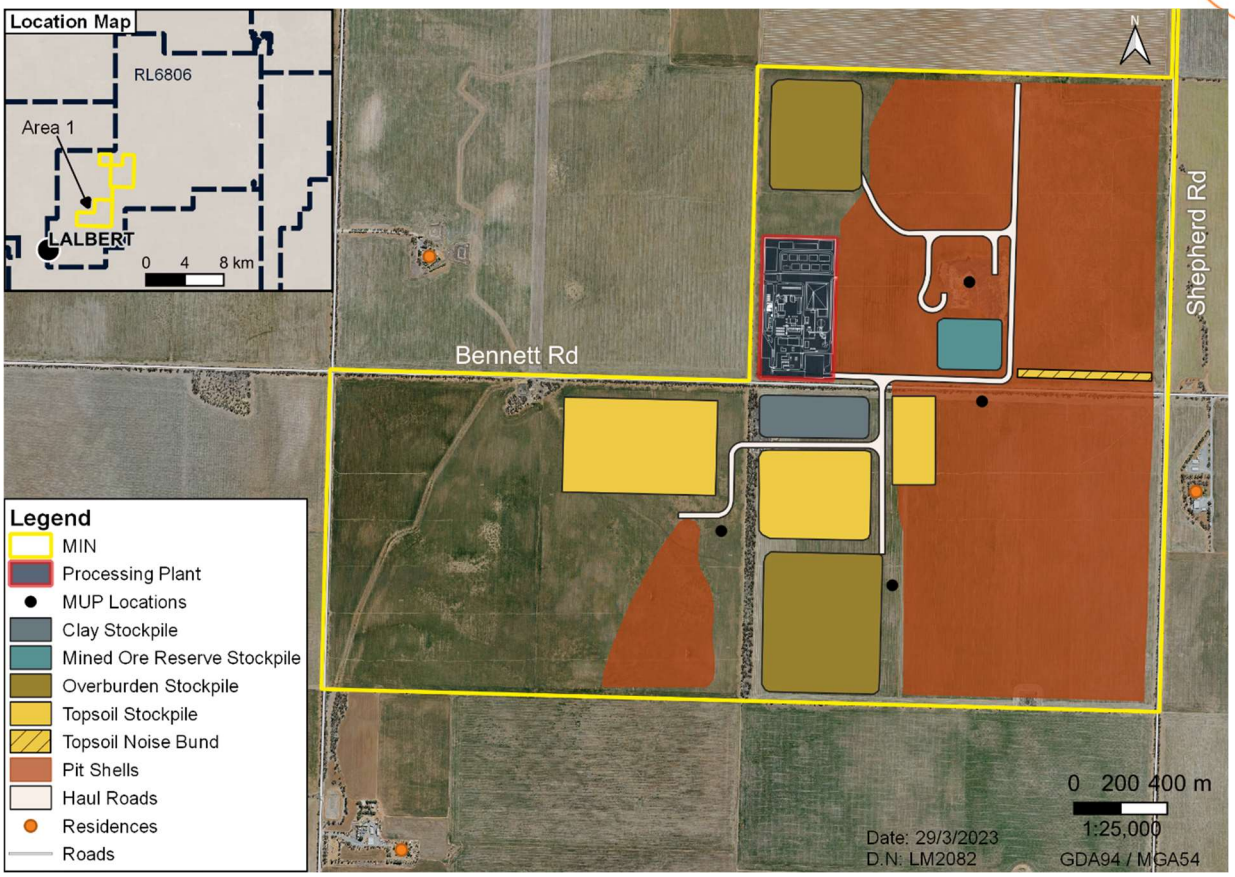


*Figure 2-3: Conceptual layout of Area 1*

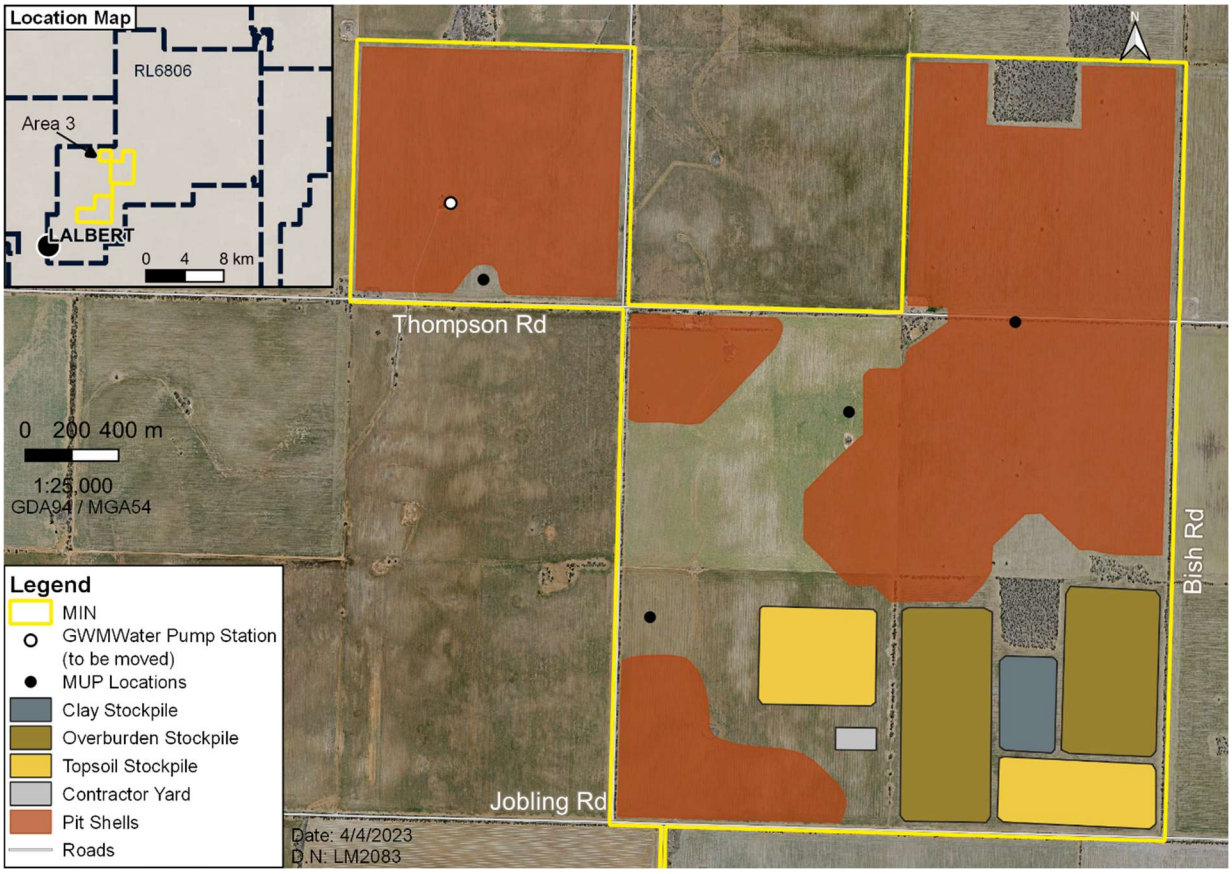


*Figure 2-4: Conceptual layout of Area 3*

The key components that make up the project are described below.

Mining – Mining will take approximately 20 to 25 years at 5M tonnes of ore produced per year and will occur only above groundwater across approximately 1,479 hectares of farmland using conventional open cut mining methods of excavation, load, and haul.

Processing – Heavy mineral sands and rare earths ore will be separated via an on-site WCP and MSP to generate a Rare Earth Mineral Concentrate (REMC). Refining of the REMC on-site is limited to hydrometallurgical extraction to produce a mixed rare earth carbonate. Tailings from the various mineral processes will be homogenised and placed back into the ore zone earlier mined.

Rehabilitation – The mined areas will be progressively backfilled in a staged manner, with tailings dewatered in-pit to allow overburden and topsoil placement in a profile that reinstates the background soil structure. This will result in the ability for a return to the current agricultural land uses within 3 years of commencing topsoil removal of a mining block.

Power – Electrical power needed for mining and processing will be produced from an on-site power plant fuelled by either diesel, liquefied natural gas (LNG) or liquefied petroleum gas (LPG), with a gradual evolution over the life of mine to renewables, hydrogen and/or battery as technologies and commercial viability increase. Heat energy for the on-site gas fired appliances shall be provided from an extension of the distribution network from the main LNG storage and regasification system.

Transport – Final products shall be containerised in 20ft sealed sea containers on site and exported via Melbourne Port using road and/or rail-based land logistics solutions. Ultima will provide intermodal rail solution, to reach the shipping export ports.

Water – Water will be required for construction earthworks, processing, dust suppression and rehabilitation. 4.5 Gigalitres per year (GL/y) will be needed for the start-up of the Project, and then reduced to between 3.1 GL/year during operations. Water will be sourced from Goulburn-Murray Water (GMW) from a new pumpstation at Kangaroo Lake via the open water market. A 38 km underground pipeline is proposed beneath existing local road easements as shown in Figure 2-5. The section of the pipeline annotated as ‘alternative route’ shown in Figure 2-5 is not proposed to be constructed.

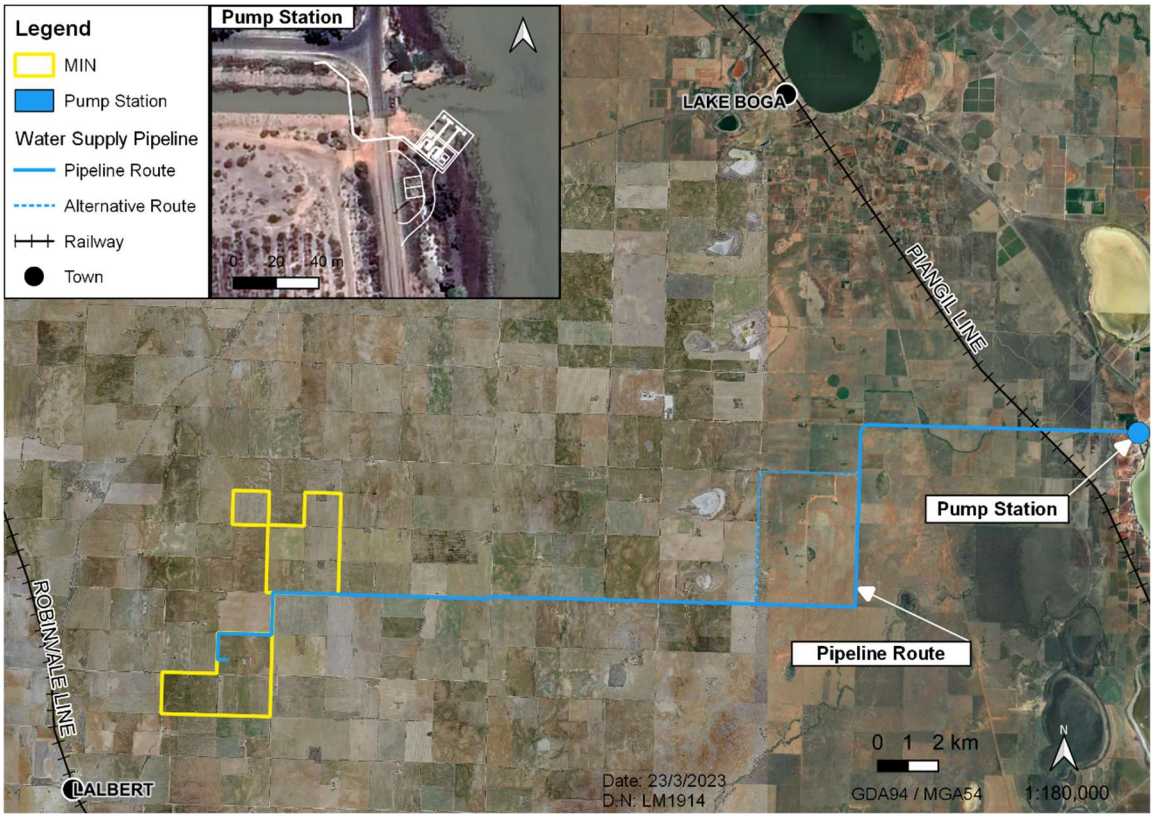


*Figure 2-5: Proposed water supply pipeline route to Area 1 and Area 3 (yellow)*

# 3. Scoping

## 3.1 EES evaluation objectives and scoping requirements

The scoping requirements for the Goschen Mineral Sands and Rare Earths Project Environment Effects Statement ('scoping requirements') by the Minister for Planning, set out the specific environmental matters the project must address in order to satisfy the Victorian assessment and approval requirements.

The scoping requirements include a set of evaluation objectives. These objectives identify the desired outcomes to be achieved in managing the potential impacts of constructing and operating the project in accordance with the *Ministerial guidelines for assessment of environmental effects* under the *EE Act*.

The following evaluation objectives have been identified as relevant to the Mine Site Surface Water Impact Assessment:

- To minimise effects on water resources and on beneficial and licensed uses of surface water, groundwater, and related catchment values over the short and long-term.

The aspects from the scoping requirements relevant to the evaluation objective are shown in Table 3-1 as well as the location where these items have been addressed in this report.

*Table 3-1: Scoping requirements relevant to mine site surface water*

| Aspect | Scoping requirement | Section addressed |
|---|---|---|
| Key issues | The potential for adverse effects on the functions, values, beneficial and licensed uses of surface water due to the project's activities, including water extraction, interception or | Sections 7.6, 8, 9 & 10<br><br>Refer footnote[1] |

| Aspect | Scoping requirement | Section addressed |
|---|---|---|
| | diversion of flows, discharges or seepage from operational areas or saline water intrusion. | Summarised in section 7.5 and addressed separately in the following specialist report/s:<br><br>Groundwater. |
| | The potential for adverse effects on nearby and downstream water environments (including the Murray and Avoca Rivers and Kerang Wetlands Ramsar site) due to changed water quality, flow regimes, groundwater mounding or waterway conditions during construction, operations, rehabilitation, decommissioning and post-closure. | Addressed separately in the following specialist report/s:<br><br>(Regional) Surface Water.<br><br>Refer footnote[1] |
| | Ore, product, overburden, tailings and mining by-products management, in the context of potential water quality impacts including those arising from sedimentation, release of radionuclides, other contaminants and pollutants, acid sulphate soils, acid/metalliferous drainage formation, and salinity. | Section 6.4, Section 8<br><br>Impacts of site discharge addressed separately in the following specialist report/s:<br><br>(Regional) Surface Water. |
| | Potential erosion, sedimentation and landform stability effects during construction, operation, rehabilitation and post-closure. | Addressed separately in the following specialist report/s:<br><br>Rehabilitation. |
| Existing environment | Identify and characterise the relevant groundwater and surface water environments, including the Kerang Wetlands Ramsar site, in terms of their protected environmental values and values, existing drainage functions and behaviours and catchments. | Refer footnote[1]<br><br>Summarised in section 7.5 and addressed separately in the following specialist report/s:<br><br>Groundwater. |
| | Identify existing groundwater and surface water users and allocations in the broader area, including downstream of the site. | Addressed separately in the following specialist report/s:<br><br>(Regional) Surface Water,<br><br>Groundwater. |

[1] The original 2017 referral area was much larger and included the Murray and Avoca Rivers and Kerang Wetlands catchments. The mine site area in this impact assessment comprises a significantly reduced footprint, is not located in or near these catchments, and minimises the probability of interaction.

| Aspect | Scoping requirement | Section addressed |
|---|---|---|
| | Characterise the interaction between surface water and groundwater within the project site and the broader area. | Summarised in section 7.2 and addressed separately in the following specialist report/s:<br><br>Groundwater. |
| | Provide a hydrogeological characterisation (e.g. a model) of the current allocations, extractions and uses of groundwater or surface water (e.g. irrigation use, stock and domestic use and environmental flows) in the broader area, including downstream of the site. | Addressed separately in the following specialist report/s:<br><br>Groundwater. |
| | Characterise the physical and chemical properties of the project area soils/mine geological materials including the potential environmental risks (e.g. potential for erosion, salinity, nutrients and acidification). | Section 7<br><br>More detailed assessment and reporting of groundwater, soils, mine geology and associated potential risks is provided separately in the following specialist report/s:<br><br>Groundwater,<br><br>Soil & Land Resource, and<br><br>Geotechnical. |
| Assessment of likely effects | Develop a water balance model to quantify the project's demand (both quantity and quality) on groundwater and/or surface water resources, including volume to be extracted, stored and released during the construction, operations, decommissioning and post-closure phases of the project. | Section 7.6.3 |
| | Use appropriate methods, including modelling, to identify and evaluate effects of the project and feasible alternatives on groundwater and surface water environments, including:<br><br>The likely extent, magnitude and duration of groundwater level drawdown in the vicinity of the mine and water supply bores during construction and operation, and the expected timing and scale of recovery of groundwater levels post-closure (spatial and temporal groundwater modelling),<br><br>The potential for mounding and migration of groundwater from the backfilled tailings material along the mine-path during operations, decommissioning and post-closure (including predicted volume, timing and water characteristics), | Addressed separately in the following specialist report/s:<br><br>Groundwater.<br><br>Addressed separately in the following specialist report/s:<br><br>Groundwater. |

| Aspect | Scoping requirement | Section addressed |
|---|---|---|
| | Changes to groundwater and surface water quality at all project phases, including effects from drawdown and rebound of groundwater levels in the vicinity of the mine-path and water supply bores, present contaminants (including radionuclides), as well as downstream and upstream effects on ecological values (e.g. groundwater dependent ecosystems and the Kerang Wetlands Ramsar site), | Groundwater is addressed separately in the following specialist report/s:<br><br>Groundwater, &<br><br>(Regional) Surface Water. |
| | Changes to availability of surface water and groundwater for environmental values (e.g. licenced users and/or ecosystems) as a result of the project (e.g. as a result of predicted extraction groundwater and/or surface water for operational use), accounting for climate risks and the potential effects of climate change, | Addressed separately in the following specialist report/s:<br><br>Groundwater, &<br><br>(Regional) Surface Water.<br><br>Summarised in section 6.4, section 8 |
| | Risks associated with potential acid forming materials (soil and rock) which may be disturbed or exposed by mining activities, and | More detailed assessment and reporting of acid forming materials is provided separately in the following specialist report/s:<br><br>Soil & Land Resource.<br><br>Section 7.1 |
| | Potential erosion, sedimentation, and landform stability effects of the project. | Landform stability is addressed separately in the following specialist report/s:<br><br>Geotechnical, &<br><br>Rehabilitation. |
| Design and mitigation measures | Describe proposed design options and measures which could avoid or minimise significant effects on environmental values of surface water, groundwater and downstream water environments, accounting for climate risks and the potential effects of climate change, during the project construction, operations, decommissioning and post-closure phases. | Section 9 |
| Approach to manage performance | Describe monitoring programs to be implemented to ensure prompt detection of surface water and groundwater effects associated with the project. | Section 9 |
| | Identify possible contingency actions to respond to foreseeable changes that may be identified through the monitoring program. | Section 11 |

# 4. Evaluation framework

The assessment will consider legislation, policy, and standards relevant to Mine Site Surface Water along with specific assessment criteria that have been derived for the purposes of the study.

## 4.1 Legislation, policy, guidelines, and standards

The legislation, policy, guidelines, and standards relevant to this assessment are summarised in Table 4-1.

*Table 4-1: Legislation, policy, guidelines, and standards relevant to the assessment*

| Document title | Summary | Relevance to the project |
|---|---|---|
| **Commonwealth government** | | |
| Australian and New Zealand Governments (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality | The Australian and New Zealand Guidelines for Fresh and Marine Water Quality were prepared as part of Australia's National Water Quality Management Strategy and contain guidelines for water and sediment chemical and physical parameters, and biological indicators to assess water quality. The key aim of the guidelines is to develop management frameworks for protecting environmental values of water resources in Australia and New Zealand. | Where indicators and objectives are not prescribed in the Environment Reference Standard 2020 (ERS), trigger values for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems (lowland rivers) were used in the assessment of water quality. |
| Australian Rainfall and Runoff (2019) | Australian Rainfall and Runoff sets out technical guidelines for policy decisions and technical assessment for projects involving mine projects. | The recommendations set out in Australian Rainfall and Runoff (2019) are used as the base methodology for hydrology and hydraulics technical assessment. |
| **Victorian government** | | |
| *Water Act 1989 (Vic)* | Provides the legal framework for managing Victoria's water resources. | Sets out water rights, entitlements, and licencing requirements for harvesting of surface water and associated water storage infrastructure. |
| *Planning and environment act 1987* | Establishes a framework for planning the use, development and protection of land in Victoria | Describes objectives to be achieved in surface water-use related planning schemes, and describes the Responsible Authorities responsible for administering those schemes<br><br>Provides a framework for managing conflicts in surface water demand, i.e. runoff over catchments, between, for example, developers and communities, through establishment of additional Responsible Authorities in the form of Referral Authorities |

| Document title | Summary | Relevance to the project |
|---|---|---|
| *Flora and Fauna Guarantee Act 1988* | Protect threatened species. | Examine potential effects on biodiversity and ecological values. |
| *Catchment and Land Protection Act 1994* | The *CaLP Act* applies to the management and protection of water catchments throughout Victoria.<br>Provides a framework for the integrated management and protection of catchments. | Considers adverse groundwater effects due to extraction on receptors,<br>Guidance for works on waterways. |
| *Environment Effects Act 1978* | Provides a framework for investigation of projects that may significantly affect the environment. | Provides a framework for investigation under a range of outcomes,<br>Requires methods for mitigating adverse environmental effects and risks. |
| *Environment Protection Act 2017* | Provides the legislative framework for protecting the environment in Victoria. | Includes regulations regarding protection of environmental values.<br>Regulations regarding protection of environmental values including the environmental values for and of the environment.<br>Storm water drainage and water supply systems are defined as infrastructure under the Act and subject to general environmental duty (GED) requirements.<br>Project must demonstrate it is implementing measures so far as 'reasonably practicable' to meet the GED. |
| *Environment Reference Standard (2021)* | Principles of environment protection. | Environment Reference Standard (ERS) supersedes the State Environment Protection Policy (Waters) (SEPP (Waters)).<br>The ERS includes environmental values, indicators and objectives. |
| *Gannawarra and Swan Hill Planning Schemes* | Contains policies and provisions that control land use and development | Provides overlays to illustrate extents of environmentally protected areas, floodways, land prone to inundation and other<br>environmental values, within Swan Hill and Gannawarra<br><br>Provides ordinances to control developments which may interact with these values |

| Document title | Summary | Relevance to the project |
|---|---|---|
| *Mineral Resources (Sustainable Development) Act 1990 (MRSD Act)* | Mining and extractive industries must operate in accordance with the provisions of the *MRSD Act*<br>The *MRSD Act* is administered by the Department of Jobs, Precincts and Regions - Earth Resources Regulation. | Earth Resources have developed Guidelines and Codes of Practices that include preparation of work plans for mining licences and treatment of surface water to support compliance with Victorian Legislation. |
| **Catchment Management Authorities (CMAs)** | | |
| Mallee CMA and North Central CMA | 2021-27 North Central Regional Catchment Strategy<br>2013-19 Mallee Regional Catchment Strategy<br>Each CMA prepares the RCS on behalf of their region. It's the overarching strategy for all involved in managing land, water and biodiversity. | The project is located within in the North Central CMA management area and in proximity to the Mallee CMA management area.<br>Works would be undertaken in accordance with North Central CMA Works on a Waterway permit licence requirements. |
| **Earth Resources** | | |
| Preparation of Work Plans and Work Plan Variations - Guideline for Mining Projects | Provides guidance on the preparation of work plans, work plan variations, and work plan notifications for mining projects to meet the requirements of the *Mineral Resources (Sustainable Development) Act 1990* and associated regulations. | Provides a framework for assessment and acceptance criteria for stormwater. |
| Guidelines for the management of water in mines and quarries | Provides basic information for operators on how to manage discharges of wastewater from a mine site to ensure compliance with Victorian legislation. It includes protection of ground and surface water quality for downstream users. | The guideline provides references to relevant legislation and recommendations for storage, treatment and offsite disposal of mine affected water. |
| Code of Practice for small quarries (2010) | Provides industry recommendations for stormwater treatment and discharge from small quarries. | Stormwater treatment should meet/exceed the recommendations. |
| Code of Practice for low-risk mines (2014) | Provides industry recommendations for stormwater treatment and discharge from low-risk mines. | Stormwater treatment should meet/exceed the recommendations. |
| **International Erosion Control Association (IECA) Australasia** | | |
| Best Practice Erosion and Sediment Control (BPESC) (2008) | IECA provides technical guidelines and design principals for management of erosion and sediment control and prevention of sediment transfer in stormwater. | Industry best practice standard for management of erosion and sediment control for surface water flow. |

## 4.2 Assessment criteria

The *General Environmental Duty* (GED) under the *Environmental Protection Amendment Act 2017* requires reasonably practicable steps to eliminate, or otherwise reduce risks.

The Proponent intends to comply with its GED obligations by:

- Eliminating the risk to the extent that it is practicably possible by retaining all water from disturbed areas within the Study Area and implementing best practice erosion and sediment controls appropriate for the site and development stage, and
- Surface water from undisturbed and rehabilitated sections of the site that can meet water quality objectives under the Environment Reference Standard (2021) will be permitted to leave site via overland flow paths and clean water diversion drains to downstream watercourses, to mitigate water removed from the downstream catchments.

As surface water from disturbed catchments within the active mining area is to be contained onsite, this assessment considers the feasibility of this approach in terms of infrastructure requirements to enable the approach to be implemented.

A risk assessment for sensitive receptors identified within the mining lease has been undertaken based on the Preparation of Work Plans and Work Plan Variations Guideline for Mining Projects December 2020 (version 1.3).

# 5. Consultation and engagement

Consultation and stakeholder engagement has been undertaken for the project with a broad range of community participants and stakeholders. Relevant stakeholders include (but are not limited to) landholders, businesses, local community groups, local shire councils, water authorities and catchment management authorities. Further information is provided in EES Chapter 22: Community and stakeholder engagement.

While the subject of water supply and environmental flows during drought has been raised by community members, potential impacts that may result from mine site surface water management have not been raised as an issue of concern to date.

Any queries or concerns raised will be addressed with subsequent documentation and engagement.

# 6. Methodology

## 6.1 Overview of method

This section describes the method that was used to assess the potential impacts of the project. Figure 6-1 shows an overview of the assessment method. A risk-based approach was applied to prioritise the key issues for assessment and inform measures to control impacts.

The approach used in the assessment has been guided by the evaluation framework that applies to the project comprising the regulatory framework (that is, applicable legislation and policy) as well as the scoping requirements set by the Victorian Minister for Planning.

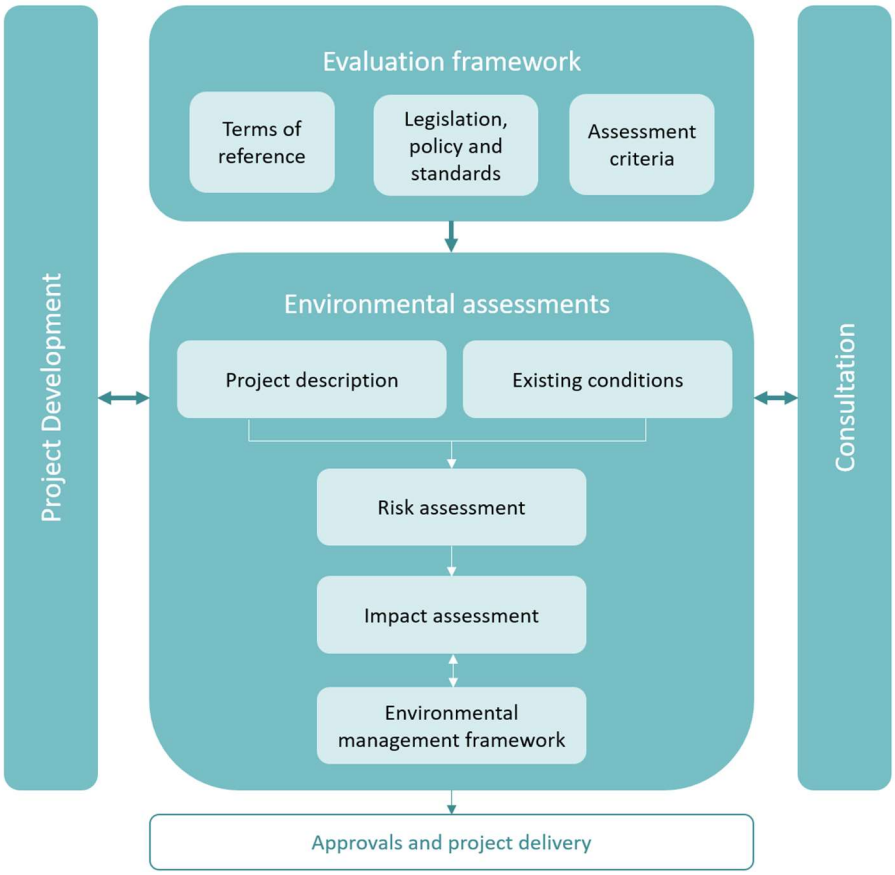


*Figure 6-1: Overview of assessment framework*

The impact assessment was undertaken according to the following steps:

1. Establishment of a Study Area and characterisation of existing environment,
2. Review of the project description, comprising the key project components (including locations and form), proposed construction and operation activities (in the context of existing environment) and decommissioning activities to determine the location, type, timing, intensity, duration, and spatial distribution of potential project interactions with sensitive receptors,
3. An initial risk-based analysis to evaluate the potential effects of proposed project activities and their likelihood of occurring (considering initial mitigation measures) to determine the relative importance of impacts associated with the project and therefore prioritise issues for attention in the subsequent assessment of impacts. Initial mitigation measures would include measures that are common industry practice or required to meet legislation,
4. An assessment of impacts that examines the severity, extent, and duration of the potential impacts and considers the sensitivity and significance of the affected receptors,
5. Evaluation of predicted outcomes against benchmarks and criteria such as those described in applicable legislation, policy, and standards,
6. Evaluation of the potential for cumulative impacts (where relevant) caused by impacts of the project in combination with impacts of other existing and proposed projects that may have an overall significant impact on the same environmental asset,
7. Identification of additional mitigation measures to address potential residual environmental impacts including magnitude, duration and extent, taking into account the proposed mitigation measures, and
8. Evaluation and reporting of the residual environmental impacts including magnitude, duration, and extent, considering the proposed mitigation measures and their likely effectiveness.

Based on the findings of the environmental assessments, an Environmental Management Framework (EMF) has been prepared to monitor and control environmental performance during project implementation. The EMF has specified the committed mitigation measures to avoid, minimise and manage impacts, proposed contingency measures and offset commitments, and describe the roles and responsibilities for implementation throughout project construction, operation, and decommissioning.

## 6.2 Study Area

The Goschen Project is located near Lalbert, approximately 27 km south of Swan Hill. The Study Area for mine site surface water impact assessment covers surface water within mine operational areas 1 and 3, shown in Figure 6-2.

Surface water impacts on areas outside the mine site have been assessed in the Regional Surface Water Impact Assessment (Water Technology 2023).

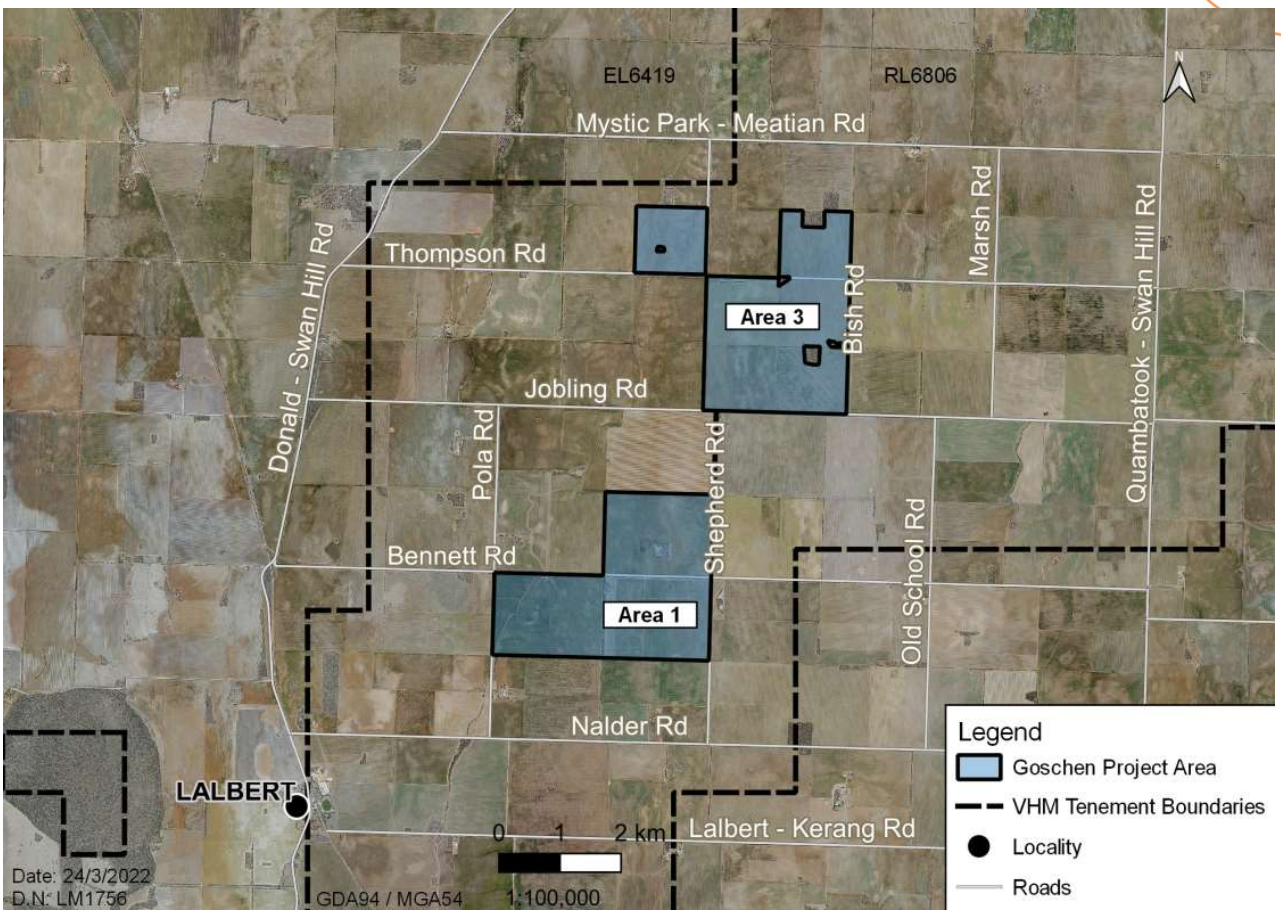


*Figure 6-2: Mine site surface water assessment - Study Area (Source: VHM Limited)*

## 6.3 Existing environment

A comprehensive assessment was undertaken to understand the existing environment of the Study Area, to inform the environmental impact assessment for the works. This assessment incorporated:

- A desktop assessment of environment, land, water, planning, climate change and rainfall datasets provided by the Victorian State Government (Vicmap, MapShareVic) and Bureau of Meteorology,
- Review of current legislation, policies, and climate change literature, and
- Review of specialist studies for geotechnical, groundwater, soils and land resource, flora, fauna, tailings, surface water and mine rehabilitation.

Assessment was undertaken to understand the existing environment of the mine site area to identify specific sensitive environmental receptors that may be affected by surface water.

## 6.4 Avoidance and minimisation

Relevant to this impact assessment, the following measures have been adopted in relation to the design, construction and operation of the project to avoid and minimise impacts:

***Surface Water Management***

Given the potential for contamination of surface water due to mining and construction activities coupled with the site's semi-arid climatic conditions, it is intended that surface water from disturbed catchments (mine affected water) be contained within the mine site.

Design of internal surface water flows allows for storage of surface water flows up to the 5% AEP over a 9hr duration (1 in 20-year Average Recurrence Interval) design storm event, with further allowance for surface water from more extreme events to be contained locally and directed to the active pit, ensuring that surface water that has reasonable risk of not achieving required water quality objectives cannot impact sensitive receptors.

The mine strategy includes a staged mining and rehabilitation sequence, where completed sections of mine are progressively filled and rehabilitated to keep the disturbed footprint as small as practicably possible over the life of mine and maintain water quality. Further information on the rehabilitation process is provided in the Draft Rehabilitation Plan (pitt&sherry 2022)

Plans illustrating how surface water is intended to be directed throughout the mine site area are included in Appendix B and C.

***Water quantity***

- The staged mining strategy means that a significant portion of the Study Area catchment will be undeveloped or rehabilitated. Area 3 for example, contains 7km² of catchment that is not planned to be mined until year 8 of the mine life. Surface water from undeveloped and rehabilitated sections of the Study Area that can meet required water quality objectives may be directed to the natural drainage systems to mitigate the quantity of water removed from external catchments.

Excess surface water that is directed to the pit will be stored temporarily and then recycled or pumped out to keep the workings dry during mining operations. The stored surface water is not anticipated to impact ground water. Assessment of surface water and groundwater interactions is provided in the Groundwater Report (CDM Smith 2023).

***External site drainage***

Stormwater runoff within undisturbed areas can be managed using existing surface drainage lines in keeping with current farm management practices. In instances where the mine is operating in a drainage line or overland flow path, drainage lines can be diverted and returned to their natural termination points via lined open channels and diversion bunds.

***Infrastructure locations***

Stockpiles and processing infrastructure are located outside key drainage areas. Catchment ridges have been identified as optimal locations for infrastructure, as they are outside overland flow paths.

***Erosion and sediment control***

The Revised Universal Soil Loss Equation (RUSLE) procedure outlined in IECA (2008) was used to assess the erosion risk, which was determined to be very low (<10 T/ha/yr). The very low erosion risk is attributed to the flat topography, semi-arid climate, low rainfall erosivity (R-factor value of 450) and not being prone to frequent high intensity rainfall. Soil loss calculations using the RUSLE procedure are contained in Appendix D

Progressive rehabilitation of site stockpiles and completed mine areas will reduce the extent of disturbed catchment. Rehabilitation and erosion and sediment control is discussed in detail in the Mine Rehabilitation Plan (pitt&sherry 2022)

Progressive rehabilitation and a conventional suite of erosion and sediment controls is expected to be effective to manage the sedimentation risks for the project.

***Potential acid formation***

Soil and land resource assessment (SLR 2022) found that soils and subsoils in the Study Area are very alkaline and the presence of acid sulfate soils is extremely unlikely. Potential Acid Forming rock was not identified in the assessment and it was determined that the Study Area has a very low potential for acidification.

***Water use efficiency***

To optimise water use, a water efficiency program is recommended to be incorporated into the Surface Water Management Plan. This program would provide strategies to investigate water use efficiency/recovery opportunities and a framework for implementation with consideration of current or emerging technologies over the life of mine.

## 6.5 Risk assessment

A risk assessment of project activities was performed to prioritise the focus of the impact assessments and development of mitigation measures. The risk pathways link project activities (causes) to their potential effects on the environmental assets, values or uses that are considered in more detail in the impact assessment. Risks were assessed for the construction, operation and decommissioning phases of the Project. The risk assessment focused on surface water impacts to the protected vegetation. The assessment found that water quality risks can be mitigated through installation of diversion channels and bunds. Impacts to water quantity will need investigation by an ecologist to determine the sensitivity to changes in surface water flows and if mitigation measures will be required. Risk assessment results are provided in Appendix A.

The likelihood and consequence ratings determined during the risk assessment process and the adopted mitigation measures are presented in Appendix A. The risk assessment has been undertaken in line with the Preparation of Work Plans and Work Plan Variations Guideline for Mining Projects December 2020 (version 1.3).

## 6.6 Impact assessment

A change to baseline conditions (or the no-project case) caused by project activities in any of the project phases (construction, operation, or decommissioning) may give rise to impacts.

The impact assessment involved identifying the severity, extent, and duration of any impacts, positive or negative, that the project may have on the existing environment.

The significance of the impacts has been assessed in accordance with the evaluation framework, based on applicable legislation, policy and standards and the evaluation objectives and environmental significance guidelines arising from the scoping requirements established to guide the assessments.

This study has assessed the impacts of construction, operation and decommissioning of the project on mine site surface water assets and values to be protected.

The scoping requirements and evaluation criteria were used to define the key technical components of the study. The assessment included the following:

- All surface water relevant policy and legislation was reviewed to ensure the technical assessment methodology would cover the required detail,
- The existing surface water environment, data availability and sensitive receptors / environmental values were identified and made a focus for the technical assessment outcomes,
- Consideration of climate change,
- Mitigation measures were identified in consultation with the Proponent with consideration to the mitigation hierarchy to avoid or minimise impacts as far as reasonably practicable, and

- An assessment of residual impacts following implementation of the proposed mitigation measures and controls.

## 6.7 Limitations, uncertainties, and assumptions

The following limitations, uncertainties and assumptions apply to this assessment:

- The mining operation will not allow mine impacted water to exit the operational mine areas, through containment and water reuse. Only rehabilitated areas of the mine may release surface water runoff outside the mining area. Surface water from within operational mining areas of the mine site will not be allowed to exit the site and will be directed and used within the process water circuit. Process plant areas will be collected from sealed surface areas and directed to the lined Process Water Pond (PWP),
- It is assumed that the surface water within the process plant and mined ore reserve stockpile catchments will contain contaminants of concern (CoC) in concentrations that will require capture and treatment. It is assumed that topsoils and overburden stockpiles that make up the remainder of the site do not contain concentrated ore material and will not contain CoC in concentrations that will affect surface water or groundwater quality. All run-off from process areas will be directed to the lined 60ML PWP. Treatment will be principally sediment and oil traps prior to entering the PWP. The PWP will have a TARP as required under the Work Plan,
- In absence of local water quality objectives, national default guidelines nominated in the Guidelines for Fresh & Marine Water Quality, (Australia & New Zealand Guidelines for Fresh & Marine Water Quality 2018) have been adopted. It is assumed that the project will undertake a testing regime to understand and set water quality objectives that represent local conditions,
- Construction activities will occur above the groundwater table and where groundwater mounding intersects with the pit floor, a system of dewatering bores will be installed to ensure that groundwater is maintained at a level of nominally 1m below pit floor,
- The decommissioned surface water channels that intersected with the Study Area have been removed from the topography so far as practicable and no longer function as channels,
- Specific discussion on potential acid forming (PAF) rock and possibility of acid mine drainage (AMD) was not provided within the referenced site investigations and studies. It is understood from the soil and land resource assessment (SLR September 2022) and the geotechnical assessment (pitt&sherry 2022) that potential for acid formation is very low and surface water mitigations will not be required. Should it be found that PAF materials are present and there is potential for AMD, then appropriate treatments (such as encapsulation with non-acid forming materials) will be required to minimise surface water infiltration,
- Assessment of radionuclide conditions in soils and waters and its impacts is provided in Radiation Impact Assessment and has not been considered in this assessment
- A review of the *Water Act* 1989 was undertaken to determine water licencing requirements for storage and use of captured surface water. Referenced water corporations have not been contacted and detailed assessment of licencing requirements to determine if the project would be granted required licences has not been undertaken and is understood to be outside the scope of this assessment, and
- It is assumed that mitigation and contingency measures considered in the ecological impact assessments (Nature Advisory 2023 & EcoAerial Pty Ltd 2022) and will be implemented and these measures will be sufficient to protect listed and protected flora within the mine Study Area against impacts from mine site surface water. Mitigation measures relating to surface water include management of clean down bays by burying waste below topsoil, restricting changes to natural drainage lines and directing saline discharge away from areas of retained native vegetation.

## 6.8 Linkages to other technical reports

This report has interdependencies with the technical reports. The associated components and the linking reports are provided in Table 6-1

*Table 6-1 Linkages to Other Technical Reports*

| Impact assessment component | Linking Reports |
|---|---|
| External surface water catchments and interactions with mine site surface water | Regional Surface Water Impact Assessment (Water Technology, 2023) |
| Groundwater characteristics and potential for interaction with mine site surface water | Groundwater Impact Assessment (CDM Smith 2022) |
| Mine pit design and interaction with surface water | Geotechnical Impact Assessment (pitt&sherry 2022)<br><br>Groundwater Impact Assessment (CDM Smith 2022) |
| Soil and subsoil characteristics and relationship to soil transport and water quality | Soil and Land Resource Impact Assessment (SLR 2022) |
| Surface water interaction with listed threatened species and communities | Flora and Native Vegetation Assessment (Nature Advisory 2022)<br><br>Terrestrial Fauna Impact Assessment (EcoAerial 2022) |

The specialists undertaking these assessments worked collaboratively to evaluate potential impacts and design suitable mitigation measures to be adopted by the project.

# 7. Existing environment

## 7.1 Soils and erosion hazard

The proposed surface water management strategy intends to capture and control runoff from disturbed areas. Soil erosivity has been assessed to inform whether this strategy is practicable.

For the surface activities associated with this mining proposal the most significant water quality risk for assessment is that associated with soil erosion and subsequent offsite transport of sediment in stormwater runoff.

The Soil and Land Resource assessment undertaken by SLR describes the soil profile within the Study Area as having:

- Neutral to moderately alkaline, non-saline, non-sodic topsoils, and
- Moderately to strongly alkaline, slightly to moderately saline, marginally to strongly sodic soils.

The erosion potential and prediction of annual soil loss by sheet and rill water erosion can be calculated using the Revised Universal Soil Loss Equation (RUSLE) procedure outlined in IECA (2008).

The equation is written as A = R x K x LS x C x P and includes the following factors:

- rainfall and runoff erosivity (R-factor),
- soil erodibility (K-factor),
- slope length and steepness (LS-Factor),
- cover management (C-factor), and
- support practices (P-factor).

The RUSLE procedure was used to assess erosion risk, which was determined to be very low (<10 T/ha/yr). Two main factors influence the very low erosion hazard at this site – climate and the landform. The site has a relatively dry climate and low rainfall erosivity (R-factor value of 450) and is not prone to frequent high intensity rainfall. RUSLE calculations are included in Appendix D.

The predicted effects of climate change (decrease in rainfall, less frequent rain events & increased rainfall intensity) are not anticipated to substantially alter the assessed erosion risk.

## 7.2 Groundwater

Groundwater has potential to interact with surface water, either through expression of groundwater through the surface, where it could change the characteristics of surface waters, or through surface water infiltrating the groundwater table, impacting groundwater characteristics

A groundwater investigation was undertaken by CDM Smith and is included in the groundwater assessment report (CDM Smith 2023).

The investigation found:

- Groundwater is highly saline and relatively deep, varying from 30m below ground level (m bgl) to greater than 50m bgl, and does not discharge to the surface within the mine site area. The depth of mining will be between 30 and 47 m bgl, with depths selected to be above the groundwater table.
- There is low permeability at depth and there are no known permanent surface expressions of groundwater that interact with surface water within 10km of the Study Area.
- Groundwater is unsuitable for human consumption due to elevated electrical conductivity and based on the

available information groundwater is not used for human consumption, stock watering, irrigation or industrial purposes within 10 km of the Project area.

- Groundwater recharge due to infiltration from rainwater is low due the low permeability at depth and the relatively deep ground water level and that there is little to no evidence of any considerable seasonal recharge of the ground water.

Assessment of mining operations on groundwater found:

- Localised increases in groundwater levels (mounding) below the pit floor is anticipated due to mining operations. Mine dewatering systems such as groundwater dewatering bores are planned to be used, and the system will be used to reduce water levels beneath the pit floor until the area is backfilled.
- Construction activities are unlikely to intersect the water table and due to the depth to water table and low permeability, the water table is unlikely to receive any environmental risks from surface construction activities.

## 7.3 Location and topography

The mine site area is situated within an area of broad very gently undulating topography currently predominantly used for large scale farming activities. Most of the proposed mine project would occur on farmland, with remnant native vegetation existing within small communities within the project area and also aligned along road reserves. Rural residences are located over the Project area and surrounds.

The topography in the Study Area ranges from approximately 75m to 125m Australian Height Datum (AHD) and is characterised by a north–south-orientated ridge (Cannie Ridge) elevated around 100–125m AHD that can be seen transecting the proposed mine areas as shown in Figure 7-1.

The ridgeline forms the top of catchment in the area and the site is not near any waterways. Surface water from the proposed mine site catchment does not interact with any designated waterways.

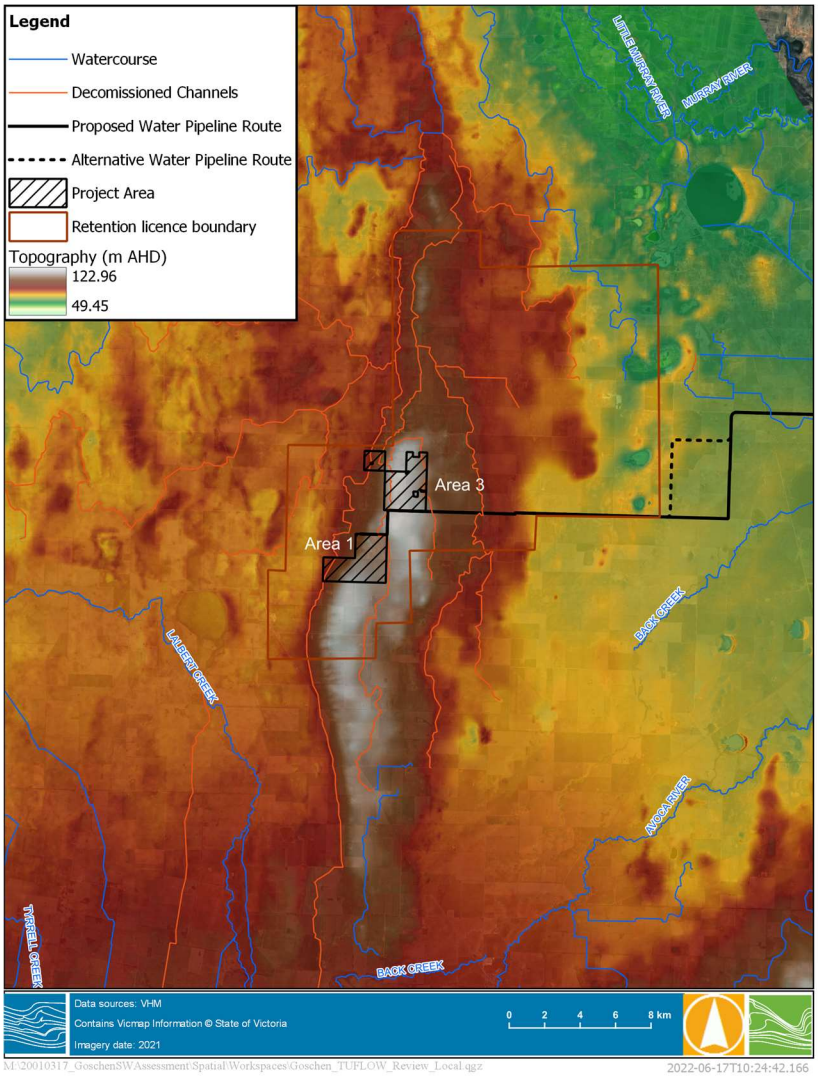


*Figure 7-1: Project area topography (reproduced from Water Technology)*

## 7.4 Climate

The Study Area is characterised by a semi-arid climate with low rainfall (365mm/year) and high evaporation (1600mm/year). Mean annual minimum and maximum temperatures range between 9.4 and 24.0°C.

Several climate gauges are located within a 20km radius of the mine and provide an indicator of flood risk. Climate data, sourced from the Australian Government Bureau of Meteorology (BoM) weather stations 077094 (Swan Hill Aerodrome) & Weather station 077023 (Lalbert), is presented below:

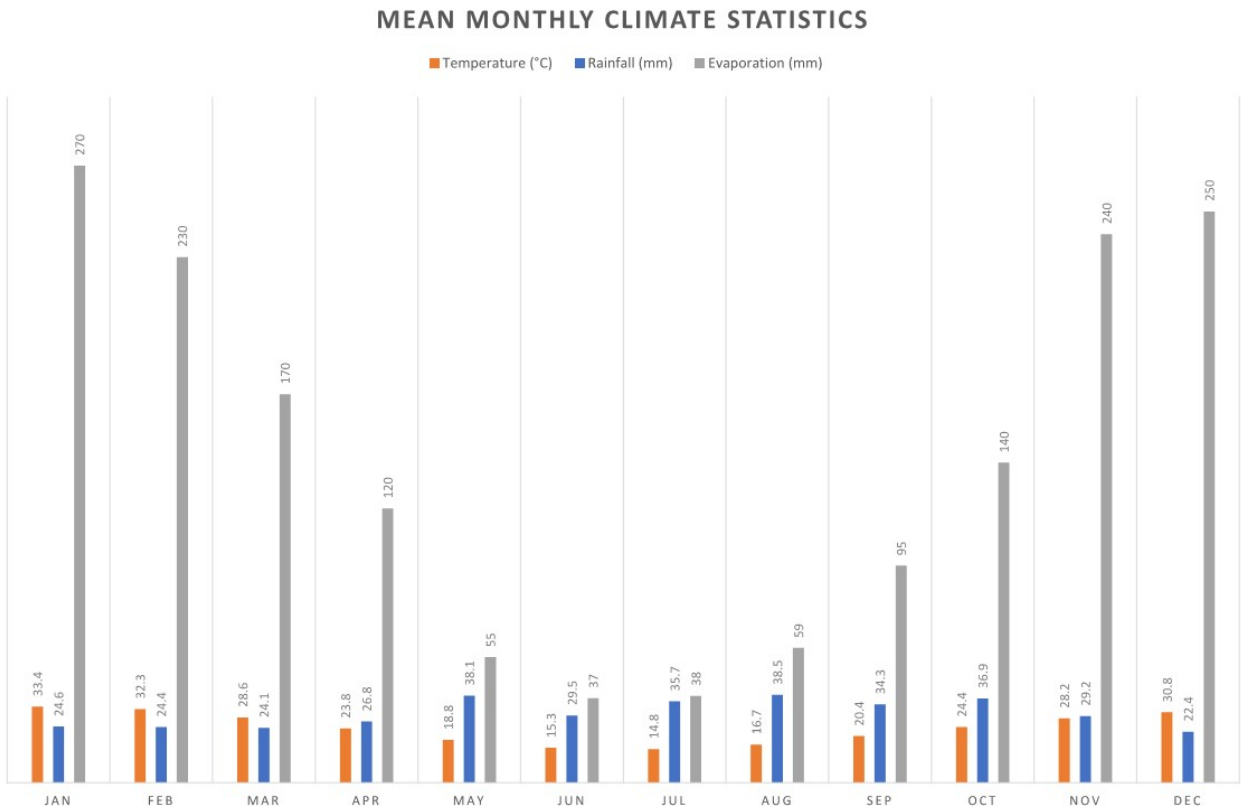


*Figure 7-2: Mean monthly climate statistics from 1917 to 2022 at Station Swan Hill Aerodrome & 77023 (Lalbert) – source: BoM*

### 7.4.1 Climate change

State of the Climate 2020 is a joint publication by CSIRO and BoM. This State of the Climate report draws on the latest climate research, encompassing observations, analyses and projections to describe year-to-year variability and longer-term changes in Australia's climate (State of the Climate 2020).

The report notes the following climate trends and future impacts relevant to surface water changes within the Study Area:

- In the southeast of Australia there has been a decline of around 12 per cent in April to October rainfall since the late 1990s,
- There has been a decrease in streamflow at the majority of streamflow gauges across southern Australia since 1975, and
- In the coming decades Australia is projected to see continued decrease in cool season rainfall across many regions of southern and eastern Australia, likely leading to more time in drought, yet more intense, short duration heavy rainfall events.

The climate change impact to surface water within the Study Area is likely to be observed through:

- Net reduction in available surface water for harvesting and use in process,
- Increased likelihood of drought conditions negatively impacting ground vegetation and an increase in exposed soil, generation of dust and erosion potential, and
- Intense and extreme storm events with heavy rainfall will be likely for short durations.

These impacts can be controlled in design and through a surface water management plan. Further discussion on onsite surface water flow including allowance for climate change impacts are discussed in sections 7.6 and 7.7

## 7.5 Regional Surface Water Setting

### 7.5.1 Existing conditions

The original 2017 referral area was much larger and included the Murray and Avoca Rivers and Kerang Wetlands catchments. The mine site area in this impact assessment is a significantly reduced footprint, is not located in or near these catchments and surface water does not have potential to impact.

Site investigations of the Study Area and assessment of regional surface water conditions were undertaken by Water Technology, which is included in the Surface Water Impact Assessment report (Water Technology 2022). The Water Technology impact assessment assumed that run-off from disturbed catchments within the mine site area would be contained within the mine site and assessed risks on this basis. This assumption is aligned in both the water Technology report and this impact assessment.

Surface water conditions are summarised below:

- The Project area has relatively low rainfall and is not in direct proximity to any waterways,
- Surface water does not interact with any designated waterways,
- Water supply channels that crossed the Study Area have been decommissioned and are no longer in use,
- Surface water runoff within the Study Area flows to the west. There are more defined flow paths across Area 1 than Area 3. The runoff from both areas largely forms isolated pools in shallow depressions and quickly evaporates or transpires. An extract from the Surface Water Impact Assessment report (Water Technology 2023) report showing 1%AEP flood depths in Figure 7-3 shows flow paths and isolated pool structures that receive flow from the Study Area catchment, and
- Surface water runoff originating from the Study Area drains to into a number of smaller depressions of potentially high biodiversity value. Biodiversity values are discussed in the Native Vegetation and Flora Assessment (Nature Advisory 2022).

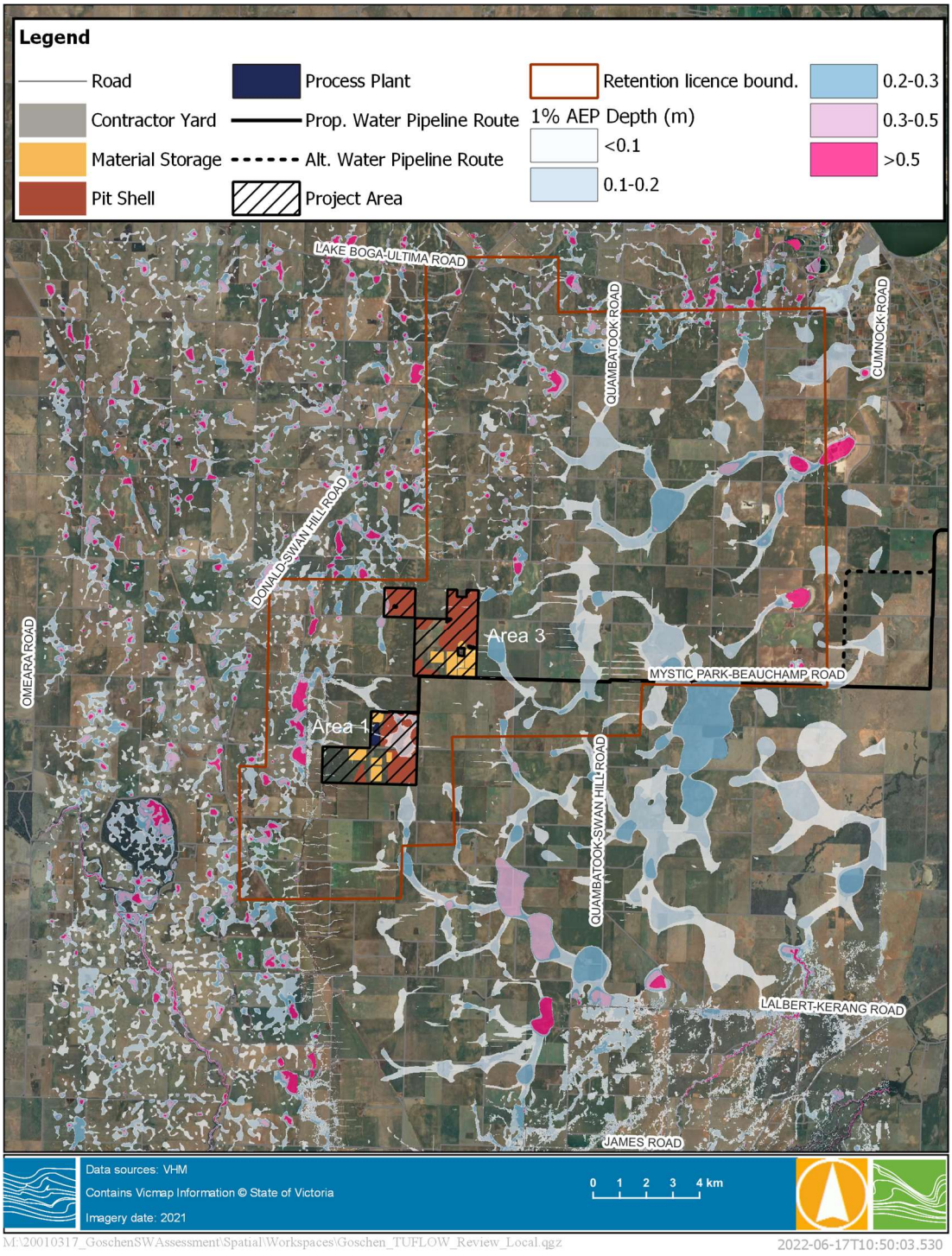


*Figure 7-3: Regional 1% AEP flood depths - source: Water Technologies*

### 7.5.2 Environmental values

The ERS under section 93 of the *Environment Protection Act 2017*, sets out the environmental values of the ambient air, ambient sound, land and water environments that are sought to be achieved or maintained in Victoria and standards to support those values (ERS 2021).

The ERS divides surface water environments into geographic regions. Environmental values and standards are prescribed based on the catchment type, segment and reach within a given geographic region. The Study Area falls within the Rivers and Streams Type, Murray and Western Plains Segment and Avoca Basin Reach. The figure below, extracted from the ERS, shows the Study Area in the context of surface water geographic regions.

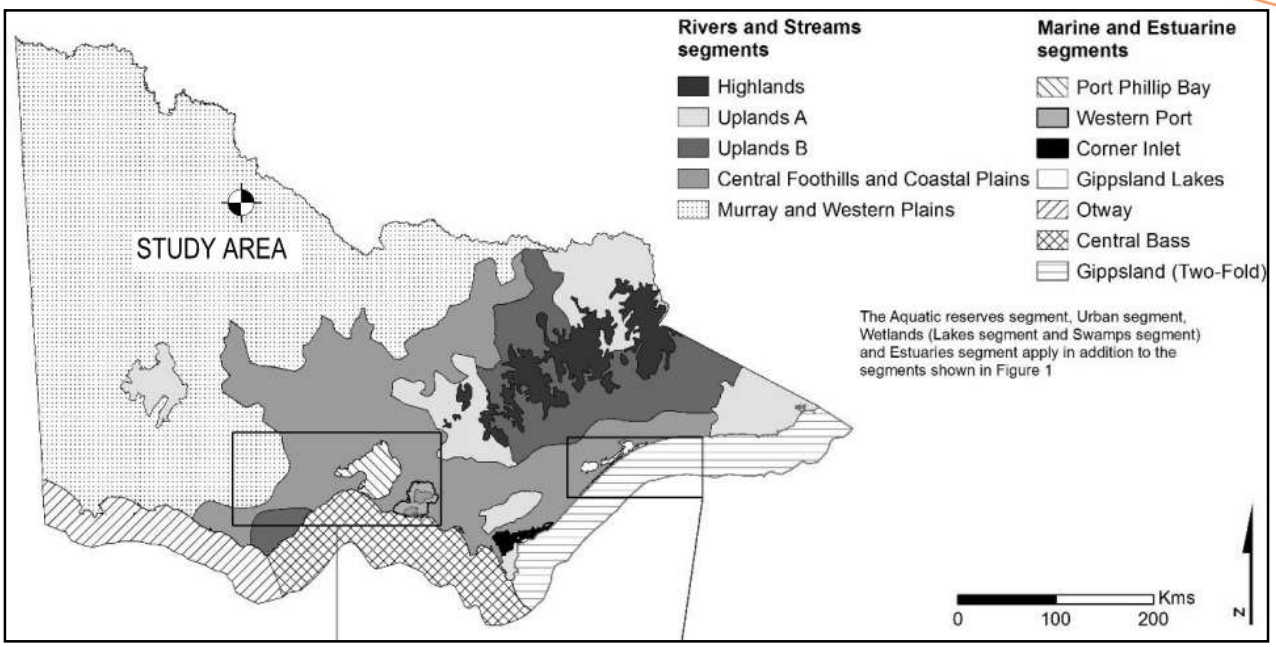


*Figure 7-4: Surface water segments - source: ERS 2021*

Environmental values for the Study Area are described in the ERS and are noted below:

*Table 7-1: Environmental values for the Study Area - source: ERS 2021*

| **Environmental values of inland waters (ERS 2021)** | **Applicable** |
|---|---|
| Water dependent ecosystems and species that are slightly to moderately modified | □ |
| Human consumption after appropriate treatment | □ |
| Agriculture and irrigation | □ |
| Human consumption of aquatic foods | □ |
| Aquaculture | □ |
| Industrial and commercial | □ |
| Water based recreation (primary contact) | □ |
| Water-based recreation (secondary contact) | □ |
| Water-based recreation (aesthetic enjoyment) | □ |
| Traditional Owner cultural values | □ |
| Navigation and shipping | X |
| Buildings and structures | X |
| Geothermal properties | X |

### 7.5.3 Surface water use and licencing

Surface water from disturbed areas within the site will be captured in water management basins. Captured water may be used on site for functions such as dust suppression and irrigation.

The *Water Act 1989 (Vic)* provides the legal framework for managing Victoria's water resources and applies to, among other water resources, use of surface water within the Project Area. The *Water Act* sets out water rights, entitlements, and licencing requirements.

Where water is captured and used onsite, water shares or licences issued by the relevant local water corporation will be required as authorised under the *Water Act.*

The *Water Act* is administered by the DEECA and Water Corporations (formerly Water Authorities). Water Corporations are defined in Schedule 1 of the *Water Act*. Water Corporations relevant to the Study Area include:

- Grampians Wimmera Mallee Water Corporation, and
- Goulburn–Murray Rural Water Corporation.

### 7.5.4 Surface water quality

Surface water within the Study Area that leaves site during operational phase or is present on site at completion of operations must comply with specific water quality objectives as prescribed in the environment reference standard (ERS 2021).

As the Project intends to contain all water from disturbed catchments onsite and not permit offsite release until the catchment is rehabilitated, assessment of water quality objectives for surface water discharge is contained within the Mine Site Rehabilitation Plan (pitt&sherry 2022).

## 7.6 Mine site surface water and overland flows

### 7.6.1 Onsite Containment

Given the semi-arid site conditions, high water demand from the mining process and the desire to eliminate potential for pollutants to be transported offsite in surface water, the project intends to capture and retain all surface water from disturbed catchments onsite. The surface water strategy includes capturing surface water at the source for storm events up to the 5% AEP (1 in 20 year ARI) and to direct excess water from more extreme events to the open pit.

The sections below detail the assessment process undertaken to determine whether the strategy is practicable.

#### 7.6.1.1 Hydrologic and hydraulic assessment

A hydrologic and hydraulic assessment has been undertaken to suitably size the stormwater infrastructure on the mine site. The software package DRAINS has been used to model the storage volumes required. The subject site comprises various stockpiles and mine operation facilities which drain to detention ponds in close proximity. Each of these basins was sized to contain the run-off generated in a 5% AEP rainfall event for all durations. Runoff generated above this was modelled to be directed to the mine pit where possible. If this cannot be achieved run-off will be contained up to the 1% AEP events.

A hydrologic Initial Loss/Continuing Loss model has been prepared, with data sourced from (https://data.arr-software.org/), for this analysis the following parameters have been adopted:

- Analysis has been carried out in accordance with the *Australian Rainfall and Runoff 2019 guidelines*, most notably, the assessment has included an assessment of temporal variation which is considered to be the best

practice approach for hydrologic assessment,

- Design rainfall data were extracted from the Bureau of Meteorology (http://www.bom.gov.au/) at the following coordinates, located along the northern boundary of Area 1:
- Latitude: -35.627, and
- Longitude: 143.43
- The extracted data is typical for both Area 1 and Area 3.
- Median pre-burst depths have been adopted,
- Pervious Area Initial Loss: 21mm,
- Impervious Area Initial Loss: 1mm,
- Pervious Area Continuing Loss: 2.7mm/hr* (Technical Report: Surface Water Impact Assessment, Goschen Mineral Sands and Rare Earth Metals, WaterTechnology, 2022),
- Impervious Area Continuing Loss: 0mm/hr,
- Murray Basin Temporal Patterns were adopted, and
- Climate change factor of 20.2% (RCP 8.5, year 2100) has been adopted.
- For the preliminary sizing of detention basins, it has been assumed that 0.04m3/s will be pumped out from each basin for the duration of the modelled events, for use in mining operations.

### 7.6.1.2 Results

***Area 1***

The model arrangement is shown in Figure 7-5 and the results from the basin sizing for each stockpile area is shown below in Table 7-2

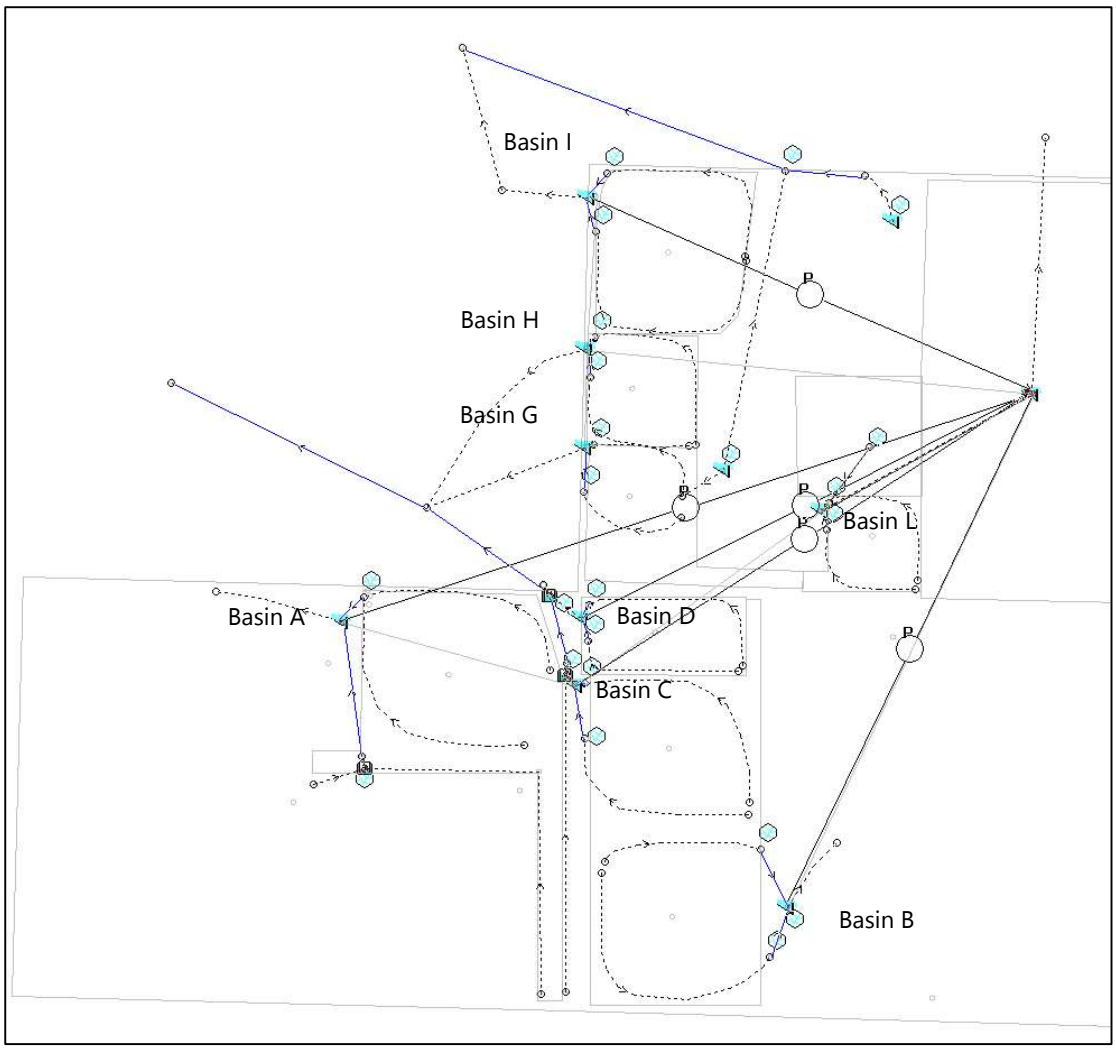


*Figure 7-5: Area 1 DRAINS model*

*Table 7-2: Area 1 5% AEP BASIN Volume*

| Basin ID | Catchment Area (ha) | 5% AEP Basin Volume ($m^3$) | Flow to pit in 1% AEP Event ($m^3/s$) | 12hr Pump to Empty ($m^3/s$) | 24hr Pump to Empty ($m^3/s$) | 36hr Pump to Empty ($m^3/s$) |
|---|---|---|---|---|---|---|
| Basin A | 39.3 | 17,000 | 1.86 | 0.39 | 0.20 | 0.13 |
| Basin B | 73.8 | 30,500 | 0.259 | 0.71 | 0.35 | 0.24 |
| Basin C | 26.5 | 10,400 | 1.32 | 0.24 | 0.12 | 0.08 |
| Basin D | 13.2 | 4,800 | 1.23 | 0.11 | 0.06 | 0.04 |
| Basin G | 17.2 | 6,600 | 1.23 | 0.15 | 0.08 | 0.05 |
| Basin H | 12.6 | 4,700 | 1.04 | 0.11 | 0.05 | 0.04 |
| Basin I | 24.6 | 9,400 | 1.49 | 0.22 | 0.11 | 0.07 |
| Basin L | 24.7 | 13,800 | 1.48 | 0.32 | 0.16 | 0.11 |

***Area 3***

The model arrangement is shown in Figure 7-6 and the results from the basin sizing for each stockpile area are shown below in Table 7-3

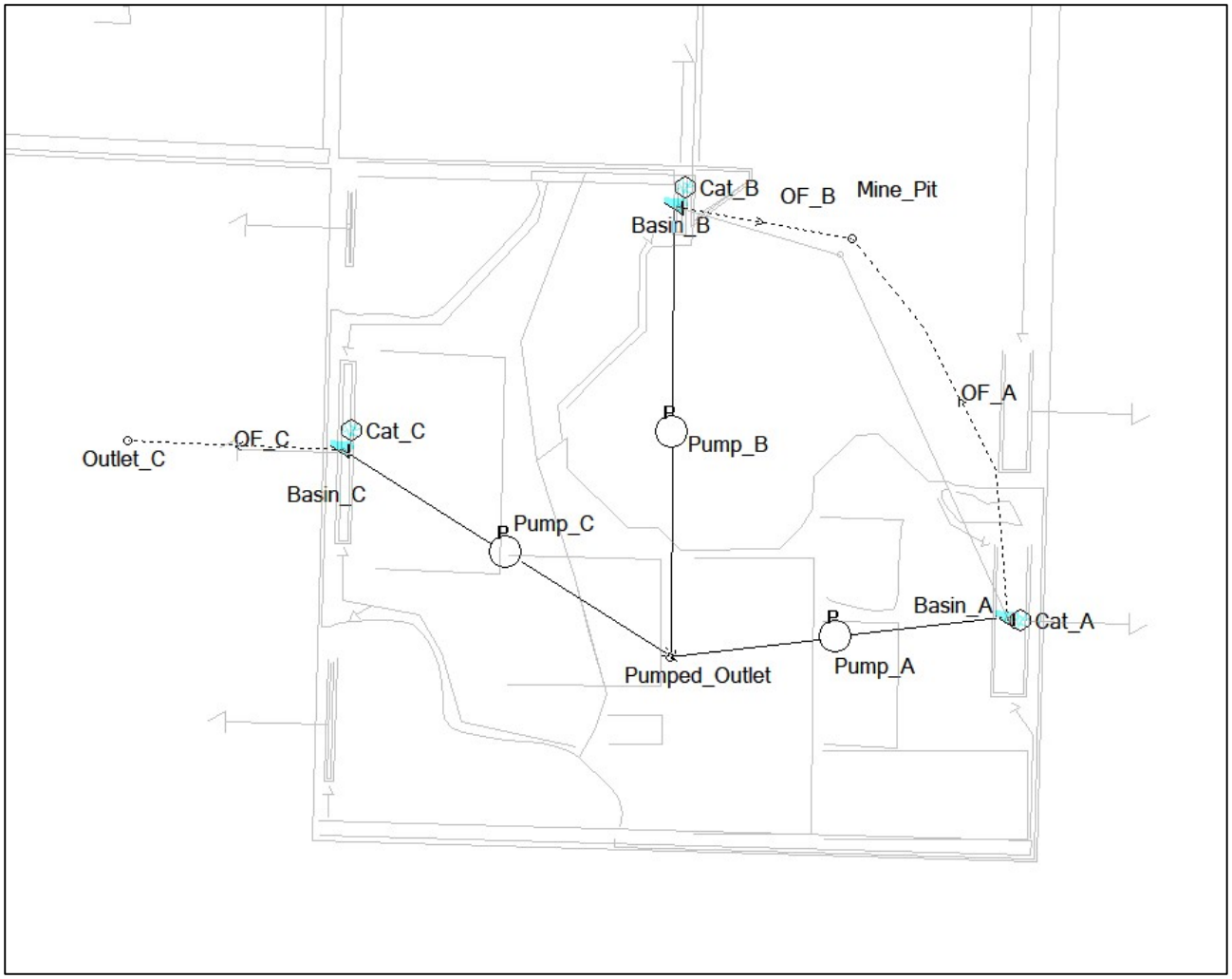


*Figure 7-6: Area 3 DRAINS model*

*Table 7-3: Area 3 5% AEP basin volume*

| Basin ID | Catchment Area (ha) | 5% AEP Basin Volume ($m^3$) | Flow to pit in 1% AEP Event ($m^3/s$) | 12hr Pump to Empty ($m^3/s$) | 24hr Pump to Empty ($m^3/s$) | 36hr Pump to Empty ($m^3/s$) |
|---|---|---|---|---|---|---|
| Basin A | 170 | 80,100 | 3.5 | 1.85 | 0.93 | 0.62 |
| Basin B | 27 | 12,200 | 1.83 | 0.28 | 0.14 | 0.09 |
| Basin C | 102 | 47,800 | 2.92 | 1.11 | 0.55 | 0.37 |

### 7.6.2 Discussion

It was identified from the modelling that during the 5% AEP events the continuing loss was controlling in events longer than 9 hours, meaning that the additional depth of rainfall during these events is cancelled out by the continuing loss. Climate Change has been included in the modelling by way of applying a multiplier to the rainfall intensity. The RCP 8.5 suggested multiplier for this region is 1.202 from the Australian Rainfall and Runoff Data Hub. RCP 8.5 estimates a 3.2 to 4.5 Celsius increase in temperatures (https://climatenexus.org/climate-change-news/rcp-8-5-business-as-usual-or-a-worst-case-scenario/). This represents a scenario of no emission reduction or control and has the potential to result in higher intensity rainfall.

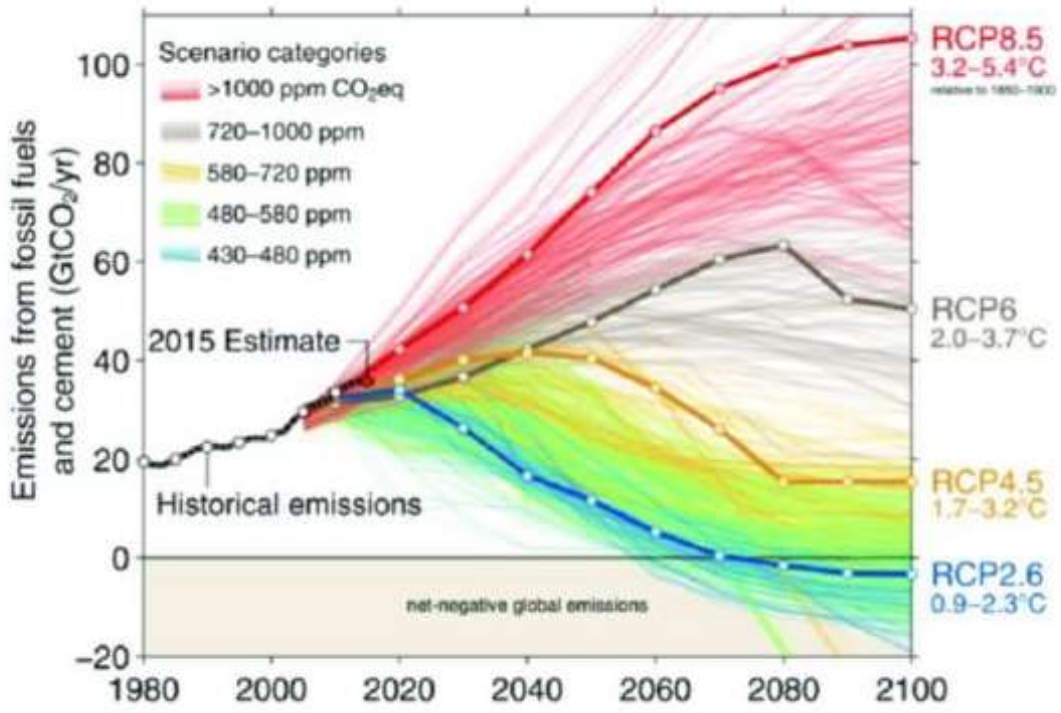


*Figure 7-7: Climate change - image credit: Neil Craik, University of Waterloo*

The mine site is located in a generally arid region of Australia, with relatively low rainfall and subject to droughts. This means that containing the water for 5% AEP events is practical even with the large catchment areas and low loss values. There is an added benefit of being able to reuse captured water on site which reduces the size of the basins. In a higher rainfall region this may not be a feasible approach.

The modelling has adopted a conservative approach with no allowance for evaporation. While it is unlikely that evaporation will occur while the rain is falling, post storm there will be significant loss from the basins due to evaporation. This could further reduce the risk of overtopping during consecutive events.

### 7.6.3 Water balance modelling

The water balance model has been set up in the MUSIC 6. The model arrangement is shown in Figure 7-9. The model has the following input parameters:

- Rainfall data was sourced from the Bureau of Meteorology (http://www.bom.gov.au/climate/data/) from Station number 80023 in Kerang:
- Latitude: -35.72,
- Longitude: 143.92, and
- Elevation: 82m.
- Data period 1900 to present (refer Figure 7-8),
- Average Potential Evapotranspiration was sourced from Bureau of Meteorology for the Swan Hill Aerodrome for 2020,
- Source Catchment Details:
- Rainfall Threshold: 1mm/day,
- Soil Storage Capacity: 30mm,
- Field Capacity: 20mm, and
- All other properties are default values.
- Source nodes have been modelled as 90% pervious with 10% impervious area to account for roads and buildings on the mine site, and
- Reuse demand is modelled as 11,400kL/day.

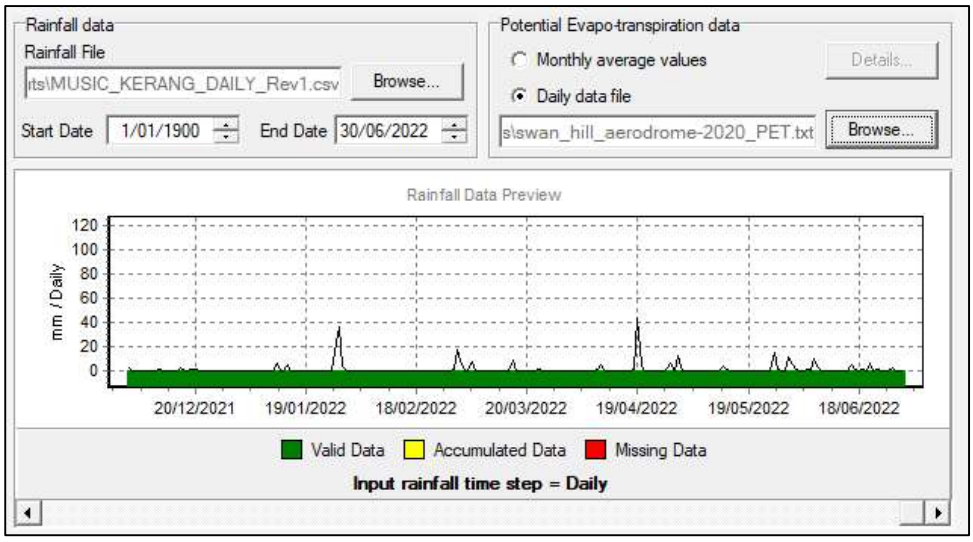


*Figure 7-8: MUSIC 6 - meteorological data*


*Figure 7-9: MUSIC 6 model layout*

### 7.6.4 Assumptions

A list of key assumptions is as follows:

- All water from Site 3 can be captured and pumped back to the processing plant, and
- All run-off generated on site can be reused in the mining process (e.g. no issues with contaminants).

The model assumptions made in relation to proposed mining activity include zero infiltration to groundwater from diversion of storm events into the pit voids. The reasoning being that it is understood that any stormwater that collects within the pits will be extracted and used and therefore infiltration will be negligible and not sensitive to other recharge mechanisms.

*Table 7-4: Water balance results*

| Description | Flow (ML/yr) |
|---|---|
| Flow In | 318 |
| ET Loss | 30.5 |
| Infiltration Loss | 0 |
| Low Flow Bypass Out | 0 |
| High Flow Bypass Out | 0 |
| Pipe Out | 2.2 |
| Weir Out | 9.5 |
| Transfer Function Out | 0 |
| Reuse Supplied | 147.8 |
| Reuse Requested | 4165.4 |
| % Reuse Demand Met | 3.5 |
| % Load Reduction | 96.3 |

### 7.6.5 Discussion

A reuse demand of 11,400kL/day has been selected based on matching the water decanted from the mining process. This represents 43% of the water used in processing (VHM Limited 2022). The results indicate that only 3.5% of the demand can be met from stormwater harvested from onsite basins. Given the very small capacity for stormwater harvesting to contributing to water demand, there is limited economic benefit to investing in water transfer infrastructure (pumps and pipes) to support operational material processing needs. There is however opportunity for stormwater from site basins to be used in other ways that can provide value, such as dust suppression or irrigation of revegetated areas.

## 7.7 Sensitive receptors

The Project intends to contain all water from disturbed catchments within the mine site area and not permit offsite release until the catchment is rehabilitated and surface water meets required water quality objectives. Assessment of internal receptors found the following:

- Residential houses and dams within the study area have been or will be removed prior to project commencement and are not considered to be in the scope of impact assessment.
- Water supply channels that crossed the study area have been decommissioned and are not counted as sensitive receptors.
- Four patches of remnant vegetation located in Area 3 are required to be retained and protected. These sensitive receptors are located in the protected areas, as shown in Figure 7-10. Development upstream of these receptors has potential to change the quantity and/or quality of surface water that currently flows to these receptors. The impacted catchments upstream of the receptors is illustrated in Figure 7-12.
- A strip of vegetation located in Area 1 is required to be retained and protected. This sensitive receptor is in the protected area shown in Figure 7-11. Development upstream of this receptor has potential to change the quantity and/or quality of surface water that currently flows to this receptor. The impacted catchments upstream of this receptor is illustrated in Figure 7-13.

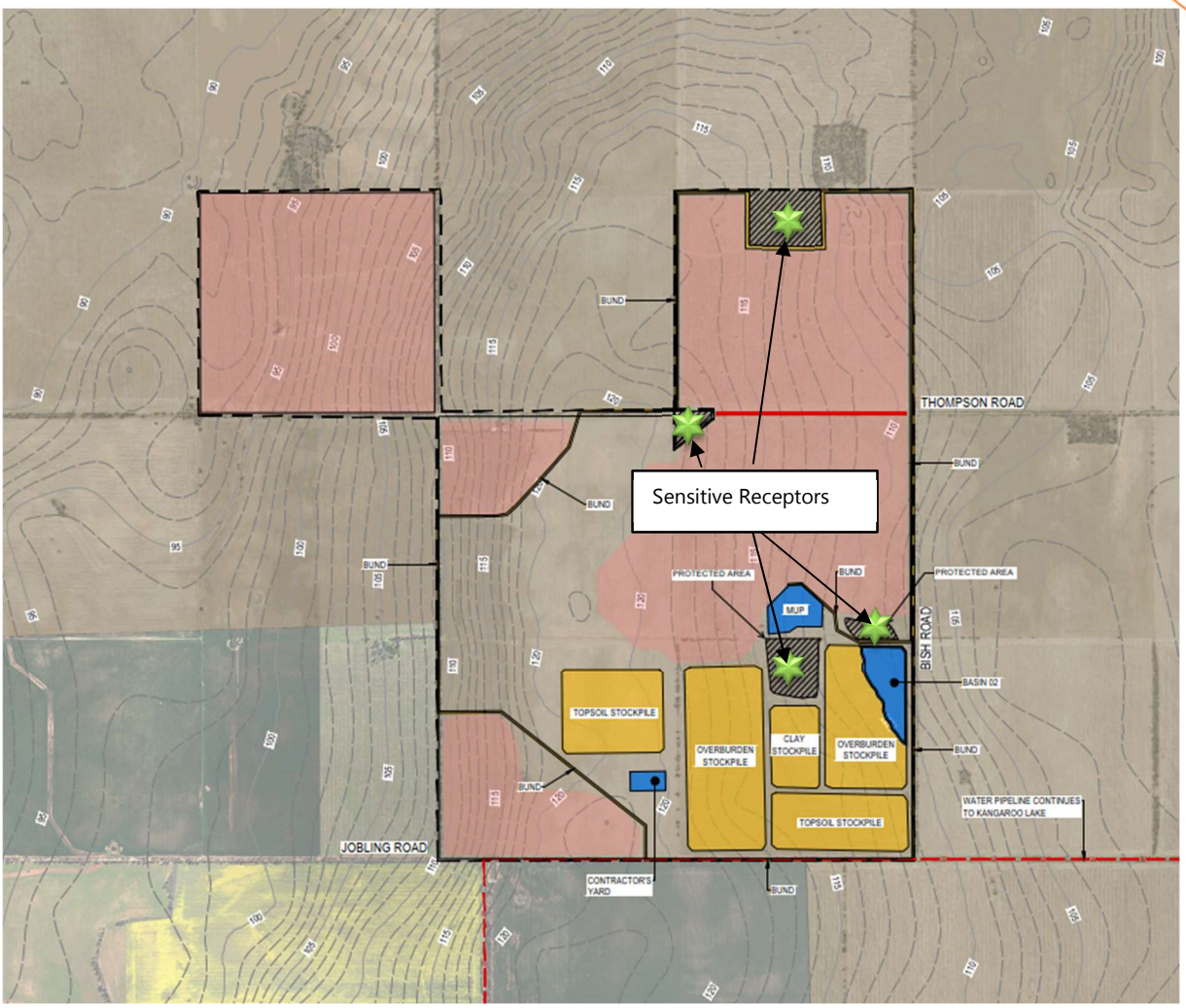


*Figure 7-10: Sensitive receptors (protected vegetation) in Area 3*

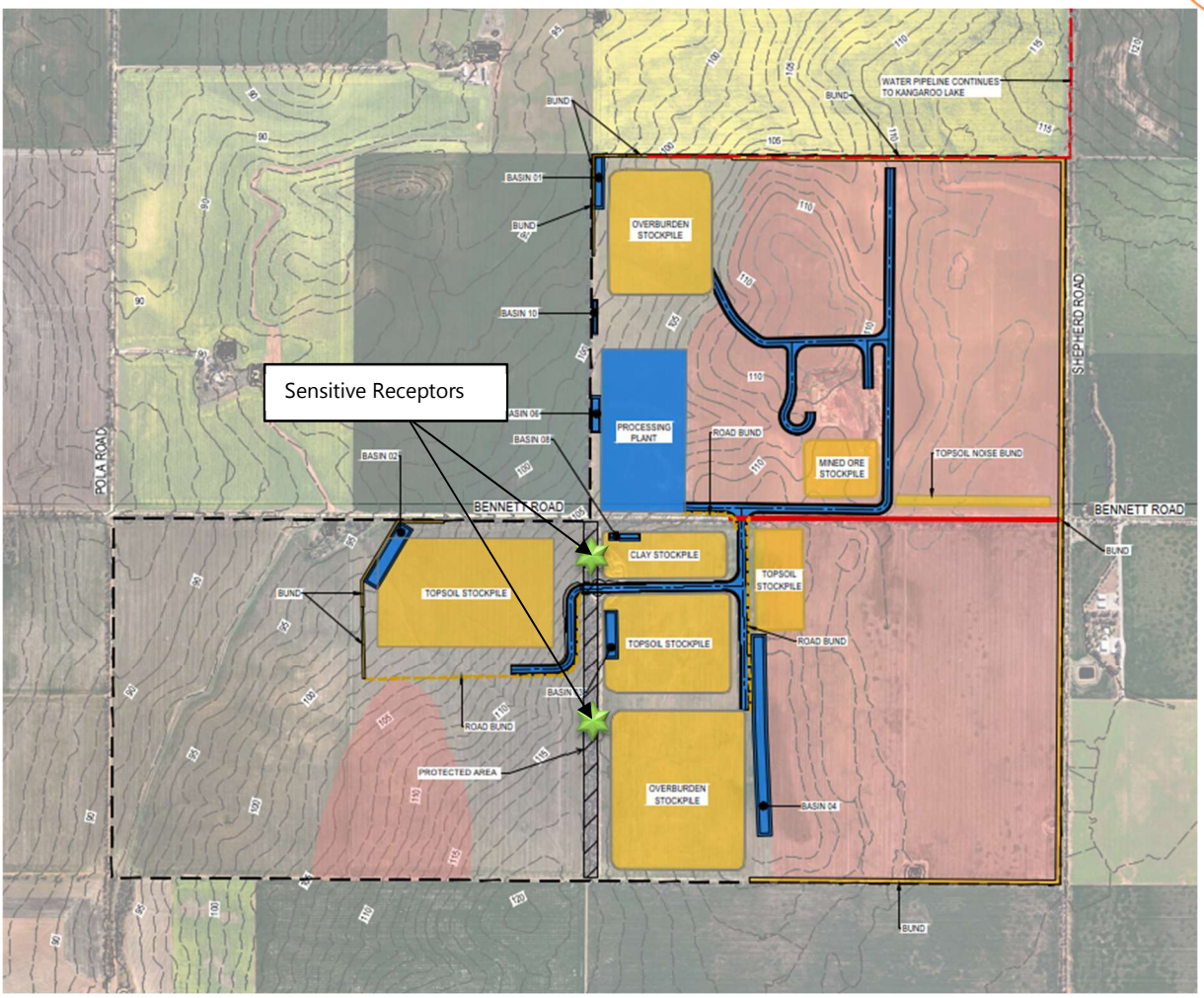


*Figure 7-11: Sensitive receptors (protected vegetation) in Area 1*

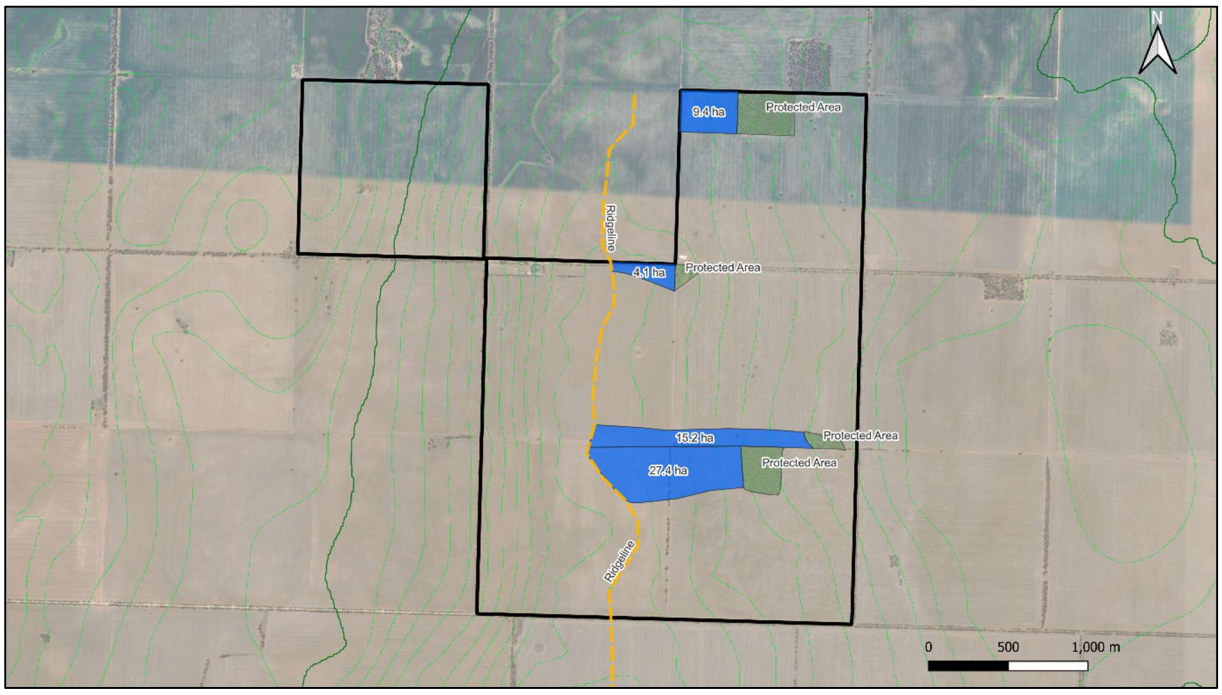


*Figure 7-12: Catchment to receptors in Area 3*

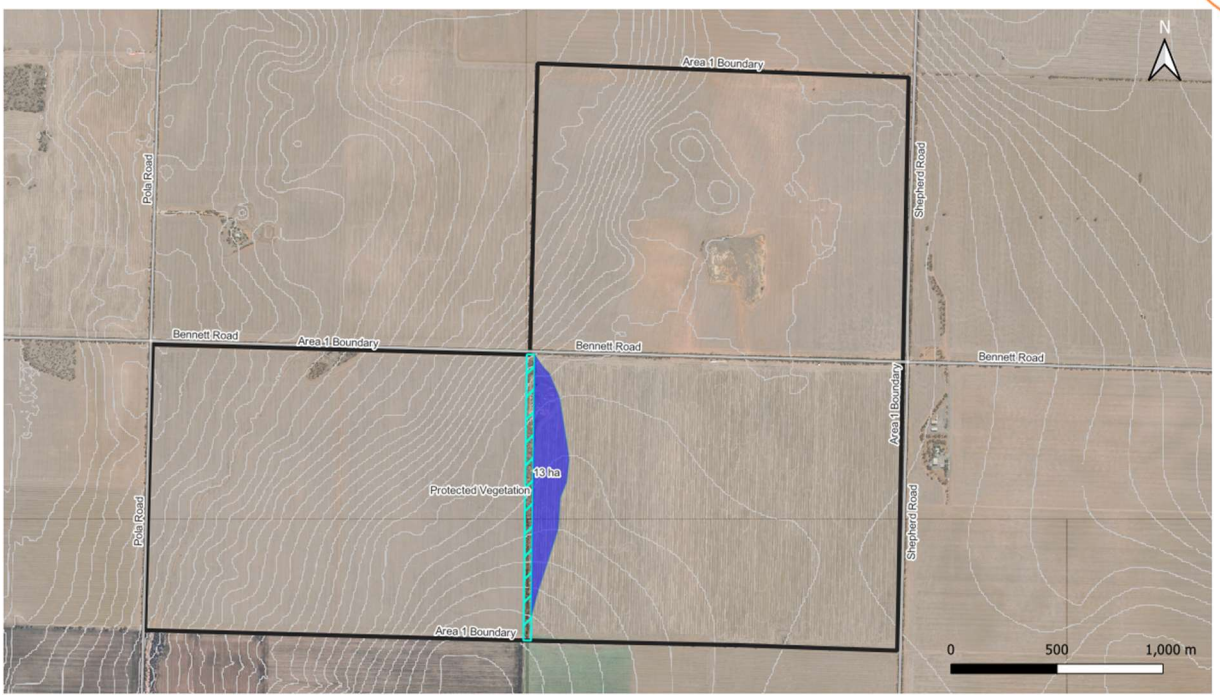


*Figure 7-13: Catchment to receptor in Area 1*

### 7.7.1 Catchment and surface water changes to sensitive receptors

To understand the impact of surface water changes to the sensitive receptors, an assessment on catchment changes and surface water flows was undertaken. The assessment adopted the following assumptions:

Mean monthly rainfall: 30mm
Monthly rainfall that becomes overland flow: 7.5mm (based on a conservative runoff coefficient of 0.25)

Changes in catchments and monthly flows are presented below. Note post-development areas comprise the area of the protected zone in which the sensitive receptor is located.

Table 7-5: Surface water reduction to onsite sensitive receptors

| Receptor | | Area 3 27.4 ha | Area 3 15.2 ha | Area 3 4.1 ha | Area 3 9.4 ha | Area 1 13 ha |
|---|---|---|---|---|---|---|
| Catchment Area (ha) | Pre-development | 27.4 | 15.2 | 4.1 | 9.4 | 19 |
| | Post-Development | 6.9 | 1.7 | 1.4 | 9.5 | -3 |
| | Change | 20.5 | 13.5 | 2.7 | -0.1 | 16 |
| Surface Flow ($m^3$/month) | Pre-development | 2055 | 1140 | 307.5 | 705 | 1425 |
| | Post-Development | 517.5 | 127.5 | 105 | 712.5 | -225 |
| | Change | 1537.5 | 1012.5 | 202.5 | -7.5 | 1200 |

# 8. Risk assessment

The identified risks and associated residual risk ratings are listed in Table 8-1. The likelihood and consequence ratings determined during the risk assessment process and the mitigation measures to be achieved are presented in Appendix A.

*Table 8-1: Surface water risks*

| Risk ID | Phase | Potential threat and effects on the environment | Residual risk rating |
|---|---|---|---|
| SW01 | C O D | Runoff from active mining areas containing contaminants impacts sensitive receptors | Low |
| SW02 | C O D | Reduction in upstream catchment area reduces water supply to sensitive receptors | Low |

**Legend:**
**C: Construction Phase**
**O: Operations Phase**
**D: Decommissioning Phase**

# 9. Construction, operation, and decommissioning impact assessment

This section discusses the potential impacts of the project as a result of construction activities and the associated mitigation measures that aim to reduce impacts to as low a level as possible.

## 9.1 Runoff from active mining areas containing contaminants impacts sensitive receptors (SW01)

During storm events there is potential for stormwater runoff containing contaminants to escape the internal stormwater diversion system and flow toward sensitive receptors. This could occur if the drainage infrastructure does not have capacity to contain runoff within the site, or as a result of inadequate surface water management controls.

### 9.1.1 Impact

Discharge of contaminated runoff that comes in contact with protected vegetation and has potential for detrimental effects.

### 9.1.2 Mitigation

Internal drainage infrastructure should be designed with capacity to prevent overflow into protected areas. Bunds of sufficient height should be placed around the sensitive receptors to prevent surface water intrusion from disturbed catchments.

### 9.1.3 Residual impact

By implementing recommended mitigation measures, no residual impacts are expected.

## 9.2 Reduction in upstream catchment area reduces water supply to sensitive receptors

During construction, operation and decommission of the mine, the remnant native vegetation patches will be protected from disturbed catchments through installation of diversion channel and bunds, reducing water supply.

### 9.2.1 Impact

Reduction in upstream catchment areas generating surface water runoff that is directed towards the vegetation

### 9.2.2 Mitigation

Rehabilitation of disturbed areas should commence as soon as practicable to restore surface water flows to pre-development levels.

### 9.2.3 Residual impact

By implementing recommended mitigation measures, no residual impacts are expected.

## 9.3 Summary of residual impacts

Residual impacts are those that remain once mitigation and management measures have been implemented.

If all mitigation measures are applied correctly, no residual impacts are expected.

# 10. Summary of implications under relevant legislation

This study has assessed the impacts of construction, operation and closure of the project on surface water assets and values to be protected.

The significance of the impacts has been assessed in accordance with the evaluation framework, based on applicable legislation, policy and standards and the evaluation objectives and environmental significance guidelines arising from the scoping requirements established to guide the assessments.

The major legislation and policies applied include:

- Environment Effects Act (1978),
- Environment Protection Act (2017),
- Environment Protection Amendment Act (2018),
- Environment Reference Standard (2021), and
- The Water Act (1989).

The following sections summarise these identified impacts under the relevant Commonwealth and Victorian legislation.

## 10.1 Commonwealth

In relation to the evaluation matters of national environmental significance (MNES), which are protected under Part 3 of the *EPBC Act*: Ramsar wetlands (sections 16 and 17B); listed threatened species and communities (sections 18 & 18A); and protection of the environment from nuclear actions (sections 21 and 22A), the project is not considered to have significant impacts on water quality and quantity for the following reasons:

- Mine site surface water from the Study Area in both undeveloped and operational states does not interact with the wetlands,
- No *EPBC Act*-listed flora species are recorded the footprint of Area 1 and Area 3 (mining area), and
- Surface water that has potential for exposure to contaminants of concern in concentrations that could impact sensitive receptors will be physically separated and isolated from other sections of the mine site area. It is considered unlikely that mine affected surface water would interact with the *EPBC Act* listed threatened community (Plains Mallee Box Woodland).

## 10.2 Victorian

In relation to the evaluation objectives set out in the EES Scoping Requirements, the project would not have significant impacts on surface water for the following reasons:

- The Project is located at the top of the catchment, in an area with flat topography, low rainfall, high evaporation, deep water table and very low erosion risk, the site has an inherently low risk for sediment transport in surface water. A conventional suite of erosion and sediment controls is expected to be effective to manage the sedimentation risks for the project. Erosion and sediment control planning, implementation and monitoring will be

an important aspect for construction, operation, and decommissioning activities,

- Groundwater assessment (CDM Smith, 2023) confirmed there is not an existing interaction between groundwater and surface water, and interaction is unlikely during construction, operation and rehabilitation phases through mine dewatering systems.
- Water quantity to sensitive receptors will be reduced through capture of water from disturbed catchments within the Study Area. Impacts due to change in water supply are described in the Flora and Native Vegetation Assessment (Nature Advisory 2022).

# 11. Conclusion

The purpose of this report is to provide a surface water management strategy and assess impacts of mine site surface water on sensitive receptors within the study area, to inform the preparation of the EES required for the Goschen project. A summary of the surface water management strategy, key assets, values or uses potentially affected by the project, and an associated assessment of mine site surface water impacts and recommended mitigation measures, are summarised below.

## 11.1 Existing environment

The existing environment is located in an agricultural setting and is characterised by low rainfall, high evaporation, deep ground water table and flat topography that is not near any waterways. Potential for acid formation is unlikely. Soil erosion hazard risk is very low.

Water supply channels that crossed the proposed mine site have been decommissioned and are no longer in use. One environmental value, a farm dam, exists within the proposed mine site. The dam is understood to be decommissioned and will be removed as part of the mining process.

No other sensitive receptors have been identified.

## 11.2 Mine site surface water management strategy

The objective of the proposed surface water management strategy is for:

- Onsite containment of surface water that has come into contact with active/disturbed areas so that there is no offsite discharge and no discharge to sensitive receptors within the mine site.
- Progressive rehabilitation and return of mine areas back to catchment hydrology as soon as the surface is comparable to pre-mining and surface water can meet water quality objectives.

Assessment of the containment strategy found that:

- containment can be achieved at the source for storms up to the 5%AEP, through design of appropriately sized channels, basins and bunds.
- Containment of additional surface water from storm events greater that the 5%AEP design storm can be achieved by directing the excess surface water to the mine pit or other appropriately sized containment structures via channels and bunds or through pumps and pipes.
- Sensitive receptors can be protected through installation of earth berms and diversion channels.

## 11.3 Impact assessment findings

The existing site is characterised by low annual rainfall, semi-arid climactic conditions, high evaporation, a deep water able, and does not interact with any designated waterways. These characteristics naturally mitigate the likelihood and consequence of surface-water related risks.

The proposed drainage strategy exceeds industry guidelines and code of practice recommendations for management and treatment of surface water and is considered achievable and practicable.

Surface water environmental values can be achieved by managing disturbed waters per the proposed strategy.

No other residual impacts have been identified.

With the implementation of the mitigation measures recommended throughout this assessment, adverse impacts arising from contaminated surface water will be controlled.

## 11.4 Mitigation and contingency measures

The proposed mitigation and contingency measures comprise standard operational mining practices and are summarised as follows:

- Bunds will be installed to contain all disturbed surface water flows to within the mine site area,
- Protective bunds will be installed to redirect disturbed surface water flows away from sensitive receptors, and
- Disturbed areas will be progressively rehabilitated to catchment hydrology as soon as practicable.

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# Important information about your report



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# Surface Water Risk Assessment

Appendix A

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| | |
|---|---|
| Title | Surface Water Risk Assessment |
| Doc # | T-P.22.0327-00-WAT-MISC-0001 |
| Version | 0 |
| Date | 1/11/2023 |
| Prepared | DW |
| Checked | AM |
| Approved | AT |

# Goschen Mineral Sands Project

| Risk ID | Risk pathway | Causes / Background | Initial risk level | | | Final mitigation | Residual risk level | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Likelihood | Consequence | Risk | | Likelihood | Consequence | Risk |
| **Construction, Operation and Decommissioning** | | | | | | | | | |
| SW01 | **Water Quality**<br>Runoff from active mining areas containing contaminants impacts sensitive receptors | Inadequate sizing of channels and bunds intended to isolate the sensitive receptors from active mining.<br><br>Diversion channels and protective bunds deteriorate due to lack of maintenance. | Possible | Moderate | Medium | Channels and bunds that are intended to isolate sensitve receptors from active mining areas are to be designed and engineered to ensure no surface water from disturbed catchments can enter.<br><br>An inspection and maintenance program to be included in the operation management plan to ensure channels and bunds are operational and in good working order | Unlikely | Minor | Low |
| SW02 | **Water Quantity**<br>Protection of sensitive receptors from upstream catchments reduces water supply | Construction of protective bunds around sensitive receptors<br><br>Construction of diversion channels to shield sensitive receptors from contaminated surface water | Possible | Moderate | Medium | Rehabilitation of disturbed areas should commence as soon as practicable to restore surface water flows to pre-development levels. | Unlikely | Minor | Low |

# Mine Staging Plan

Appendix B

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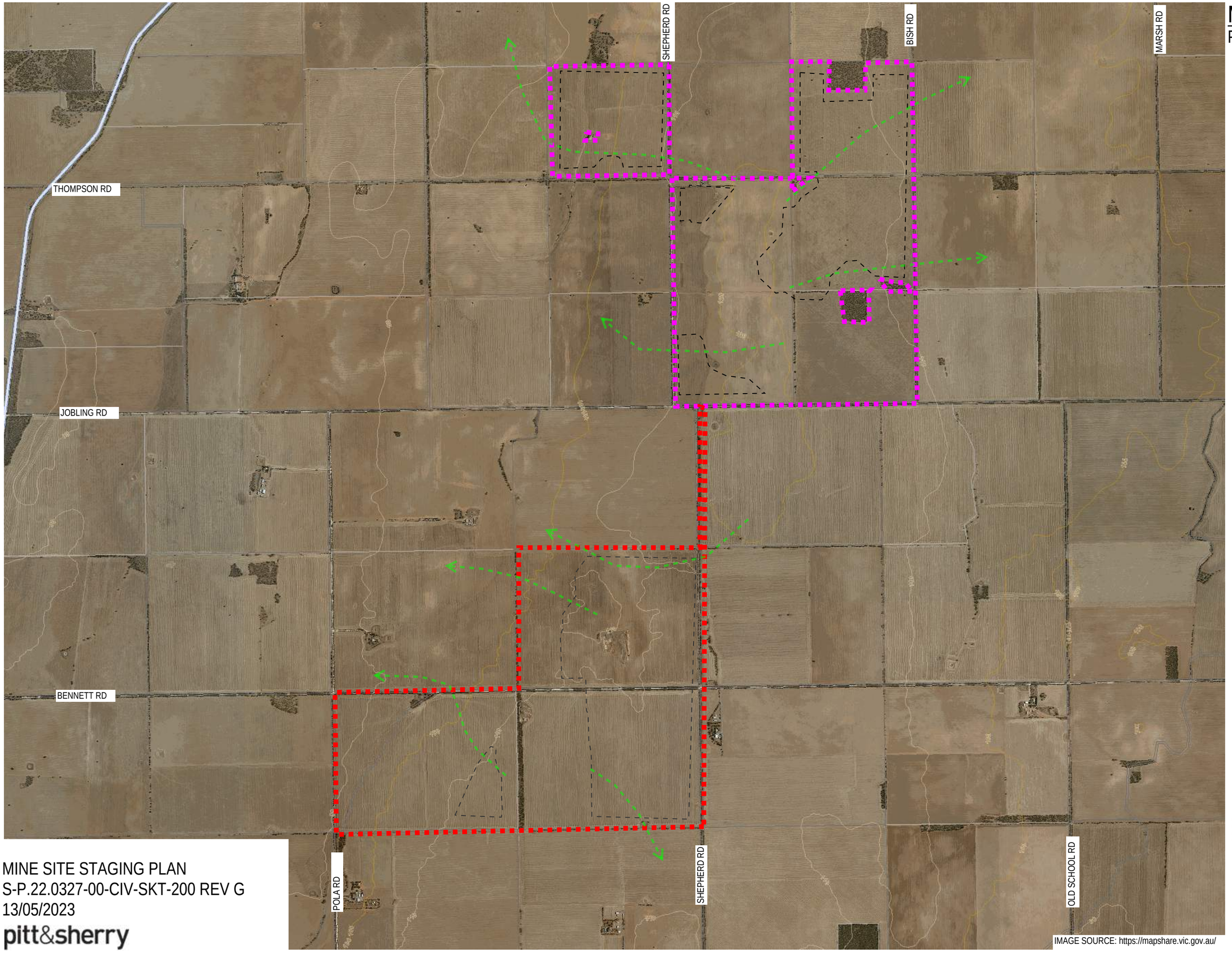
# MINE STAGE
## PRE-DEVELOPMENT




NORTH

## LEGEND

- EXISTING FLOW PATH
- WATER MANAGEMENT DAM
- WATER MANAGEMENT DAM (LINED)
- BUNDED STOCKPILE (ORE)
- BUNDED STOCKPILE (GENERAL)
- PROCESS PLANT
- MINE EXTENTS
- ACTIVE MINING
- TAILINGS DEPOSITION
- OVERBURDEN PLACEMENT
- HANDBACK
- AREA 1 BOUNDARY
- AREA 3 BOUNDARY

0.6km

IMAGE SOURCE: https://mapshare.vic.gov.au/

MINE SITE STAGING PLAN
S-P.22.0327-00-CIV-SKT-200 REV G
13/05/2023

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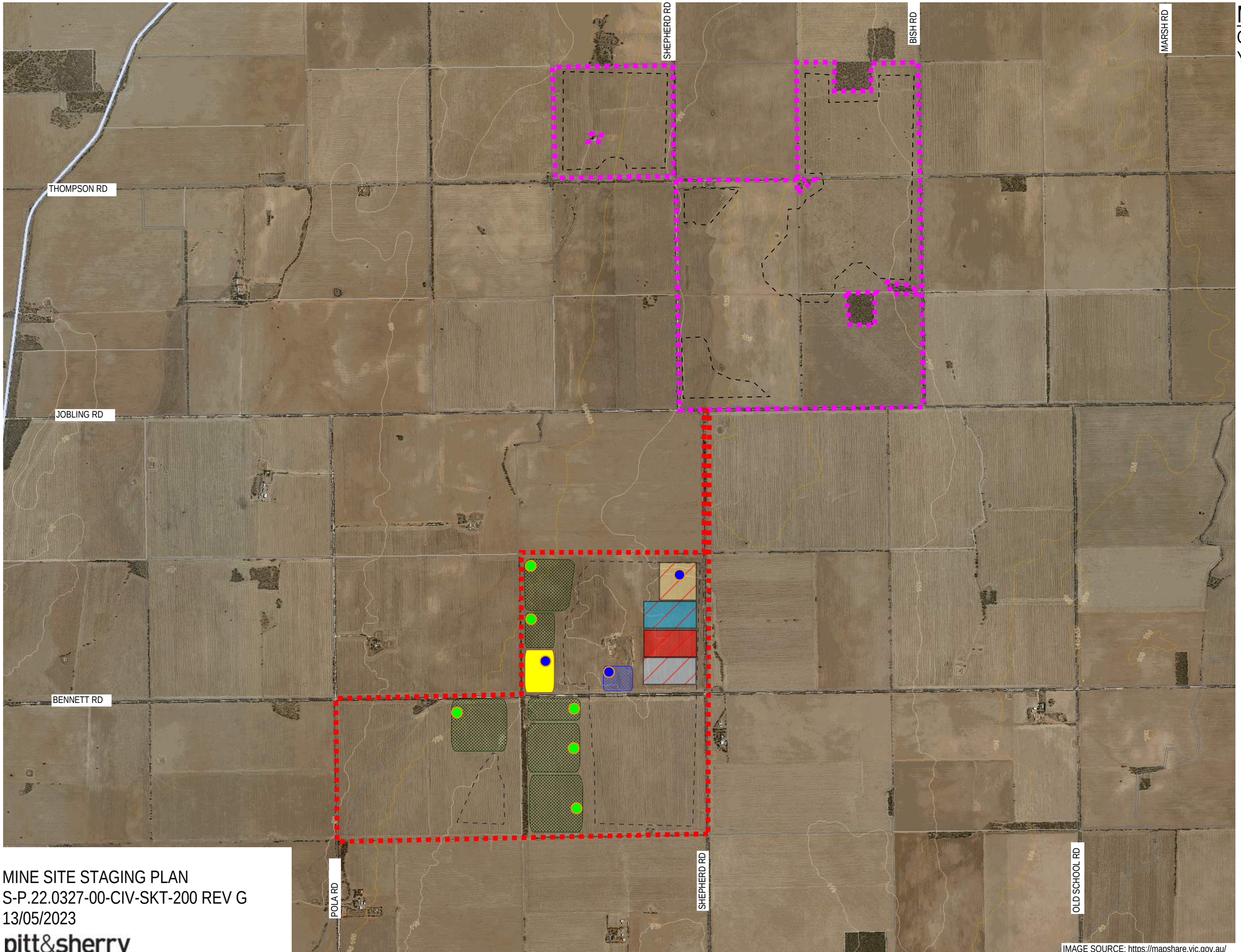


# MINE STAGE
OPERATION
YEAR: 1 - 2

NORTH

## LEGEND

- WATER MANAGEMENT DAM
- WATER MANAGEMENT DAM (LINED)
- BUNDED STOCKPILE (ORE)
- BUNDED STOCKPILE (GENERAL)
- PROCESS PLANT
- MINE EXTENTS
- ACTIVE MINING
- TAILINGS DEPOSITION
- OVERBURDEN PLACEMENT
- HANDBACK
- AREA 1 BOUNDARY
- AREA 3 BOUNDARY

0.6km

IMAGE SOURCE: https://mapshare.vic.gov.au/

MINE SITE STAGING PLAN
S-P.22.0327-00-CIV-SKT-200 REV G
13/05/2023

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# MINE STAGE
OPERATION
YEAR: 5 - 6

THOMPSON RD
JOBLING RD
BENNETT RD
SHEPHERD RD
BISH RD
MARSH RD
POLA RD
SHEPHERD RD
OLD SCHOOL RD

NORTH

## LEGEND

- WATER MANAGEMENT DAM
- WATER MANAGEMENT DAM (LINED)
- BUNDED STOCKPILE (ORE)
- BUNDED STOCKPILE (GENERAL)
- PROCESS PLANT
- MINE EXTENTS
- ACTIVE MINING
- TAILINGS DEPOSITION
- OVERBURDEN PLACEMENT
- HANDBACK
- AREA 1 BOUNDARY
- AREA 3 BOUNDARY

0.6km

IMAGE SOURCE: https://mapshare.vic.gov.au/

MINE SITE STAGING PLAN
S-P.22.0327-00-CIV-SKT-200 REV G
13/05/2023

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# MINE STAGE
OPERATION
YEAR: 9 -10

NORTH

THOMPSON RD
JOBLING RD
BENNETT RD
SHEPHERD RD
BISH RD
MARSH RD
POLA RD
SHEPHERD RD
OLD SCHOOL RD

## LEGEND

- WATER MANAGEMENT DAM
- WATER MANAGEMENT DAM (LINED)
- BUNDED STOCKPILE (ORE)
- BUNDED STOCKPILE (GENERAL)
- PROCESS PLANT
- MINE EXTENTS
- ACTIVE MINING
- TAILINGS DEPOSITION
- OVERBURDEN PLACEMENT
- HANDBACK
- AREA 1 BOUNDARY
- AREA 3 BOUNDARY

0.6km

IMAGE SOURCE: https://mapshare.vic.gov.au/

MINE SITE STAGING PLAN
S-P.22.0327-00-CIV-SKT-200 REV G
13/05/2023

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# MINE STAGE

OPERATION

YEAR: 13 - 14

NORTH

THOMPSON RD

JOBLING RD

BENNETT RD

SHEPHERD RD

BISH RD

MARSH RD

POLA RD

SHEPHERD RD

OLD SCHOOL RD

## LEGEND

- WATER MANAGEMENT DAM
- WATER MANAGEMENT DAM (LINED)
- BUNDED STOCKPILE (ORE)
- BUNDED STOCKPILE (GENERAL)
- PROCESS PLANT
- MINE EXTENTS
- ACTIVE MINING
- TAILINGS DEPOSITION
- OVERBURDEN PLACEMENT
- HANDBACK
- AREA 1 BOUNDARY
- AREA 3 BOUNDARY

0.6km

IMAGE SOURCE: https://mapshare.vic.gov.au/

MINE SITE STAGING PLAN

S-P.22.0327-00-CIV-SKT-200 REV G

13/05/2023

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# MINE STAGE

OPERATION
YEAR: 20
(DECOMMISSION)

NORTH

THOMPSON RD
JOBLING RD
BENNETT RD
SHEPHERD RD
BISH RD
MARSH RD
POLA RD
SHEPHERD RD
OLD SCHOOL RD

## LEGEND

- WATER MANAGEMENT DAM
- WATER MANAGEMENT DAM (LINED)
- BUNDED STOCKPILE (ORE)
- BUNDED STOCKPILE (GENERAL)
- PROCESS PLANT
- MINE EXTENTS
- ACTIVE MINING
- TAILINGS DEPOSITION
- OVERBURDEN PLACEMENT
- HANDBACK
- AREA 1 BOUNDARY
- AREA 3 BOUNDARY

0.6km

IMAGE SOURCE: https://mapshare.vic.gov.au/

MINE SITE STAGING PLAN
S-P.22.0327-00-CIV-SKT-200 REV G
13/05/2023

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# Surface Water Domains

Appendix C

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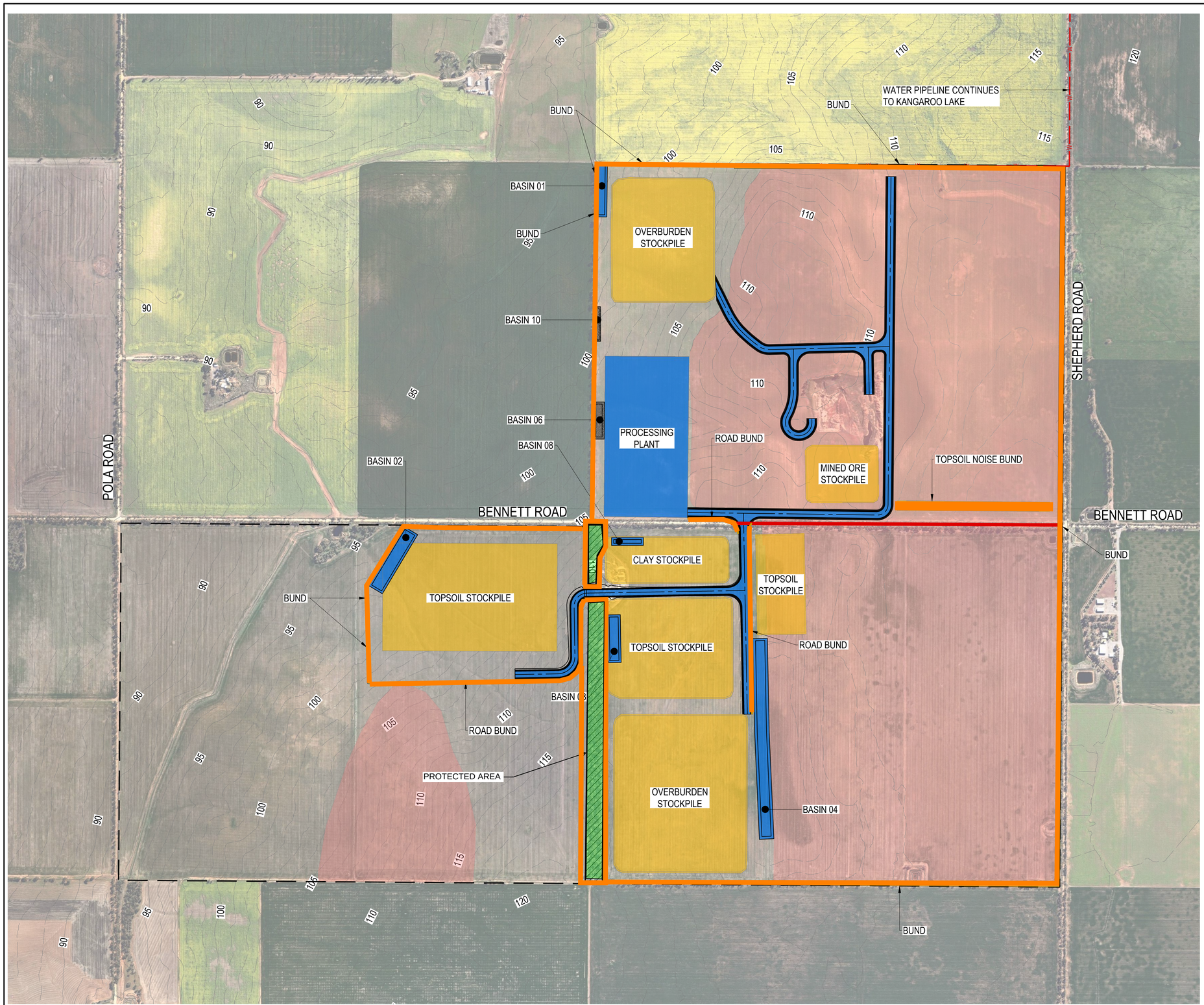


REFERENCE FILES ATTACHED: S-P.22.0327-00-CIV-XRF-1120; S-P.22.0237-00-CIV-XRF-1110; S-P.22.0327-00-CIV-XRF-1950; S-P.22.0327-00-CIV-XRF-1113

P&S FORM DRG-A1 REV 29

DRAWING REVISION HISTORY

| No. | DESCRIPTION | DRAWN | DESIGNED | REVIEWED | DATE | APPROVED |
|---|---|---|---|---|---|---|
| | | | | | | ORIGINAL COPY ON FILE "e" SIGNED BY |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| B | LAYOUT UPDATES | CJV | AB | AT | 20/04/2023 | SIGNED |
| A | FOR INFORMATION | CJV | AB | AT | 16/11/2022 | |
| | | CJV | AB | AT | | DATE |

SCALE (PLOTTED FULL SIZE) 1:7500

SHEET SIZE A1

150 0 150 300 450 600

SCALE IN METRES - 1:7500

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pittsh.com.au Phone 1300 748 874 ABN 67 140 184 309



CLIENT: VHM LIMITED

CONTRACT TITLE: GOSCHEN MINE MINE REHABILITATION

STATUS: CONCEPT

DRAWING TITLE: SURFACE WATER DOMAINS - AREA 1

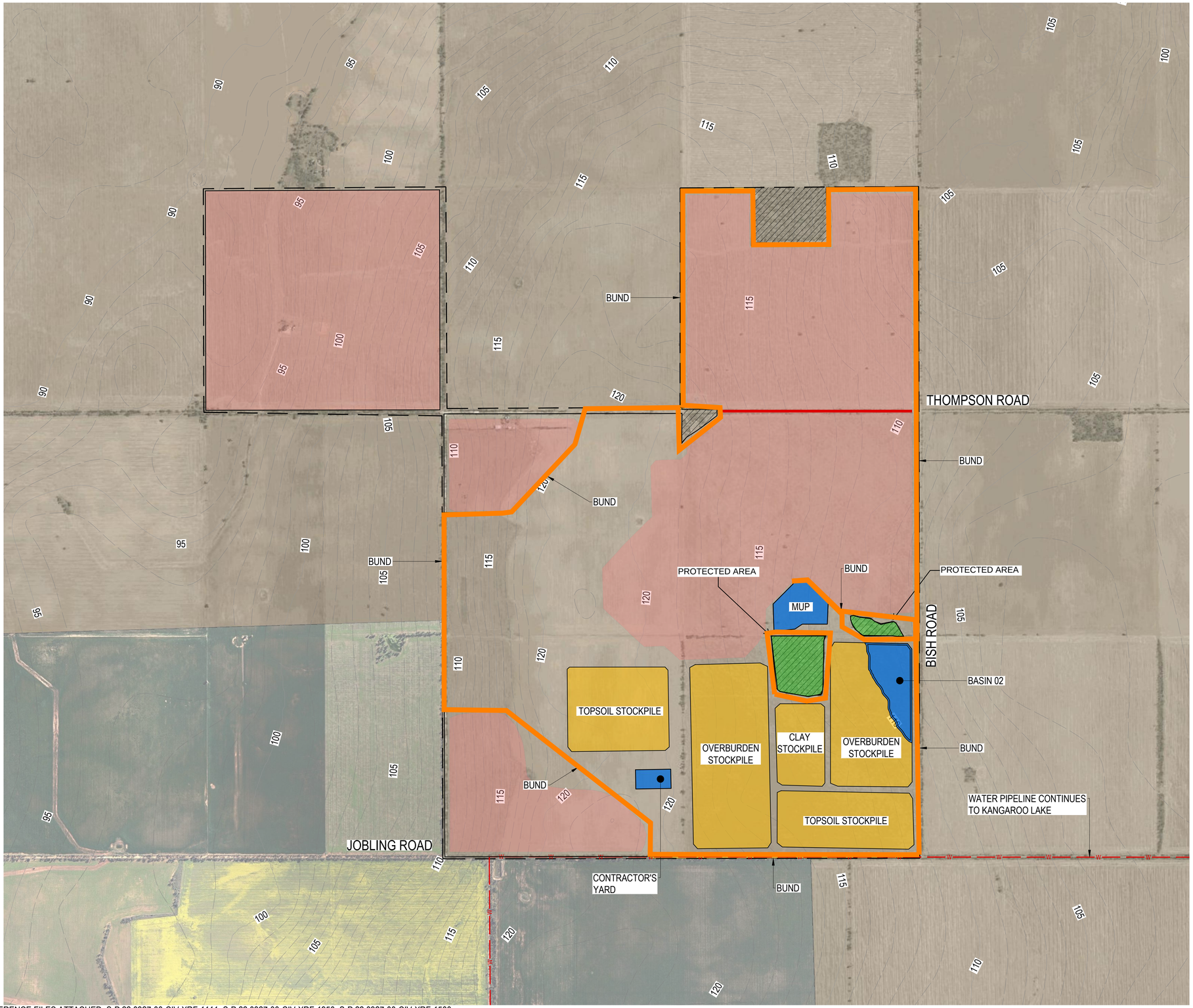
DATUMS: GDA20-MGA54

CLIENT No.:

DRAWING No.: S-P.22.0327-00-CIV-SKT-003

REVISION: B -

Apr. '20, 23 - 14:28:08 Name: S-P.22.0327-00-CIV-SKT-003.dwg Updated By: Caleb Van Der Reyden




LEGEND

- SITE BOUNDARY
- PROPOSED CONTOURS
- PIT SHELL AREAS
- STOCKPILE AREAS
- PROCESSING AND INFRASTRUCTURE AREAS
- PROTECTED AREA
- SERVICES AND TRANSPORT CORRIDORS - PUBLIC ROAD
- SERVICES AND TRANSPORT CORRIDORS - WATER LINE
- SENSITIVE RECEPTOR
- SITE BUND

NORTH

REFERENCE FILES ATTACHED: S-P.22.0327-00-CIV-XRF-1111; S-P.22.0327-00-CIV-XRF-1950; S-P.22.0327-00-CIV-XRF-1500

P&S FORM DRG-A1 REV 29

DRAWING REVISION HISTORY

| No. | DESCRIPTION | DRAWN | DESIGNED | REVIEWED | DATE | APPROVED |
|---|---|---|---|---|---|---|
| | | | | | | ORIGINAL COPY ON FILE "e" SIGNED BY |
| B | LAYOUT UPDATES | CJV | AB | AT | 20/04/2023 | SIGNED |
| A | FOR INFORMATION | CJV | AB | AT | 16/11/2022 | |
| | | CJV | AB | AT | | DATE |

SCALE (PLOTTED FULL SIZE) 1:10000

SHEET SIZE A1

200 0 200 400 600 800

SCALE IN METRES - 1:10000

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pittsh.com.au Phone 1300 748 874 ABN 67 140 184 309



CLIENT: VHM LIMITED

CONTRACT TITLE: GOSCHEN MINE MINE REHABILITATION

STATUS: CONCEPT

DRAWING TITLE: SURFACE WATER DOMAINS - AREA 3

DATUMS: GDA20-MGA54

CLIENT No.:

DRAWING No.: S-P.22.0327-00-CIV-SKT-004

REVISION: B -

Apr. 20, 23 - 14:01:29 Name: S-P.22.0327-00-CIV-SKT-004.dwg Updated By: Caleb Van Der Reyden

# Soil Loss Calculations

Appendix D

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| | | | |
|---|---|---|---|
| pitt&sherry | | Project No.: | **P.22.0327** |
| | | Page: | **1 of 1** |
| | | Prepared by: | **AM** |
| Project: | VHM Goschen Project EES Support Services | Date: | **17/06/2022** |
| Subject: | Soil Loss Calculation | Checked | **AB** |

**Site Profile**

The soils are heavy textured, clay loam topsoils and clay subsoils. They are sodic to strongly sodic (dispersive) in the subsoils.

**RUSLE:**

**A = R*K*LS*C*P**

| | | | |
|---|---|---|---|
| A = annual soil loss due to erosion [t/ha/yr] | = | **7** | |
| R = rainfall erosivity factor | = | 450 | Refer Note 1 |
| K = soil erodibility factor | = | 0.03 | Refer Note 2 |
| LS = topographic factor derived from slope length and slope gradient | = | 0.41 | Refer Note 3 |
| C = cover and management factor | = | 1 | Refer Note 4 |
| P = erosion control practice factor | = | 1.3 | default value |

**Notes:**

1. Based on values in IECA Table E1
2. Average of CL/MC soils
3. Average of 2% over 80m
4. Based on 0% cover (Conservative)

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# Goschen Mineral Sands and Rare Earths Project -

# Environment Effects Statement Mine Site Surface Water Impact Assessment

**Pitt & Sherry (Operations) Pty Ltd**
ABN 67 140 184 309

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**Located nationally**
–
Melbourne
Sydney
Brisbane
Hobart
Launceston
Newcastle
Devonport