# AUDALIA RESOURCES LIMITED

## MEDCALF PROJECT (EGS CODE: TBA)
## INTERIM MINE CLOSURE PLAN
## M63/656, L63/75

DOCUMENT ID: AUD-MED-MCP-01_Rev1

28 January 2022

**PREPARED FOR AUDALIA RESOURCES LIMITED**

BY PRESTON CONSULTING PTY LTD

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# DOCUMENT CONTROL

| | | | |
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| **Approved** | Geoffrey Han<br>Audalia Resources Limited |  <br>Signature | 28/01/2022 |

# MINE CLOSURE PLAN CHECKLIST

| Q No | Mine Closure Plan Checklist | Y/N/NA | Section | Comments | Changes from previous version (Y/N) | Page No. | Summary |
|---|---|---|---|---|---|---|---|
| 1 | Has the Checklist been endorsed by a senior representative within the tenement holder/operating company? (See bottom of checklist.) | Y | N/A | N/A | N/A | | |
| **Public Availability** | | | | | | | |
| 2 | Are you aware that from 2015 all MCPs will be made publicly available? | Y | N/A | N/A | | | |
| 3 | Is there any information in this MCP that should not be publicly available? | N | N/A | N/A | | | |
| 4 | If "Yes" to Q3, has confidential information been submitted in a separate document/section? | N/A | N/A | N/A | | | |
| **Cover Page, Table of Contents** | | | | | | | |
| 5 | Does the MCP cover page include:<br>• Project Title<br>• Company Name<br>• Contact Details (including telephone numbers and email addresses)<br>• Document ID and version number<br>• Date of submission (needs to match the date of this checklist) | Y | Cover Page and Page ii | N/A | N/A | Cover Page and Page ii | MCP cover page includes required information |
| **Scope and Purpose** | | | | | | | |
| 6 | State why the MCP is submitted (e.g. as part of a Mining Proposal, a reviewed MCP or to fulfil other legal requirements) | Y | 1.2 | To support Part IV EP Act assessment | N/A | 1 | MCP prepared to support Part IV EP Act assessment |
| **Project Overview** | | | | | | | |
| 7 | Does the project summary include:<br>• Land ownership details (include any land management agency responsible for the land / reserve and the purpose for which the land / reserve [including surrounding land] is being managed)<br>• Location of the project;<br>• Comprehensive site plan(s);<br>• Background information on the history and status of the project. | Y | 2 | Information provided in MCP | N/A | 5 | Information provided in MCP |

| Q No | Mine Closure Plan Checklist | Y/N/NA | Section | Comments | Changes from previous version (Y/N) | Page No. | Summary |
|---|---|---|---|---|---|---|---|
| **Legal Obligations and Commitments** | | | | | | | |
| 8 | Does the MCP include a consolidated summary or register of closure obligations and commitments? | Y | 3 | N/A | N/A | 17 | Closure obligations and commitments included |
| **Stakeholder Engagement** | | | | | | | |
| 9 | Have all stakeholders involved in closure been identified? | Y | 4 | All stakeholders identified | N/A | 19 | All stakeholders identified |
| 10 | Does the MCP include a summary or register of historic stakeholder engagement with details on who has been consulted and the outcomes? | Y | 4.2 | Register provided | N/A | 19 | Register provided |
| 11 | Does the MCP include a stakeholder consultation strategy to be implemented in the future? | Y | 4.3 | Consultation strategy provided | N/A | 19 | Consultation strategy provided |
| **Post-mining land use(s) and Closure Objectives** | | | | | | | |
| 12 | Does the MCP include agreed post-mining land use(s), closure objectives and conceptual landform design diagram? | Y | 6 | Information included | N/A | 135 | Information included |
| 13 | Does the MCP identify all potential (or pre-existing) environmental legacies, which may restrict the post mining land use (including contaminated sites)? | N/A | N/A | No legacies identified | N/A | N/A | No legacies identified |
| 14 | Has any soil or groundwater contamination that occurred, or is suspected to have occurred, during the operation of the mine, been reported to DER as required under the *Contaminated Sites Act 2003*? | N/A | N/A | New mine site | N/A | N/A | No contamination to-date |
| **Development of Completion Criteria** | | | | | | | |
| 15 | Does the MCP include an appropriate set of specific completion criteria and closure performance indicators? | Y | 8 | Specific completion criteria and closure performance indicators provided | N/A | 145 | MCP includes required information |
| **Collection and Analysis of Closure Data** | | | | | | | |
| 16 | Does the MCP include baseline data (including pre-mining studies and environmental data)? | Y | 5 | N/A | N/A | 26 | Data provided |
| 17 | Has materials characterisation been carried out consistent with applicable standards and guidelines (e.g. GARD Guide)? | Y | 5.3 | Materials characterisation information provided | N/A | 38 | N/A |
| 18 | Does the MCP identify applicable closure learnings from benchmarking | Y | 5.9 | Closure learnings | N/A | 133 | Information |



| Q No | Mine Closure Plan Checklist | Y/N/NA | Section | Comments | Changes from previous version (Y/N) | Page No. | Summary |
|---|---|---|---|---|---|---|---|
| | against other comparable mine sites? | | | from Gold mining are applicable | | | provided |
| 19 | Does the MCP identify all key issues impacting mine closure objectives and outcomes (including potential contamination impacts)? | Y | 7.2 | Key issues identified | N/A | 138 | Key issues identified |
| 20 | Does the MCP include information relevant to mine closure for each domain or feature? | Y | 9.2 | Closure work program is separated into domains | N/A | 153 | Information provided |
| **Identification and Management of Closure Issues** | | | | | | | |
| 21 | Does the MCP include a gap analysis / risk assessment to determine if further information is required in relation to closure of each domain or feature? | Y | 7; Appendix 7 | Risk assessment provided | N/A | 136; App 7 | Risk assessment provided |
| 22 | Does the MCP include the process, methodology, and has the rationale been provided to justify identification and management of the issues? | Y | 8 | Risk process and methods provided | N/A | 145 | Information included |
| **Closure Implementation** | | | | | | | |
| 23 | Does the MCP include a summary of closure implementation strategies and activities for the proposed operations or for the whole site? | Y | 9 | N/A | N/A | 151 | Strategies included |
| 24 | Does the MCP include a closure work program for each domain or feature? | Y | 9.2 | N/A | N/A | 153 | Closure work programs included |
| 25 | Does the MCP contain site layout plans to clearly show each type of disturbance as defined in Schedule 1 of the MRF Regulations? | Y | Figure 66 | N/A | N/A | 152 | Site layout plans updated |
| 26 | Does the MCP contain a schedule of research and trial activities? | Y | 9.5 | Potential research and trial activities to be determined at the completion of construction | N/A | 163 | Potential research and trial activities to be determined at the completion of construction |
| 27 | Does the MCP contain a schedule of progressive rehabilitation activities? | N | 9.6 | To be determined at the completion of construction | N/A | 163 | To be determined at the completion of construction |
| 28 | Does the MCP include details of how unexpected closure and care and maintenance will be handled? | Y | 9.7 | N/A | N/A | 163 | Details provided |
| 29 | Does the MCP contain a schedule of decommissioning activities? | Y | 9.8 | N/A | N/A | 164 | Schedule provided |

| Q No | Mine Closure Plan Checklist | Y/N/NA | Section | Comments | Changes from previous version (Y/N) | Page No. | Summary |
|---|---|---|---|---|---|---|---|
| 30 | Does the MCP contain a schedule of closure performance monitoring and maintenance activities? | Y | 9 | N/A | N/A | 151 | Schedule provided |
| **Closure Monitoring and Maintenance** | | | | | | | |
| 31 | Does the MCP contain a framework, including methodology, quality control and remedial strategy for closure performance monitoring including post-closure monitoring and maintenance? | Y | 10 | N/A | N/A | 165 | Framework provided |
| 32 | Does the MCP include costing methodology, assumptions and financial provision to resource closure implementation and monitoring? | Y | 11 | N/A | N/A | 170 | Details provided |
| 33 | Does the MCP include a process for regular review of the financial provision? | Y | 11.1 | N/A | N/A | 171 | Process provided |
| 34 | Does the MCP contain a description of management strategies including systems and processes for the retention of mine records? | Y | 12 | N/A | Y | 173 | Strategies provided |

**to be signed prior to submission to DMIRS*

**Corporate endorsement:**

I hereby certify that to the best of my knowledge, the information within this Mine Closure Plan and checklist is true and correct and addresses all the requirements of the *Statutory Guidelines for the Mine Closure Plans* approved by the Director General of the Department of Mines, Industry Regulation and Safety.

**Name**: Geoffrey Han **Signed**: 

**Position**: Project Director **Date**: 28/01/2022

(*NB: The corporate endorsement must be given by tenement holder(s) or a senior representative authorised by the tenement holder(s), such as a Registered Manager or Company Director*)

# CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# LIST OF APPENDICES

**Appendix 1 - 6 are available as appendices to the Environmental Review Document available to download from WA Environmental Protection Authority website (Assessment Number: 2156)**

**Appendix 1: Geotechnical Desktop Study of Pit North Shell Stability Memorandum (Knight Piesold, 2019)**

**Appendix 2: Soils of the Audalia Medcalf Area (Western Horticultural Consulting, 2019)**

**Appendix 3: Flora and Vegetation reports**

- 3.1 Geomorphology of the *Marianthus aquilonaris* sub-populations. Bremer Range West Australia (Word Technical Services Group Pty Limited, 2019)
- 3.2 Component 2 Report. Assessment of genetic diversity in sub-populations of *Marianthus aquilonaris* (DBCA, 2019a)
- 3.3 *Marianthus aquilonaris* demographic monitoring: spring 2018 - spring 2019 (Botanica, 2020a)
- 3.4 *Marianthus aquilonaris* landform monitoring: spring 2018 (Botanica, 2019)
- 3.5 Deposition Study (Ramboll, 2020a)
- 3.6 Haul Road Dust Deposition Study (Ramboll, 2020b)
- 3.7 CFD Wind Study (Ramboll, 2020c)
- 3.8 Germination memo (Botanica, 2020b)
- 3.9 Detailed Flora & Vegetation Survey Medcalf Vanadium Mining Project & Proposed Haul Road (Botanica, 2020c)
- 3.10 Flora and Vegetation Impact Assessment (Botanica, 2020d)
- 3.11 Summary on ecology of *Marianthus aquilonaris* (Botanica, 2020e)
- 3.12 Detailed maps of significant flora records
- 3.13 Medcalf Project Rehabilitation Plan (Botanica, 2022)

**Appendix 4: Fauna reports**

- 4.1 Fauna survey. Medcalf Vanadium Mining Project (Harewood, 2020a)
- 4.2 Assessment of Subterranean Fauna Values (Bennelongia 2020)
- 4.3 Fauna Assessment. Medcalf Vanadium Mining Project. Proposed Haul Road (Harewood, 2020b)
- 4.4 Insect visitors to *Marianthus aquilonaris* and surrounding flora (Prendergast, 2019)

**Appendix 5: Terrestrial Environment reports**

- 5.1 Geochemical Characterisation of Slurry Samples of Deslimed-Tailings and Gravity-Reject-Tailings and Implications for Tailings Management (GCA, 2020a)
- 5.2 Characterisation of Mine-Waste Samples from Vesuvius, Fuji and Egmont Pits – Implications for Mine-Waste Management (GCA, 2020b)

# 1 BACKGROUND

## 1.1 SCOPE

This interim Mine Closure Plan (MCP) has been prepared to inform and accompany the Environmental Review Document (ERD) for the Medcalf Vanadium Project (the Project). The proponent, Audalia Resources Limited (Audalia) has addressed the *Statutory Guidelines for Mine Closure Plans* (Department of Mines, Industry Regulation and Safety (DMIRS), 2020a) (the Guidelines) and the *Mine Closure Plan Guidance – How to prepare in accordance with Part 1 of the 'Statutory guidelines for Mine Closure Plans'* (DMIRS, 2020b) (the MCP Guidance) in preparing this MCP. The MCP is not provided for approval under the *Mining Act 1978* (Mining Act) – it will be updated with final Project design details to support approvals under the Mining Act at the appropriate time.

The MCP details relevant background information, stakeholder consultation, post-mining land use, preliminary closure outcomes and completion criteria, identification and management of closure issues, and closure implementation. The MCP also describes planned Project closure and rehabilitation activities in the form of a task list, including tasks for all disturbed areas, plant and other built infrastructure. Contingencies for temporary suspension of operations and unplanned closure are also addressed.

Consistent with the adaptive management approach recommended by DMIRS, the MCP will be regularly updated through the life of the Project to ensure changes in the regulatory environment and / or stakeholder expectations, and technical developments in closure planning, are captured and incorporated into decision making until relinquishment of the Project tenements.

## 1.2 PURPOSE

The purpose of this MCP is to demonstrate that the Project is able to be decommissioned, closed and rehabilitated in an environmentally acceptable manner consistent with agreed post-mining land uses, and without unacceptable liability to the State. It provides the information required by Audalia to progress toward closing the Project consistent with an agreed set of outcomes relevant to closure.

## 1.3 LAND OWNERSHIP

Audalia is a public company (ASX listed, code: ACP) and the current registered owner of all Project tenements. Relevant Project leases and licences are listed in Table 1.

**Table 1: Project Tenure**

| Tenement ID | Type | Grant date | Expiry date |
|---|---|---|---|
| M63/656 | Mining Lease | 13/11/2015 | 12/11/2036 |
| L63/75 | Miscellaneous Licence | 12/10/2017 | 11/10/2038 |

Audalia's registered office and other details are:

| | |
|---|---|
| Street Address: | Office F, Level 1, 1139 Hay St, West Perth, Western Australia 6005 |
| Postal Address: | PO Box 354, West Perth, Western Australia 6872 |
| Telephone: | +61 8 9481 2600 |
| Website: | www.audalia.com.au |
| ABN: | 49 146 035 690 |

The key contact person for this MCP is:

| | |
|---|---|
| Name: | Geoffrey Han – Project Director |
| Telephone: | +61 8 9481 2600 |
| Email: | geoffrey.han@audalia.com.au |

## 1.4 LOCATION AND TENURE

The Project is located in the Shire of Dundas in the Bremer Range, Lake Johnston region, approximately 470 km south east of Perth, Western Australia (WA) (Figure 1). The Project will link with existing transport and export infrastructure via the Coolgardie-Esperance Highway, with product expected to be exported through Esperance Port.

The works described in this MCP are to be implemented within two development envelopes (DEs); a Mine DE and a Haul Road DE (Figure 2), within the following tenements issued under the Mining Act:

- Mining activities will be undertaken within M63/656; and
- The haul road will be developed within L63/75.

Project tenements, shown in Figure 2, are located within Unallocated Crown Land (UCL).


Figure 1: Regional Location of the Project

292500 295000 297500

6400000

6397500

6395000

M 63/656

L 63/75

E 63/1134

Stennets Lake

Lake Gilmore

COOLGARDIE ESPERANCE HWY

LAKE KING - NORSEMAN RD

0 2.5 km

292500 295000 297500

**Legend**

- Mine Development Envelope
- Haul Road Development Envelope
- Mine Disturbance Footprint
- Haul Road Indicative Disturbance Footprint
- Tenement

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DMRS 2020
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE

BOTANICA CONSULTING

0 0.2 0.4 0.6 0.8 1 km

Scale: 1:25,000 @ A3

N

**LOCALITY MAP**


| CREATED BY | JOB | DATE | REVISION |
|---|---|---|---|
| ENVIRONMAPS | BOT1 | 18/06/2020 | 0 |

audalia resources limited

ENVIRONMAPS | t: 0406 590 006 | Environmental Mapping Solutions | www.environmaps.com.au

Figure 2: Development Envelopes

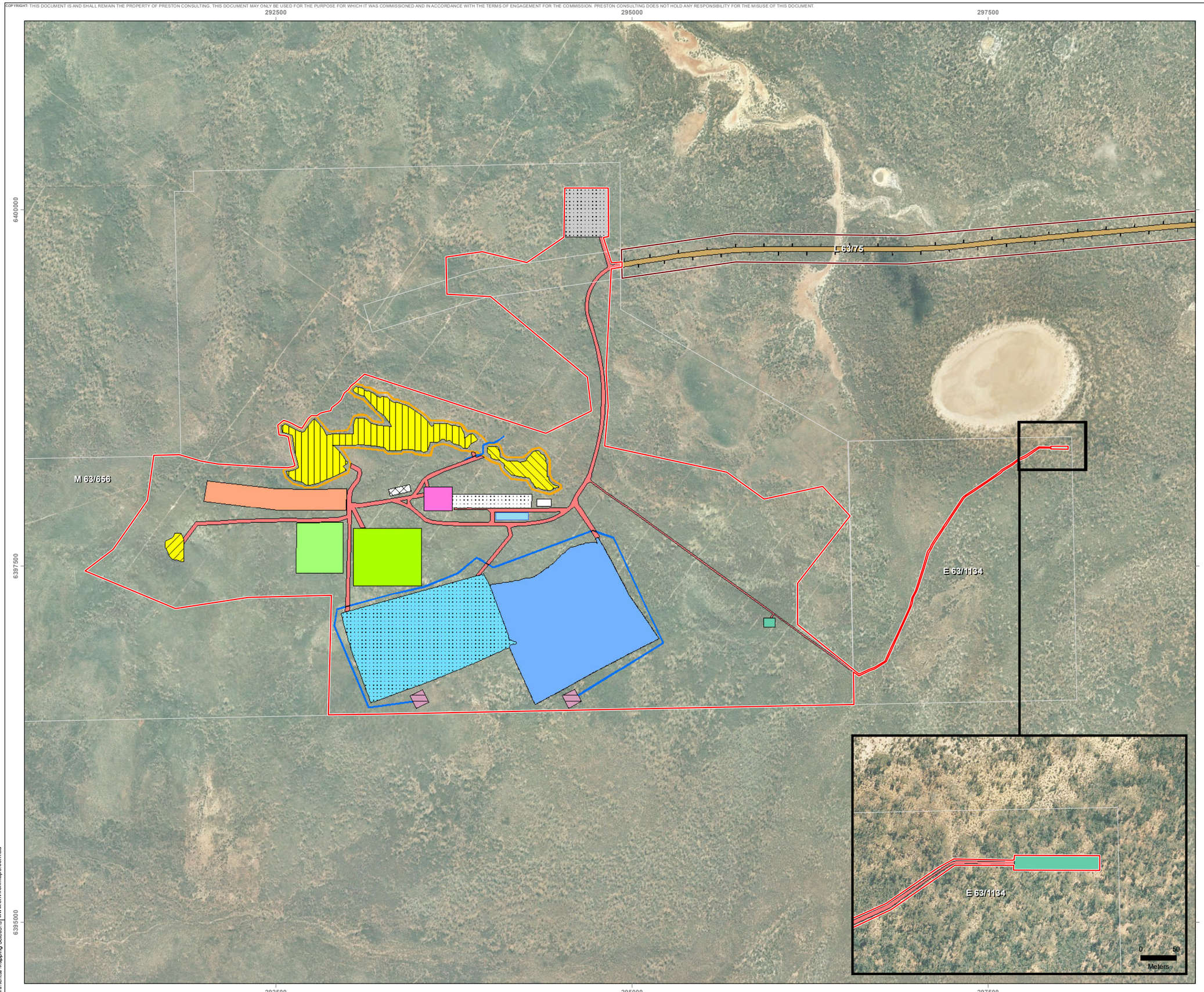
# 2 PROJECT DESCRIPTION

The Project is a vanadium, titanium and iron deposit with a JORC (2012) compliant Indicated and Inferred Mineral Resource of 31.8 million tonnes (Mt) at 0.44% $V_2O_5$ and 8.36% $TiO_2$.

The Project involves mining, processing and exporting a concentrate of vanadium, titanium and iron. The Project includes the development of three open mine pits, beneficiation plant, tailings storage facility (TSF), topsoil stockpile, private haul road, road train transfer area and associated infrastructure such as laydown areas, borrow and gravel pits, groundwater bores, workshops and an accommodation camp.

Audalia intends to transport the concentrate product in road trains from the mine to a transfer hub at the Coolgardie to Esperance Highway via private 74 km haul road. The concentrate will then be loaded onto smaller road trains and transported to the Port of Esperance for export.

The Project consists of two distinct DEs. Clearing of no more than 300 ha within the 898 ha Mine DE is required in order to develop the mine pits and associated infrastructure (Figure 3). Clearing of no more than 350 ha within the 1,633 ha Haul Road DE is required in order to develop the haul road and associated infrastructure (Figure 4 and Figure 5).




**Legend**

- Mine Development Envelope
- Haul Road Development Envelope
- Haul Road Indicative Disturbance Footprint
- Tenement

Mine Disturbance Footprint

- Admin Office
- Plant Site
- Workshop
- Camp
- Roads
- Egmont Pit
- Pinatubo Pit
- Vesuvius/ Fuji Pit
- Borrow Pit
- Overburden Stockpile
- Topsoil Stockpile
- ROM Pad
- Evaporation Pond
- Settlement Pond
- Process Water Dam
- Tailings Storage Facility
- Bore Field
- Diversion Drain
- Pit Bund

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DMRS 2020
- LOCALITY MAP SOURCED LANDGATE
- AERIAL PHOTOGRAPHY OPEN SOURCE

Preston Consulting

0 200 400 600 800 1,000
Meters
Scale: 1:5,000 @ A3

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**LOCALITY MAP**


| CREATED BY | JOB | DATE | REVISION |
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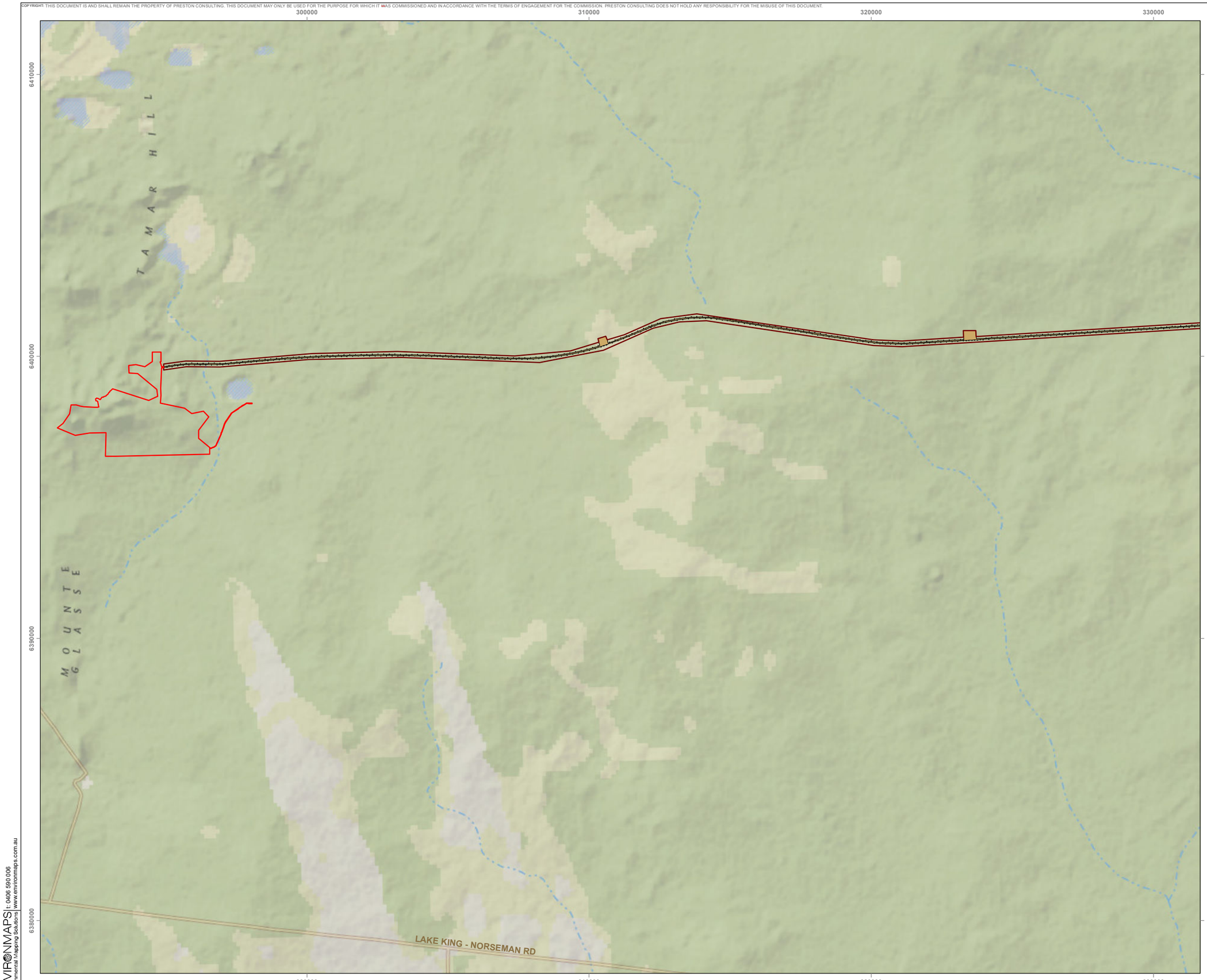
C:\GIS\Jobs\Preston Consulting\PC2900035 - Audalia Resources, Part IV Approvals ERD\P_Figures\PC2900035_Mine Development Envelope and Indicative Infrastructure_200713.mxd

Figure 3: Mine DE and indicative infrastructure




**Legend**

- Mine Development Envelope
- Haul Road Development Envelope
- Haul Road Indicative Disturbance Footprint

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE
- BASE DATA OPEN SOURCE NATGEO WORLD MAP

Preston Consulting

0 1 2 3 4 5
Kilometers
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**LOCALITY MAP**


| CREATED BY | JOB | DATE | REVISION |
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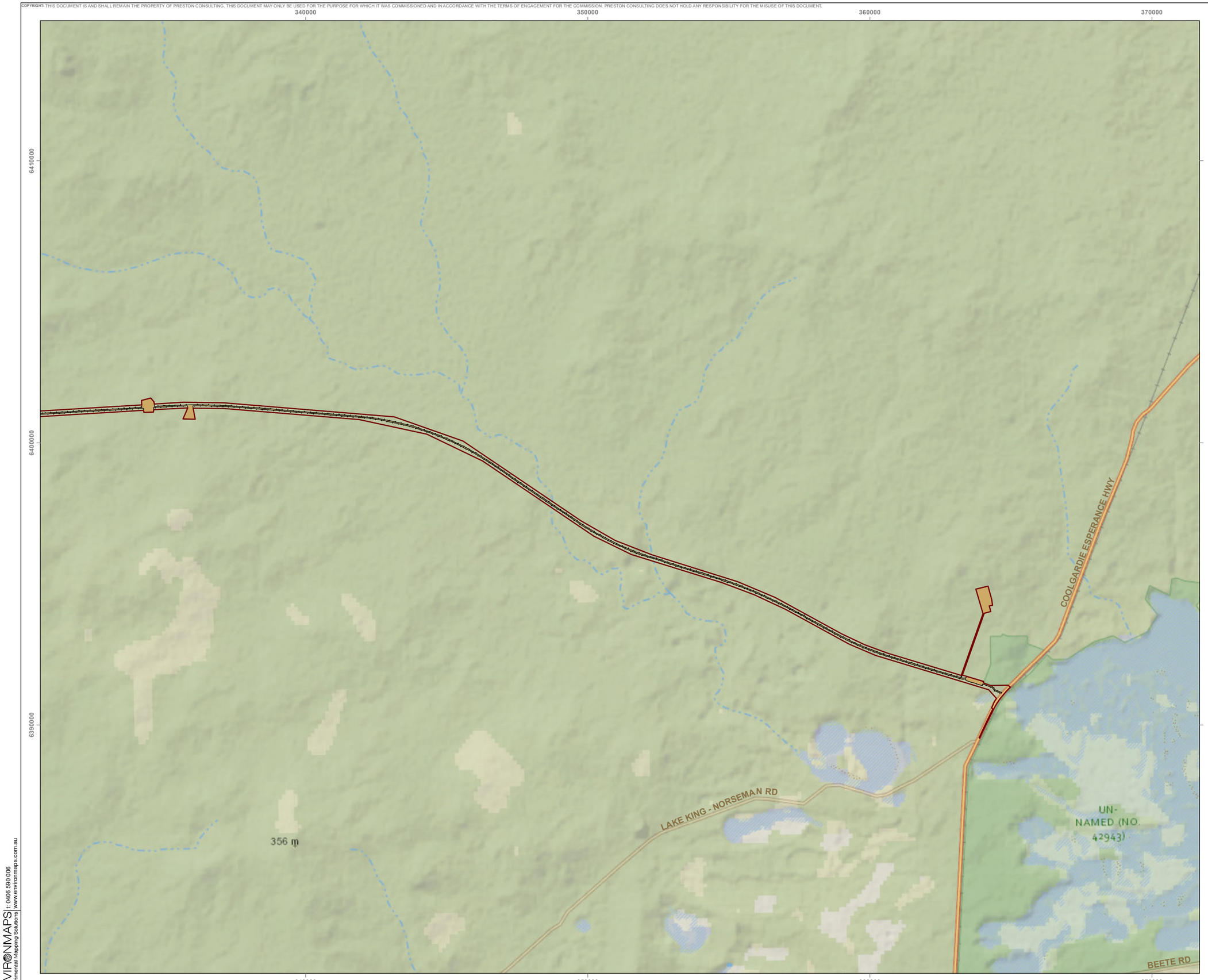
audalia resources limited

ENVIRONMAPS | t: 0406 590 006 | Environmental Mapping Solutions | www.environmaps.com.au

Figure 4: Haul Road DE and indicative layout (1 of 2)




**Legend**

- Mine Development Envelope
- Haul Road Development Envelope
- Haul Road Indicative Disturbance Footprint

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE
- BASE DATA OPEN SOURCE NATGEO WORLD MAP

Preston Consulting

0 1 2 3 4 5
Kilometers
Scale: 1:125,000 @ A3

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**LOCALITY MAP**


| CREATED BY | JOB | DATE | REVISION |
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Figure 5: Haul Road DE and indicative layout (2 of 2)

## 2.1 Open Mine Pits

Open pit mining is planned to be undertaken to shallow depths of approximately 50 m (above the groundwater table) from three or four separate open pits; namely Vesuvius / Fuji, Egmont and Pinatubo (Figure 3). Cube Consulting Pty Ltd (Cube) has undertaken a range of open pit optimisation studies and supplied input parameters. The mining study (Cube, 2019) identified a combined ore tonnage inventory of 19.1 million tonnes (Mt) with a very low total strip ratio (waste : ore tonnes) of only 0.15. A mining production schedule was completed using the final and staged pit designs with a minimum annual ore production of 1.5 million tonnes per annum (Mtpa) and a life of mine of 13 years. The resultant estimates of ore and waste being extracted from each mine pit are shown in Table 2.

These resulted in a total of 19.1 Mt of Ore at 53.36% average Hematite ($Fe_2O_3$) grade, 0.51% average vanadium pentoxide ($V_2O_5$) grade, 9.34% average titanium dioxide ($TiO_2$) grade; and 2.8 Mt of waste resulting in a waste : ore strip ratio of 0.15

The current pit shell footprints and tonnages are listed in Table 2 as follows and are shown in Figure 3.

**Table 2: Mine pits footprint and tonnages**

| Mine Pit | Pit shell footprint (ha) | Ore tonnages (Mt) | Waste tonnages (Mt) |
|---|---|---|---|
| Egmont | 1.96 | 0.82 | 0.10 |
| Vesuvius / Fuji | 31.51 | 16.73 | 2.44 |
| Pinatubo | 5.85 | 1.55 | 0.26 |
| **TOTAL** | 39.32 | 19.1 | 2.8 |

Knight Piesold Pty Ltd (Knight Piesold) conducted a geotechnical desktop study of the proposed pit slope profiles and assessed stability. Knight Piesold (2019) recommended to maintain a safety bund of at least 17 m away from the crest of the pit slopes as shown in Figure 6. Appropriate dimensions shall be maintained to prevent surface run-off from flowing into the pit and eroding the pit slope surfaces.

## 2.2 Waste Rock Disposal

The majority of waste rock will be used for mine closure. An estimated 1.6 $Mm^3$ will need to be used to construct embankments. The remaining 1.2 $Mm^3$ of waste rock will be disposed into the void created by the excavation of construction material for the TSF. This has allowed Audalia to remove the requirement for a Waste Rock Landform (WRL). A temporary waste rock stockpile will be developed next to the void to allow waste material to be stored while the TSF is being operated.

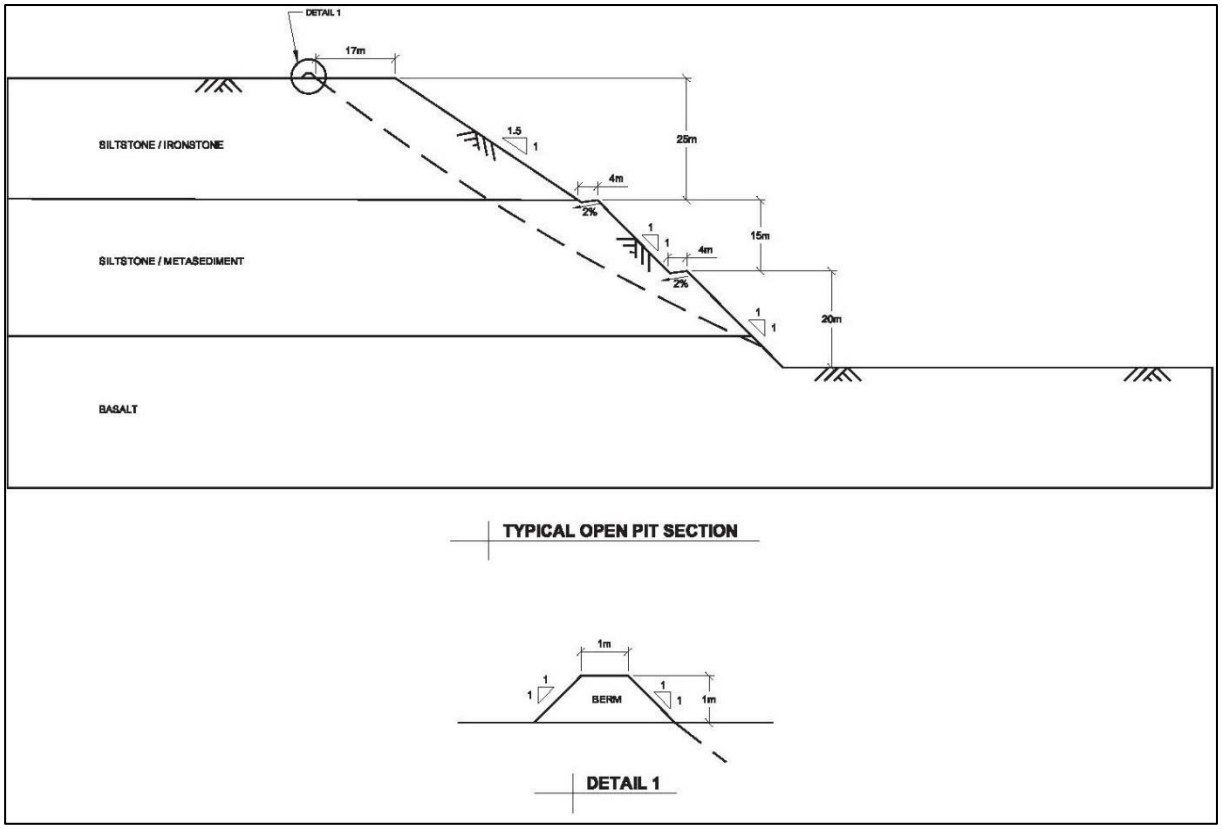


Figure 6: Proposed slope and bund profiles

## 2.3 PROCESSING / ORE BENEFICIATION PLANT

The processing plant incorporates a comminution circuit and a magnetic beneficiation circuit. The comminution circuit includes crushing and milling processes; and the magnetic separation (magsep) circuit consists of two different types of magnetic separation plants.

The processing plant will upgrade the run of mine (ROM) ore to the primary concentrate by removing the gangue materials through the beneficiation circuit. The primary concentrate will then be dewatered by thickening and filtration, with the filter cake stacked and prepared for transport (Figure 7). The tailings generated from the magnetic separation circuit will be thickened and stored in a TSF (refer section below).

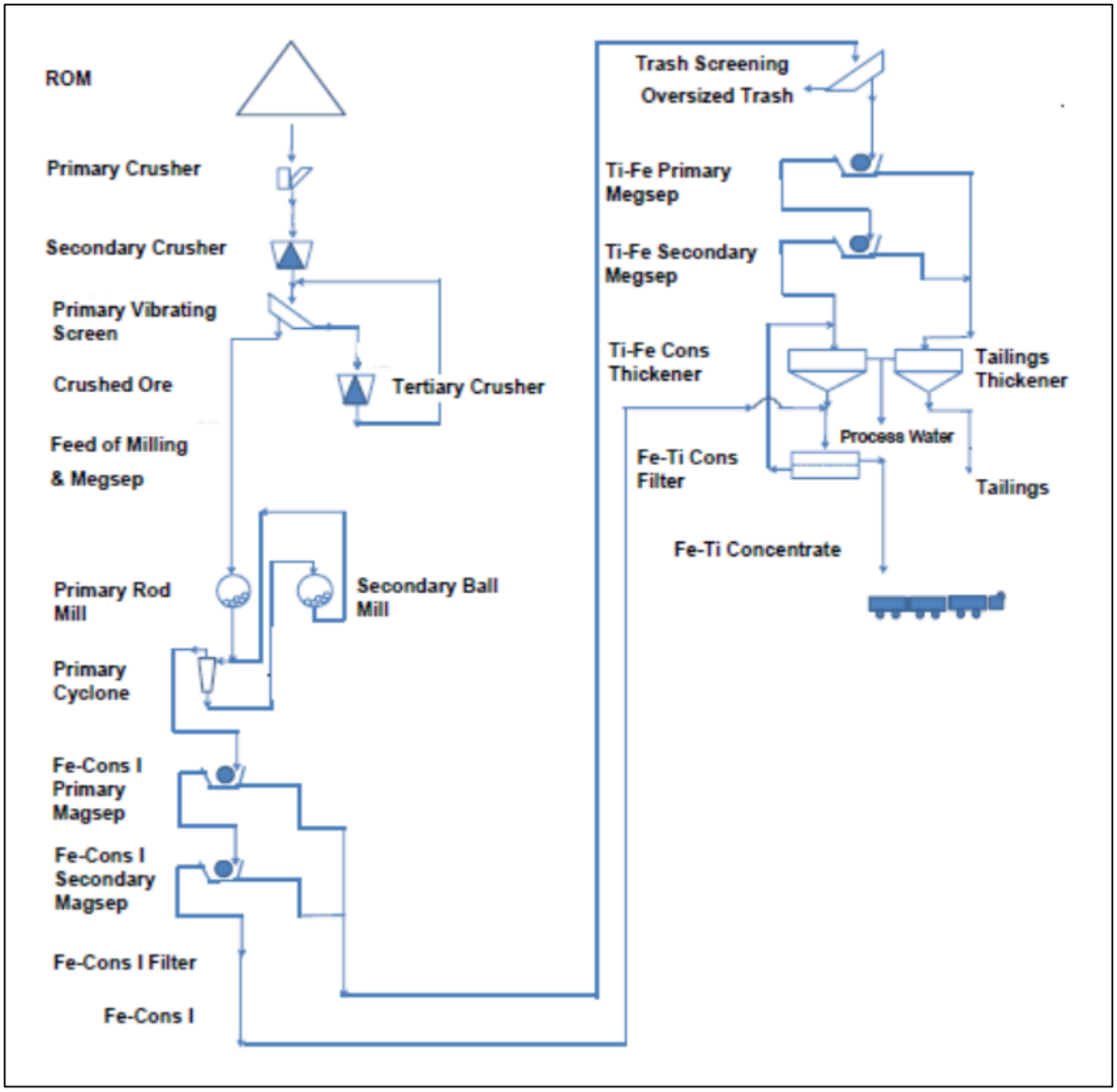


Figure 7: Process flow diagram

## 2.4 TAILINGS STORAGE FACILITY

Golder Associates Pty Ltd (Golder) was commissioned to provide a conceptual design of the TSF (Appendix 7.4 of ERD). Based on the current mining rate of 1.5 Mtpa, there will be a requirement to store approximately 7.2 Mt of tailings / process waste production over the 13 year mine life (Golder, 2020).

A side-hill TSF design was selected to be constructed with locally borrowed material to provide a sufficient capacity to retain tailings for the anticipated 13 years of production. The TSF will be located to the south of mining operations within the Audalia leases (Figure 8).

Audalia is progressing a slurry tailings option, which will form the basis of the design concept. However, Audalia is also investigating filtered tailings options to increase reuse of available water and reduce the water demands across the site.

The TSF downstream batter slopes of confining embankment are assumed to be constructed at a slope of 1V: 3H, above 18°. This relatively flat batter will allow the slopes to be trafficked during closure. The upstream batter slopes have been assumed to be constructed at a slope of 1V:2H, above 27°.

Tailings will be deposited as a slurry at a beach slope of 0.5 % allowing for a 300 mm freeboard. Deposition will occur from the confining embankments resulting in the supernatant pond being located in the north corner of the facility, providing sufficient freeboard to contain a 1 in 100 year, 72-hour rainfall event. The supernatant pond will be remote to the embankment reducing risks associated with embankment instability, overtopping and seepage. Water will be collected from the TSF by either a pump located on a floating barge or turret decant system for reuse within the processing circuit (Golder, 2020).

The concept assumes that the embankment would be constructed using the downstream raise approach, or constructed as a single embankment prior to commencement of operations, depending on availability of materials locally and waste scheduling from the pit(s).

The TSF will have a crest of 10 m to allow for the implementation of the tailings delivery pipeline, safety windrow and vehicle access tracks. TSF cross-sections are presented in Figure 9. The volume of fill required to construct the TSF is estimated to be approximately 1.6 $Mm^3$.

The rate of rise of the hydraulically-deposited tailings will be approximately 2 m per year. This rate of rise is aimed at achieving air drying of the tailings away from the supernatant pond and the targeted overall average tailings dry density of 1.5 $t/m^3$ for the tailings. In the areas of the TSF where tailings are submerged by water, the tailings will only consolidate through self-weight and thus likely reach a lower density than on the beaches.

The TSF is expected to undergo a total of 3 - 4 m of consolidation settlement, based on the consolidation test results obtained by Golder. The majority of this consolidation settlement is expected to occur during operation of the TSF due to the low rate of rise. Therefore, only a small amount of post operational settlement is expected.

Whilst the tailings are expected to be benign (section 5.4.3), a cover design will be prepared as part of the detailed TSF design.

## 2.5 Evaporation Ponds

Two evaporation ponds (Figure 8) have been designed to provide storage of approximately 500,000 $m^3$ per annum. The evaporation ponds are required to store the reject water from the reverse osmosis plant (RO plant). The process plant requires 805 kL/day of fresh water, which will be obtained from the RO plant through treatment of groundwater. Assuming a 40% conversion rate, an estimated 1,200 kL/day will be discharged into the evaporation pond.

## 2.6 Borrow / Temporary Storage Area

The orebodies are generally ore to surface and have an overall strip ratio of waste to ore of 0.15. Planning has identified that all the waste materials from the pits are likely to be useful in construction and closure of the TSF.

As waste rock from the pits will be insufficient to meet all of the construction requirements for the TSF (Golder, 2020), with borrow material being required to source specific material types. The materials balance for the planned operations thus indicates a borrow area of approximately 15 ha.

Closure of the TSF requires storage of competent materials to be incorporated into final outer surfaces to protect them from erosion. The borrow area will be used as a temporary storage area for these materials to avoid having to clear further vegetation.

## 2.7 HAUL ROAD

As there are no major roads available to the Project, a 74 km unsealed private haul road is proposed from the mine site to an ore transfer hub adjacent to the Coolgardie-Esperance Highway (Figure 4 and Figure 5). Audalia investigated numerous access and haulage options for the Project and determined that a private haul road was the most appropriate method of enabling ore to be transported from the mine site.

The road will have a running surface of approximately 11 m width and requires an average disturbance width of approximately 40 m. This average disturbance width allows for wider areas where drainage features are installed. The haul road will follow the path of existing tracks along most of its length (where suitable) to minimise vegetation disturbance.

The primary concentrate is to be hauled by heavy haulage road trains along this haul road. The availability of a private haul road means that larger haul trucks can be used to transport more efficiently.

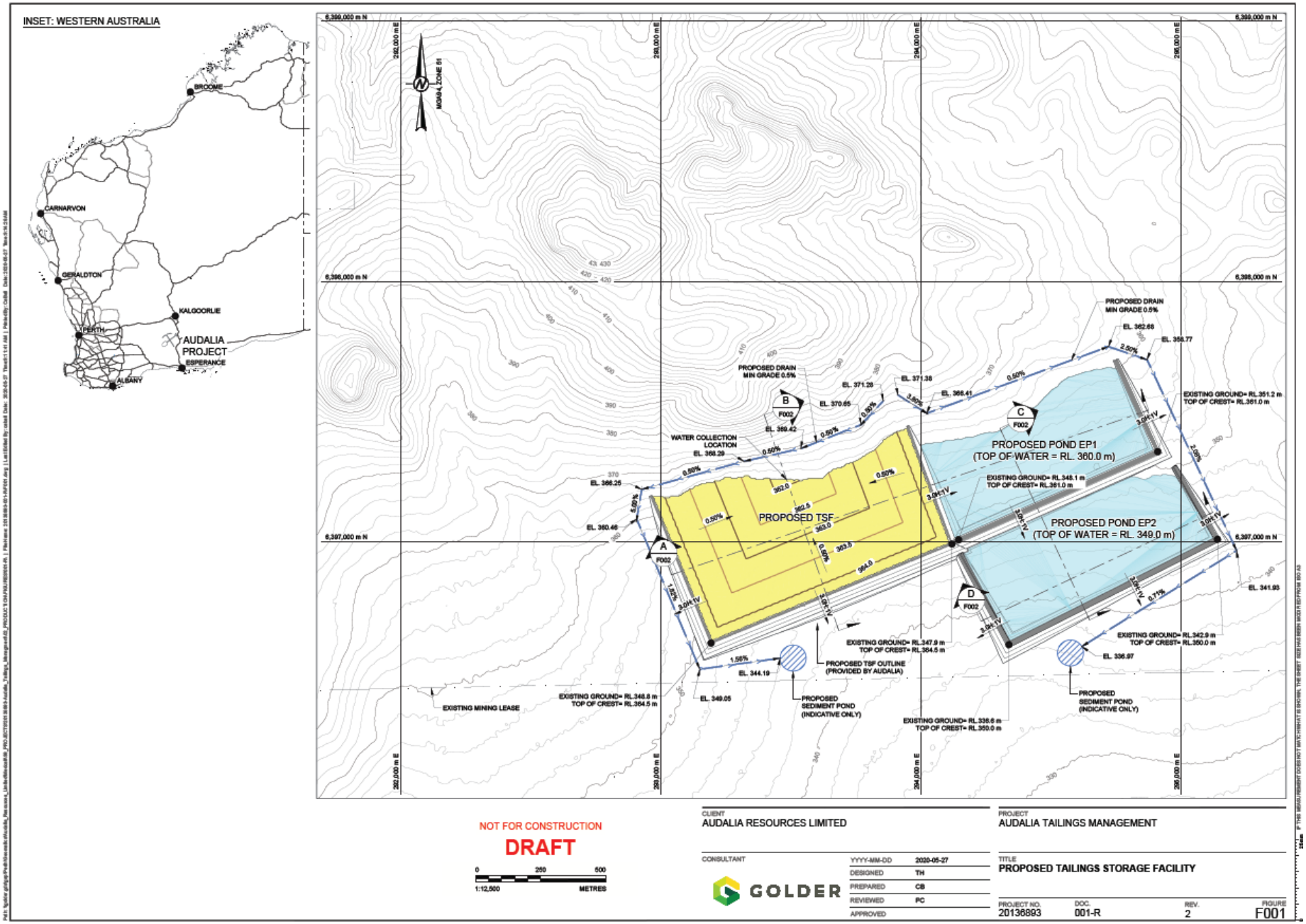


Figure 8: Layout of the TSF and Evaporation Ponds

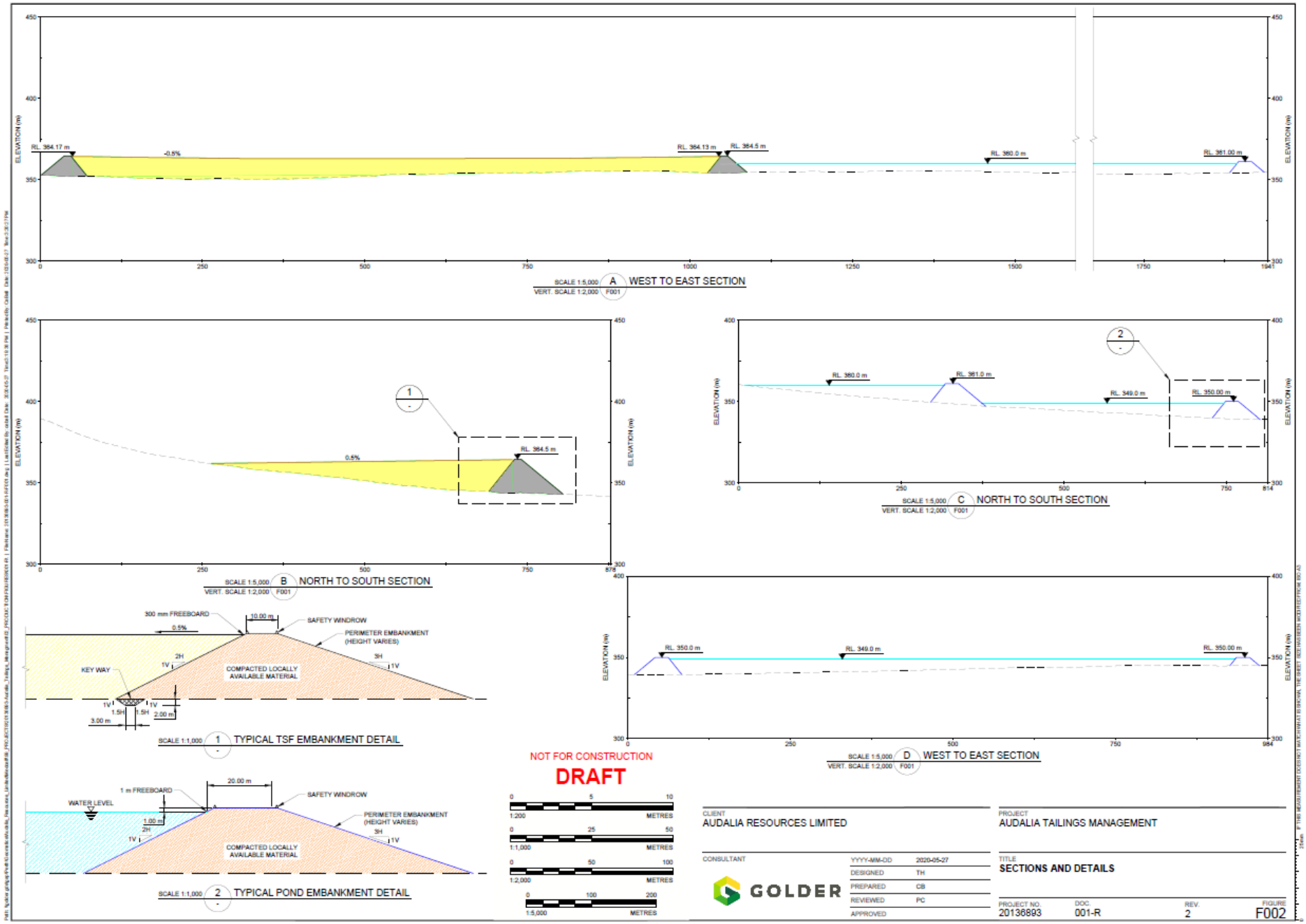


Figure 9: TSF cross-sections

## 2.8 EXPORT

A transfer hub will be constructed adjacent to the Coolgardie - Esperance Highway. When the heavy haulage road trains reach the transfer hub they will either offload the concentrate or will continue south to the Esperance Port as highway-approved road trains by disconnecting the required number of trailers. There is a widening of the DE near the Coolgardie - Esperance Highway to accommodate the transfer area.

Approximately 34 road trains per day will transport the concentrate to Esperance Port. Only minor works are required to be conducted at Esperance Port to accommodate the new shipment. The ore concentrate is planned to be stored within an existing enclosed storage area before being exported via an existing export berth. These works and activities do not form part of this MCP as they are managed under approval from the Southern Ports Authority.

## 2.9 SUPPORTING INFRASTRUCTURE

The Project requires water to run mine processing, accommodation and workshop facilities. This will be pumped via surface pipelines from a series of new bores targeting sources just east of the mining area, and along the haul road (Figure 3 to Figure 5). The water supply is brackish to saline, which is suitable for processing and dust suppression (with specific controls), however a small reverse-osmosis plant will be installed to supply potable water for personnel.

Power will be supplied initially by a series of diesel-fuelled generators with local power lines for electrical distribution. Solar panels may be used in conjunction with diesel generators to provide power to low flow pumps where appropriate.

Accommodation for up to 50 people is required to operate and maintain the site operations, with up to 100 additional construction rooms if required. The accommodation village will be located within the Mine DE (Figure 3).

Other supporting infrastructure may include workshops, laydown, fuel storage and communications.

# 3 IDENTIFICATION OF CLOSURE OBLIGATIONS AND COMMITMENTS

Legal obligations relating to the closure of the Project are provided within Table 3.

**Table 3: Legal Obligations Register – Closure**

| Relevant DMIRS Tenement Conditions | | |
|---|---|---|
| **Tenement** | **Condition No.** | **Closure conditions** |
| M63/656 | 2 | All disturbances to the surface of the land made as a result of exploration, including costeans, drill pads, grid lines and access tracks, being backfilled and rehabilitated to the satisfaction of the Environmental Officer, DMP. Backfilling and rehabilitation being required no later than 6 months after excavation unless otherwise approved in writing by the Environmental Officer, DMP. |
| | 3 | All waste materials, rubbish, plastic sample bags, abandoned equipment and temporary buildings being removed from the mining tenement prior to or at the termination of exploration program. |
| | 4 | Unless the written approval of the Environmental Officer, DMP is first obtained, the use of drilling rigs, scrapers, graders, bulldozers, backhoes or other mechanised equipment for surface disturbance or the excavation of costeans is prohibited. Following approval, all topsoil being removed ahead of mining operations and separately stockpiled for replacement after backfilling and/or completion of operations. |
| L63/75 | 3 | All topsoil that may be removed ahead of pipelaying operations to be stockpiled for replacement in accordance with the directions of the Environmental Officer, DMIRS. |
| | 12 | All disturbance to the surface of the land made as a result of exploration, including costeans, drill pads, grid lines and access tracks, being backfilled and rehabilitated to the satisfaction of the Environmental Officer, DMIRS. Backfilling and rehabilitation being required no later than 6 months after excavation unless otherwise approved in writing by the Environmental Officer, DMIRS. |
| | 13 | All waste materials, rubbish, plastic sample bags, abandoned equipment and temporary buildings being removed from the licence area prior to or at the termination of exploration program. |
| **Ministerial Statement** | | |
| **Condition** | **Date** | **Closure condition** |
| N/A | N/A | Ministerial Statement not yet granted. |
| **EP Act Part V Works Approval- W6149/2018/1 Category 85: Sewage Facility** | | |
| **Condition** | | **Aspect related to closure** |
| N/A | | No closure conditions imposed |
| **EP Act Part V Licence** | | |
| **Condition** | **Date** | **Aspect related to closure** |
| N/A | N/A | Licence not yet granted |
| **Licence to Take Water (5C) – GWL** | | |
| **Tenement** | **Condition** | **Closure conditions** |
| N/A | N/A | Licences not yet issued. |
| **Medcalf Project Mining Proposal** | | |
| **Section No.** | | **Closure commitment** |
| N/A | | Mining Proposals not yet submitted and approved. |

The tenure for the Project is based on the Mining Act which utilises tenement conditions to impose legal obligations. As no Mining Proposals or MCPs have been submitted under the Mining Act, obligations to implement the Project in accordance with a Mining Proposal and MCP do not yet exist. These will be added to the obligations register above based on the Mining Act approvals, as and when they are acquired.

The legislation listed below will also be considered in planning for closure:

- *Biosecurity and Agriculture Management Act 2007* (WA);
- *Building Act 2011* (WA);
- *Contaminated Sites Act 2003* (WA);
- *Environment Protection and Biodiversity Conservation Act 1999* (Cth);
- *Land Administration Act* (WA);
- *Mines Safety and Inspection Act 1995* (WA);
- *Rights in Water and Irrigation Act 1914* (WA) and
- *Soil and Land Conservation Act 1945*.

In addition to the above, Native Title Agreement obligations (arising from Native Title Agreement), commitments and agreements with Local Government and other entities with land management responsibilities would be considered in planning for closure.

# 4 STAKEHOLDER ENGAGEMENT

## 4.1 PRINCIPLE OF STAKEHOLDER ENGAGEMENT

The core principle of the stakeholder engagement strategy adopted for the Project is to identify relevant external stakeholders during the early stages of the Project and consult with them to determine their concerns, identify appropriate mitigation strategies and determine environmental outcomes. Stakeholder feedback has been considered in the development of the Project Risk Register.

## 4.2 TARGETED COMMUNITY AND ENGAGEMENT STRATEGY

Audalia has a Consultation Strategy which identifies key external stakeholders and determines how they will be impacted by the Project and what influence they have over its implementation. The aim of the consultation is to develop productive relationships that ensure the Project is underwritten by sustainable agreements and necessary statutory approvals. The Consultation Strategy has also been developed to secure the approvals necessary for the construction and operation of the Project, which will require consultation with the following stakeholders:

- Local Government (including Shire);
- State Government;
- Aboriginal groups; and
- Corporate and community stakeholders.

Audalia maintains a Stakeholder Engagement Register. This register maintains records of all consultations with stakeholders and will be updated as required throughout the life of the Project – it is summarised in Table 4.

## 4.3 ONGOING COMMUNITY AND STAKEHOLDER ENGAGEMENT

Stakeholder engagement is a continuous process that has been and will continue to be conducted throughout the life of the Project. In particular, ongoing stakeholder engagement will be undertaken during the following components of the Project:

- During high risk activities (as required by the risk assessment);
- Prior to any major changes to proposed activities; and
- Upon identification by stakeholders of areas of concern.

Table 5 summarises the planned stakeholder consultation relevant to Project closure, including specific topics of discussion and key issues.

**Table 4: Stakeholder Engagement Register**

| Stakeholder | Date/s | Nature of Engagement / Issues / Topics Raised | Proponent Response / Outcome |
|---|---|---|---|
| **Government Stakeholders** | | | |
| DAWE | 2 November 2017 - Meeting<br>24 November 2017 – Letter<br>4 December 2017 - Email<br>9 January 2018 - Letter | • Pre-referral discussion<br>• Matters of National Environmental Significance<br>• Referral under the EPBC Act<br>• Determination: Not a Controlled Action | No further action required – Not a Controlled Action. |
| DWER – EPA Services | October 2015<br>August (meeting), December 2017<br>March (letter), June, July (meeting), October (email), November (email), December (email) 2018<br>February (email, letter and meeting), March, July, August 2019<br>February 2020 | • Environmental survey effort requirements and findings<br>• Pre-referral discussions<br>• Exploration activities<br>• Priority and Threatened Flora populations<br>• Formal submission of EPA Referral<br>• Formal submission of the draft ESD<br>• Draft ESD submitted with peer review<br>• Formal submission of the revised draft ESD<br>• Impacts to proposed Bremer Range Nature Reserve<br>• Methodologies for *M. aquilonaris* studies<br>• Clearing permit for investigations<br>• Clarification on ESD process if *Eucalyptus rhomboidea* and *Stenanthemum bremerense* are made threatened species<br>• ESD updated to incorporate peer review comments<br>• Assessment and comments on ESD<br>• Review *M. aquilonaris* study results<br>• *M. aquilonaris* critical habitat boundary | • Concerns taken on board during ERD preparation.<br>• Advice in *Eucalyptus rhomboidea* and *Stenanthemum bremerense* included in ESD revision<br>• Audalia to continue to liaise during Part IV approval process. |
| DWER – Industry Regulation | April 2020 (meeting) | • Project briefing and update<br>• Regulation under Part V of the EP Act<br>• Parallel processing with Part IV assessment | • Audalia to submit works approval applications for parallel processing towards the end of the EIA process |

| Stakeholder | Date/s | Nature of Engagement / Issues / Topics Raised | Proponent Response / Outcome |
|---|---|---|---|
| DMIRS | June (letter), July (letter and meeting), August, October (letter) 2014<br>February (meeting), April (meeting), May (meeting), June (letter), July (meeting), December (meeting) 2015<br>March (meeting) 2016<br>September 2017<br>July (email), November (meeting) 2018<br>March (teleconference) 2020 | • Project overview and updates<br>• Project access<br>• Mining tenure applications<br>• Safety Management Plan<br>• Priority and Threatened Flora populations<br>• Conservation Management Plan<br>• Exploration activities and approvals<br>• MP and MCP<br>• Pre-referral discussions<br>• Clearing permit for investigations<br>• Review of conceptual TSF design<br>• MCP to be submitted with ERD | • MCP to be submitted to allow parallel assessment with the Part IV EP Act process.<br>• MP and MCP to be prepared in accordance with DMIRS guidelines. |
| DBCA | July 2013 (letter)<br>March (meeting), April (email), May (letter), August, October (letter) 2014<br>April (meeting), May (meeting), July (meeting and letter), October 2015<br>March (meeting), May (letter), June (letter) 2016<br>January, March, June (email), September (site visit), October (email), November (meeting) 2018<br>January (meeting), March, July, December 2019<br>February 2020<br>July 2020 | • Project overview and updates<br>• Priority and Threatened Flora populations<br>• Permit to take Threatened Flora<br>• Conservation Management Plan<br>• Exploration activities and approvals<br>• Update on Mining Plan<br>• Project access<br>• Environmental study and survey effort requirements and findings<br>• Pre-referral discussions<br>• Impacts to proposed Bremer Range Nature Reserve<br>• ESD draft flora and vegetation section<br>• Methodologies for *M. aquilonaris* studies<br>• Notification that *Eucalyptus rhomboidea* and *Stenanthemum bremerense* are going to be nominated as threatened species<br>• Location of dust deposition gauges<br>• Scope of proposed modelling of *M. aquilonaris* locations | • Comments addressed in ESD<br>• Provision of study works information for PoW. Studies undertaken in agreed manner<br>• *Eucalyptus rhomboidea* and *Stenanthemum bremerense* considered in project planning and studies<br>• Audalia to continue to liaise with DBCA during the Part IV approval process |

| Stakeholder | Date/s | Nature of Engagement / Issues / Topics Raised | Proponent Response / Outcome |
|---|---|---|---|
| | | • Genetic study for *M. aquilonaris*<br>• Review *M. aquilonaris* study results<br>• *M. aquilonaris* critical habitat boundary<br>• Proposed offsets | |
| Shire of Esperance | April, June (letter), August 2014<br>April 2016 | • Project Overview<br>• Access road and road upgrades<br>• Shipping out of the Esperance Port<br>• Discussion of DMIRS concerns<br>• Notification of release of Project PFS report | Audalia to continue to liaise with the Shire and to obtain required approvals. |
| Shire of Dundas | June 2015 (meeting)<br>April 2016 (letter) | • Project Overview<br>• Potential mining and processing plant operation<br>• Proposal of private haul road and rational<br>• Future engagement with Shire<br>• Potential upgrade of airport<br>• Notification of release of Project PFS report | Audalia to continue to liaise with the Shire and to obtain required approvals. |
| Southern Ports Authority | January, February 2017 | • Enquiry about port access by mineral exporter<br>• Visit to Esperance Port and discussion with Port CEO Alan Byers on port access by Audalia<br>• Port infrastructures availability and requirements for new exporter | Audalia to continue to liaise with the Southern Ports Authority and to obtain required approvals. |
| Goldfields-Esperance Development Commission | April 2016 (letter) | • Notification of release of Project PFS report | Audalia to continue to liaise with the Commission and provide project update. |
| **Community and Corporate Stakeholders** | | | |
| Conservation Council of WA | Aug 2014 (meeting)<br>May 2015 (meeting)<br>July 2020 (email) | • Project introduction and environmental considerations / issues<br>• Information Pack provided<br>• Offer for meeting or further information<br>• Notification of preparation of draft ERD | Consideration of issues in Project design and the preparation of ERD<br>Audalia to meet with stakeholder and / or provide additional information upon request |
| Gondwana Link Ltd. | Aug 2014 (meeting)<br>July 2020 (email) | • Project introduction and environmental considerations / issues<br>• Information Pack provided | Consideration of issues in Project design and the preparation of ERD |

| Stakeholder | Date/s | Nature of Engagement / Issues / Topics Raised | Proponent Response / Outcome |
|---|---|---|---|
| | | • Offer for meeting or further information<br>• Notification of preparation of draft ERD | Audalia to meet with stakeholder and / or provide additional information upon request |
| Main Roads WA | July 2017 (letter)<br>March 2020 (phone) | • Application and approval for highway access – Coolgardie Esperance Highway<br>• Project updates of Goldfields Esperance region provided | Audalia to meet with stakeholder and / or provide additional information upon request |
| Ngadju People | September 2012 (meeting)<br>January - May, September, October 2015 (meetings)<br>July (letter), November 2017 (meeting)<br>July 2020 (letter) | • Project overview and updates<br>• Ethnographical survey<br>• Ethnographic and Anthropological heritage surveys, including over M63/656 and L63/75, undertaken with the assistance of nominated Ngadju Native Title Holders<br>• Negotiation and community meetings<br>• Consultation of bush tucker and medicine in the Project area<br>• Heritage and native title agreement<br>• Notification of submission of draft ERD | Audalia to meet with stakeholder and / or provide additional information upon request |
| Optus Pty Limited | April 2014 | • Fibre optic cables within the vicinity of the proposed haul road | Haul road Option 3 was chosen to avoid impact to fibre optic cables. |
| The Wilderness Society (WA) Inc. | Aug 2014 (meeting)<br>May 2015 (meeting)<br>July 2020 (email) | • Project introduction and environmental considerations / issues<br>• Information Pack provided<br>• Offer for meeting or further information<br>• Notification of preparation of draft ERD | Consideration of issues in Project design and the preparation of ERD<br>Audalia to meet with stakeholder and / or provide additional information upon request |
| Wildflower Society of WA | May 2015 (meeting)<br>July 2020 (email) | • Project introduction and environmental considerations / issues<br>• Information Pack provided<br>• Offer for meeting or further information<br>• Notification of preparation of draft ERD | Consideration of issues in Project design and the preparation of ERD<br>Audalia to meet with stakeholder and / or provide additional information upon request |

**Table 5: Stakeholder Engagement Plan**

| Timing | Stakeholder | Type | Purpose of planned engagement | Issues to be raised |
|---|---|---|---|---|
| 2020 - ongoing | EPA Services - DWER | Telephone, letters, email and meetings | • Correspondence to obtain approval under Part IV of the EP Act<br>• EPA Board meeting. | • Presentation of EIA<br>• Review of draft ERD<br>• Response to public comments<br>• Draft conditions<br>• EPA Board meeting<br>• Compliance. |
| 2020 - ongoing | Industry Regulation - DWER | Telephone, letters, email and meetings | Correspondence to obtain works approvals under Part V of the EP Act. | • Future Works Approvals and Licence requirements<br>• Project timing (i.e. construction)<br>• Potential environmental impacts<br>• Compliance. |
| 2020 - ongoing | DMIRS | Telephone, letters, email and meetings | Correspondence to obtain approval for Programme of Works (PoWs), Mining Proposal, MCP and Project Management Plan. | • Tenement applications<br>• Mining Proposal and MCP assessment<br>• Timing<br>• Project specific requirements<br>• Closure requirements<br>• Project Management Plan assessment<br>• Compliance and Reporting<br>• Mine Rehabilitation Fund. |
| 2020- ongoing | DBCA | Telephone, letters, email and meetings | Suitability of offsets proposals.<br>Advice for ongoing management of Project within close proximity to Threatened and Priority Flora. | • Threatened and Priority Flora<br>• Proposed Nature Reserve<br>• PEC<br>• Great Western Woodlands. |
| 2020 - ongoing | Main Roads WA | Telephone, letters, email and meetings | Discussions regarding intersection works and haulage. | • Future applications<br>• Site access<br>• Timing (i.e. construction & operation)<br>• Operating hours<br>• Site access/routes. |
| 2020 - ongoing | Department of Transport | Telephone, letters, email and meetings | Discussions regarding haulage. | • Future applications<br>• Timing (i.e. construction & operation)<br>• Site access/routes. |

| Timing | Stakeholder | Type | Purpose of planned engagement | Issues to be raised |
|---|---|---|---|---|
| 2020 - ongoing | Southern Ports Authority | Telephone, letters, email and meetings | Correspondence to negotiate terms for the export of ore through Esperance Port. | • Future applications<br>• Export options<br>• Path forward for the Project. |
| 2020 | Relevant Ministers | Letters and meetings | Letter summarising the Project status (i.e. approvals to date and path forward). | • Approvals status<br>• Future applications<br>• Studies undertaken<br>• Key findings<br>• Path forward for the Project. |
| 2020 - ongoing | Shire of Dundas | Telephone, letters, email and meetings | Correspondence summarising the Project status (i.e. approvals to date and path forward). | • Approvals required<br>• Future applications<br>• Path forward for the Project<br>• Local workforce availability. |
| 2020 - ongoing | Shire of Esperance | Telephone, letters, email and meetings | Correspondence summarising the Project status (i.e. approvals to date and path forward). | • Export through Esperance Port<br>• Path forward for the Project<br>• Local workforce availability. |
| 2020 - ongoing | Ngadju People | Letter and copies of approval documents | Feedback on Project design and mine closure.<br>Employment opportunities. | • Native Title rights and negotiations<br>• Heritage agreement<br>• Approvals to date<br>• Future applications<br>• Studies undertaken and key findings<br>• Path forward for the Project<br>• Potential for indigenous contracting and employment opportunities<br>• Bush tucker/ bush medicine management. |
| 2019 - ongoing | Non-government organisations and community groups | Telephone, letters, email and meetings | Input and provision of information. | • Provision of ecological information<br>• Invitation for comment<br>• Threatened and Priority Flora<br>• Great Western Woodlands<br>• PECs<br>• Proposed Bremer Range Nature Reserve. |



# 5 BASELINE AND CLOSURE DATA AND ANALYSIS

Baseline and closure data provided in this section includes information relevant to both the Mine DE and Haul Road DE on the existing environment, environmental management and rehabilitation requirements for setting the closure completion criteria for the proposed disturbance footprints of the Project.

Relevant scientific reports referred to in the following information have been attached as appendices.

## 5.1 TENURE AND LAND USE

The Project is located within the following tenements issued under the Mining Act:

- M63/656; and
- L63/75.

The Project is located entirely within Unallocated Crown Land (UCL). It has not been developed for pastoral or agricultural purposes.

The Proposal lies on land held by the Ngadju people, who have lived on country between Kalgoorlie and Esperance for an estimated 50,000 years. The Proposal lies within the Ngadju Native Title determination area.

The Project is within the proposed Bremer Range Nature Reserve, as identified by the then Department of Conservation and Land Management in its South Coast Regional Management Plan (Department of Conservation and Land Management, 1992). The Nature Reserve proposal has not been implemented.

The Mine DE and approximately 4 km of the Haul Road DE lie within the *Bremer Range vegetation complexes* Priority 1 Ecological Community and its buffer.

Neither the Mine DE nor the Haul Road DE are within areas that are proclaimed surface water areas (to protect water quality for water supply) under the RIWI Act (as accessed on 5 May 2020) (https://www.water.wa.gov.au/__data/assets/pdf_file/0004/1669/86306.pdf). None of the surface water catchments within the DE's drain into conservation estate, freehold land or other tenure held by other potential water users.

## 5.2 CLIMATE

The Coolgardie bioregion has an arid to semi-arid Mediterranean climate with warm summers and mild winters. There is a tendency for more rain to be received over winter, but rain occurs all year round with 250 – 300 mm of rainfall (McKenzie et. al., 2002).

The nearest Bureau of Meteorology (BoM) weather station is Norseman Aero (Site No: 012009). Norseman Aero records the highest maximum mean monthly temperature (32.6°C) in January and the lowest maximum mean annual temperature (17.3°C) in July. The lowest mean minimum temperature is recorded in July (4°C) and the highest in February (16.1°C). Annual rainfall is

298 mm with January, March and November recording the highest monthly averages (36.5, 30.8 and 29.1 mm respectively) (BoM, 2019).

Evaporation rates are much lower in winter than in summer. Mean annual pan evaporation is some 1,500 mm/year. Mean monthly evaporation exceeds mean rainfall in every month of the year. This pattern of variation in evaporation combined with rainfall distributed during the year in variable falls suggests that the soil profile prior to larger events is likely to be relatively dry in summer but could be moist to saturate in winter (GRM, 2020a).

A summary of rainfall and evaporation statistics derived for the Project site is given in Figure 10.

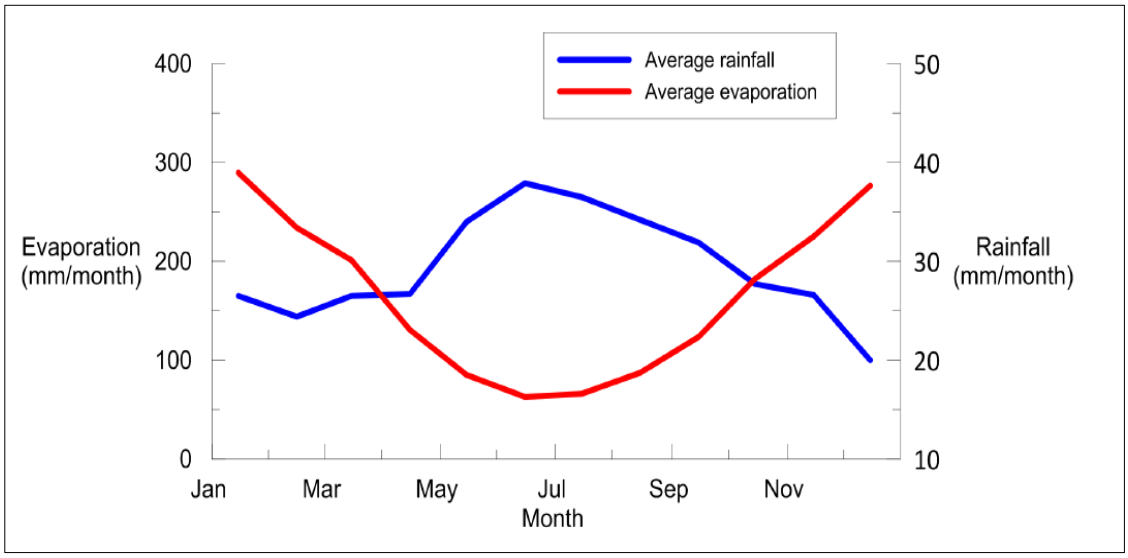


Figure 10: Average rainfall and evaporation of the Project site (GRM, 2020a)

### 5.2.1 Climate Change

Climate change projections have been prepared at a regional scale in Australia by CSIRO (2020). The Medcalf Project is within the Southern and South-Western Flatlands West (SSWFW) sub-cluster of the Southern Australian region. A summary of the relevant projections are:

- Average temperatures will continue to increase in all seasons (*very high confidence*);
- More hot days and warm spells are projected with *very high confidence*. Fewer frosts are projected with *high confidence*;
- A continuation of the trend of decreasing winter rainfall is projected with *high confidence*. Spring rainfall decreases are also projected with *high confidence*. Changes in other seasons unclear, although downscaling suggests a continuation of the observed autumn declines;
- Increased intensity of extreme rainfall events is projected, with *high confidence*;
- A harsher fire-weather climate in the future (*high confidence*); and
- On annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall. However, SSWFW is one region of the world with very high model consensus on forced drying during the observed period and in the near-term.

# 5.3 LANDSCAPE AND GEOLOGY

## 5.3.1 LANDSCAPE

***Biogeographic Regions***

The Project lies in the Coolgardie bioregion within the Southern Cross (COO2) and Eastern Goldfields (COO3) subregions in the Yilgarn Craton. The COO2 relief is subdued and comprises of gently undulating uplands dissected by broad valleys with bands of low greenstone hills. The COO3 relief is subdued and comprises of gently undulating plains interrupted in the west with low hills and ridges of Archaean greenstones and in the east by a horst of Proterozoic basic granulite (Cowan, 2001).

Beard (1990) describes the topography of the region as gently undulating with occasional ranges of low hills and sandplains in the western area and some large playa lakes. The dominant soil type is calcareous earth.

***Soil Landscape Systems***

Based on geographic information provided by the Department of Primary Industries and Regional Development (DPIRD), the survey area is located within the Salmon Gums Mallee Zone (246) of the Stirling Province (24) and the Norseman Zone (266) of the Kalgoorlie Province (26). These zones are further divided into soil landscape systems, with the soil landscape systems of the survey area shown in Table 6 and Figure 11 (CSIRO, 2014).

Table 6: Soil Landscape Systems within the survey area

| Zone | Landscape System / Mapping Unit | Description |
|---|---|---|
| Salmon Gums Mallee Zone (246) | Halbert System | Level to gently undulating plain with numerous salt lakes within a paleo valley on Tertiary marine sediments (Plantagenet and Werrilup formations). Soils are alkaline grey shallow sandy duplex soils and salt lake soils. |
| | Johnston System | Gently undulating inland plain with occasional rises on Archaean granite deeply weathered. |
| | JY1 | Undulating land with small valleys and flats. |
| | Salmon Gums System | Level to very gently undulating, slightly elevated, inland plain with few surface drainage features and occasional swamps.<br>Soils are alkaline grey shallow sandy duplex soils with associated calcareous loamy earths and red non- cracking clays. |
| Norseman Zone (266) | DD13 | Gently undulating plains with some gilgai areas, occasionally broken by stony ridges and hills. |
| | Nc2 | Gently undulating plains with some gilgai areas, and irregularly broken by small remnants of sand plain, unit AC1, and granitic bosses and tors. |
| | SV2 | Saline valleys with some dunes including barchan forms-salt lake channels, mostly devoid of true soils, and their fringing areas. |
| | Ya28 | Sandy plains with some clay pans and small salt lakes, dunes, and lunettes. |

300000 325000 350000

6425000 6400000 6375000

Ya28 AC1 SV2 Red Roo Rock Nc2 LAKE JOHNSTON SV2 Nc2 AC1 Nc2 JY1 3 Mile Rock Lb10 Tamar Hill LAKE MEDCALF Bremer Waters BB5 HAUL ROAD DEVELOPMENT ENVELOPE Ya28 MINE DEVELOPMENT ENVELOPE DD13 BB5 Wellstead Rock Lackman Rock Bull Rocks Daniell STENNETS LAKE Salmon Gums System Salmon Gums System Salmon Gums System LAKE GILMORE COOLGARDIE ESPERANCE HWY Johnston System JY1 Salmon Gums System BEETE RD FULLER RD BURNSIDE RD BERRYMAN RD LAKE KING - NORSEMAN RD KUMARL - LAKE KING RD EXCLAMATION LAKE KUMARL RD KUMARL NORTH RD Halbert System Kumarl QUAST RD PEAK CHARLES RD Ellison Rock Salmon Gums System MAGAGNOTTI RD GIMLET RD BEETE WEST RD SPRATT RD AINSWORTH RD BOLT RD Lb10 PANSY LAKE Ya29 SV2 LAKE TAY SV2 LAKE SHARPE Peak Charles CUPS RD HANSON RD Dowak Salmon Gums System

300000 325000 350000

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**Legend**

- Mine Development Envelope
- Haul Road Development Envelope
- Road
- Railway

Soil Landscape Systems

- AC1
- BB5
- DD13
- Halbert System
- JY1
- Johnston System
- Lb10
- Nc2
- SV2
- Salmon Gums System
- Ya28
- Ya29

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DMRS 2020
- LOCALITY MAP SOURCED LANDGATE
- AERIAL PHOTOGRAPHY OPEN SOURCE
- SOIL LANDSCAPE SYSTEMS SOURCED DAFWA

Preston Consulting

0 2 4 6 8 10 km

Scale: 1:250,000 @ A3

N

**LOCALITY MAP**


| CREATED BY | JOB | DATE | REVISION |
|---|---|---|---|
| ENVIRONMAPS | PC2900035 | 8/07/2020 | 0 |

audalia resources limited

Figure 11: Land Systems (Botanica, 2020c)

### 5.3.2 GEOLOGY

Butler (2020a) reviewed the regional geological structure, regional mineralisation, and Medcalf deposit mineralisation. The Butler (2020a) report is included as Appendix 5.3

The Medcalf deposit was discovered by Union Laporte Miniere in the 1960s. Historic exploration in the 1970s and 1980s by Amoco defined three separate areas of vanadium mineralisation known as the Vesuvius, Fuji and Egmont Prospects. The mineralisation is contained within a pyroxenite sill and was drilled during 2013 by Audalia for resource definition. The latest JORC (2012) Resource of 32 Mt @ 0.47% $V_2O_5$, 8.98% $TiO_2$ and 49.2% $Fe_2O_3$ was announced to the market on August 31st, 2018. The Project resource is thus relatively small, and the resource geology is understood to a fine resolution.

The Project lies in the Archaean aged Lake Johnston greenstone belt in the Yilgarn Craton. This belt contains komatiite lava flows, subvolcanic intrusions, mafic volcanic rocks, felsic volcanic rocks, banded iron formation (BIF) and sedimentary rocks. The bedrock geology is generally masked by lateritic duricrust, deep oxidation and transported material. Regolith and weathered bedrock thickness is usually 60 to 80 m. Intense weathering of ultramafic rock types has resulted in widespread development of silica-rich "cap-rock" in the saprolite zone (often referred to as laterite or limonite). The fully developed lateritic weathering profile is divisible into four zones. Starting from the top, they are lateritic residuum, mottled zone, saprolite and saprock.

The ore deposit is hosted by the Medcalf layered sill, which is a flat-lying igneous body which has intruded parallel to the enclosing basalts. The sill is comprised of an upper gabbroic zone, a middle pyroxenite zone, and a lower amphibolite zone (Butler, 2020a). The geology of the Medcalf sill is relatively simple and not analogous to gold deposits in the Yilgarn that may have large variability (lithological and alteration) in their width, direction and shape. It is more analogous to the iron ore deposits of the Pilbara, i.e. long (several kilometres) tabular flat deposits that are exposed at the surface (Figure 12, Figure 13 and Figure 14) (Butler, 2020b). Project geology has been investigated at a detailed level by Butler (2020b). The Butler (2020b) report is included as Appendix 5.6.

***Mineralogy***

Three separate zones of vanadium, titanium and iron mineralisation have been identified within the Mine DE - named the Egmont, Vesuvius / Fuji and Pinatubo prospects. The three major rock types within the proposed pits (Figure 14) are:

- Gabbro (dark green);
- Pyroxenite (red); and
- Ultramafic (purple)

Vanadium, iron and titanium have been concentrated in a pyroxenite unit in the Medcalf deposit. Pyroxenite, which is the ore to be mined and processed, is the dominant rock type within the pits. In the mineralised area the magnetite-rich sequence is deeply weathered, with 60+ m of saprolite showing vertical zonation of weathering minerals due to progressive weathering. Further enrichment of these metals has occurred through weathering and regolith formation, and almost all the vanadium and titanium mineralisation lies in the saprolitic zone.

The target ore within the pit shell is almost entirely weathered, with the weathered zone extending beyond the pit floor (approximately 50 m deep) (Figure 15). No fresh rock will be mined from within the pit. All ore and waste is being mined from above the water table.

The pyroxenite host rock of the Medcalf sill often outcrops, including at the Project prospects. Very little waste material is therefore present within the pit shell, being gabbro, ultramafic and sub-grade pyroxenite (which resides within the cover material (Figure 15). The majority of the waste lies near the surface and is generated through stripping the hangingwall to access the deeper ore (Figure 14; section 5.4.2) (Butler, 2020b).

Mineralogy of the vanadium rich zone is dominated by hematite-goethite and kaolinite with minor ilmenite, diaspore, gibbsite, anatase, rutile, magnetite, quartz and mica. Table 7 details the mineral abundance recorded for Medcalf ore.

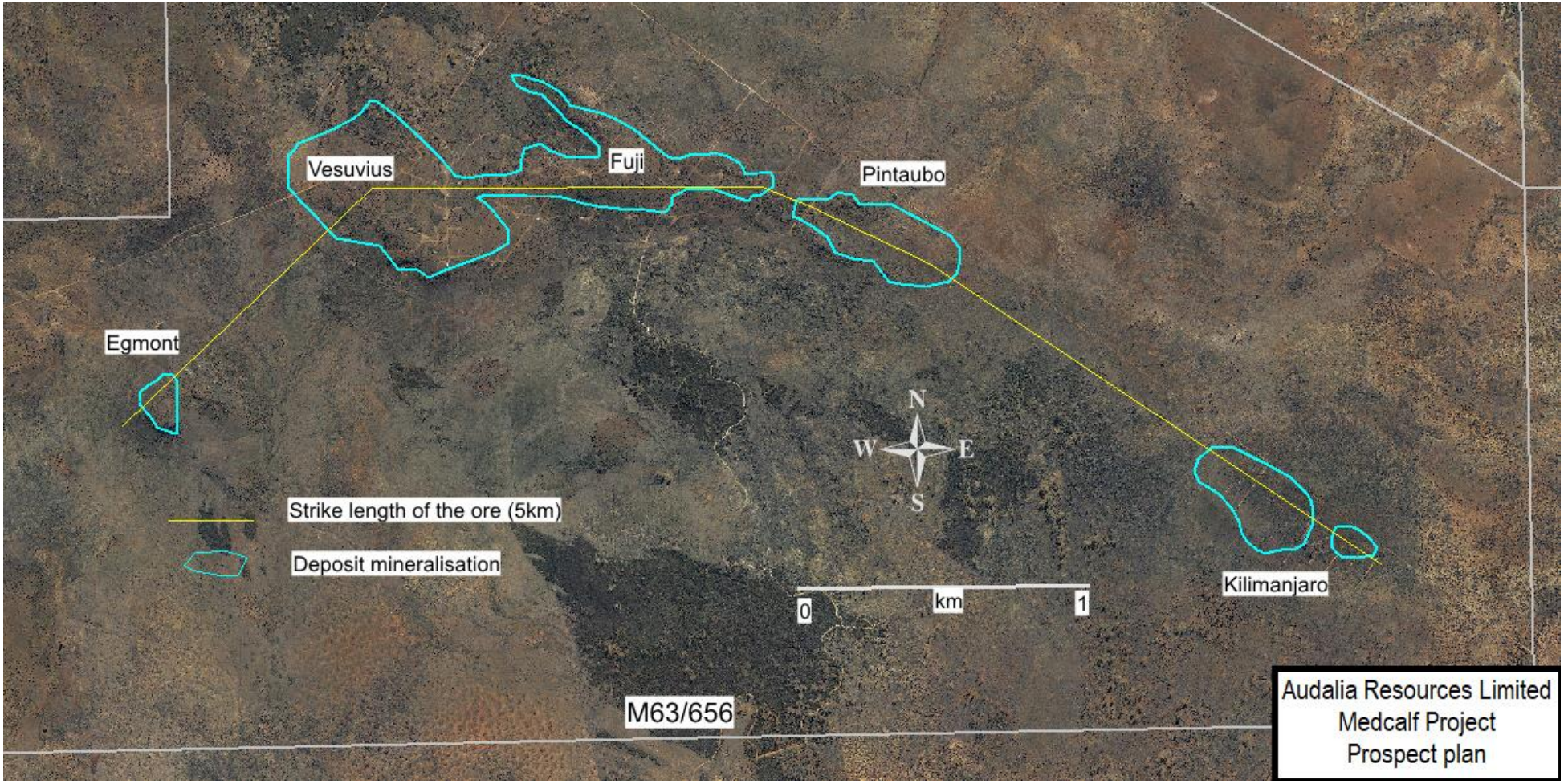



Figure 12: Prospect Plan showing Continuous Mineralisation over 5 km of strike

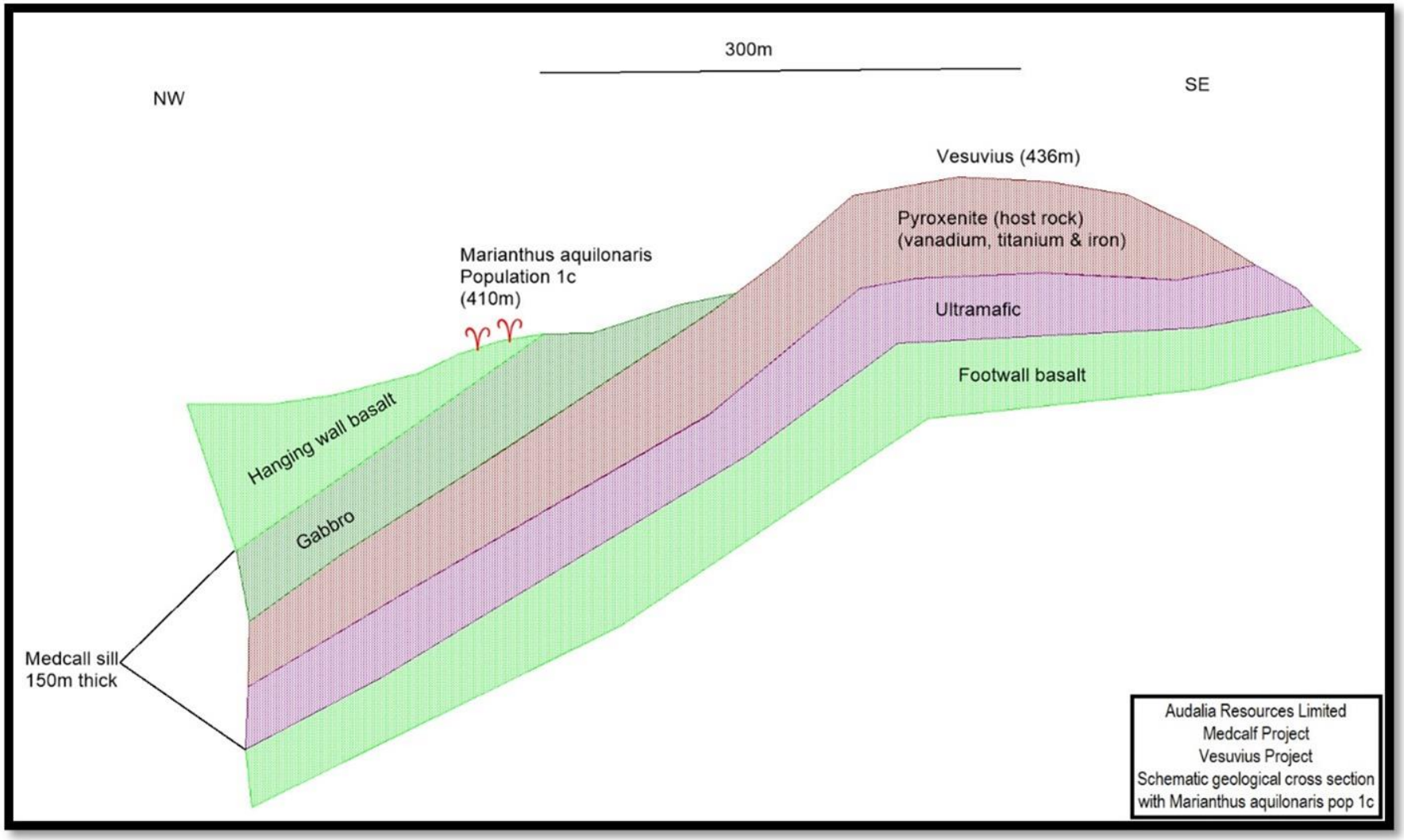



Figure 13: Schematic cross section of the Medcalf Sill

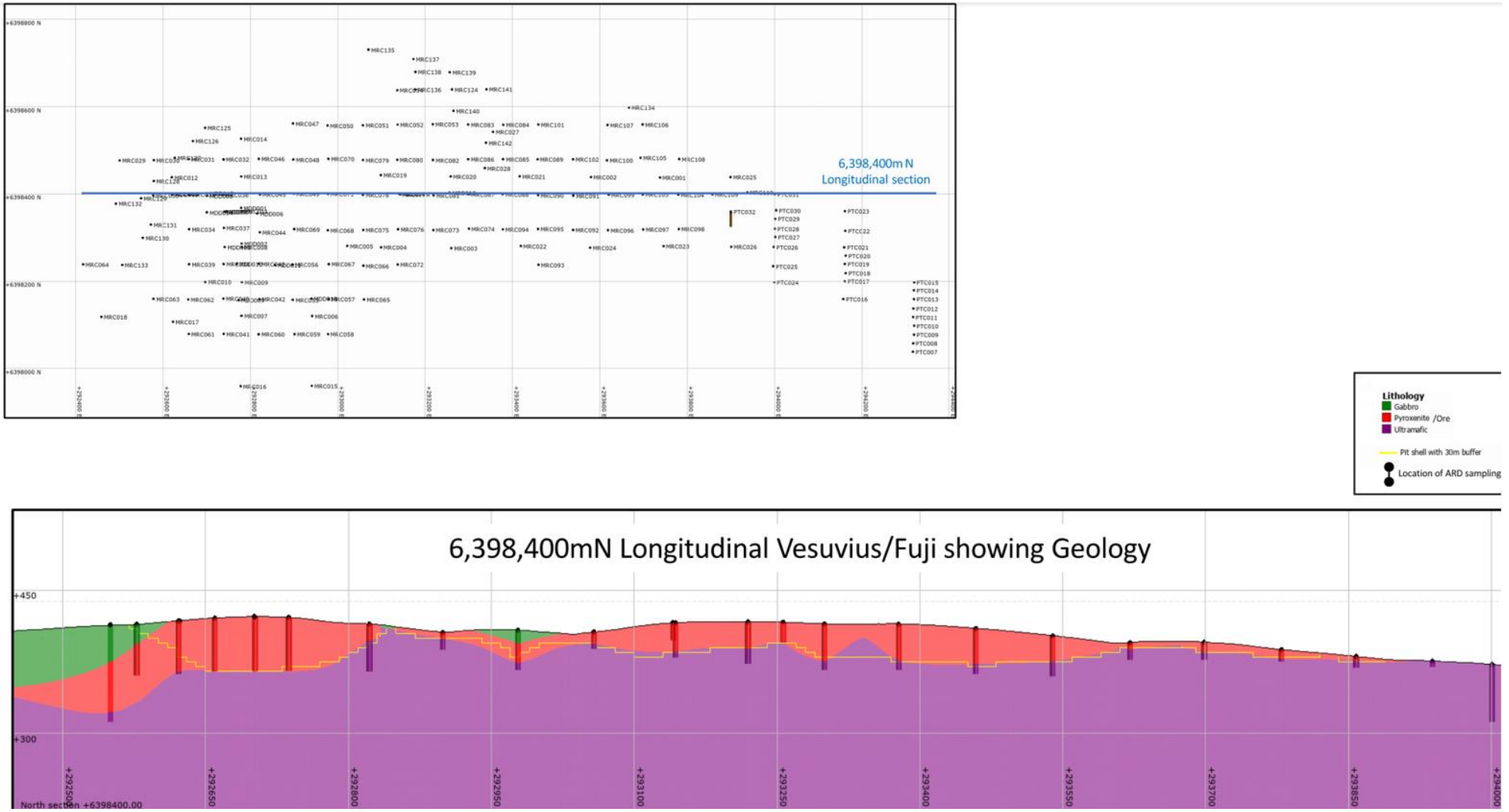



Figure 14: Long section through the Vesuvius/Fuji Deposits showing Continuous Lateral and Vertical Extent of the Ore

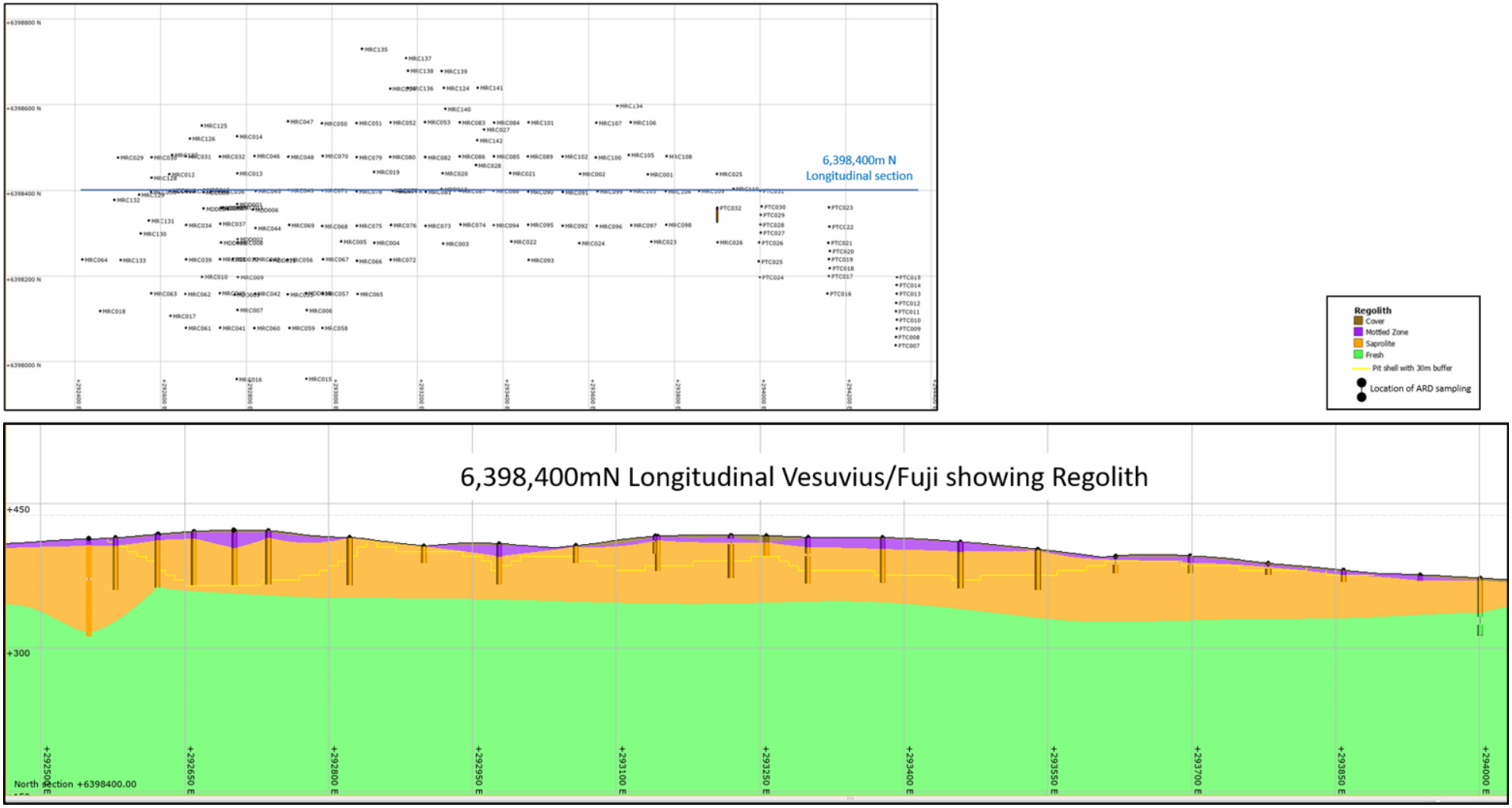



Figure 15: Long section through the Vesuvius/Fuji Deposits showing Continuous Lateral and Vertical Extent of the Regolith

Table 7: Mineralogy of Medcalf Ore

| Mineral | Abundance % | Mineral | Abundance % | Mineral | Abundance % |
|---|---|---|---|---|---|
| Magnetite-maghemite-hematite (Ti-hematite) | 40.845 | Muscovite | 0.006 | Psilomelane | 0.023 |
| Limonite | 22.953 | Biotite | 0.002 | Siderite | 0.036 |
| Ilmenite-alteration ilmenite | 15.823 | Kyanite | 0.002 | Zircon | 0.003 |
| Leucoxene | 0.221 | Phenakite | 0.001 | Pyrrhotite | 0.001 |
| Rutile | 0.008 | Greenalite | 0.050 | Chalcopyrite | 0.002 |
| Kaolinite | 18.240 | Amesite | 0.255 | Sphalerite | 0.001 |
| Montmorillonite | 0.191 | Diopside | 0.001 | Alunite | 0.026 |
| Pyrophyllite | 0.124 | Homblende | 0.004 | Gibbsite | 0.042 |
| Illite | 0.300 | Almandine | 0.008 | Others | 0.578 |
| Talc | 0.003 | Fluorite | 0.002 | Total | 100.00 |
| Quartz | 0.223 | Calcite | 0.001 | | |
| Feldspar | 0.023 | Dolomite | 0.002 | | |

### 5.3.3 SEISMICITY

No site specific seismic studies have been completed, nor are considered necessary at this stage as the TSF detailed design will consider seismic conditions. Geoscience Australia (2018) published a National Seismic Hazard Assessment for Australia in 2018 from which the map below has been extracted (Figure 16). The map shows epicentres of historic earthquakes in Australia and provides a basis for hazard assessment. Clusters of epicentres are noted to the east of the Darling Scarp, including a cluster of moderate activity around the southern Goldfields region.



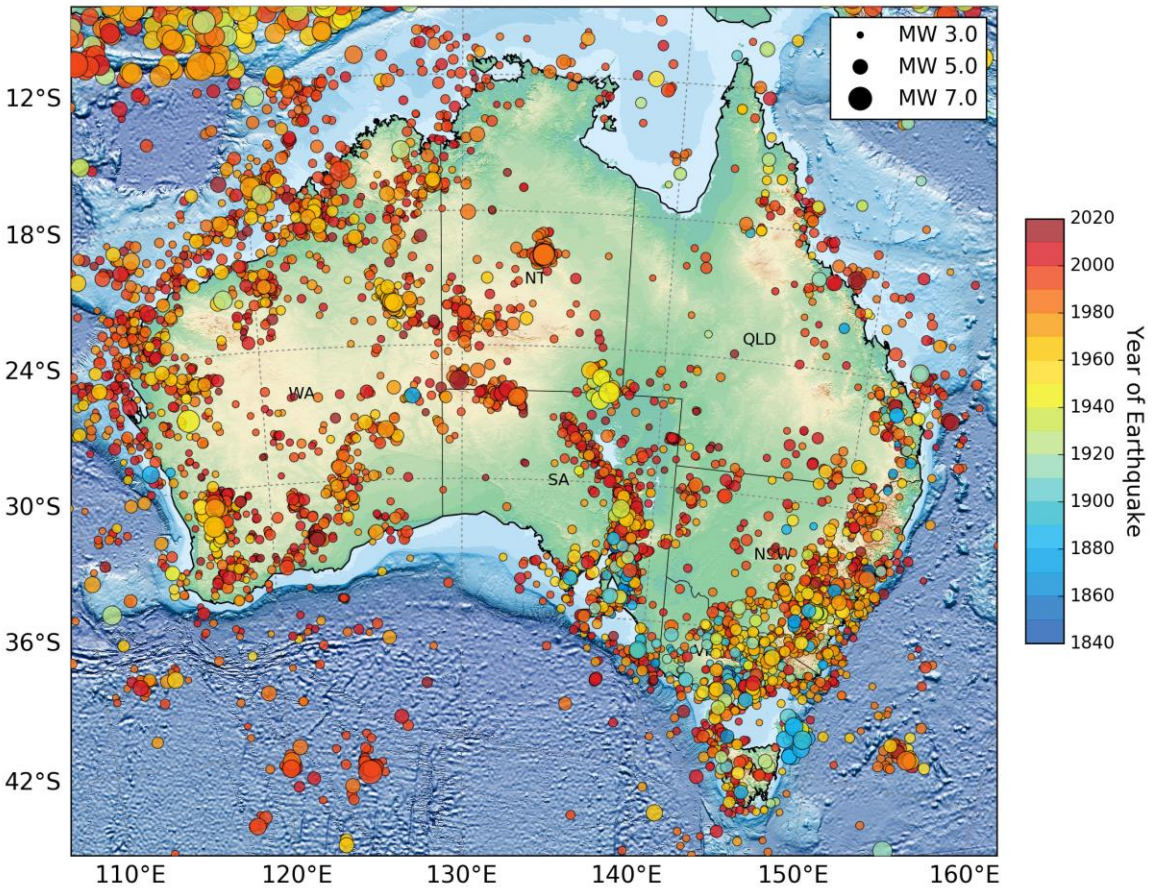



Figure 16: Earthquake epicentres in Australia (from Geoscience Australia, 2018)

# 5.4 MATERIALS CHARACTERISATION

## 5.4.1 SOILS

The upper surface of the rocks in the Mine DE has undergone laterisation. The lateritic profile can be seen at the top of the Project landscape. The soil profiles are generally noted to be gravelly sandy loam overlying ferricrete (duricrust) and lateritic boulders. Beneath the ferricrete layer is the mottled zone, which in turn overlies saprolite and then sap rock. The parent material is mafic rock which results in a darker red, loamier topsoil in other locations (Western Horticultural Consulting, 2019).

The lateritic material and the underlying mafic rock provide the parent material for the soils. The extent of dissection of the lateritic profile has a large influence on what soils are formed (Western Horticultural Consulting, 2019). The soil types are noted to generally follow a sequence down the slope (catena) with:

- Gravelly lateritic soils developing over ferricrete or ironstone boulders at the top of the landscape;
- Below the breakaway face shallow gravelly soils develop over the mottled zone;
- Where the underlying mafic rocks have been exposed on the upper and mid slopes these rocks generally weather to form loam over clay (duplex) soils;
- Deeper loamy surfaced duplex soils develop as a result of colluvial movement on the mid and lower slopes; and
- Salt lakes that occur at the bottom of the landscape.

The topsoil materials within the mining area are noted to be generally sandy loams, non-saline, not sodic, with moderate to high levels of organic carbon. The only subsoil found to be saline was the 'Alkaline red shallow loamy duplex' soil, which was found near the valley floor, well away from the area to be mined (Western Horticultural Consulting, 2019).

A total of 74 soil profiles were sampled in the survey area. Additional observations sites of the surface soil texture and vegetation type were also made at locations outside the tenement to gain an understanding of the regional distribution of the soils. The soil types can be broken down into 5 main groups which are outlined in Table 8. Unless otherwise referenced, all information is from Western Horticultural Consulting (2019).

**Table 8: Major soil groups of the Medcalf study area**

| Soil Types of the Study Area | | |
|---|---|---|
| **Soil Type** | **Location in the landscape** | **Soil Description** |
| Alkaline red shallow loamy duplex | Major soil group within the Mine DE and surrounding areas.<br>It occurs below the gravelly lateritic plateau and extends towards the valley floor.<br>The soil surface contains a scree of dark lateritic gravels, particularly on the upper slopes where they may cover 70% of the soil surface. | Contains a range of red, loamy duplex soils with the soil properties at each site being influenced by the geology of the parent material and its position in the landscape.<br>The topsoil is 10 - 15 cm of dark red / brown sandy loam.<br>A dark brown/ red clay sub soil occurs within 40 cm of the soil surface.<br>The soil has a sub angular blocky structure.<br>Contains 0-60 % dark angular iron stone gravel and rocks.<br>The topsoil is neutral to alkaline pH (pHwater = 7 – 8.5).<br>The subsoil is alkaline ($pH_{water}$ = 8.5 – 9).<br>The salinity of the soil is low except when this soil group occurs lower in the landscape where the subsoil is affected by the saline regional water table. |
| Loamy gravel | Major soil group within the Mine DE and surrounding areas.<br>It occurs on the lateritic plateau at the top of the landscape, and on the upper, mid and lower slopes.<br>The soil surface contains a scree of dark lateritic gravels that may cover 70% of the soils surface.<br>Ironstone rocks occur on the soil surface, particularly on the upper slopes. | Topsoil is generally about 10 - 15 cm thick and is a dark reddish brown, gravelly loamy sand to sandy loam.<br>The surface horizon grades into a dark reddish brown sandy loam to sandy clay loam which extends to depths of greater than 50 - 80 cm.<br>Percentage of gravel generally increases from 20 - 50% in the topsoil to 60% in the subsoil.<br>Clay layer may be encountered at depth.<br>pH is close to neutral.<br>Soil is not saline. |
| Shallow gravel over indurated mottled zone | Minor soil group within and surrounding the Mine DE.<br>Occurs in the upper slopes below the lateritic plateau.<br>Usually found on ridges that are often only one or two meters higher than the surrounding areas.<br>70 – 90 % of the soil surface is covered with a scree of dark lateritic gravels and fragments of limonite rock. | Topsoil is generally about 10 to 15 cm thick and is a dark reddish brown sandy loam.<br>In most examples the dense, indurated mottled zone occurs directly below the topsoil (at less than 15 cm deep).<br>In some cases, a sandy clay loam subsoil layer can occur below the topsoil, with the indurated mottled zone occurring at depths of no greater than 30 cm.<br>The soil contains between 10 and 50 % dark angular ironstone gravel.<br>Topsoils and subsoils are generally acid, with a $pH_{water}$ of 4.5 - 7.<br>The salinity of this soil is generally low |

| Soil Types of the Study Area | | |
|---|---|---|
| **Soil Type** | **Location in the landscape** | **Soil Description** |
| Stony soils | Minor soil group within and surrounding the Mine DE.<br>Usually occurs higher in the landscape<br>Soil surface contains rocks that may cover up to 90 % of the soils surface.<br>The bedrock may outcrop in places. | Topsoil is generally about 10 to 25 cm thick and is a dark reddish brown, rocky loamy sand to sandy loam.<br>The percentage of gravels and rocks in the topsoil can be as high as 90%.<br>This topsoil overlays bedrock.<br>The pH is close to neutral ($pH_{water}$ = 7 - 7.5)<br>This soil is not saline. |
| Shallow gravel | Minor soil group within and surrounding the Mine DE.<br>Soil is often found at the top of the landscape adjacent to the breakaway face.<br>Soil surface contains a scree of dark lateritic gravels and rocks that may cover up to 90% of the soils surface<br>Ironstone cap rock (ferricrete) may outcrop in places. | The topsoil is generally about 10 to 25 cm thick and is a dark reddish brown, gravelly loamy sand to sandy loam.<br>The percentage of gravels and rocks in the soil can be as high as 90%.<br>This topsoil overlays ironstone boulders or lateritic cap rock.<br>The pH is close to neutral ($pH_{water}$ = 7 to 7.5).<br>This soil is not saline. |

***Percentage of stones (> 2mm)***

All soils generally contained a high percentage of gravels. The percentage of gravels was typically between 20 - 50% in the topsoils, with some soils containing up to 80% gravel.

***pH***

The 'Alkaline red shallow loamy duplex' soils typically had neutral pH's in the topsoil and were strongly alkaline in the subsoil with the $pH_{CaCl}$ ranging from 7.2 - 8.6. The 'Loamy gravel' and 'Shallow gravel' soils had pH's that were close to neutral (the $pH_{CaCl}$ ranged from 5.9 - 7.7).

The 'Shallow gravel over indurated lateritic zone' soil is typically acidic. The $pH_{CaCl}$ of this soil ranged from 3.8 - 6.3. Many of the samples had a $pH_{CaCl}$ of less than 4.5.

***Electrical conductivity***

Electrical conductivity is a measure of the salinity of the soil. The laboratory analysis showed that three of the sites contained soil that had a high salinity.

One of these sites was a 'Shallow gravel over indurated lateritic zone' soil. This site was located immediately below a small breakaway and the site notes indicated that this area was bare of vegetation. The other two sites were 'Alkaline red loamy shallow duplex' soils which were located away from the mining area, lower in the landscape near a drainage line. It is likely that the regional saline groundwater table was influencing the soil salinity in the subsoil at these locations (Western Horticultural Consulting, 2019).

***Organic carbon***

The topsoil of all soil groups contained moderate to high levels of organic carbon (1.2 - 2.8%).

***Percentage of clay, silt and sand***

The particle size analysis conducted by the laboratory agreed well with the textures described in the field during the soil survey. The topsoil of all soil groups contained a similar percentage of each particle size fraction and generally had sandy loam textures.



***Exchangeable sodium percentage (ESP)***

Sodic soils are prone to dispersion and soil structural issues which can reduce water infiltration and root penetration. A soil with an ESP of greater than 15 is regarded as sodic.

None of the topsoils of any of the soil types that were analysed were sodic. One sample collected by Western Horticultural Consulting (2019) from the indurated mottled zone directly underlying the topsoil horizon was sodic (sample 10 C which had an ESP of 23.8).

Graeme Campbell and Associates (GCA) (2020b) analysed four saprolite zone samples, and the ESP values were 47-65 %, with generally elevated salinity. The samples were typically highly dispersive with Emerson Class Numbers of either 1 or 2. The presence of 'swelling-clays' (smectites) was readily apparent when assaying the saprolite samples.

***Acid sulfate soils***

The Project site is not located within Class I or Class II areas as per the Australian Soil Resource Information System (ASRIS) Acid Sulfate Soils (ASS) mapping.

### 5.4.2 WASTE ROCK

Due to the low strip ratio of the pit, no waste rock dump is required. All waste rock will be utilised in construction (reducing the need to excavate for construction materials) or be backfilled into the borrow pit.

Waste materials will be mined from three regolith horizons – cover, oxide and transitional – and are comprised of three rock types: gabbro, pyroxenite and (ultramafic) amphibolite. The weathered zone extends beyond the pit floor - no fresh rock will be mined from within the pit. GCA (2020b) assessed waste rock geochemical characteristics.

Following a review of the %S, and other assays for 1 m intervals in the Project's geological database, 26 samples were selected for testing by GCA (2020b). The samples selected reflected the indicative pit shells as at 2019, GCA (2020b) typically composited three successive 1 m interval samples to form one sample for geochemical characterisation. The individual 1 m interval samples from which the GCA (2020b) samples were composited are presented in Table B1 of the GCA (2020b) waste rock characterisation report included as Appendix 5.2

A map of the GCA (2020b) composite sample locations and depths is provided in Figure 17. Given the small scale of operation, detailed knowledge of the orebody, the consistently low sulphur concentrations, mineralogy of the deposit and significant number of samples assayed in the geological database, the sampling is considered adequate to characterize the materials.

As the pit shell design was further refined, 8 of the 3 m composites initially selected were no longer relevant for testing. GCA (2020b) therefore results presented and discussed geochemical characteristics of 18 composite samples from within the pit shells. The composite waste rock samples analysed by GCA (2020b) included four samples of basalt from the Vesuvius Pit, and one basalt sample from near the Pinatubo Pit. These samples were tested for characterisation of the fresh zone basalt to be taken from the borrow-pit for TSF construction. Although some drillholes sampled for waste characterisation were located outside the pit footprints, the geologic profiles sampled from these drillholes are representative of the mottled zone and saprolite zone making up the pit waste zones (GCA, 2020b).



***Gabbro***

The gabbro is a mafic intrusive greenish grey rock that has a grain size of 2 to 5mm and ranges from massive to moderately foliated. In the mottled and lateritic residuum zones the gabbro's plagioclase and tremolite are replaced by a textureless limonitic clay (Butler, 2020b).

Audalia has mapped gabbro outside the known extent of the Medcalf Sill, extending from Egmont through Vesuvius and Fuji to Kilimanjaro. These gabbro outcrops are currently regarded as faulted or folded extensions (Butler, 2020b).

Gabbro is located in the hanging wall of the Vesuvius (Figure 18), Pinatubo (Figure 19) and Fuji (Figure 14) pits. The Egmont pit does not contain gabbro. The gabbro accounts for 25% of the waste volume.

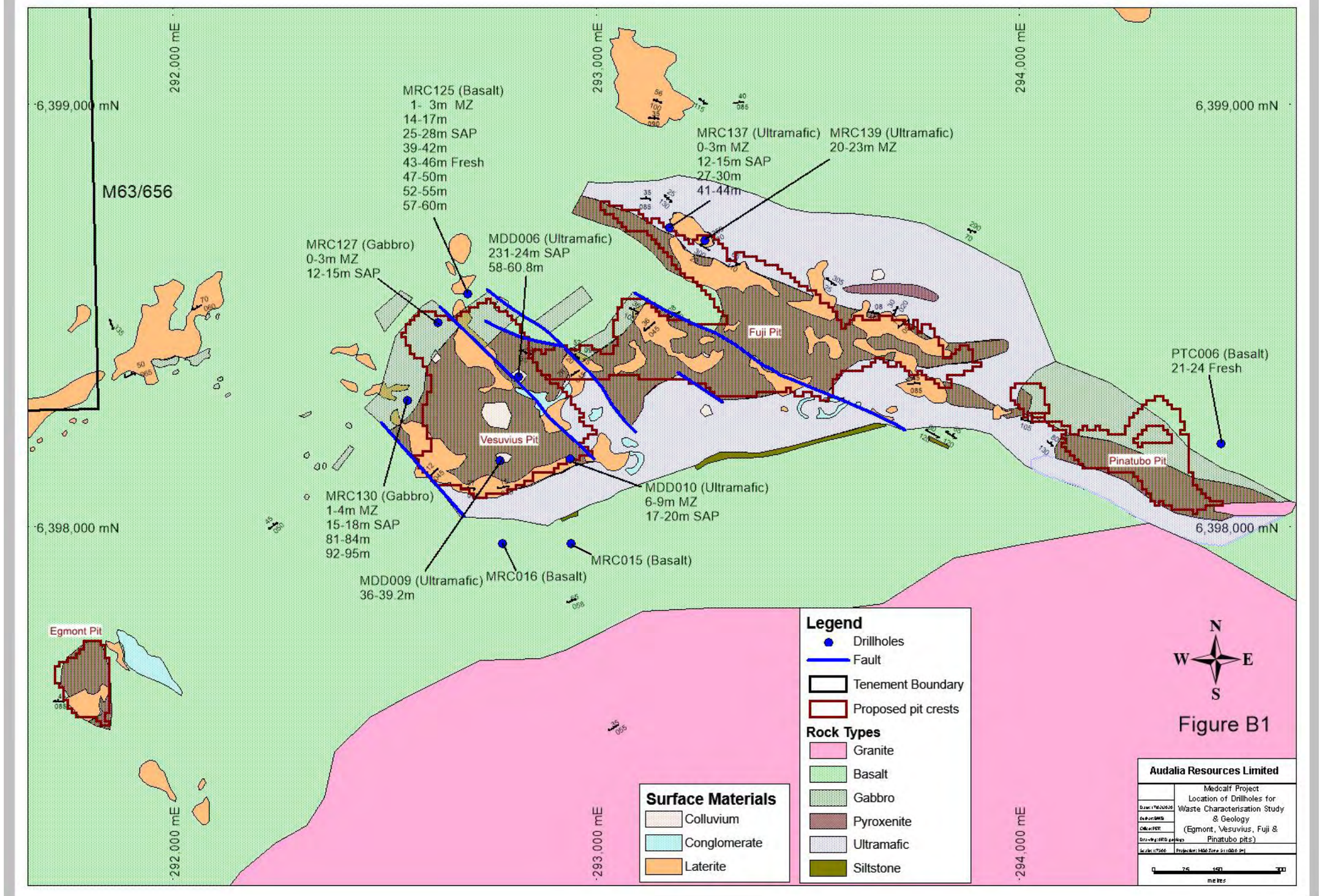



Figure 17: Map Waste Rock Samples

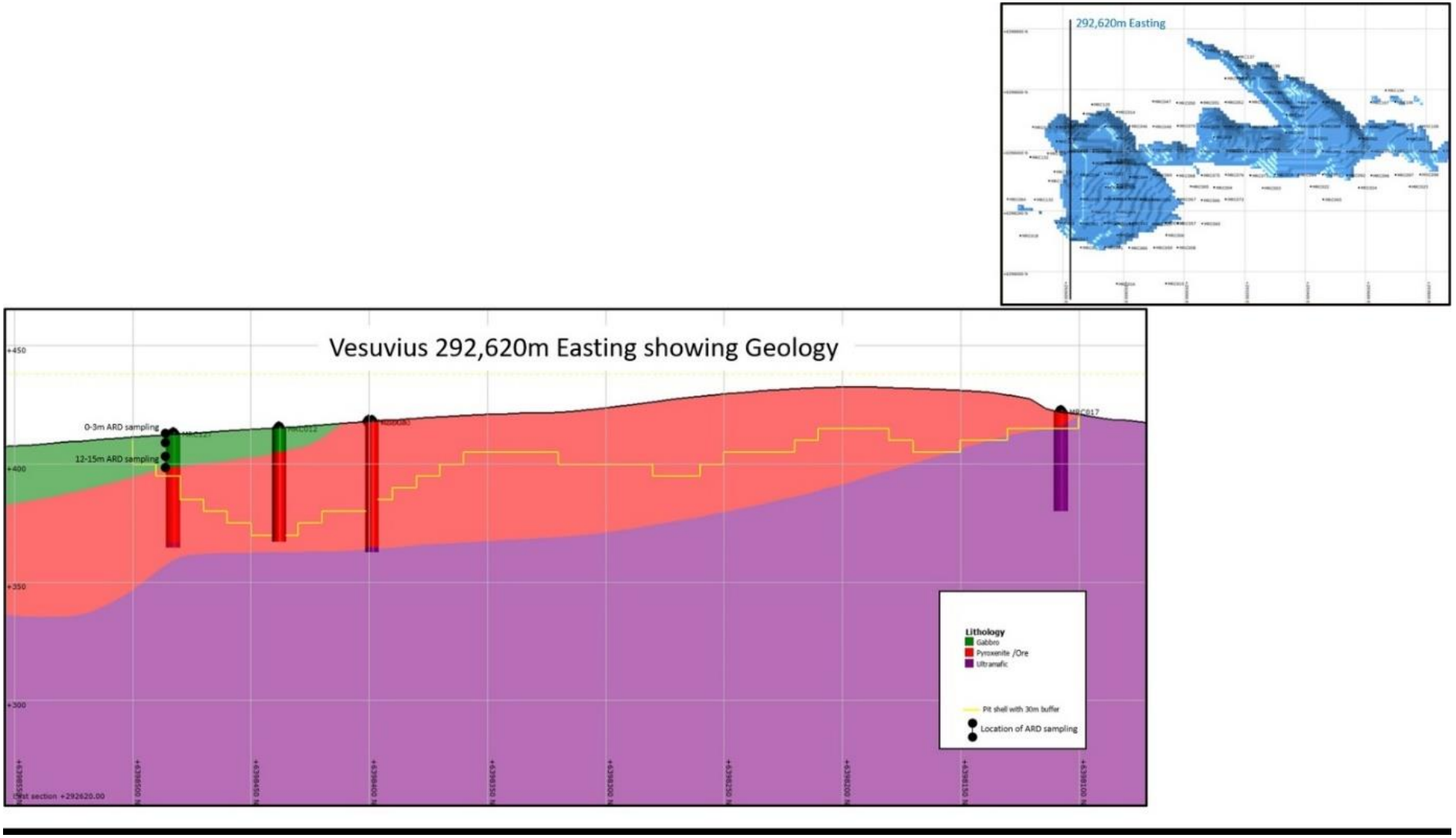



Figure 18: Vesuvius Cross Section showing where Gabbro Waste is located in the Pit and AMD Samples

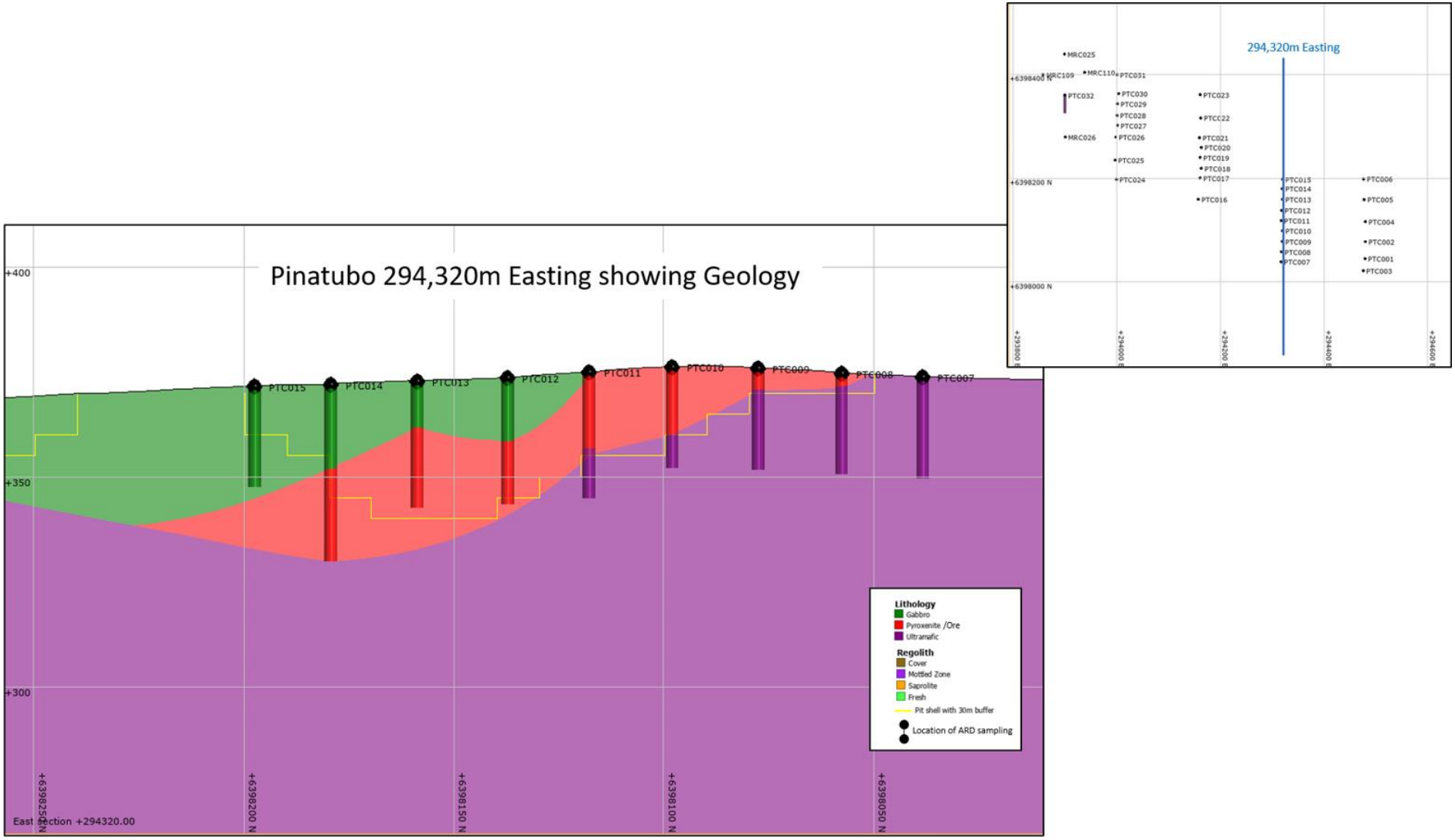



Figure 19: Pinatubo Cross Section showing where Gabbro Waste is located in the Pit

The composition of the gabbro is very consistent over the deposits, with the two main regolith types being the mottled zone and the saprolite zone.

Drillhole MRC127 (Figure 18) was sampled for the GCA (2020b) waste rock characterisation study (i.e. gabbro mottled zone from interval 0-3m depth). Geological logging of the mottled zone of the Vesuvius gabbro (Figure 20) and the Pinatubo gabbro (Figure 21) mirrors each other. This is reflected in the photos of the drill cuttings from each area below in Plate 1. Refer to Figure 18 and Figure 19 for the drillhole locations.

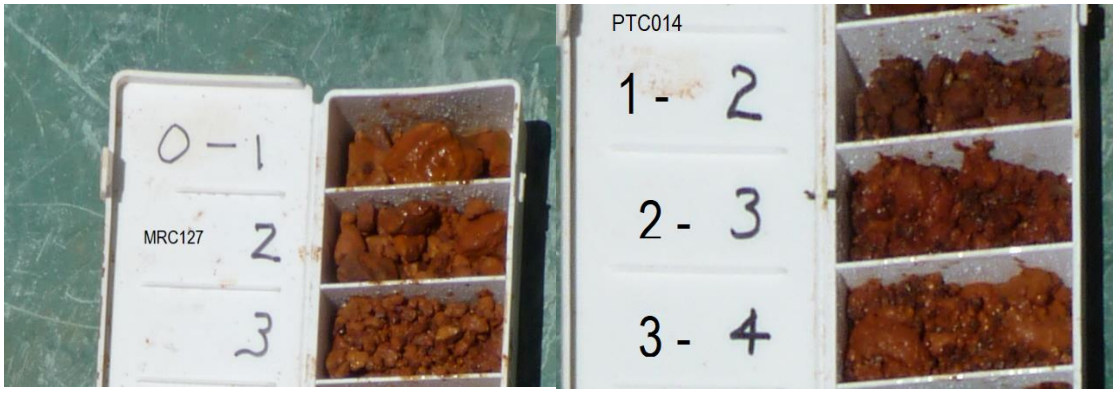



**Plate 1: Vesuvius Drillhole MRC127 Gabbro Mottled Zone Drill Cuttings from 0 – 3 m and Pinatubo Drillhole PTC014 Gabbro Mottled Zone from 1 – 4m Depth**

Drillhole MRC130 was sampled from gabbro adjacent and to the northwest of the Vesuvius prospect for the GCA (2020b) characterisation the gabbro saprolite zone from 15-18 m depth. Geological logging of the saprolite zone of the Vesuvius gabbro (Figure 20) and the Pinatubo gabbro (Figure 21) mirrors each other. This is reflected in the photos of the drill cuttings from each area below in Plate 2.

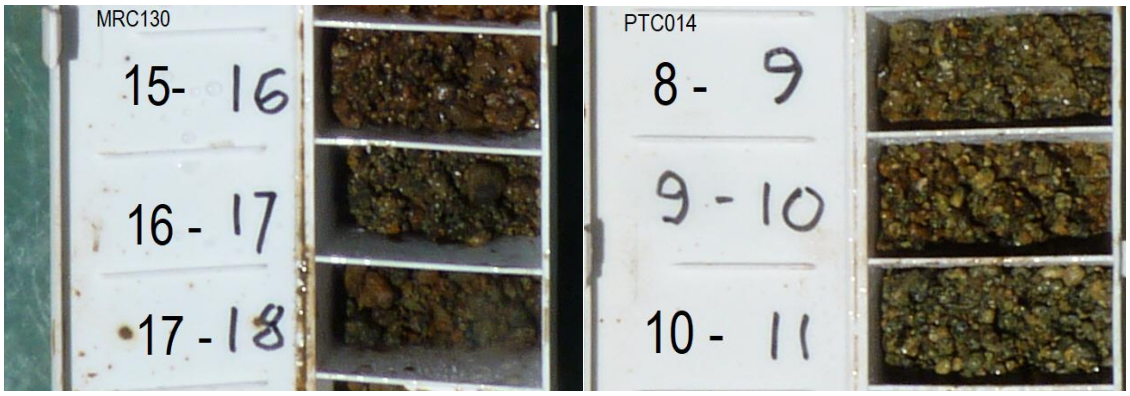



**Plate 2: Vesuvius drillhole MRC130 Gabbro Saprolite Drill Cuttings from 15–18 m and Pinatubo Drillhole PTC014 Gabbro Saprolite from 8-11 m Depth**

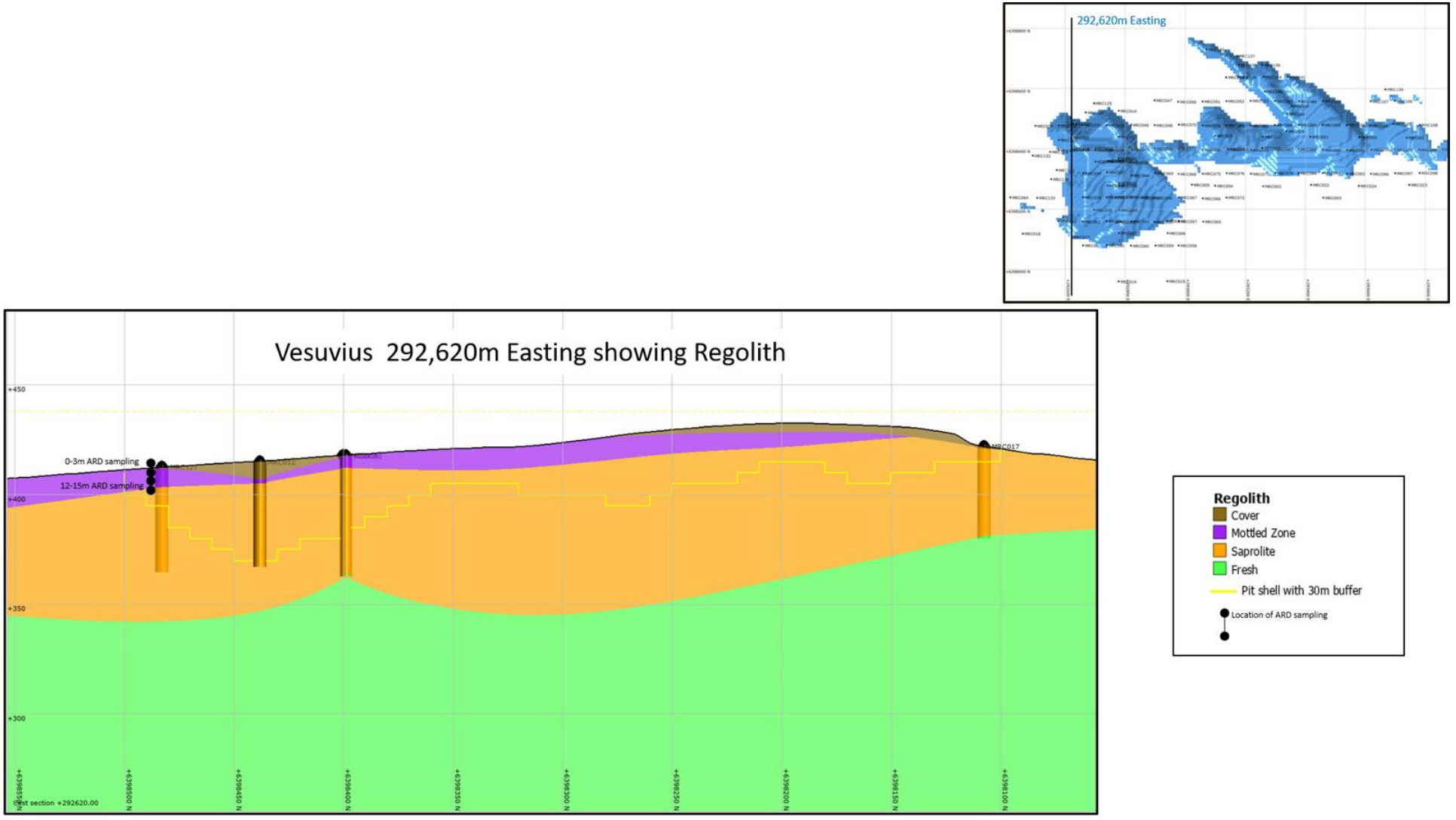



Figure 20: Vesuvius Cross Section Showing the Two Gabbro Regolith types that have been sampled (black dots downhole) in the Mottled and Saprolite Zones

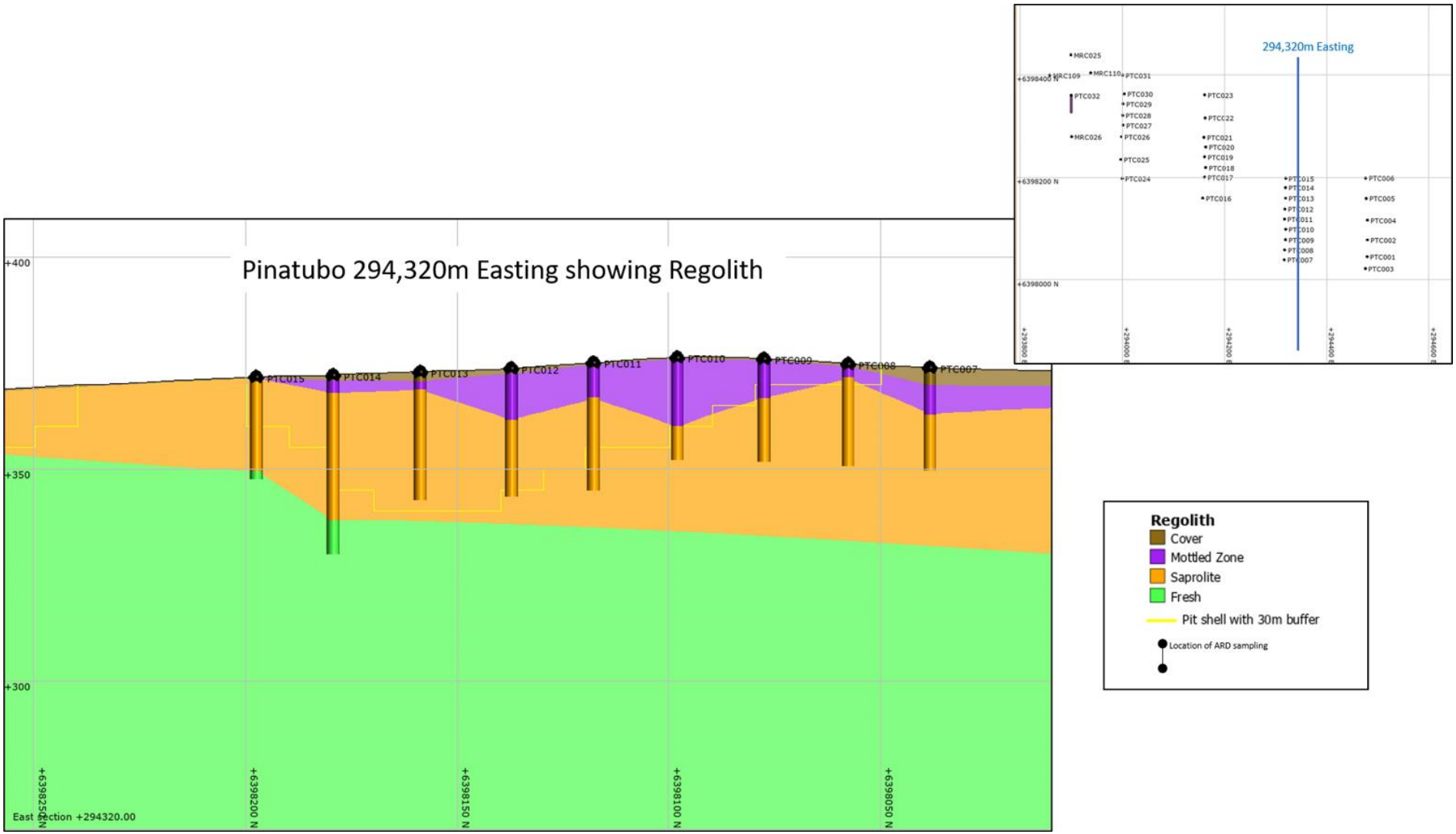



Figure 21: Pinatubo Cross Section showing the Mottled Zone and Saprolite Zone Gabbro Regolith types

In the context of Audalia's understanding of the relatively straightforward Medcalf deposit geology, the samples collected from the two Vesuvius drillholes MRC127 and MRC130 are sufficient for physical and geochemical characterisation of the mottled zone and saprolite gabbro. It was determined that the gabbro:

- Lies at shallow depths (0 - ≈ 20 m);
- Is oxidised; and
- Contains no sulphides.

***Ultramafic***

The ultramafic zone is variously represented by talcose tremolite chlorite schist, medium-grained tremolite rock and pale orange jasper. Talc is stable through the weathering profile and can still be identified in iron-rich or clay-rich material otherwise lacking diagnostic features. The ultramafic zone consists of brown to pale grey-green clay with subordinate orange chert. Relic textures in the grey green clay were restricted to disseminated 1 to 10%, 0.5 mm black opaques. The orange chert is a weathering product and forms thin veinlets in saprolitic ultramafic. The chert contains disseminated 0.5mm black opaques similar to those in surrounding saprolite.

The ultramafic zone is mainly located in the pit footwalls (Figure 13 for Vesuvius / Fuji and Pinatubo; Figure 22 for Egmont), and accounts for 30% of the total waste volume.

The composition of the ultramafic zone is very consistent over the deposits, with mottled zone and saprolite zone being the two main regolith types.

Drillhole MRC137 was sampled (Figure 23 and Figure 24) as part of the GCA (2020b) work with the following samples collected for testing: ultramafic cover zone (0-1 m), mottled zone (1-3 m) and saprolite zone (12-15 m), (27-30 m) and (41-44 m).

Geological logging of the saprolite zone of the Fuji ultramafic (Figure 23) and the Pinatubo ultramafic (Figure 21) mirrors each other. This is reflected in the photos of the drill cuttings from each area in Plate 3.

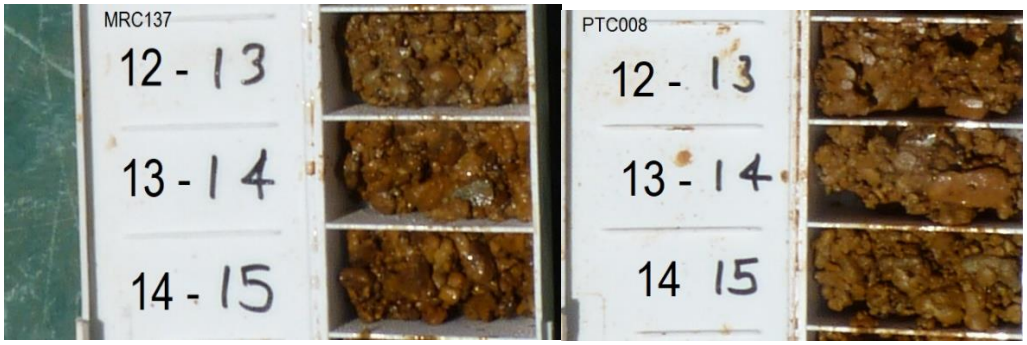
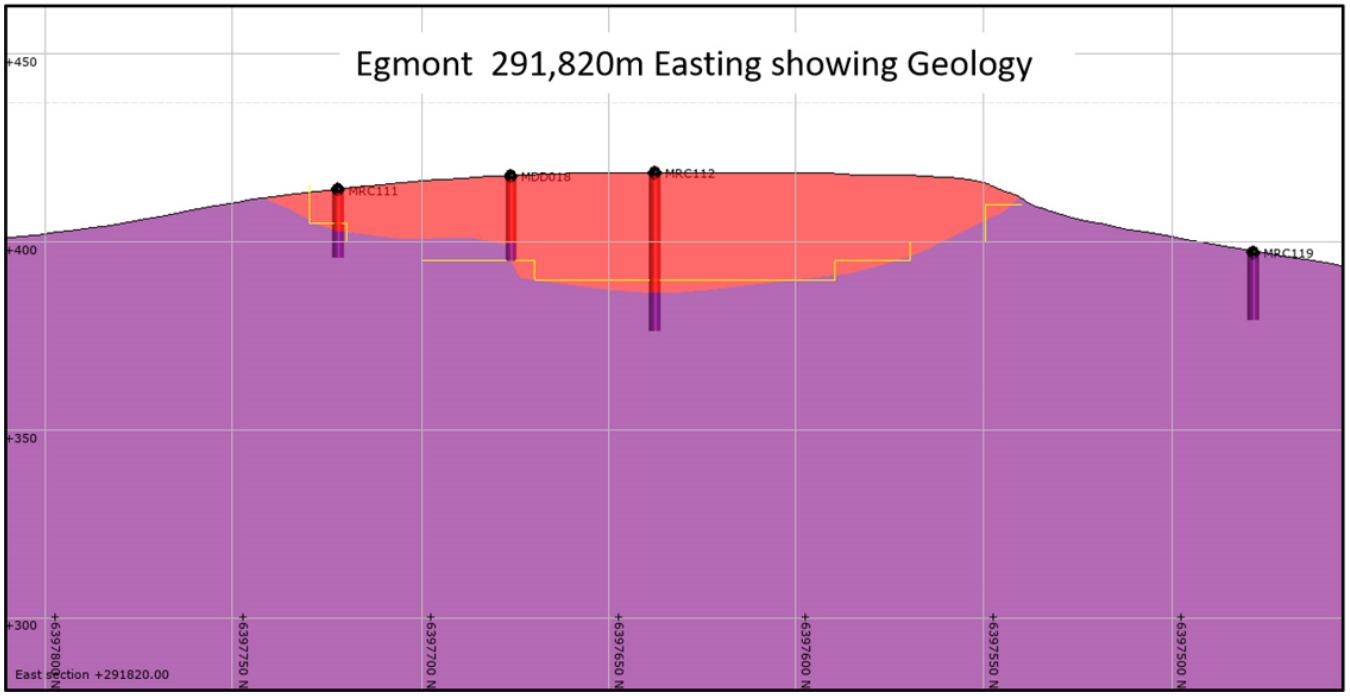
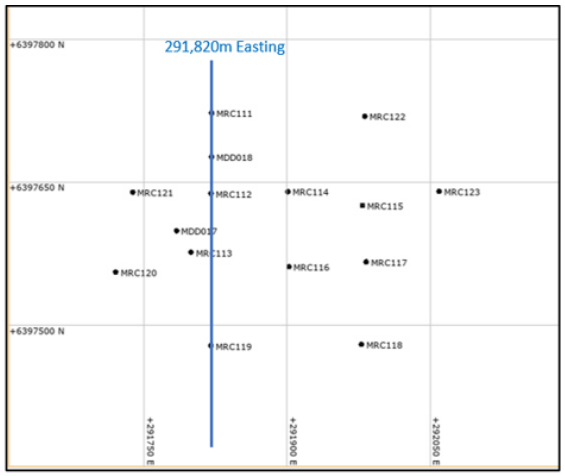



**Plate 3: Fuji drillhole MRC137 ultramafic zone drill cuttings from 12 - 15m depth and Pinatubo drillhole PTC008 ultramafic zone from 12 – 15m depth**

This saprolite zone extends across to Egmont as well (Figure 25); Plate 4 shows the Egmont ultramafic similar to all the other pit areas at a depth of 35-36 m.



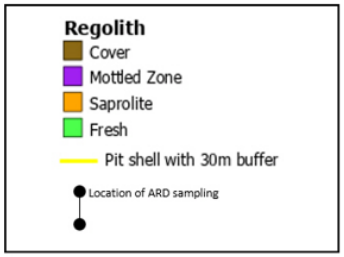




Figure 22: Egmont Cross Section showing where the Ultramafic Zone is located in the Pit

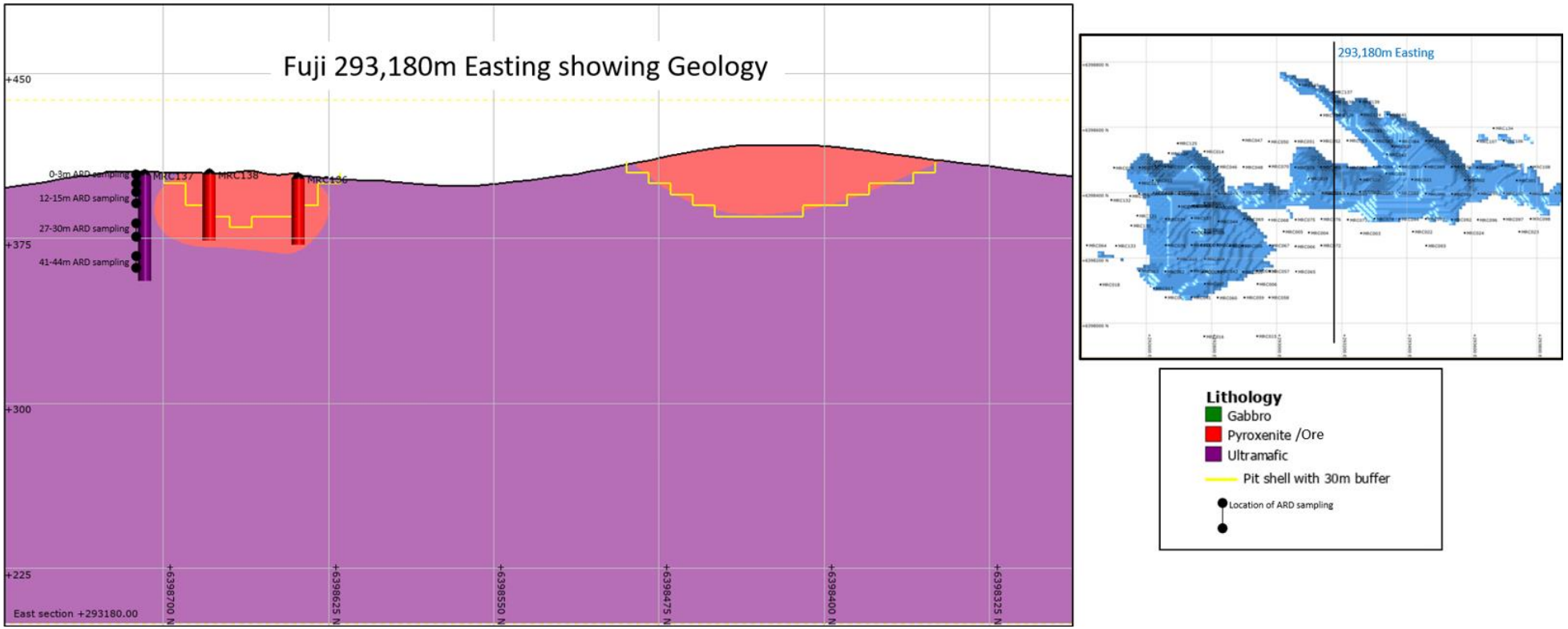



Figure 23: Fuji Cross section showing where the ultramafic zone is located in the pit showing ARD hole MRC139's location

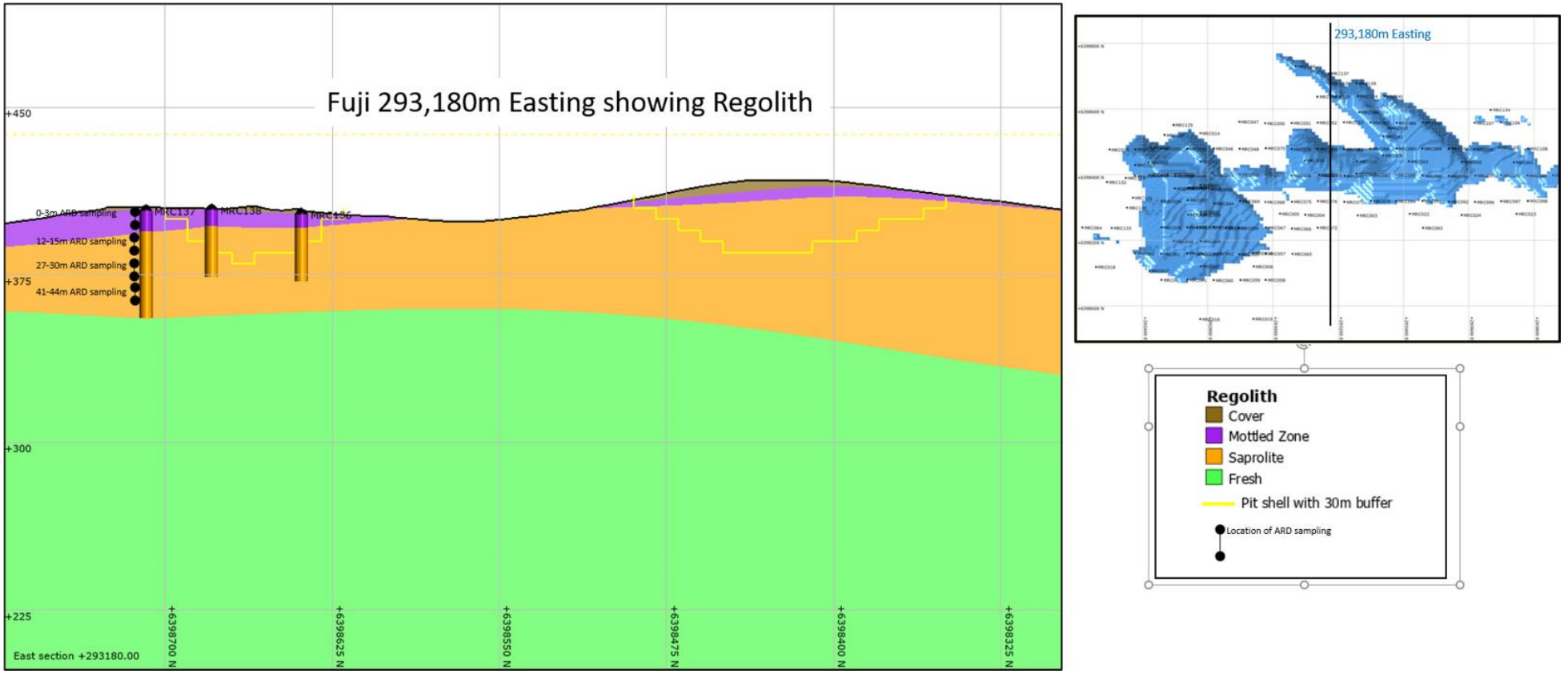



Figure 24: Fuji Cross section showing all the regolith types which ARD hole MRC139 has sampled

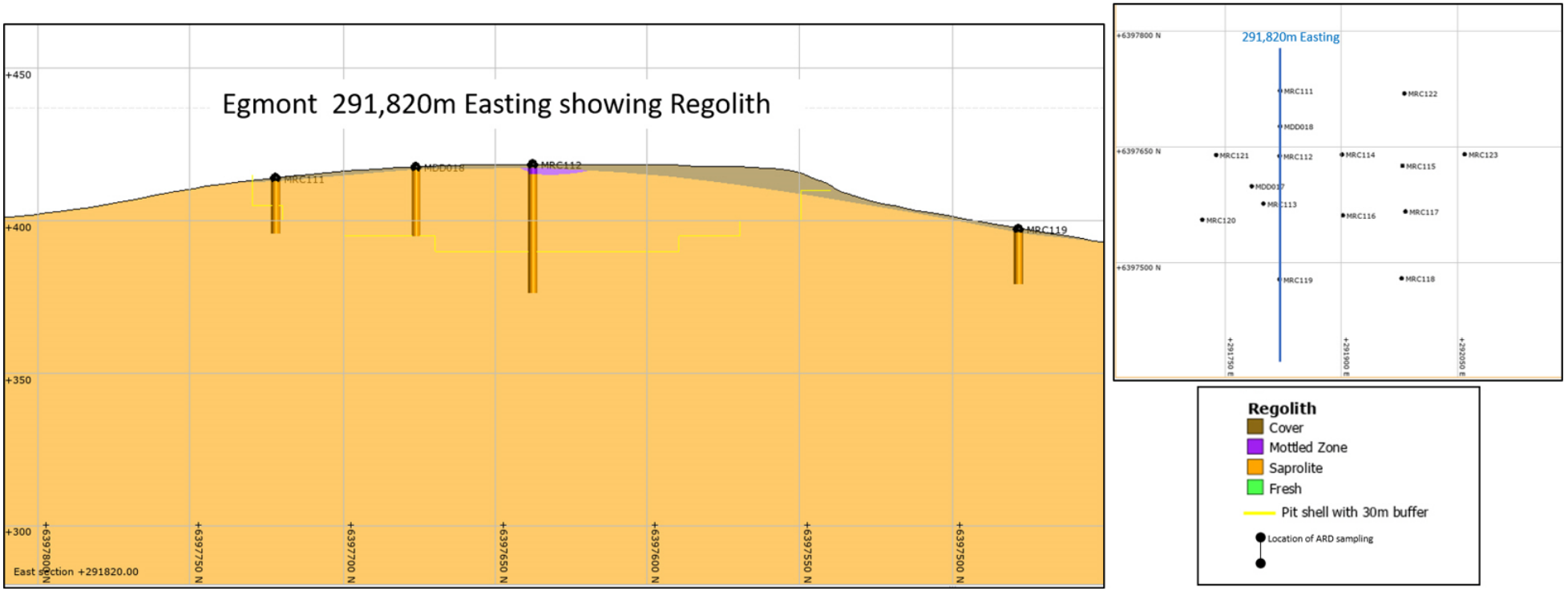



Figure 25: Egmont Cross Section showing all the Regolith types (mainly Saprolite)


Plate 4: MDD017 drill core from 35-36m

The two Vesuvius drillholes MDDD006 and MDD009 and the two Fuji drillholes MRC137 and MRC139 provide are physically and geochemically representative of the Project gabbro and ultramafic zones. In summary, the ultramafic:

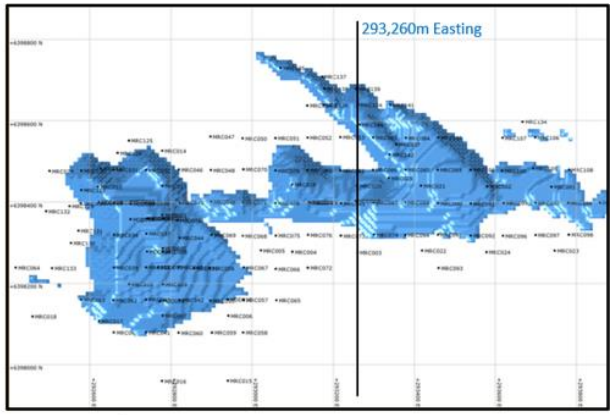
- Lies at mostly at the base of the pit (footwall);
- Is oxidised; and
- contains no sulphides.

***Pyroxenite (below cut-off grade) – Cover (Construction material)***

The pyroxenite is a coarse-grained 2 to 5 mm tremolite igneous rock with black opaques. The pyroxenite contains the mineralisation of vanadium, titanium and iron and the mineralisation varies across the deposits as seen in Figure 14.

The cut-off grade for pyroxenite is 25.7% iron content. Pyroxenite with iron content below the cut-off grade reports as mineralised waste. The pyroxenite cover (Figure 26) waste accounts for 85% of the total pyroxenite waste volume and is exposed at the surface on topographic highs (Figure 27) as laterite zones and conglomerates (Plate 5). This material is heavily leached and blocky (Plate 6 and Plate 7), making it well suited to use as a construction material (i.e. competent and benign). Geochemical Analysis results for Pyroxenite Cover Sample MDD013 are listed in Table 9. Of particular relevance to the proposed use as construction material are the low sulphur and phosphorus concentrations.

Plate 5: Lateritic Pyroxenite Cover Material



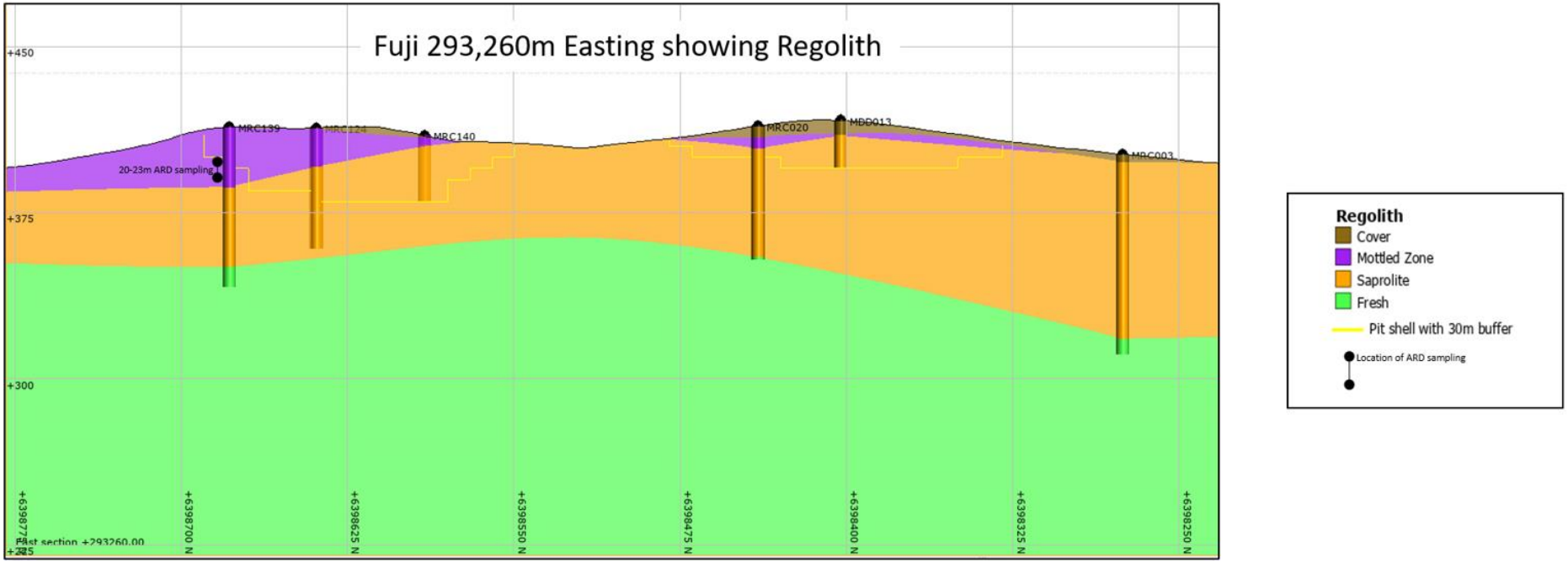




Figure 26: Fuji Cross Section showing all the Regolith types with MDD013 Drilled in Cover

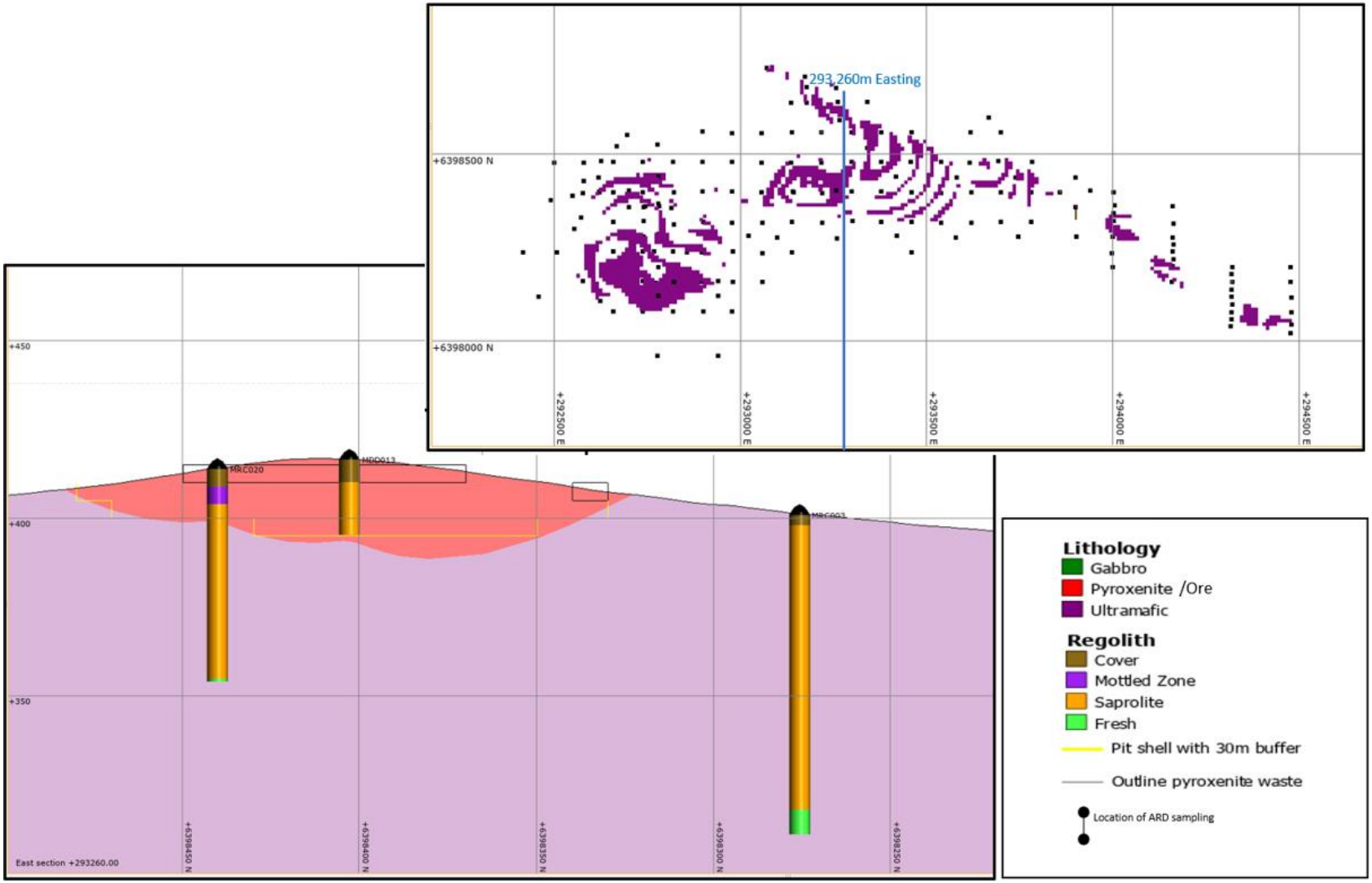



Figure 27: Plan (dark purple) and section view (black rectangles) of the location of the cover


Plate 6: MDD013 (Fuji) showing blocky pyroxenite cover from 0 to 1.6m deep.


Plate 7: MDD003 (Vesuvius) showing blocky pyroxenite cover from 0 to 1.3m deep.

Table 9: Geochemical Analysis results for Pyroxenite Cover Sample MDD013 (0 – 1 m depth)

| $TiO_2$ | $V_2O_5$ | $Fe_2O_3$ | $SiO_2$ | $Al_2O_3$ | MnO | CaO | P | S |
|---|---|---|---|---|---|---|---|---|
| 3.41 | 0.38 | 53.07 | 17.83 | 15.59 | 0.09 | 0.06 | 0.01 | 0.06 |
| **MgO** | **$K_2O$** | **$Na_2O$** | **Zn** | **Cu** | **$Cr_2O_3$** | **Ni** | **Cl** | **Co** |
| 0.14 | 0.02 | 0.22 | 0.01 | 0.02 | 0.11 | 0.01 | 0.19 | <0.005 |

The same blocky material (Plate 8) occurs at depth in the saprolite zone where MRC130 was sampled for waste rock characterisation at a depth of 92 -95 m.

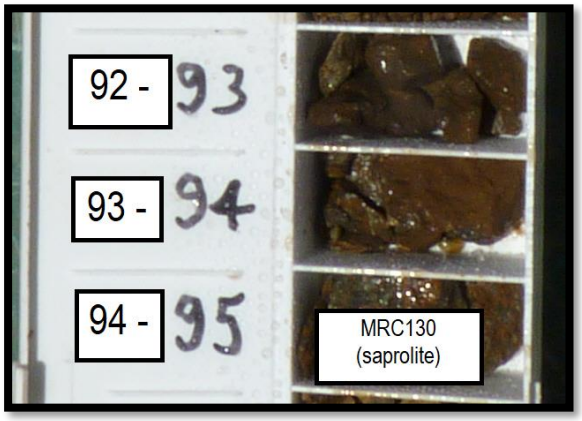



Plate 8: MRC130 pyroxenite saprolite (92-95m)

The physical and geochemical characteristics of the pyroxenite waste, comprised mostly of cover material, are well understood. In summary, the pyroxenite waste:

- Lies at surface on topographic highs (Figure 27);
- Is heavily leached over billions of years to leave residual iron;
- Contains negligible, if any, sulphides; and
- Is physically competent and geochemically benign.

### 5.4.3 TAILINGS

The Medcalf ore is somewhat unique in being oxidised and non-sulphide bearing (non-acid forming) and therefore non-magnetic making the conventional processing route not suitable to this orebody (Butler, 2020b).

Comminution and beneficiation of the ore will produce a concentrate stream (product) and a tailings slurry, which will be piped to the TSF for disposal. GCA (2020a) analysed the geochemistry of two tailings slurry samples:

- Deslimed Tailings (D-Tailings)
  - Bulk Cyclone OF; and
- Gravity Reject Tailings (GR-Tailings)
  - CUF P100 0.5mm Bulk RC100 OF

GCA (2020a) reported that, geochemically, the D-Tailings and GR-Tailings samples are essentially identical, reflecting physical (i.e. sizing/density-based) fractionation and differentiation when beneficiating the ore blends. The GCA (2020a) report is attached as Appendix 5.1

***Tailings Solids***

Both tailings solids samples were mostly comprised of hematite, goethite, and kaolin, with subordinate anatase, rutile, and quartz. The GR-Tailings solids sample also contained halloysite as a minor component (GCA, 2020a).

Cr(II)-reducible S concentrations were below the detection-limit of 0.005 % for both the D-Tailings and GR-Tailings solids samples, with both samples classified as Non-Acid Forming (NAF) by GCA (2020a).

Each tailings solids sample was characterised by major/minor-element concentrations below, or comparable with, those typically recorded for soils, regoliths and bedrocks derived from non-mineralised terrain (Table 3). Although each tailings solids sample was enriched in Cu, Ag, Bi, and V, the degree of enrichment was not of concern in a geochemical context (GCA, 2020a). The element enrichments reported fall within ranges recorded for strongly ferruginous tailings solids produced at hard rock mines for a wide range of commodities throughout the WA mining industry (GCA, 2020a).

The D-Tailings and GR-Tailings solids samples were subjected to extraction testing at pH 5 (using dilute acetic acid solutions) to measure the strength with which elements are chemically bound to Fe/Al/Ti/Si oxyhydroxide and kaolinite surfaces. Despite the mildly acidic conditions, the concentrations of elements in the pH extracts were typically below detection limits (1 µg/L) or within the range 10-100 µg/L. The similarity of elemental extraction from the tailings solids at 'process' and elevated acidities indicates that elements are bound relatively strongly to sesquioxide surfaces (i.e. predominance of strong 'inner-sphere' complexes of the high-affinity / poorly-reversible type involving surface hydroxyl groups. It is implicit that elements

incorporated into the crystal structures of the various 'resistate minerals' are totally 'fixed' geochemically (GCA, 2020a).

The more weakly bound elements assayed (those with concentrations within the range 10-100 µg/L), such as Cu, Ni, Zn, and Co, would be characterised by potentially leachable pools within the sub-mg/kg (dry-solids basis) range only. Exceptions to the above were:

- Mn with pH 5-extract concentrations of 200-720 µg/L; and
- B with pH 5-extract concentrations of 160-220 µg/L

The pH5-extract Mn concentrations reflect the weaker interaction of Mn(II) forms with oxyhydroxide surfaces. The pool size for such weakly bound Mn forms is within the 1-10 mg/kg (dry-solids basis), and thus modest. The elevated pH5-extract B concentrations were a function of the B concentration of the pH5-Feed solution, which was 89 µg/L (GCA, 2020a).

***Tailings Slurry Waters***

The slurry waters for the D-Tailings and GR-Tailings samples were neutral, and of potable salinity' reflective of both a low salt content of the ore blends, and the use of Perth tap water in the metallurgical testwork program (in place of the desalinated water to be used in ore processing).

The concentrations of a wide range of minor elements were typically below, or close to, the respective detection limits (1 µg/L). Several elements that were enriched in the corresponding tailings solids (Cu, Ag, Bi, and V) exhibited low solubilities in the tailings slurry waters. Notable tailings slurry water elemental enrichment included D-Tailings V (78 µg/L) and GR-Tailings Mn (420 µg/L). Both tailings slurry water samples had $NO_3$-N concentrations of 5-6 mg/L (GCA, 2020a).

## 5.5 HYDROLOGY

This section describes the hydrology and hydrogeology of the mine site and haul road areas.

### 5.5.1 REGIONAL HYDROLOGY

Regional topography is gently undulating with occasional ranges of low hills and sandplains. The Project DEs have some relatively small playa lakes nearby (e.g. Lake Medcalf), with larger playa lakes to the north, south, east and west.

Hydrology in the Project DEs has been documented by GRM for the haul road (GRM, 2020a), and the proposed mine area (GRM, 2020c) (focused on the populations of *Marianthus aquilonaris*).

***Haul Road***

Topography through the haul road alignment is relatively flat, with isolated low granite outcrops and sandy rises (Plate 1). Catchments for drainage lines crossing the alignment and potential crossing locations are shown in Figure 28.

There are a number of catchments that drain across the haul road. Most drainage line crossings are low areas with ponded water or shallow flow; however there are a few defined (but un-named) stream channels. The most defined drainage line crossing the haul road is a tributary or arm of Lake Medcalf near the mine site. Aerial imagery of the crossing point shows a broad, shallow channel that may flow and pond water in wet periods. Plate 9 shows the channel further downstream, where it is larger and more saline.

Plate 9: Lake Medcalf Channel Downstream of crossing point

There are other more defined crossing areas which may convey surface water in larger rainfall events. Flow in these locations probably occurs as shallow flow and ponding could occur for some time. However, there is still no defined or incised stream channel. Plate 10 shows a typical potential crossing area, which is the drainage line for a small playa about 1.5 km downstream (GRM, 2020a). Most of the other crossings are topographic valleys with no defined channel, as shown in Plate 11.

Plate 10: Example of more defined crossings in the haul road area

Plate 11: Example of topographic valley crossings the haul road area

A total of 28 crossing locations and three types of structures for drainage lines crossing the haul road were identified by GRM, based on interpretation of regional topographic data and site visit. Shallow overland flow, or sheet flow, could occur in areas along the road alignment (Figure 29).

***Mine Area***

Drainage through the area of the mine site is defined by a line of low hills trending in an east-west direction. Drainage from the hills through this area is generally either toward the north or south (Figure 30).

The northern side of the range of hills provides northerly-draining catchments that drain into Lake Medcalf (Figure 28) located about 3 - 4 km to the north of the Mine Study Area. Slopes in

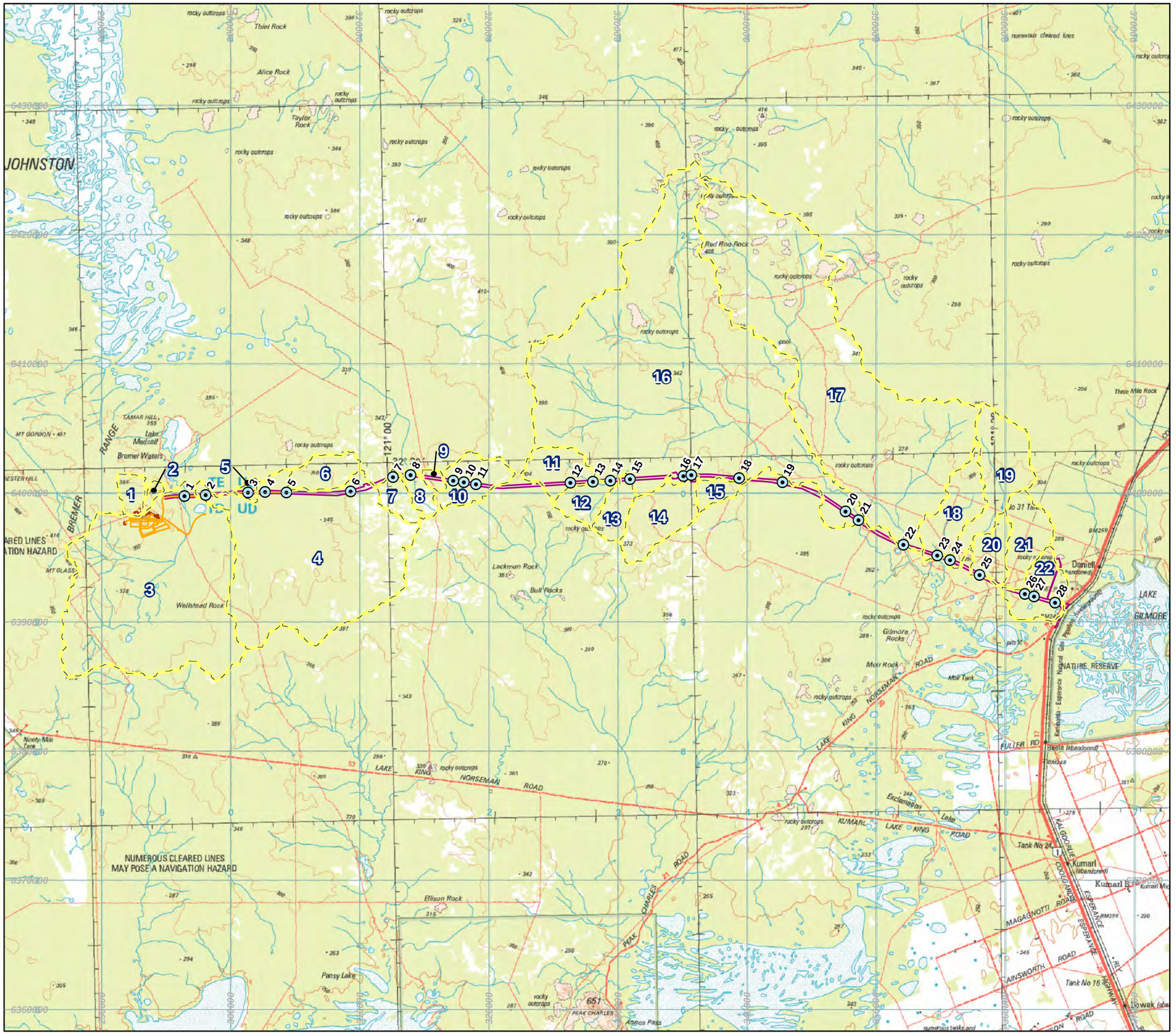
drainage lines are generally around two degrees. Drainage lines are evident and some soil erosion is noted to occur in erodible soil types.

The southern side of the range of hills provides southerly-draining catchments that also (ultimately) drain into Lake Medcalf via a tributary that crosses the haul road before joining Lake Medcalf from the south (GRM, 2020a).

The landscape is characterised by rocky hill tops grading to deeper loamy soils with distance downslope (Western Horticultural Consulting, 2019). Rock is generally exposed on or near the top of the hills, forming a surface that is likely to generate higher levels of runoff. In smaller events, most runoff will reinfiltrate in areas downstream with a deeper soil profile.

Defined streamlines form toward the bottom of the catchments. Runoff from the deeper soil areas will occur in more intense events and move as overland flow concentrating into drainage lines then defined streams as flow rates increase with distance downstream. Vegetation density increases as the soil profile increases and in proximity to drainage lines.

GRM (2020c) also identified two small cavities in the surface rock within the project disturbance footprint. These cavities collect rainfall and local streamflow and pond water for a time after rainfall. The water is lost mainly to evaporation.




**Legend**

- Crossings
- Pits
- Project Disturbance Footprint
- Catchments
- Transport Development Envelope

Data Sources:
Project Disturbance Footprint,Transport Development Envelope, Pits - Audalia Resources Limited
Crossings, Catchments - GRM
250K topography - Geoscience Australia

**Location**


**1:100 000 Map Sheet Location**

| | | | |
|---|---|---|---|
| Roundtop 2933 | Johnston 3033 | Bronzite Ridge 3133 | Norseman 3233 |
| Hope 2932 | Tay 3032 | Peak Charles 3132 | Dundas 3232 |

N

SCALE 1:300,000

0 1.5 3 6 9 12 Km

GDA 1994 MGA Zone 51

audalia resources limited

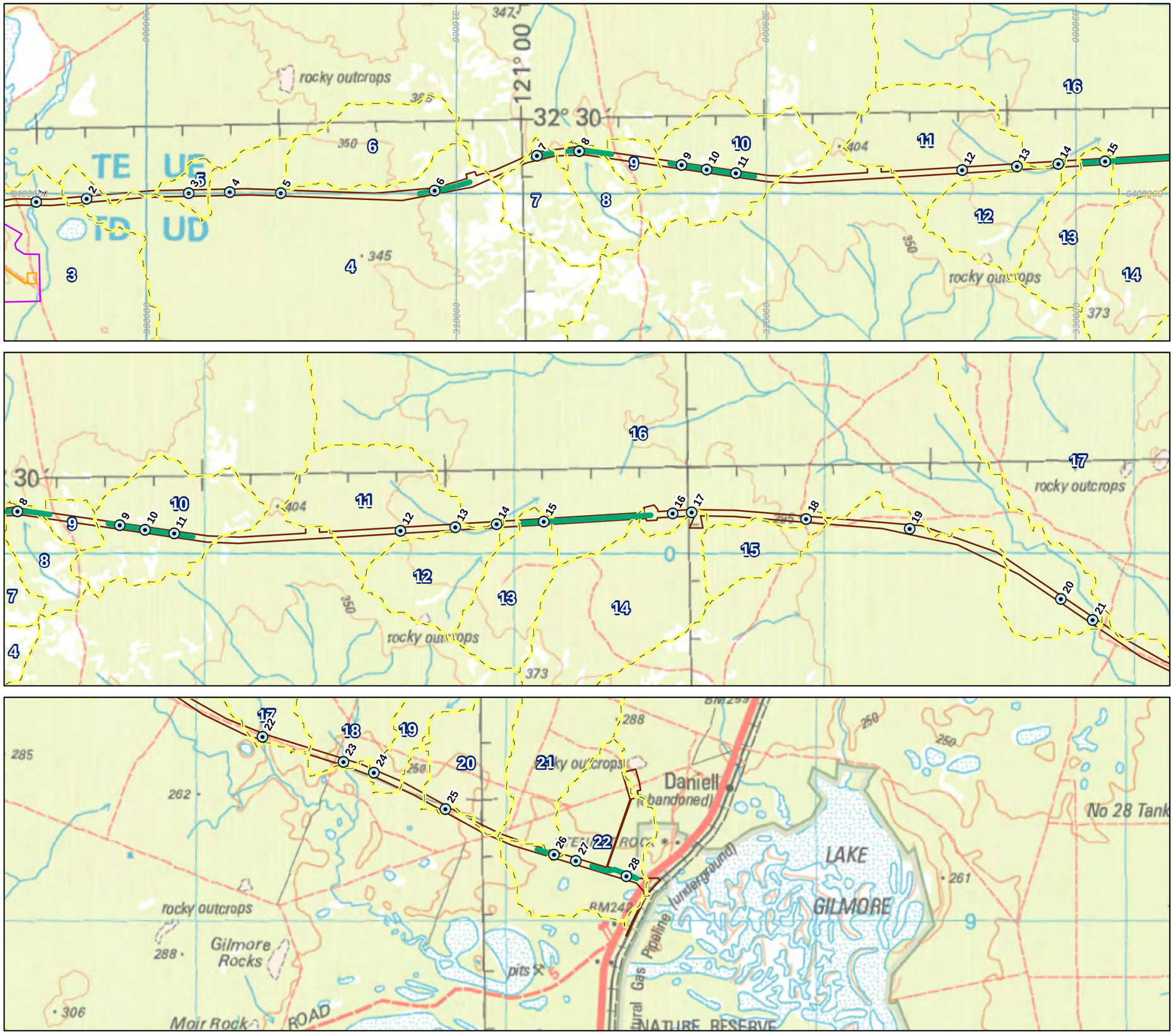
GROUNDWATER RESOURCE MANAGEMENT

**Project: Lake Medcalf Hydrogeological and Hydrological Study**
**Job no: J1843**

Additional Information

| | | | | |
|---|---|---|---|---|
| COMPILED: Gaia Resources | DATE: 5/03/2020 | LOCN: PERTH | A3 | SCALE 1:300,000 |
| GDA 1994 MGA Zone 51 | PLAN No: GR604-06_Lake_Medcalf_Fig5_R2.pdf | | | |
| DOCUMENT NAME: GR604-06_Lake_Medcalf_Fig5_R2.mxd | | | | |

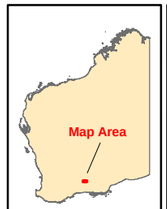
Figure 28: Haul road catchments and drainage lines (GRM, 2020a)




**Legend**

- Crossings
- Indicative overland flow areas
- Catchments
- Project Disturbance Footprint
- Mine Development Envelope
- Transport Development Envelope

Data Sources:
Mine development envelope, project disturbance footprint and transport development envelope - Audalia Resources Limited
Crossings, catchments, indicative overland flow areas - GRM 250K topography - Geoscience Australia

| Location | 1:100 000 Map Sheet Location | | | |
|---|---|---|---|---|
|  | Roundtop 2933 | Johnston 3033 | Bronzite Ridge 3133 | Norseman 3233 |
| | Hope 2932 | Tay 3032 | Peak Charles 3132 | Dundas 3232 |



N

SCALE 1:125,000

0 2 4 6 Km

GDA 1994 MGA Zone 51

audalia resources limited

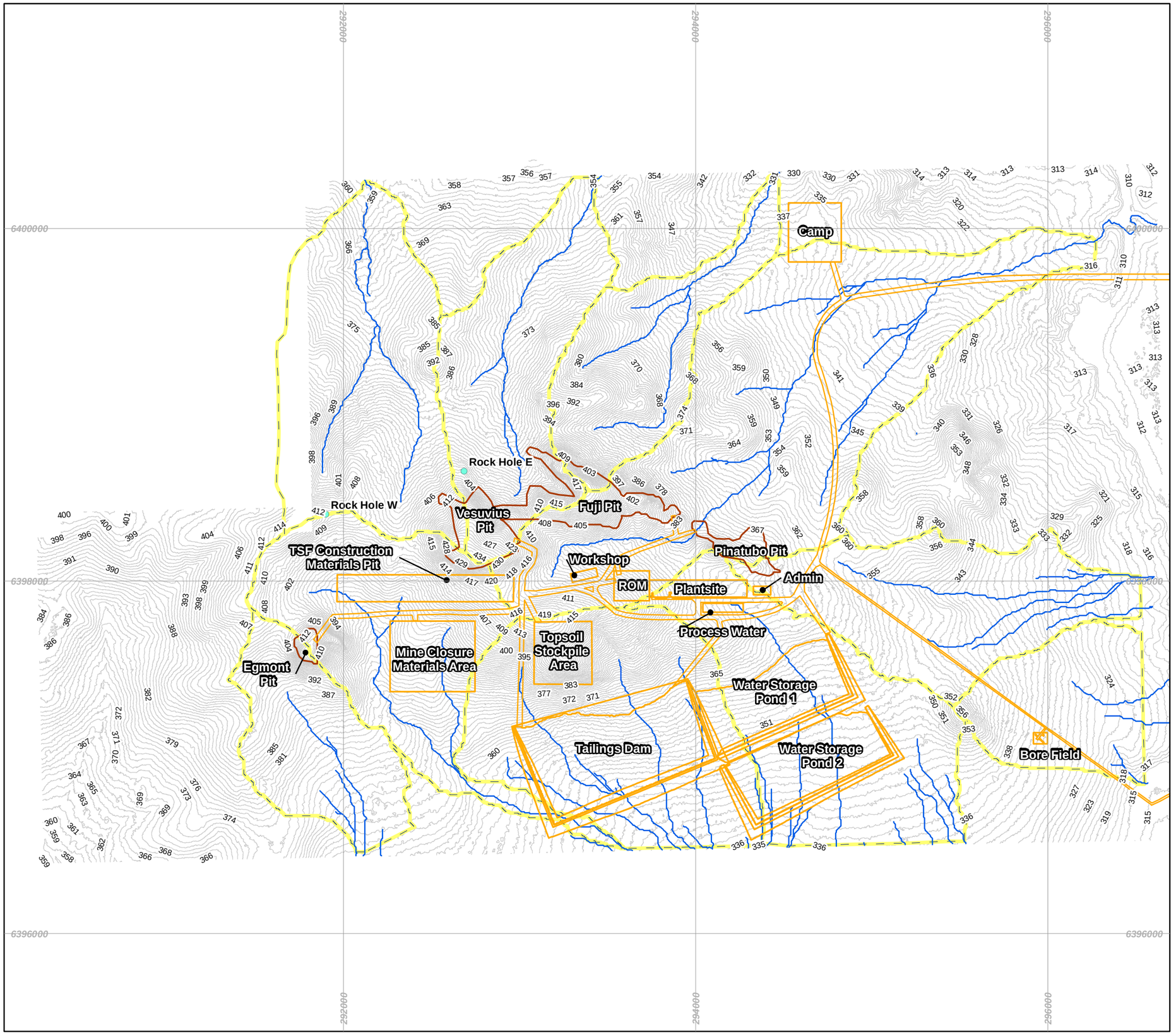
GROUNDWATER RESOURCE MANAGEMENT

**Project: Lake Medcalf Hydrogeological and Hydrological Study**
**Job no: J1843**

Additional Information

| | | | | |
|---|---|---|---|---|
| COMPILED: Gaia Resources | DATE: 20/4/2020 | LOCN: PERTH | A3 | SCALE 1:125,000 |
| GDA 1994 MGA Zone 51 | PLAN No: GR604-06_Lake_Medcalf_Fig6_R2.pdf | | | |
| DOCUMENT NAME: GR604-06_Lake_Medcalf_Fig6_R2.mxd | | | | |

Figure 29: Indicative overland flow for the haul road (GRM, 2020a)




**Legend**

- Rock Holes
- Pits
- Project Disturbance Footprint
- Drainage Lines
- Contours (1m)
- Catchments

Data Sources:
Project Disturbance Footprint,
Pits - Audalia Resources Limited
Rock Holes, Drainage Lines, Catchments,
Contours - GRM

| Location | 1:100 000 Map Sheet Location | | |
|---|---|---|---|
|  | Roundtop 2933 | Johnston 3033 | Bronzite Ridge 3133 |
| | Hope 2932 | Tay 3032 | Peak Charles 3132 |



N

SCALE 1:22,000

0 0.125 0.25 0.5 0.75 1 Km

GDA 1994 MGA Zone 51

audalia resources limited

GROUNDWATER RESOURCE MANAGEMENT

**Project: Lake Medcalf Hydrogeological and Hydrological Study**
**Job no: J1843**

Additional Information

| | | | | |
|---|---|---|---|---|
| COMPILED: Gaia Resources | DATE: 7/05/2020 | LOCN: PERTH | A3 | SCALE 1:22,000 |
| GDA 1994 MGA Zone 51 | PLAN No: GR604-06_Lake_Medcalf_Fig7_R2.pdf | | | |
| DOCUMENT NAME: GR604-06_Lake_Medcalf_Fig7_R2.mxd | | | | |

Figure 30: Mine Area drainage and topography

### 5.5.2 GROUNDWATER

Neither the Mine DE nor the Haul Road DE are within areas that are proclaimed groundwater areas (to protect water quality for water supply) under the RIWI Act (as accessed on 5 May 2020) (https://www.water.wa.gov.au/__data/assets/pdf_file/0019/1675/86307.pdf).

Groundwater investigations conducted by GRM (2020a) have focused on establishing a water supply around the mine area and immediate surrounds. This will be the most significant demand on water supply and is estimated to be 0.8 GL/yr for all processing, potable and mine site dust water supplies.

The following sections on groundwater are from GRM (2020a) unless otherwise noted.

***Regional Groundwater***

The regional hydrogeological conditions are derived from regional hydrogeological assessments completed by Kern (1995), Commander (1992), and GRM's previous experience in the Lake Johnston greenstone belt. The hydrogeology around the Mine DE is characterised by low relief and north easterly draining palaeo-drainage systems, underlain by Archean sequences.

Groundwater typically occurs in (from deepest to shallowest):

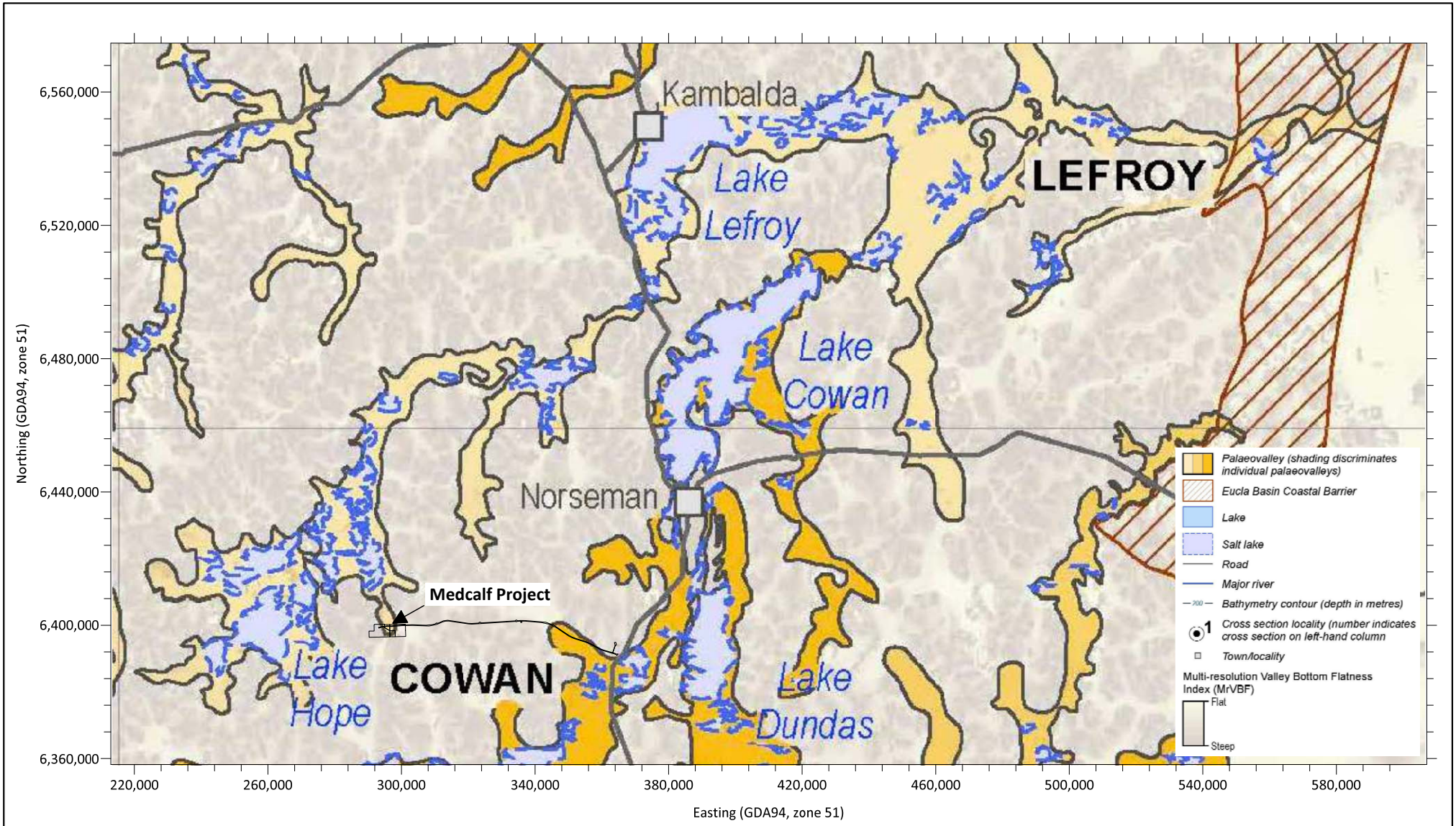
- Regional catchment-controlled flow systems in fractured rock aquifers;
- Tertiary palaeochannel sands; and
- Surficial laterite, alluvium and calcrete.

Groundwater occurrences in fresh bedrock are associated with discrete interconnected fractures in the rock. Fractured bedrock aquifers occur more commonly in mafic, ultramafic and granitic rocks than in sedimentary or felsic volcanic / volcanoclastic units. In contrast the mafic and ultramafic dykes which are prevalent in the region typically form hydraulic barriers to groundwater flow.

Fractured bedrock aquifers in the Lake Johnston area can be high yielding (i.e. up to 100 L/sec when intercepted during underground mining). However, as a result of their discrete nature (i.e. having low storage characteristics), they typically dewater rapidly and consequently may not be reliable as a long term water supply. Permeability in the bedrock away from these features is low, with low storage characteristics.

The Tertiary paleo-drainage systems of the region typically provide the largest source of groundwater in the area. The Mine DE is located at the southern extent of a tributary along the Lefroy palaeo-drainage system (Figure 31), a large north-easterly draining system which once carried surface water to the Eucla Basin. The sedimentary sequence of the Lefroy palaeo-drainage is dominated by the Wollubar Sandstone, a high yielding sequence of quartz sand, with minor conglomerate, silt, clay and lignite. Overlying the Wollubar Sandstone is the Perkollili Shale, which provides a semi-confining layer to the main channel aquifer.

The smallest groundwater source in the area are the groundwater occurrences found in the surficial sediments.




GROUNDWATER RESOURCE MANAGEMENT

**Date** Nov 19
**Client** Audalia Resources
**Project** Medcalf Water Supply
**Document** J1834R03

**Coordinate System**
GDA94 Zone 51
**Notes**

**Data Sources**
World Imagery
WASANT Palaeovalley Map

**LEGEND**
Project Tenements

FILE://J1843 Audalia Medcalf/figures/surfer/J1843R03/J1843R03 Fig4 hydrogeology.srf

**Figure 31: Regional Hydrogeology (from Kern, 1995)**

***Groundwater Users***

The Project is located within the Nullarbor Sub-Area of the Nullarbor Groundwater Area. This is an unproclaimed groundwater area and, in accordance with RIWI Act, is not subject to groundwater licensing unless abstraction is from a confined (artesian) or semi-confined aquifer.

A review of the DWER Water Information Resource (WIR) database was conducted by GRM (2020a) which showed 57 registered bores within 50 km of the Mine DE (Figure 32). The closest registered bores to the Mine DE are a cluster of 34 bores located 37 km south-east of the Mine DE that were drilled in 1929 to depths of between 1 and 49 m. There is a further cluster of similar bores located 46 km south-east of the Mine DE. These bores are all located at least 30 km from the Haul Road DE also (see Figure 32).

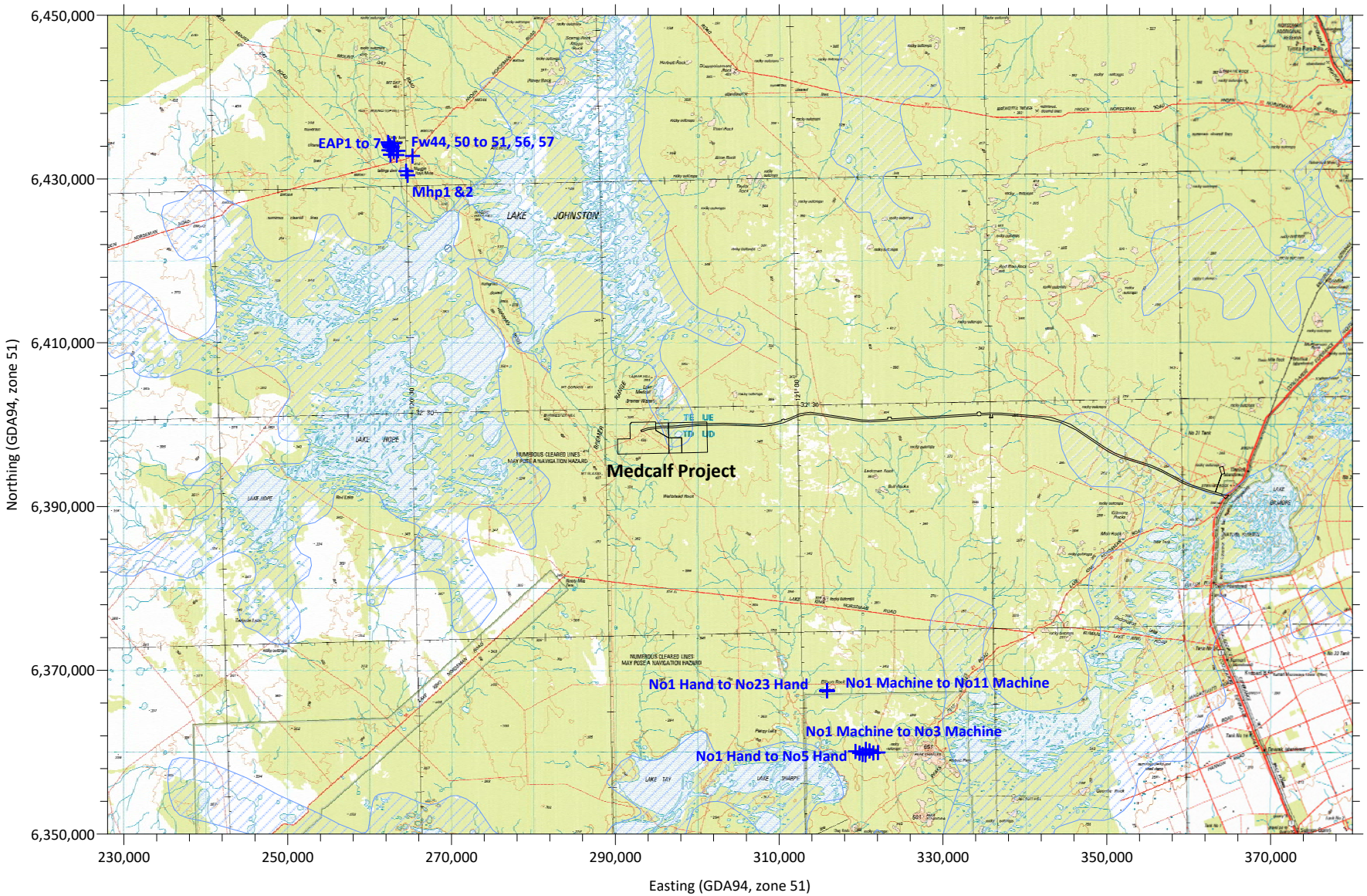
There are no water quality data associated with these bores, which were likely targeting fresh water supplies.

The next closest bores are a series of six bores drilled in 1970 for Amax Exploration Australia and are located 46 km north-west of the Mine DE. These bores are reported as being operational and understood to be the dewatering bores for Poseidon Nickel Limited's Maggie Hays mine within their Lake Johnston Operation, which are currently under care and maintenance. Poseidon Nickel Limited currently hold a licence allocation for 10 GL/yr from the fractured rock groundwater resource. The bores were reportedly low yielding (<1 L/s), to a depth of up to 92 m. Further bores are located 48 km north-west from the Mine DE and were installed in 2000 and understood to be dewatering and water supply bores for Poseidon Nickel Limited's Emily Ann mine within their Lake Johnston Operation.

The DWER online water register was also interrogated to identify the presence of existing licensed groundwater users in the vicinity of the Project. The location of existing nearest licensed groundwater users is shown in Figure 33:

- Poseidon Nickel Limited's Maggie Hays mine tenements (described above); and
- Neil Alan Hoey, located 45 km north north-west of the Mine DE for an allocation of 99,000 kL/yr from the fractured rock resource, over tenement M63/549.

Analysis of the yield ranges of regional bores shows a range of yields (Figure 34) with very few bores yielding in excess of 20 L/s. Bores yielding less than 5 L/s are most common.




GROUNDWATER RESOURCE MANAGEMENT

**Date** Nov 19
**Client** Audalia Resources
**Project** Medcalf Water Supply
**Document** J1834R03

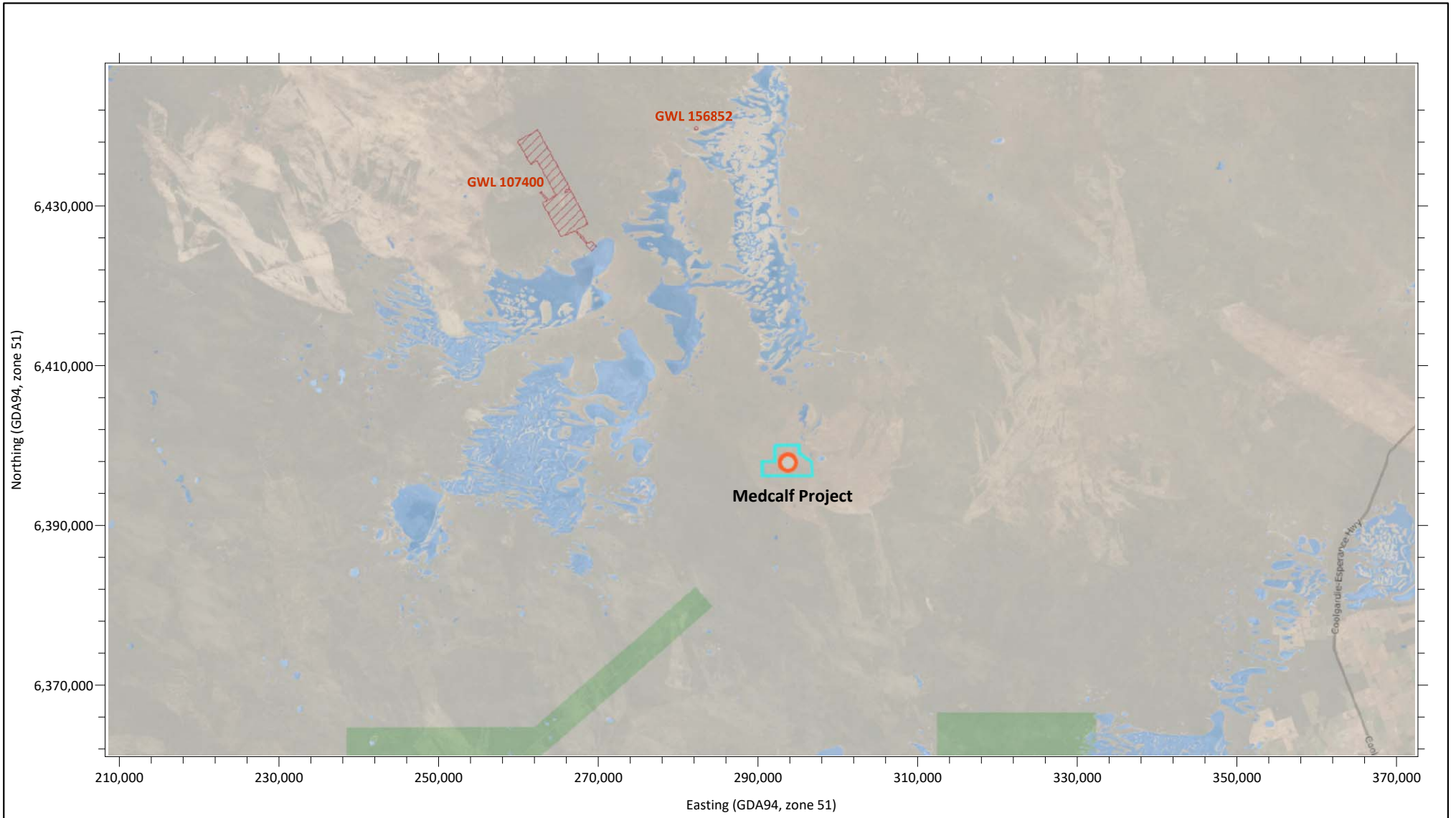
**Coordinate System**
GDA94 Zone 51
**Notes**

**Data Sources**
Lake Johnston topo
DWER WIR database
WASANT Palaeovalley Map

**LEGEND**
Project Tenements
WIR database bores
Palaeovalleys

FILE://J1843 Audalia Medcalf/figures/surfer/J1843R03/J1843R03 Fig5 other groundwater users.srf

**Figure 32: Registered bores near the Proposal**




GROUNDWATER RESOURCE MANAGEMENT

**Date** Nov 19
**Client** Audalia Resources
**Project** Medcalf Water Supply
**Document** J1834R03

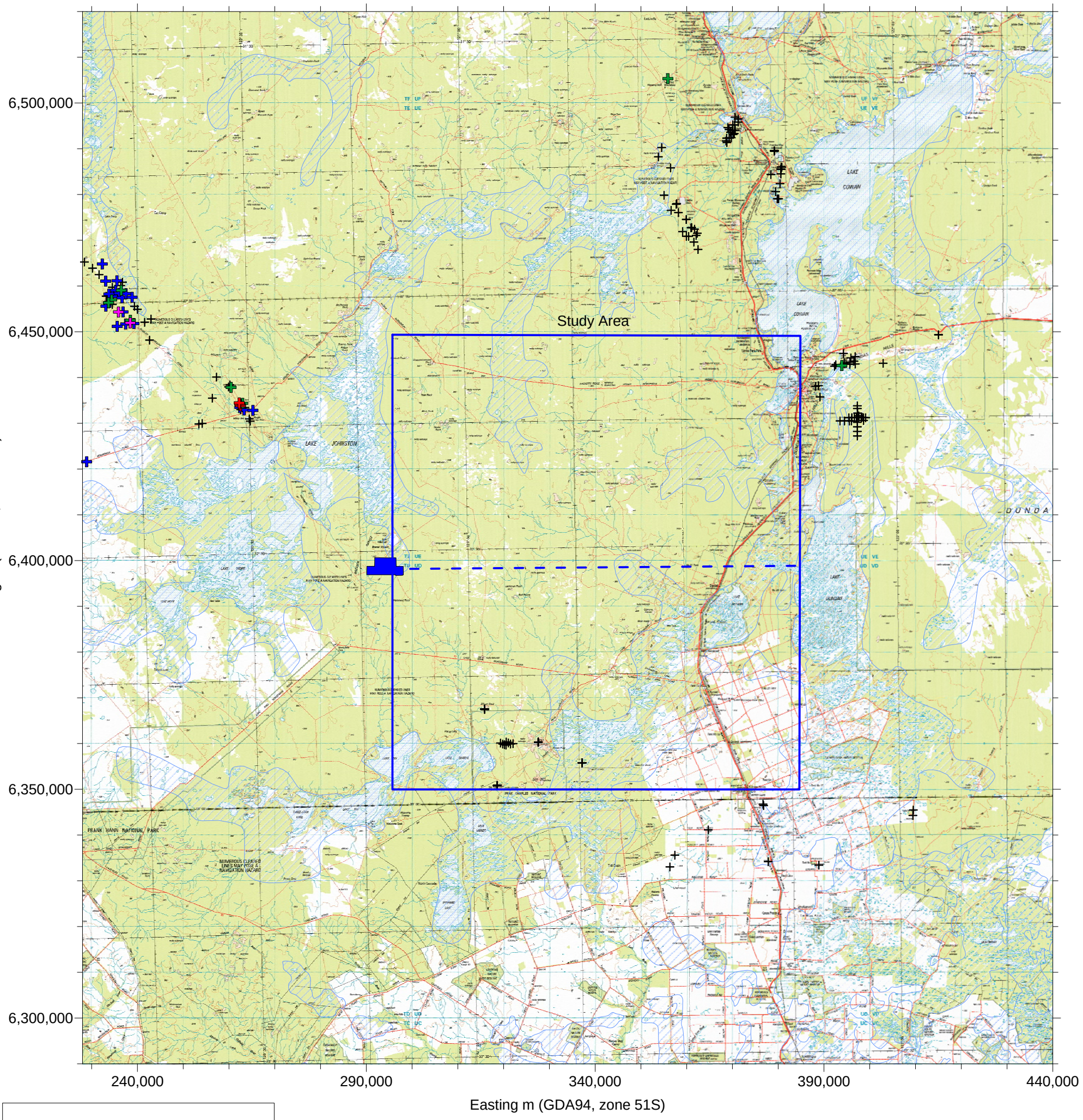
**Coordinate System**
GDA94 Zone 51
**Notes**

**Data Sources**
DWER Water Register

**LEGEND**
Project Tenemen M63/656
Existing Groundwater Licences

FILE://J1843 Audalia Medcalf/figures/surfer/J1843R03/J1843R03 Fig6 nearby groundwater licences.srf

**Figure 33: Groundwater licences in the vicinity of the Proposal**




FILE://J150007/figures/surfer/J150007R01F06 other users yield.srf

**Figure 34: Regional groundwater bore yields**

### *Groundwater System*

A summary of the groundwater drilling results is provided in Table 10. Only one of the locations is relevant to the haul road (MWH009) – this was drilled to a depth of 102 m to penetrate into the fractured rock aquifer.

**Table 10: Exploration drilling results**

| Bore ID | Depth (mbgl) | Maximum Airlift Yield (L/s) | Main Aquifer Zone (mbgl) | Aquifer type |
|---|---|---|---|---|
| MWH001 | 120 | 1 | 46 - 54<br>60 - 66 | Fractured bedrock |
| MWH002 | 30 | <0.1 | - | - |
| MWH003 | 39 | 4 | 16 - 26<br>34 - 36 | Sand-weathered breccia |
| MWH004 | 45 | 5 | 16 - 27 | Sand |
| MWH005 | 46 | 5 | 17 - 32 | Sand |
| MWH006 | 30 | 0.5 | 29 - 30 | Sand |
| MWH007 | 55 | <0.1 | - | - |
| MWH008 | 51 | <0.1 | - | - |
| MWH009 | 102 | 14 | 52 - 66 | Fractured bedrock |
| MWH010 | 90 | <0.1 | - | - |
| MWH011 | 120 | <0.1 | - | - |
| MWH012 | 114 | 10 | 29 - 75 | Fractured bedrock |
| MWH013 | 54 | 6 | 35 - 54 | Fractured bedrock |
| MWH014 | 54 | 7 | 35 - 54 | Fractured bedrock |

The recent drilling indicates that the sand aquifer within the palaeotributary, which represents the regionally extensive Wollubar Sandstone, is approximately 10 m thick and at least 150 m wide in the vicinity of MWH003. Geophysical surveying has indicated the channel extends to the north northwest, which is consistent with the Kern (1995) palaeovalley map. A map of aquifer types shows the palaeotributaries, interfluves and greenstone aquifer areas identified from the desktop survey (Figure 35).

The depth to groundwater in the palaeotributary is less than 10 m below surface. The groundwater salinity, as measured in MWH003, is hypersaline (76,000 mg/L TDS) and the pH is low (3.7). The salinity is likely to increase down hydraulic gradient (i.e. to the north) as the groundwater becomes progressively more evolved.

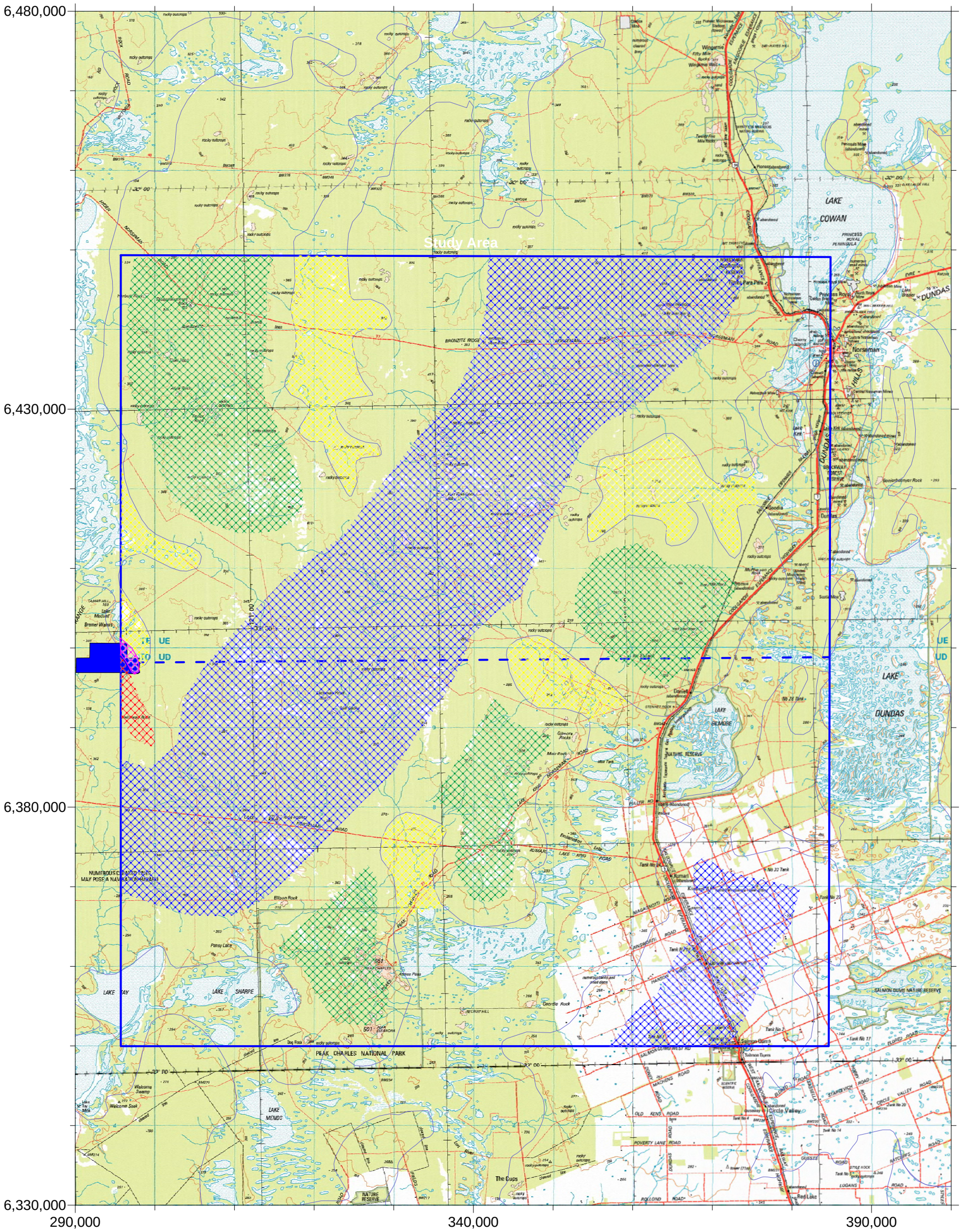
Palaeochannel aquifers are recharged directly from rainfall in the upper channel reaches. Historically recharge to palaeodrainage systems across Australia has been episodic and most effective during the warm-wet interglacial periods (Magee, 2009). The sand unit is generally a continuous aquifer, on a regional scale, and has considerably greater storage potential and transmissivity than the adjacent fractured basement rocks.

The palaeotributary is incised into weathered ultramafics of the Archean Lake Johnston greenstone belt. Drilling has indicated additional permeability in this underlying unit (in



MWH003), which represents secondary permeability from chemical dissolution during weathering. The similar groundwater chemistry in both the palaeochannel sand aquifer and the underlying weathered basement (Table 11) indicate that they are likely to be in hydraulic connection.

At the western end of the Project, away from the palaeochannel, groundwater occurrences in the fresh bedrock are associated with discrete interconnected fractures. The fracturing is characterised by secondary permeability resulting from tectonic and decompression fracturing enhanced by chemical dissolution. Drilling has indicated modest yields from two drill-holes intercepting fractured bedrock aquifers (MWH009 and MWH012), which is consistent with other fractured bedrock aquifers in the Lake Johnston area. As a result of their discrete nature (i.e. having low storage characteristics), bedrock aquifers can dewater rapidly, and consequently are not always reliable as a long term water supply. Permeability in the bedrock away from these features is low, with low storage characteristics as evidenced by drill-holes MWH002, MWH010 and MWH011 which reported yields of less than 0.1 L/s.




LEGEND

- Option I - Palaeo-tributaries
- Option II - Greenstone Belt
- Option III - Palaeo-tributary Interfluves
- Option IV - Palaeo-valley Interfluves
- Option V - Alluvium
- Project Tenements
- Proposed Haul Road

| | | |
|---|---|---|
| Water Supply Study (J150007R01) | | WATER SUPPLY OPTIONS |
| Audalia Resources Limited | | |
| KH | Sept 15 | |

GROUNDWATER RESOURCE MANAGEMENT

FILE://J150007/figures/surfer/J150007R01F08 exploration targets.srf

**Figure 35: Aquifer types**

### *Groundwater Quality*

Regional groundwater quality (in terms of salinity) in the trunk palaeochannel aquifers are hypersaline, the palaeotributaries can be less saline, with the interfluves typically reporting the best quality groundwater (GRM, 2015). In geological settings with a deep weathering profile, fractured rock aquifers at the base of the saprock, within interfluves, are known to yield groundwater quality in the order of 15,000 - 30,000 mg/L TDS, which represents the best groundwater quality likely to be present in sustainably extractable quantities. Figure 36 shows available records of bore salinity, with few locations reporting salinities of less than 30,000 mg/L TDS. GRM sampled the bores drilled for the water supply investigations undertaken during 2018 and 2019. The results of the water quality analysis from the Medcalf bores are provided in Table 11.

**Table 11: Groundwater Quality**

| Analyte | Unit | MWH003 | MWH003 | MWH001 | MWH009 | MWH012 | MWH013 | MWH014 | Drillers Bore |
|---|---|---|---|---|---|---|---|---|---|
| | | PC06 Sand | PC06 Bedrock | D501 | D801 | DB03 | DB04 | DB01 | KJC034 |
| **pH** | pH union | 3.7 | 3.8 | 7.2 | 7.0 | 7.6 | 7.9 | 7.6 | 7.7 |
| **Electrical Conductivity** | µS/cm | 100,000 | 110,000 | 140,000 | 170,000 | 89,000 | 55,000 | 56,000 | 54,000 |
| **Total Dissolved Solids (TDS)** | mg/L | 76,000 | 85,000 | 120,000 | 160,000 | 62,000 | 41,000 | 42,000 | 36,000 |
| **Total Alkalinity as $CaCO_3$** | mg/L | <5 | <5 | 150 | 96 | 420 | 560 | 580 | 630 |
| **Carbonate Alkalinity as $CO_3$** | mg/L | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| **Bicarbonate Alkalinity as $HCO_3$** | mg/L | <5 | <5 | 180 | 120 | 520 | 680 | 710 | 760 |
| **Chloride** | mg/L | 39,000 | 45,000 | 63,000 | 90,000 | 36,000 | 20,000 | 21,000 | 19,000 |
| **Sulphate** | mg/L | 8,900 | 11,000 | 12,000 | 15,000 | 5,700 | 4,300 | 4,300 | 4,200 |
| **Nitrate** | mg/L | <0.2 | <0.2 | 0.4 | 0.3 | 0.3 | 0.85 | 0.82 | <0.2 |
| **Calcium** | mg/L | 240 | 290 | 450 | 700 | 980 | 610 | 610 | 570 |
| **Magnesium** | mg/L | 3,400 | 4,000 | 4,700 | 6,600 | 2,900 | 1,700 | 1,700 | 1,700 |
| **Potassium** | mg/L | 260 | 230 | 340 | 540 | 200 | 120 | 120 | 110 |
| **Soluble Silicon as Silica** | mg/L | 87 | 64 | 9.8 | 19 | 31 | 37 | 40 | 40 |
| **Sodium** | mg/L | 18,000 | 22,000 | 34,000 | 44,000 | 17,000 | 10,000 | 9,900 | 9,400 |
| **Total Hardness** | mg/L | 14,000 | 17,000 | 20,000 | 29,000 | 14,000 | 8,600 | 8,300 | 8,300 |
| **Aluminium** | µg/L | 63,000 | 16,000 | <250 | <500 | <250 | <100 | <100 | <100 |
| **Iron** | µg/L | 54,000 | 86,000 | <250 | 3,400 | <250 | <100 | <100 | <100 |
| **Manganese** | µg/L | 1,400 | 2,000 | 2,100 | 2,600 | 1,100 | 630 | 700 | 700 |



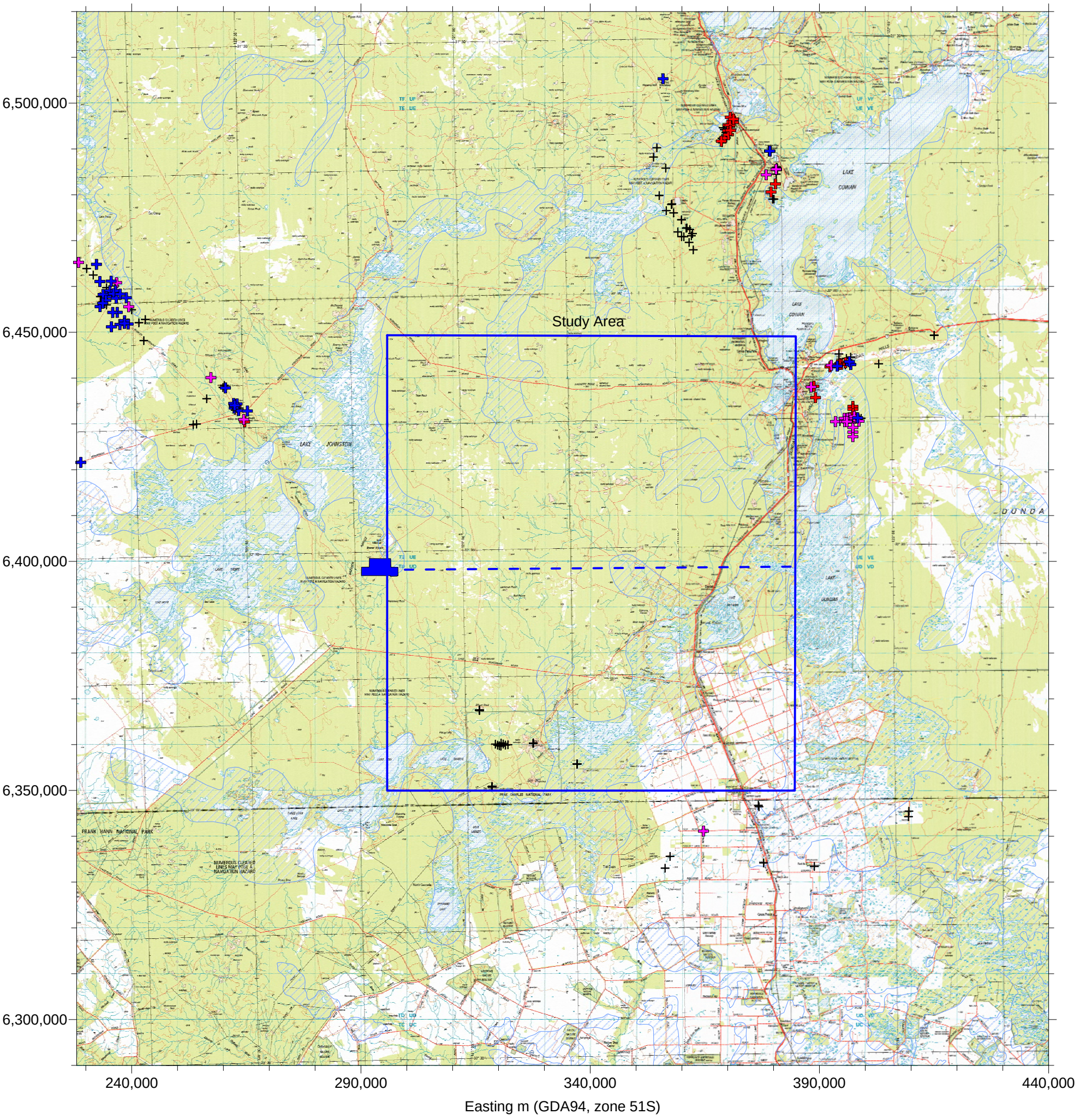
Groundwater in the fractured rock aquifer is saline to hypersaline, ranging from 36,000 mg/L TDS in the Drillers Bore to 160,000 mg/L TDS in MWH009 which is located closest to Lake Medcalf. The variability in salinity is consistent with regional conditions and is indicative of the complex nature of fractured rock environments.

The groundwater in the palaeochannel sand aquifer (MWH003) is acidic (pH 3.7) and hypersaline (76,000 mg/L TDS). The palaeochannel groundwater is significantly higher than the fractured rock aquifer in aluminium and iron which are attributed to acidity mobilising these elements from within the palaeochannel sediments.

***Groundwater Dependant Ecosystems***

A review of the BoM's Groundwater Dependant Ecosystem (GDE) Atlas completed by GRM (2020a) for an area of 25 km surrounding the DEs indicates that the area is classified as having:

- No identified aquatic or subterranean GDE's within the DEs; and
- A moderate potential within and to the north of the DEs for terrestrial GDE's, and a low potential for terrestrial GDE's to the south of the Project.




FILE://J150007/figures/surfer/J150007R01F05 other users salinity.srf

**Figure 36: Regional groundwater salinity**

***Water Supply***

The Project has a projected water demand of approximately 1.2 GL per annum, comprising:

- 0.8 GL per annum (25 L/s) of groundwater for the purposes of beneficiation, dust suppression within the mining area and camp supplies (which will need to be treated via reverse osmosis); and
- 0.4 GL per annum (12.7 L/s) of groundwater for dust suppression purposes along the 74 km haul road and transfer depot.

The exploration drilling results indicate that the mine water demand can be met by a combination of two fractured rock aquifer bores and two palaeochannel bores, assuming the acidity of the groundwater in the palaeochannel aquifer is acceptable.

The haul road groundwater supply will be sourced from a series of between three to five bores, roughly equidistant along the 74 km haul road. Individual bores will be capable of producing 2.5 - 4.2 L/s and be located within the Haul Road DE. Audalia is targeting a low salinity groundwater (<10,000 mg/L TDS), to minimise detrimental impact to equipment and vehicles. Previous studies undertaken by GRM (2015) identified three potential aquifers along the proposed haul road. A discussion of the potential water supply options is provided below:

1. **Palaeo-tributary aquifer within the Cowan Palaeodrainage**. Recent field investigations (GRM, 2020b) within the Lefroy palaeo-tributary adjacent to the mining area indicate a 10 m thick medium grained sand aquifer, overlain by a 16 m thick clay aquitard. Field investigations indicate individual bore yields in this aquifer of potentially around 4 - 5 L/s of hypersaline (76,000 mg/L TDS), although acidic (3.4 pH) groundwater. Given the regional similarities between the Lefroy and Cowan palaeodrainage systems, it is possible that similar yields and groundwater quality could be expected from the Cowan palaeo-tributary, although lower salinity is also possible based on other palaeo-tributaries in the region. Whilst the investigations conducted to date indicate this aquifer would be a suitable water supply source in terms of likely bore yields, the groundwater quality (salinity and pH) may limit their use;
2. **Fractured bedrock aquifers within the palaeo-tributary interfluves** (defined as un-dissected uplands between adjacent palaeo-tributaries). Regional information (GRM, 2015) indicates modest yielding low salinity aquifers can be found in palaeo-drainage interfluves. Recent investigations within the mining area (GRM, 2020b) indicated yields of up to 14 L/s in fractured bedrock bores, which is well above the required yield for the haul road water supply. However, the salinity in the mining area was highly variable, ranging from 54,000 - 170,000 mg/L TDS, which is likely attributed to the close proximity to the Lefroy palaeo-tributary. Lower salinity groundwater supplies are possible along the haul road corridor, particularly away from the palaeo-tributaries (i.e. closer to the catchment divides); and
3. **Surficial aquifers**. Regionally, small quantities of low salinity groundwater are known to occur in alluvial sequences, particularly along small drainage lines where the alluvium is sufficiently thick to extend below the water table. Surficial aquifers are readily recharged by rainfall, although supplies can diminish during prolonged dry periods. This aquifer type may provide a suitable shallow water source for the haul road.

In order to achieve three to five equidistant water supply bores along the haul road corridor the bores will likely comprise a combination of aquifer sources. A geophysical survey will be initiated along the corridor to further delineate the targets. Alternatively, Audalia may undertake a



preliminary exploration drilling programme at the potential surficial aquifer targets shown on Figure 37, extending the drill holes into the underlying bedrock or palaeo-tributary sediments to assess two potential aquifer types per drill-hole.

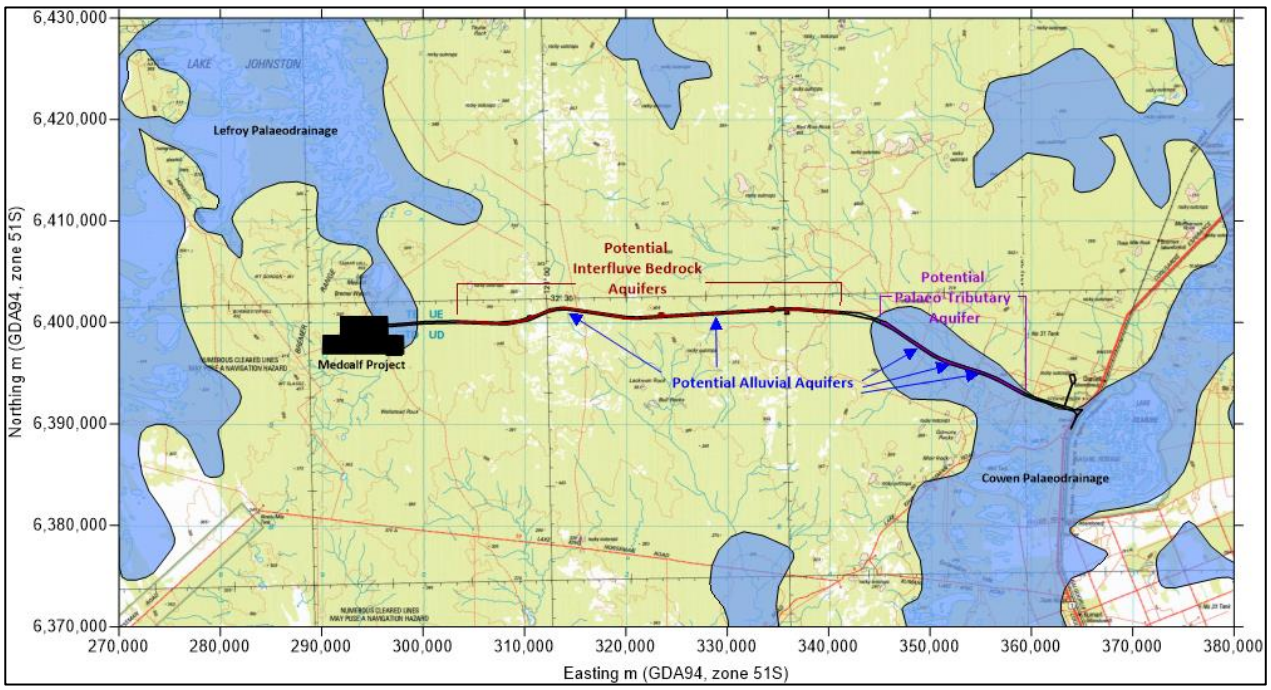



Figure 37: Haul road water supply options

## 5.5.3 Surface Water

Neither the Mine DE nor the Haul Road DE are within areas that are proclaimed surface water areas (to protect water quality for water supply) under the RIWI Act (as accessed on 5 May 2020) (https://www.water.wa.gov.au/__data/assets/pdf_file/0004/1669/86306.pdf). None of the surface water catchments within the DE's drain into conservation estate, freehold land or other tenure held by other potential water users.

### *Geology, land systems, soils and runoff*

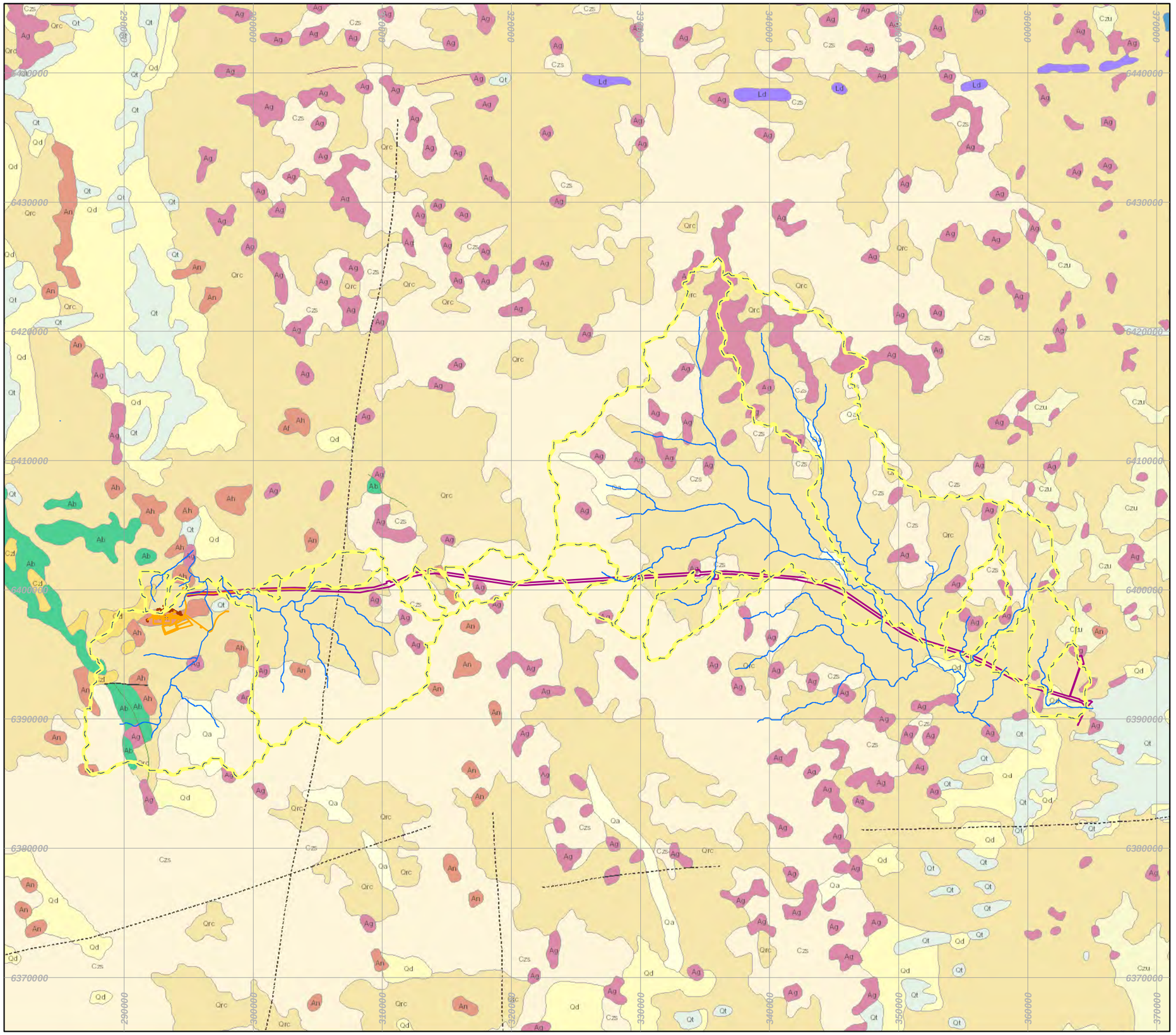
The surface geology for the area including the Haul Road and Mine DEs is shown in Figure 38. This data set is supplemented by observations made on site (map of mine area geology is shown in Figure 38). A full description of the geology is provided in Section 4.2.2. In summary, the surface geology features relevant to surface water are:

- Two main surface geologies are traversed along the Haul Road DE:
  - Colluvium at the eastern and western extremities. Soils on colluvium tend to be clay loams and will produce some runoff, at least in intense rainfall events. Some defined drainage lines cross the road;
  - Sandplain occurs in gently undulating landforms through the middle of the road alignment. Soils here are sandy loams and probably produce little runoff; and
- The Mine DE is within a band of low hills that are characterised by rocky outcrops, shallow stony soils, and steeper slopes. To the north and south of the hills is mapped as colluvium. With distance downslope the depth of soil increases into the colluvial zone.

***Vegetation and Runoff***

There is largely undisturbed native vegetation through the entire Mine and Haul Road DE's. Vegetation through the mine site and along the haul road is generally classified as Eucalypt and Mallee woodlands and shrublands. The native vegetation is relatively intact and generally rated as being in good or very good condition (Botanica, 2020c). Landforms covered with native vegetation generate less runoff than equivalent landforms that have been cleared for agriculture.

Vegetation across the area is variably affected by fire. At any one time, the vegetation will include areas in various stages of regrowth and with variable amounts of accumulated leaf litter and fallen material. The recent fire history affects the short term hydrological characteristics of the landscape (GRM, 2020b). Areas with little vegetation and ground cover (i.e. freshly burnt) will have higher rates of runoff and increased turbidity compared with heavily vegetated areas.




## Legend

- Drainage Lines
- Pits
- Project Disturbance Footprint
- Catchments
- Transport Development Envelope

### Surface Geology

**QUATERNARY**
Qa, Qd, Qrc, Qt

**CENOZOIC**
Cza, Czk, Czl, Czs, Czz

**PROTEROZOIC**
-Ps

**PALEOPROTEROZOIC**
Lc, Ls

**ARCHEAN**
Aa, Ab, Ad, Ae, Af

Ag, An, As, At, Au, Av, Aw, Ay

Data Sources:
Project Disturbance Footprint, Transport Development Envelope, Pits - Audalia Resources Limited
Catchments, Drainage Lines - GRM
Geology of Australia - Geoscience Australia

**Location**


**1:100 000 Map Sheet Location**

| | | |
|---|---|---|
| Johnston 3033 | Bronzite Ridge 3133 | Norseman 3233 |
| Tay 3032 | Peak Charles 3132 | Dundas 3232 |

N

SCALE 1:300,000

0 1.5 3 6 9 12 Km

GDA 1994 MGA Zone 51

audalia resources limited

GROUNDWATER RESOURCE MANAGEMENT

**Project: Lake Medcalf Hydrogeological and Hydrological Study**
**Job no: J1843**

Additional Information

| | | | | |
|---|---|---|---|---|
| COMPILED: Gaia Resources | DATE: 6/03/2020 | LOCN: PERTH | A3 | SCALE 1:300,000 |
| GDA 1994 MGA Zone 51 | PLAN No: GR604-06_Lake_Medcalf_Fig4_R2.pdf | | | |
| DOCUMENT NAME: GR604-06_Lake_Medcalf_Fig4_R2.mxd | | | | |

Figure 38: Regional surface geology

# 5.6 FLORA AND VEGETATION

The text in this section has been sourced from Botanica (2020a, 2020b, 2020c, 2020d and 2020e) unless stated otherwise. Further details on these studies can be found in the Project ERD.

## 5.6.1 SIGNIFICANT FLORA

One Threatened Flora taxon pursuant to the BC Act was identified within the survey area; *M. aquilonaris*. This taxon is not listed as Threatened under the EPBC Act. A map showing the *M. aquilonaris* sub-populations is provided in Figure 40. Ten Priority Flora taxa as listed by DBCA were also identified within the survey area:

1. *Acacia hystrix* subsp. *continua* (P1);
2. *Acacia mutabilis* subsp. *stipulifera* (P3);
3. *Bossiaea flexuosa* (P3);
4. *Brachyloma stenolobum* (P1);
5. *Eucalyptus pterocarpa* (P4);
6. *Eucalyptus rhomboidea* (P4);
7. *Hakea pendens* (P3);
8. *Microcybe* sp. Windy Hill (G.F. Craig 6583) (P3);
9. *Stenanthemum bremerense* (P4); and
10. *Teucrium* sp. dwarf (R. Davis 8813) (P3).

The number of individuals of each of these species recorded within the region and survey area is provided in Table 12. A map showing the locations of these flora taxa identified within the survey area is provided in Figure 39.

**Table 12: Significant flora recorded within survey area**

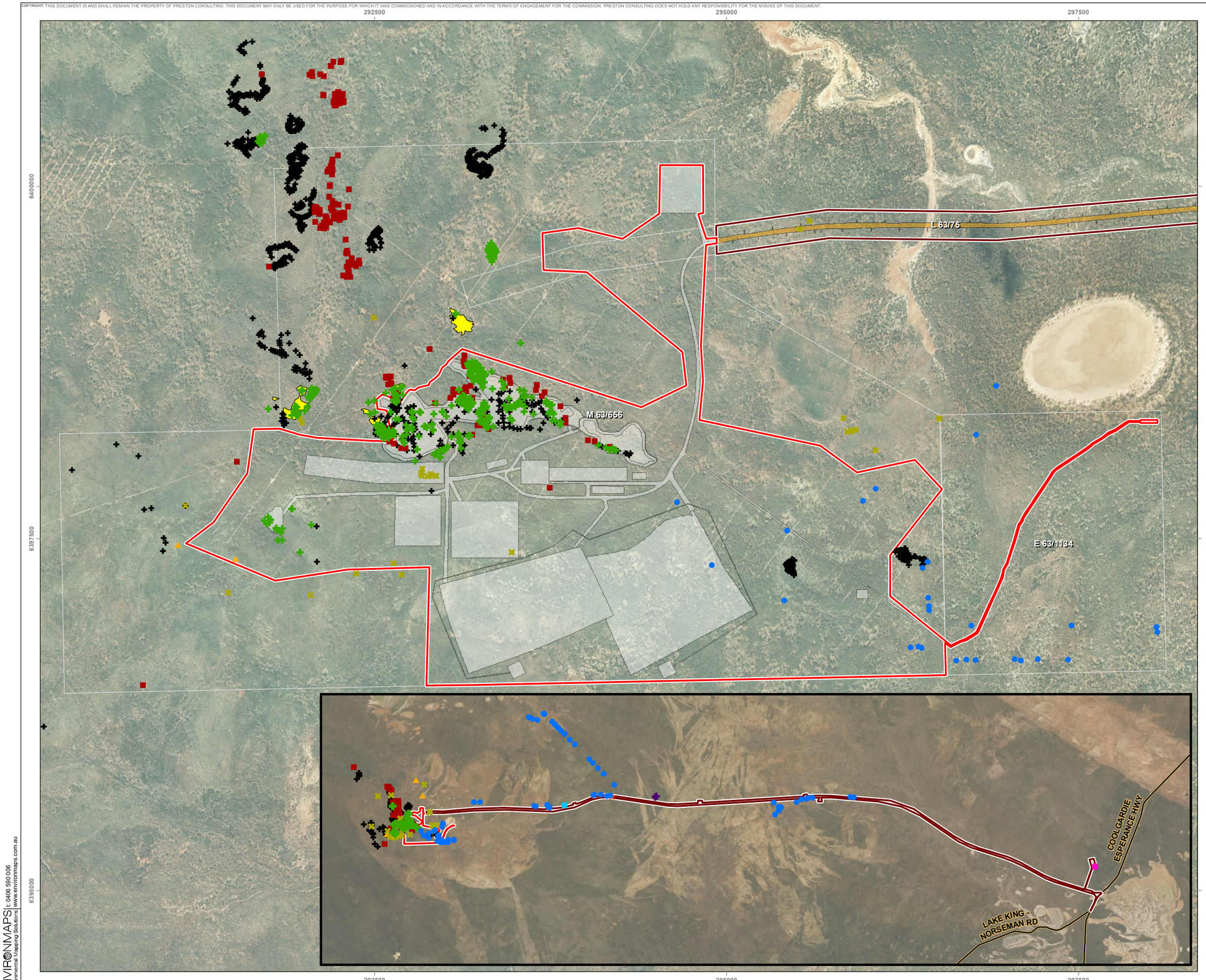
| Flora | Conservation Status | Regional extent (no.) | Extent in Survey Area (no.) | Extent in DEs (no.) |
|---|---|---|---|---|
| *M. aquilonaris* | T | 14,627 | 14,627 | 0 |
| *Acacia hystrix* subsp. *Continua* | P1 | 122 | 100 | 0 |
| *Acacia mutabilis* subsp. *Stipulifera* | P3 | 348,452 | 348,311 | 11,215 |
| *Bossiaea flexuos* | P3 | 217 | 100 | 0 |
| *Brachyloma stenolobum* | P1 | 560 | 500 | 0 |
| *Eucalyptus pterocarpa* | P4 | 100 | 100 | 0 |
| *Eucalyptus rhomboidea* | P4 | 15,606 | 5,730 | 1,198 |
| *Hakea pendens* | P3 | 6,783 | 2,100 | 1,246 |
| *Microcybe* sp. Windy Hill (G.F. Craig 6583) | P3 | 26,962 | 620 | 20 |
| *Stenanthemum bremerense* | P4 | 40,126 | 30,211 | 3,455 |
| *Teucrium* sp. dwarf (R. Davis 8813) | P3 | 16,153 | 11,200 | 1,450 |

One of the Priority Flora taxa identified; *Eucalyptus rhomboidea* (P4) is currently being nominated by DBCA for Threatened status under the BC Act. A second Priority Flora taxon; *Stenanthemum bremerense* (P4) is being considered by DBCA for nomination to Threatened status under the BC Act. A map showing the population area of *Eucalyptus rhomboidea* and *Stenanthemum bremerense* is provided in Figure 40.



Locations of all flora of conservation significance listed on the DBCA database within the survey area were searched during the surveys, however the following taxa were not identified during the surveys:

1. *Aotus* sp. Dundas (M.A. Burgman 2835); and
2. *Stylidium pulviniforme.*




**Legend**

- Mine Development Envelope
- Haul Road Development Envelope
- Mine Disturbance Footprint
- Haul Road Indicative Disturbance Footprint
- Tenement
- *Marianthus aquilonaris* Population - January 2019

Priority Flora Location

- Priority 1: *Acacia hystrix* subsp. continua
- Priority 1: *Brachyloma stenolobum*
- Priority 3: *Acacia mutabilis* subsp. *stipulifera*
- Priority 3: *Bossiaea flexuosa*
- Priority 3: *Hakea pendens*
- Priority 3: *Teucrium* sp. dwarf (R. Davis 8813)
- Priority 3: *Microcybe* sp. Windy Hill (G.F. Craig 6583)
- Priority 3: *Eucalyptus pterocarpa*
- Priority 4: *Eucalyptus rhomboidea*
- Priority 4: *Stenanthemum bremerense*

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DMRS 2020
- LOCALITY MAP SOURCED LANDGATE
- AERIAL PHOTOGRAPHY OPEN SOURCE

Preston Consulting

0 200 400 600 800 1,000
Meters
Scale: 1:363,991 @ A3

N

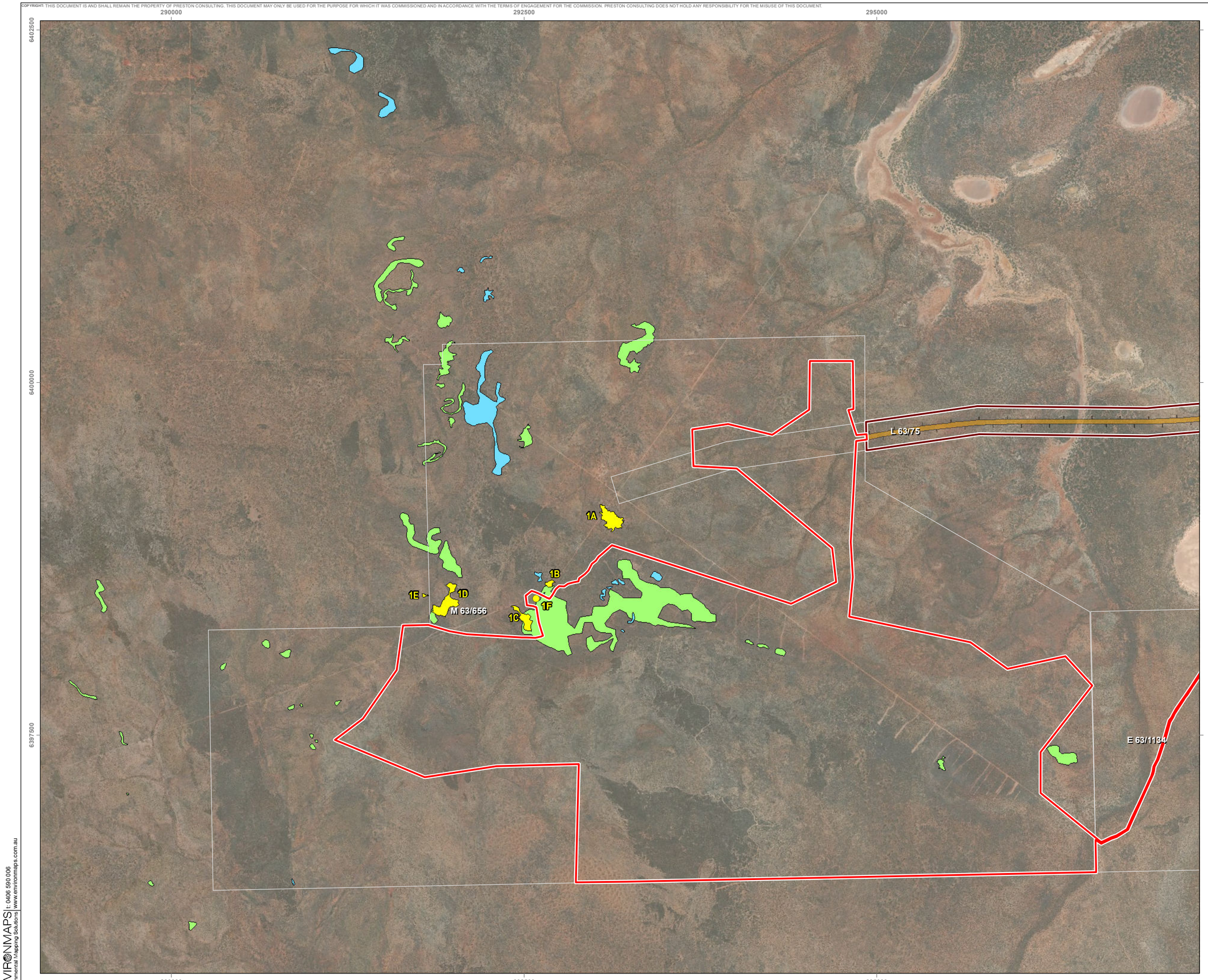
**LOCALITY MAP**


| CREATED BY | JOB | DATE | REVISION |
|---|---|---|---|
| ENVIRONMAPS | PC2900035 | 9/07/2020 | 0 |

audalia resources limited

ENVIRONMAPS | t: 0406 590 006 | Environmental Mapping Solutions | www.environmaps.com.au

Figure 39: Significant flora recorded within the survey area




**Legend**

- Mine Development Envelope
- Haul Road Development Envelope
- Haul Road Indicative Disturbance Footprint
- Tenement
- *Marianthus aquilonaris* Population
- *Eucalyptus rhomboidea* Population
- *Stenanthemum bremerense* Population

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DMRS 2020
- LOCALITY MAP SOURCED LANDGATE
- AERIAL PHOTOGRAPHY OPEN SOURCE

Preston Consulting

0 0.2 0.4 0.6 0.8 1
km
Scale: 1:25,000 @ A3

N

**LOCALITY MAP**


| CREATED BY | JOB | DATE | REVISION |
|---|---|---|---|
| ENVIRONMAPS | PC2900035 | 9/07/2020 | 0 |

audalia resources limited

ENVIRONMAPS | t: 0406 590 006 | Environmental Mapping Solutions | www.environmaps.com.au

Figure 40: Significant Flora populations in proximity to the survey area

## 5.6.2 *MARIANTHUS AQUILONARIS*

Flora and vegetation field surveys within the mine study area identified *M. aquilonaris* which is listed as Threatened under the BC Act.

***Conservation Status***

*M. aquilonaris* was declared as Rare Flora under the WA *Wildlife Conservation Act 1950* in 2002 under the name *Marianthus* sp. Bremer, and is ranked as Critically Endangered (CR) under World Conservation Union (IUCN 2001) criteria B1ab(iii,v)+2ab(iii,v); C2a(ii) due to its extent of occurrence being less than 100 km$^2$, its area of occupancy being less than 10 km$^2$, a continuing decline in the area, extent and/or quality of its habitat and number of mature individuals and there being less than 250 mature individuals known at the time of ranking. However, as more plants have since been found, it no longer meets these criteria and a recommendation will be made by DBCA to the Threatened Species Scientific Committee (TSSC) that they be changed to CR B1ab(iii,v)+2ab(iii,v). The species is not currently listed under the EPBC Act. The main threats to the species are mining/exploration, track maintenance and inappropriate fire regimes (DEC, 2010).

***Biology and Ecology***

*M. aquilonaris* is an erect, straggly shrub to 1.6 m high with hairy stems, alternate, elliptic to oblong leaves, a glabrous calyx and a pale blue and white corolla (Figure 41). Flowers appear between September and October. *M. aquilonaris* appears to be a disturbance opportunist as it was found growing in abundance in areas that had been recently burnt (DEC, 2010).

*M. aquilonaris* is considered to be a facultative seeder-sprouter, with many plants re-sprouting from basal stock following fire, however plants are also able to germinate from seed. Based on assessments conducted by DBCA, the juvenile period is approximately 36 months (DEC, 2011).

***Distribution***

*M. aquilonaris* is known only from the Bremer Range which is listed as a Priority 1 Ecological Community (PEC), located approximately 100 km west, south-west of Norseman, WA (Figure 42). The extent of occurrence for this taxon is likely to be less than 0.5 km$^2$ (DEC, 2010).

***Regional Searches***

Assessments on potential habitat for this taxon have been conducted by both DBCA and Botanica. The potential habitats targeted were based on similar geology, elevation and associated vegetation with the known *M. aquilonaris* sub-populations, however no further populations have been identified by DBCA or Botanica. From the potential habitat search conducted by Botanica, where a total of 35 potential habitat locations were surveyed, six potential optimal habitats (based on similar habitat and vegetation to known populations) were identified.

***Population Extent***

Currently there are six known sub-populations of *M. aquilonaris,* all of which occur within Bremer Range. Population 1a - 1c and 1f were previously known populations listed by DBCA. Population 1d and 1e were newly identified populations located by Botanica in September / October 2014. Details on the current status of all sub-populations are summarised in Table 13.



Table 13: Summary of *M. aquilonaris* sub-populations

| Population No. | DBCA Live Total Count (2011)[1] | DBCA Live Total Count (2015/2016)[2] | Area Occupied ($m^2$)[3] (2015) | Area Occupied ($m^2$)[4] (2018) | Population Condition |
|---|---|---|---|---|---|
| 1a | 9820 | 2259 | 25,288 | 16,050 | Moderate |
| 1b | 787 | 247 | 5,645 | 2,124 | Moderate |
| 1c | 7091 | 3205 | 16,719 | 8,668 | Healthy |
| 1d | N/A-Sub-populations were not identified | 8255 | 25,400 | 17,630 | Healthy |
| 1e | N/A-Sub-populations were not identified | 661 | 2,200 | 638 | Healthy |
| 1f | N/A-Sub-populations were not identified | 1 | 11 | 0 | Healthy |
| **Total** | **17,659** | **14,628** | **75,263** | **45,110** | |

1 Population monitoring conducted by DBCA in October 2011.
2 Simple plant count conducted by DBCA 29 September 2015 and 7 September 2016 (listed on the TPFL database).
3 Area occupied/ population condition as listed on DBCA TPFL database based on assessments conducted by Botanica and DBCA.
4 Area occupied based on assessments conducted by Botanica 28 - 30 November 2018.

As shown by the DBCA plant counts, plant numbers have declined over time since a mass germination event following bushfires in the area in 2010. Recent observations of the population area were made by Botanica in November 2018, where a number of plants were observed to have died off. Plant numbers are expected to continue to decline with increasing time since fire disturbance.

Figure 41: Image of *M. aquilonaris* (Botanica, 2020e)

120°0'0"E 121°0'0"E 122°0'0"E

31°0'0"S 32°0'0"S

Lake Deborah East
Nature Reserve
Lake Seabrook
Southern Cross
Boorabbin NP
GOLDFIELDS WOODLANDS NP
Coolgardie
Kalgoorlie
Boulder
Kambalda West
Lake Yindarigooda
Lake Lefroy
Lake Cowan
Norseman
94
JILBADJI NATURE RESERVE
JILBADJI NATURE RESERVE
BREMER RANGE PEC 1
Lake Johnston
Lake Hope
Lake Hurlstone
Lake Gulson
Lake Sharpe
Lake Dundas
*Marianthus aquilonaris*
DEVELOPMENT ENVELOPE

**Legend**

- Development Envelopes
- *Marianthus aquilonaris* population Jan 2019
- Bremer Range PEC

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DMRS 2020
- LOCALITY MAP SOURCED LANDGATE

Preston Consulting

0 10 20 30 40 50 km
Scale: 1:1,000,000 @ A3
N

**LOCALITY MAP**


| CREATED BY | JOB | DATE | REVISION |
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Figure 42: Regional map of Bremer Range and *M. aquilonaris* records

***Associated Vegetation***

All of the sub-populations are within areas mapped as 'Regrowth mixed low shrubland on hillslope' (HS-OS1) or 'Regrowth mid open mallee woodland of *Eucalyptus livida* over mid open shrubland of *Hakea pendens* and open low shrubland of *Goodia medicaginea* on hillslope' (HS-MWS1). HS-MWS1 contains *Eucalyptus livida* which Botanica have noted to be present at all areas of occupancy. However, the presence of *E. livida* does not necessarily indicate that *M. aquilonaris* will be present. The fact that insects noted to be visiting *E. livida* (Prendergast, 2019) were also noted on *M. aquilonaris* suggests that potential pollinators are not specific to *M. aquilonaris*, and the heavy and widespread flowering of *E. livida* potentially provides alternative food sources to potential pollinators.

Surrounding vegetation types occur on deeper colluvial soils that do not contain outcrops of limonite and are therefore not suitable for *M. aquilonaris.*

### 5.6.3 Weeds

Nine introduced taxa were identified within the mine study area, with none identified within the haul road study area (Botanica, 2020c):

- *Asphodelus fistulosus* (Onion Weed);
- *Bromus rubens* (Red brome);
- *Carrichtera annua* (Ward's Weed);
- *Centaurea melitensis* (Maltese cockspur);
- *Lysimachia arvensis* (Pimpernel);
- *Pentameris airoides* (False Hairgrass);
- *Rostraria pumila* (Roughtail);
- *Sonchus oleraceus* (Common sowthistle); and
- *Vulpia muralis.*

None of these taxa were considered Weeds of National Significance or Declared plants under the BAM Act.

### 5.6.4 Vegetation

***Floristic Communities***

Fourteen floristic communities were identified within the survey area. These communities were located within five different landform types and comprised of five major vegetation groups, which were represented by a total of 58 Families, 162 Genera and 411 Taxa. A summary of floristic communities is provided in Table 14 and shown in Figure 43 to Figure 48.

**Table 14: Summary of floristic communities within the survey area**

| Landform | NVIS Vegetation Group | Floristic Community[1] | Vegetation Code | Area (ha) | Area (%) |
|---|---|---|---|---|---|
| Closed Depression | Chenopod Shrublands, Samphire Shrublands and Forblands (MVG 22) | Low samphire shrubland of *Tecticornia indica* subsp. *bidens* over low open forbland of *Disphyma crassifolium* on playa | CD-CSSSF1 | 67 | 0.4 |

| Landform | NVIS Vegetation Group | Floristic Community[1] | Vegetation Code | Area (ha) | Area (%) |
|---|---|---|---|---|---|
| Clay-Loam Plain | Eucalypt Woodlands (MVG 5) | Low open woodland of *Eucalyptus salmonophloia* over mixed shrubs on clay-loam plain | CLP-EW1 | 10,022[2] | 53.4 |
| | Mallee Woodlands and Shrublands (MVG 14) | Mid mallee shrubland of *Eucalyptus* spp. over mid shrubland of *Melaleuca pauperiflora* and mixed low shrubland on clay-loam plain | CLP-MWS1 | 1,975 | 10.5 |
| | | Mid mallee woodland of *Eucalyptus* spp. over mixed low shrubland / heathland on clay-loam plain | CLP-MWS2 | 2,561 | 13.6 |
| Granite Outcrop | Heathlands (MVG 18) | Heathland of *Thryptomene* spp. over sparse tussock grassland of *Neurachne alopecuroidea* on granite outcrop | G-H1 | 265 | 1.4 |
| Hillslope | Eucalypt Woodlands (MVG 5) | Regrowth of low open forest of *Eucalyptus* sp. (Sterile) on hillslope | HS-EW1 | 15 | 0.1 |
| | Mallee Woodlands and Shrublands (MVG 14) | Regrowth mid open mallee woodland of *Eucalyptus livida* over mid open shrubland of *Hakea pendens* and open low shrubland of *Goodia medicaginea* on hillslope | HS-MWS1 | 150 | 0.8 |
| | | Regrowth low open mallee shrubland of *Eucalyptus* spp. over low shrubland of *Acacia* spp. and open tussock grassland of *Schoenus breviculmis* on hillslope | HS-MWS2 | 16 | 0.1 |
| | | Mid open mallee woodland of *Eucalyptus livida* over heathland of *Allocasuarina / Hakea / Melaleuca* and open low sedge of *Lepidosperma sanguinolentum* on hillslope | HS-MWS3 | 96 | 0.5 |
| | Other Shrublands (MVG 17) | Regrowth mixed low shrubland on hillslope | HS-OS1 | 412 | 2.2 |
| Sand-Loam Plain | Eucalypt Woodlands (MVG 5) | Low woodland of *Eucalyptus salicola* over low open shrubland of *Phebalium filifolium* and low open sedgeland of *Gahnia ancistrocarpa* on sand-loam plain | SLP-EW1 | 1,519 | 8.1 |
| | Mallee Woodlands and Shrublands (MVG 14) | Mid sparse mallee shrubland of *Eucalyptus eremophila* over heathland of *Melaleuca* spp. on sand-loam plain | SLP-MWS1 | 1,436 | 7.74 |
| | | Regrowth mid sparse mallee shrubland of *Eucalyptus* spp. over low open shrubland of *Acacia / Grevillea* spp. and open hummock grassland of *Triodia scariosa* on sand-loam plain | SLP-MWS2 | 67 | 0.4 |
| | Other Shrublands (MVG 17) | Regrowth low open woodland of *Codonocarpus cotinifolius* over mid shrubland of *Acacia / Melaleuca* spp. and open tussock grassland of *Schoenus breviculmis* on sand-loam plain | SLP-OS1 | 27 | 0.1 |
| **TOTAL** | | | | **18,770** | **100** |

[1] Descriptions of floristic communities are based on the vegetation structure at the time of survey (2014 - 2015 and 2017). Vegetation structure of regrowth vegetation types is subject to change with continued recovery from fire.

[2] 5,381 ha comprised of mature woodland. Remaining area comprised of regrowth.

292500 295000 297500

6400000 6397500 6395000

L 63/775

M 63/656

E 63/1134

Floristic Communities

- CD-CSSSF1: Low samphire shrubland of *Tecticornia indica* subsp. bidens over low open forbland of *Disphyma crassifolium* on playa.
- CLP-EW1: Low open woodland of *Eucalyptus salmonophloia* over mixed shrubs on clay-loam plain.
- CLP-MWS1: Mid mallee shrubland of *Eucalyptus* spp. over mid shrubland of *Melaleuca pauperiflora* and mixed low shrubland on clay-loam plain.
- CLP-MWS2: Mid mallee woodland of *Eucalyptus* spp. over mixed low shrubland/ heathland on clay-loam plain.
- G-H1: Heathland of *Thryptomene* spp. over sparse tussock grassland of *Neurachne alopecuroidea* on granite outcrop.
- HS-EW1: Regrowth of low open forest of *Eucalyptus* sp. (Sterile) on hillslope.
- HS-MWS1: Regrowth mid open mallee woodland of *Eucalyptus livida* over mid open shrubland of *Hakea pendens* and open low shrubland of *Goodia medicaginea* on hillslope.
- HS-MWS2: Regrowth low open mallee shrubland of *Eucalyptus* spp. over low shrubland of *Acacia* spp. and open tussock grassland of *Schoenus breviculmis* on hillslope.
- HS-MWS3: Mid open mallee woodland of *Eucalyptus livida* over heathland of *Allocasuarina/Hakea/Melaleuca* and open low sedge of *Lepidosperma sanguinolentum* on hillslope.
- HS-OS1: Regrowth mixed low shrubland on hillslope.
- SLP-EW1: Low woodland of *Eucalyptus salicola* over low open shrubland of *Phebalium filifolium* and low open sedgeland of *Gahnia ancistrocarpa* on sand-loam plain.
- SLP-MWS1: Mid sparse mallee shrubland of *Eucalyptus eremophila* over heathland of *Melaleuca* spp. on sand-loam plain.
- SLP-MWS2: Regrowth mid sparse mallee shrubland of *Eucalyptus* spp. over low open shrubland of *Acacia/Grevillea* spp. and open hummock grassland of *Triodia scariosa* on sand-loam plain.
- SLP-OS1: Regrowth low open woodland of *Codonocarpus cotinifolius* over mid shrubland of *Acacia/Melaleuca* spp. and open tussock grassland of *Schoenus breviculmis* on sand-loam plain.
- Playa: Bare playa.

## Legend

- Mine Development Envelope
- Haul Road Development Envelope
- Mine Disturbance Footprint
- Haul Road Indicative Disturbance Footprint
- Tenement

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DMRS 2020
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE

BOTANICA CONSULTING

0 0.2 0.4 0.6 0.8 1 km

Scale: 1:669,530 @ A3

N

## LOCALITY MAP


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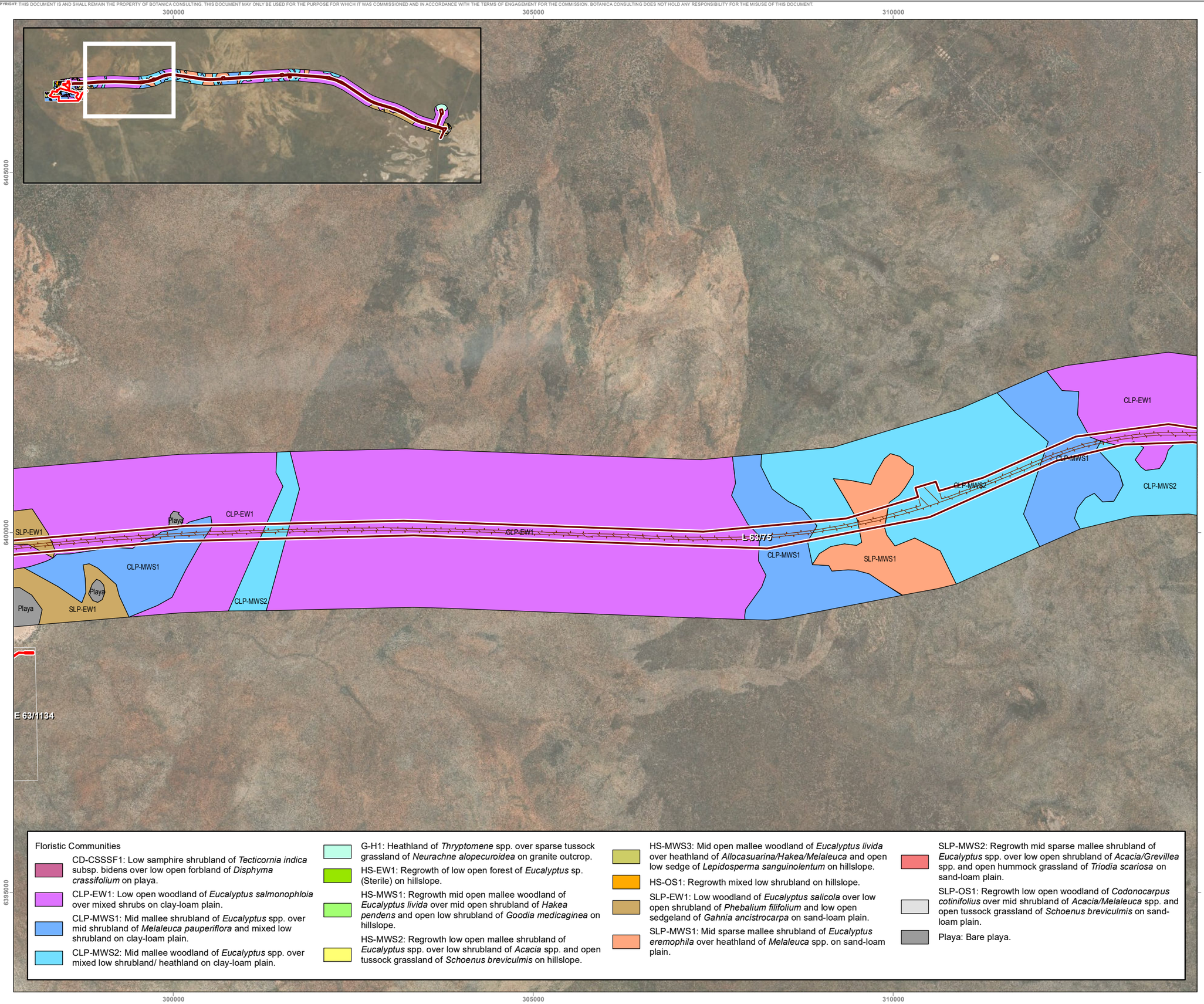
Figure 43: Floristic Communities (1 of 6)




Floristic Communities

- CD-CSSSF1: Low samphire shrubland of *Tecticornia indica* subsp. bidens over low open forbland of *Disphyma crassifolium* on playa.
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- HS-MWS2: Regrowth low open mallee shrubland of *Eucalyptus* spp. over low shrubland of *Acacia* spp. and open tussock grassland of *Schoenus breviculmis* on hillslope.
- HS-MWS3: Mid open mallee woodland of *Eucalyptus livida* over heathland of *Allocasuarina/Hakea/Melaleuca* and open low sedge of *Lepidosperma sanguinolentum* on hillslope.
- HS-OS1: Regrowth mixed low shrubland on hillslope.
- SLP-EW1: Low woodland of *Eucalyptus salicola* over low open shrubland of *Phebalium filifolium* and low open sedgeland of *Gahnia ancistrocarpa* on sand-loam plain.
- SLP-MWS1: Mid sparse mallee shrubland of *Eucalyptus eremophila* over heathland of *Melaleuca* spp. on sand-loam plain.
- SLP-MWS2: Regrowth mid sparse mallee shrubland of *Eucalyptus* spp. over low open shrubland of *Acacia/Grevillea* spp. and open hummock grassland of *Triodia scariosa* on sand-loam plain.
- SLP-OS1: Regrowth low open woodland of *Codonocarpus cotinifolius* over mid shrubland of *Acacia/Melaleuca* spp. and open tussock grassland of *Schoenus breviculmis* on sand-loam plain.
- Playa: Bare playa.

**Legend**

- Mine Development Envelope
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- Tenement

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DMRS 2020
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE

BOTANICA CONSULTING

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Scale: 1:50,000 @ A3

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**LOCALITY MAP**

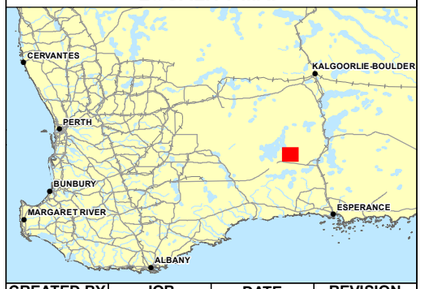


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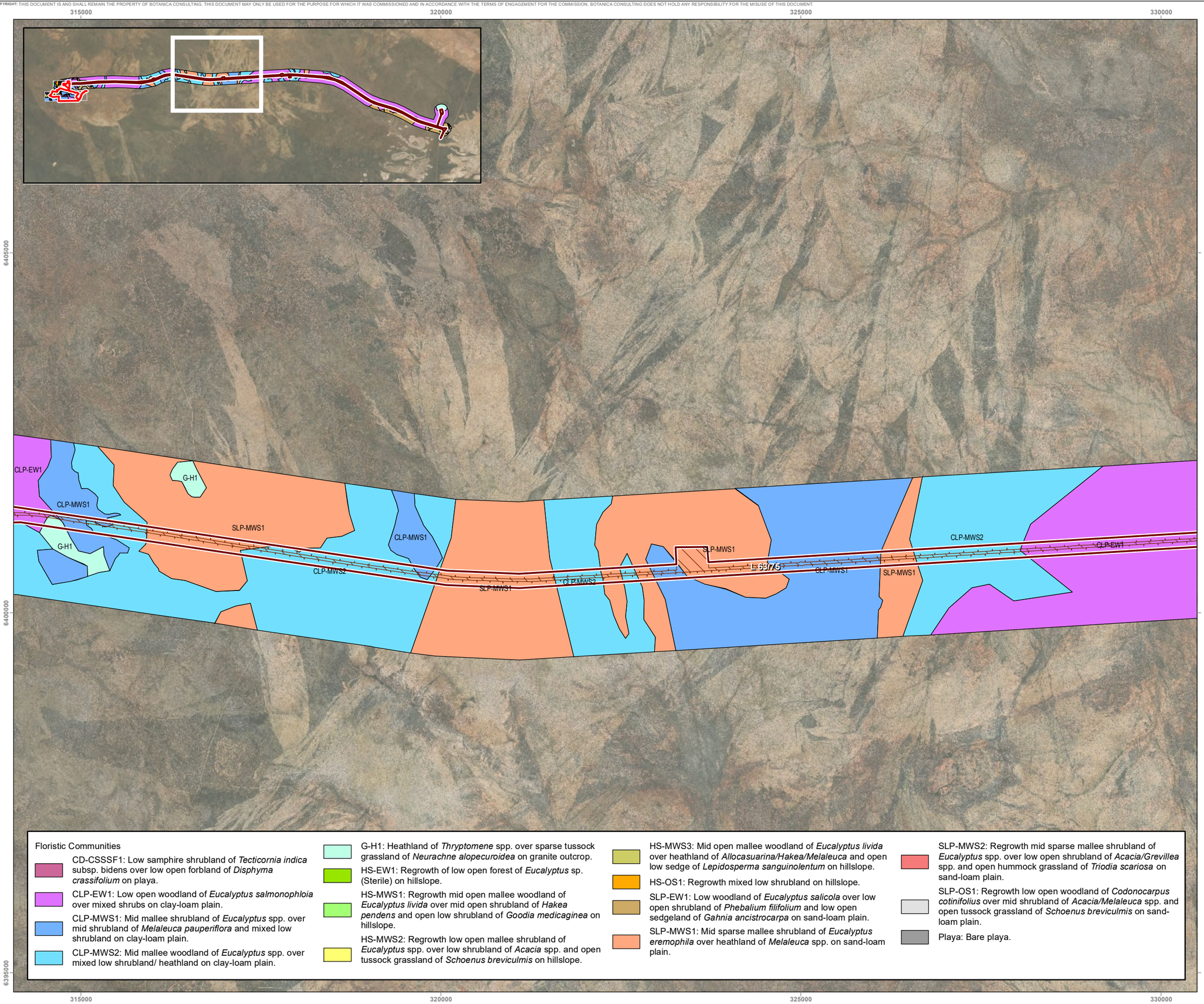
Figure 44: Floristic Communities (2 of 6)




**Legend**

- Mine Development Envelope
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- Mine Disturbance Footprint
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- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE

BOTANICA CONSULTING

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Scale: 1:50,000 @ A3

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Figure 45: Floristic Communities (3 of 6)

335000 340000 345000

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CLP-EW1

SLP-MWS1

CLP-MWS2

CLP-MWS2

CLP-MWS2

CLP-MWS2

CLP-EW1

L 63/75

Floristic Communities

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- HS-MWS3: Mid open mallee woodland of *Eucalyptus livida* over heathland of *Allocasuarina/Hakea/Melaleuca* and open low sedge of *Lepidosperma sanguinolentum* on hillslope.
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- Playa: Bare playa.

335000 340000 345000

## Legend

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- Haul Road Indicative Disturbance Footprint
- Tenement

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DMRS 2020
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE

BOTANICA CONSULTING

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Scale: 1:50,000 @ A3

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## LOCALITY MAP

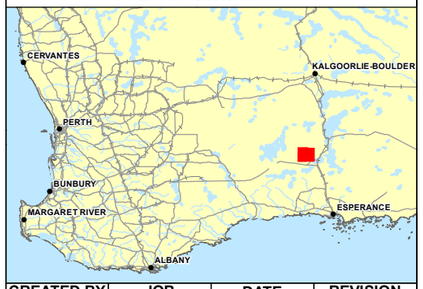


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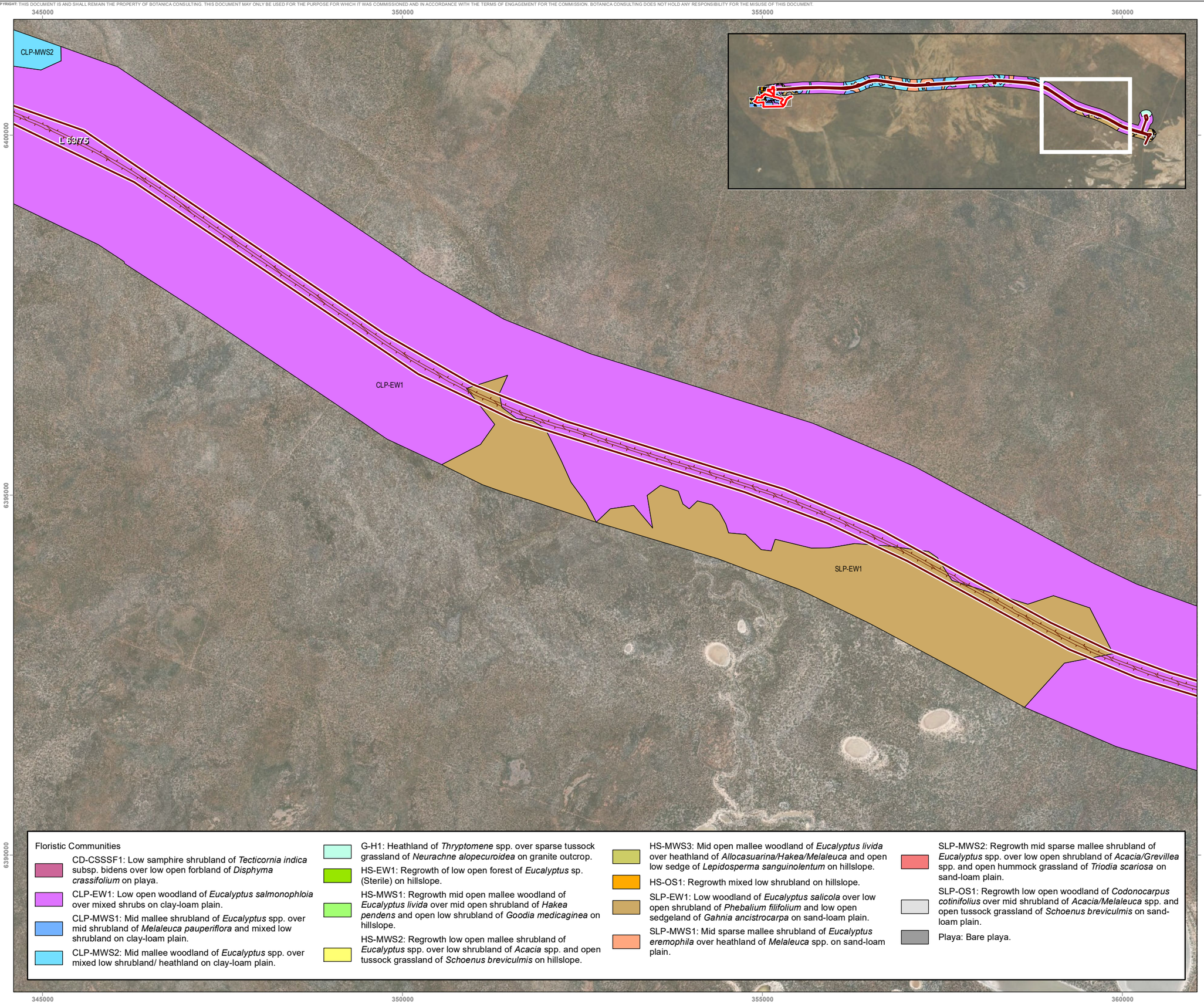
Figure 46: Floristic Communities (4 of 6)




Floristic Communities

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- Playa: Bare playa.

**Legend**

- Mine Development Envelope
- Haul Road Development Envelope
- Mine Disturbance Footprint
- Haul Road Indicative Disturbance Footprint
- Tenement

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DMRS 2020
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE

0 0.5 1 1.5 2 2.5 km

Scale: 1:669,530 @ A3

N

**LOCALITY MAP**


| CREATED BY | JOB | DATE | REVISION |
|---|---|---|---|
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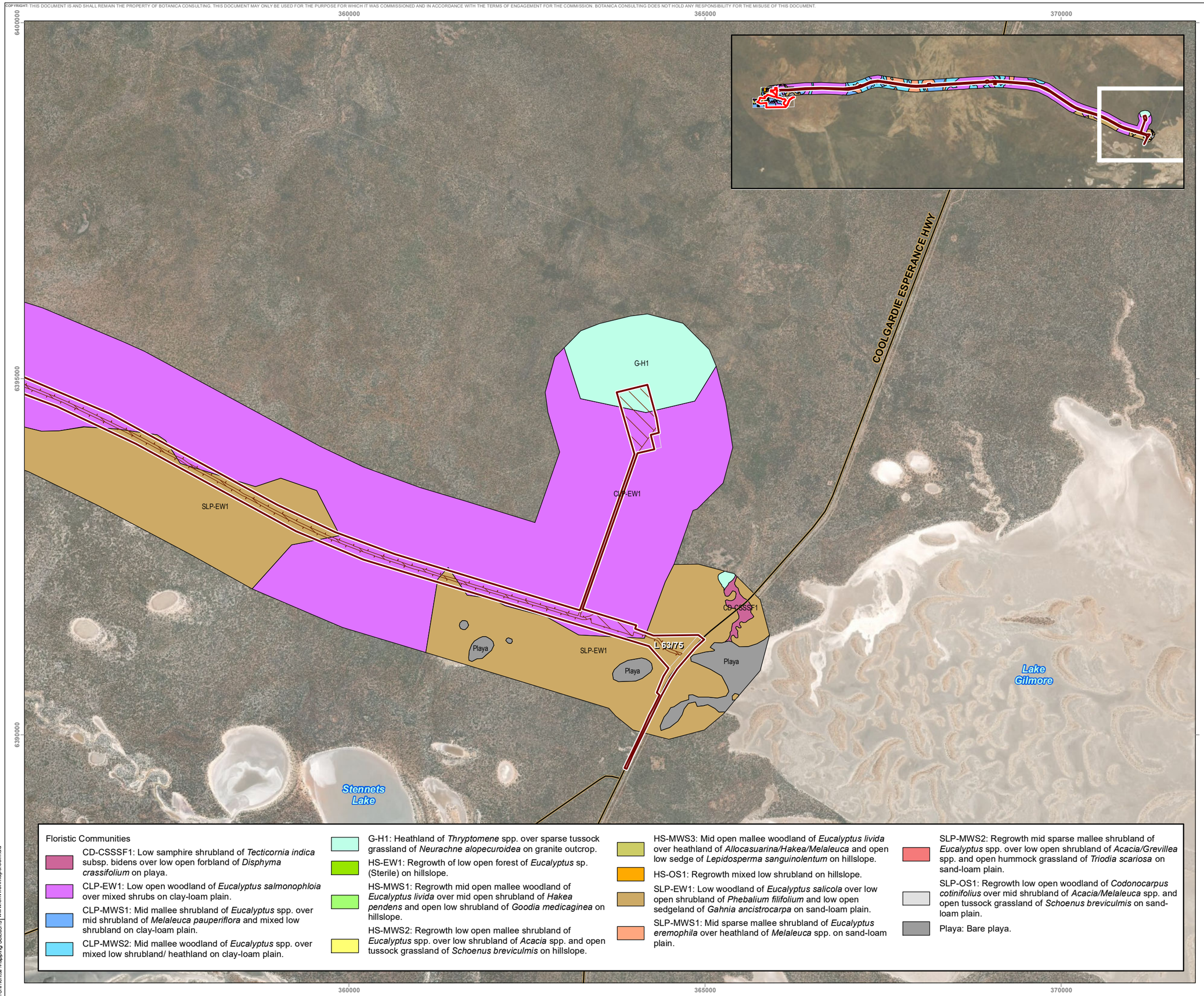
Figure 47: Floristic Communities (5 of 6)




Floristic Communities

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- Playa: Bare playa.

**Legend**

- Mine Development Envelope
- Haul Road Development Envelope
- Mine Disturbance Footprint
- Haul Road Indicative Disturbance Footprint
- Tenement
- Road

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DMRS 2020
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE

BOTANICA CONSULTING

0 0.5 1 1.5 2 2.5 km

Scale: 1:50,000 @ A3

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**LOCALITY MAP**


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|---|---|---|---|
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Figure 48: Floristic Communities (6 of 6)

***Vegetation Condition***

Based on the vegetation condition rating scale adapted from Keighery (1994) and Trudgen (1988), eight floristic communities were rated as 'good' and the remaining seven communities had a vegetation condition rating of 'very good'. A map of the vegetation condition within the survey area is provided in Figure 49.

'Good' condition is characteristic of vegetation structure that has been significantly altered by very obvious signs of multiple disturbances, however it retains its basic vegetation structure or has the ability to regenerate it. There is some disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

'Very Good' condition is characteristic of vegetation structure that has been altered by obvious signs of disturbance, such as repeated fires, the presence of some aggressive weeds, dieback, logging and/or grazing.

The survey area has been subjected to a major fire in 2010, with some areas subjected to multiple successional fires in 2010 (not available on Landgate database). In February 2015, the area was again subjected to fire (observed by Audalia staff in the area) however this fire has not been recorded on the Landgate database. In 2019, fires occurred directly west of the survey area within the Honman Ridge area. Vegetation within the survey area and surrounding region is therefore in various stages of regrowth.

***Floristic Composition***

Two 'supergroups' were identified in the PATN analysis:

1. Hillslopes (mallee woodland and shrubland), sand-loam plain (other shrubland/ eucalypt woodland / mallee woodland and shrubland), granite outcrop (other shrubland) and closed depression (chenopod/ samphire shrubland), clay-loam plain (mallee woodland and shrubland); and
2. Hillslopes (eucalypt woodland / other shrubland), clay-loam plain (eucalypt woodland / mallee woodland and shrubland), sand-loam plain (mallee woodland and shrubland).

The first supergroup was divided into eight floristic groups, comprising of quadrats from each of the five different landform types and major vegetation groups. The hillslopes communities (mallee woodland and shrubland), were divided into three groups, intermixed with quadrats from the clay-loam plain communities. The clay-loam plain communities were divided into four groups. The sand-loam plain (other shrubland / eucalypt woodland / mallee woodland and shrubland) communities were divided into four groups, also intermixed with quadrats from the clay-loam plain communities. The granite outcrop and closed depression community quadrats were grouped separately from all other quadrats.

The second group was divided into six floristic groups, comprising of quadrats from three different landform types hillslopes clay-loam plain and sand-loam plain) and three major vegetation groups (eucalypt woodland, other shrubland and mallee woodland and shrubland).

Based on the results of the PATN analysis, there was minimal heterogeneity in species composition across the survey area, with majority of vegetation types intermixed into floristic groups despite differences in both dominant stratum taxa and landform. The two super groups were highly mixed including quadrats from all the different landforms and major vegetation groups.



300000 325000 350000

6425000 6400000 6375000

Red Roo Rock
LAKE JOHNSTON
3 Mile Rock
Tamar Hill
LAKE MEDCALF
Bremer Waters
HAUL ROAD DEVELOPMENT ENVELOPE
MINE DEVELOPMENT ENVELOPE
Lackman Rock
Bull Rocks
Wellstead Rock
Daniell
STENNETS LAKE
Gilmore Rocks
Moir Rock
LAKE GILMORE
LAKE KING - NORSEMAN RD
KUMARL - LAKE KING RD
EXCLAMATION LAKE
FULLER RD
BEETE RD
BURNSIDE RD
BERRYMAN RD
KUMARL RD
KUMARL NORTH RD
Kumarl
QUAST RD
BEITTEWEST RD
COOLGARDIE ESPERANCE HWY
PRATT RD
HOLT RD
MAGAGNOTTI RD
GIMLET RD
AINSWORTH RD
HANSON RD
CUPS RD
PEAK CHARLES RD
Ellison Rock
PANSY LAKE
LAKE TAY
LAKE SHARPE
Peak Charles

**Legend**

- Mine Development Envelope
- Haul Road Development Envelope
- Road
- Railway

Vegetation Condition

- Very Good
- Good

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DIMRS 2020
- LOCALITY MAP SOURCED LANDGATE
- AERIAL PHOTOGRAPHY OPEN SOURCE

Preston Consulting

0 2 4 6 8 10
km
Scale: 1:250,000 @ A3

N

**LOCALITY MAP**


| CREATED BY | JOB | DATE | REVISION |
|---|---|---|---|
| ENVIRONMAPS | PC2900035 | 9/07/2020 | 0 |

audalia resources limited

ENVIRONMAPS | t: 0406 590 006
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Figure 49: Vegetation condition rating of the survey area

### *Significant Vegetation*

No Threatened Ecological Communities, restricted vegetation, highly disturbed vegetation, vegetation providing refuge or significant ecological function was identified within the survey area. The western region of the survey area is located within the *Bremer Range vegetation complexes* PEC which is listed by DBCA as a Priority 1 Ecological Community. This PEC (including the 500m buffer zone) encompasses an area of 88,150 ha and is centred on Mt Day, Round Top Hill and Honman Ridge (located outside of the survey area). A description of the *Bremer Range vegetation complexes* PEC provided by DBCA (DBCA, 2019b; Botanica, 2020d) is provided below:

> *Eucalyptus rhomboidea* ms and *E. eremophila* woodland on the side slopes of low ridges; *E. flocktoniae* woodland (with *E. salubris, E. salmonophloia, E. dundasii* and *E. tenuis*) on broad flat ridges and side slopes; *E. flocktoniae* and/or *E. longicornis* woodland on saline soils on ridges and flats adjacent to large salt lake systems; *E. longicornis* and/or *E. salmonophloia* or, *E. georgei subsp georgei* or, *E. dundasii* woodland, on low areas; *E. livida* woodland on lateritic tops or *Allocasuarina* thickets on greenstone ridges of lateritic breakaways; *Acacia duriuscula, Allocasuarina globosa, E. georgei* subsp. *georgei* and *E. oleosa* thickets on greenstone ridges with skeletal soils. Proposed Nature Reserve.

The lateritic hillslopes of the Medcalf deposit and lateritic hillslopes within the greater Bremer Range studied by Gibson & Lyons (Community 5) were grouped together, indicating the lateritic hillslopes of the Medcalf area have a similar species composition of lateritic hillslopes within the greater Bremer Range PEC. The Eucalypt woodland and Mallee woodland vegetation types within the Bremer Range region were also representative of the Bremer Range PEC.

The granite outcrop, closed depression community and Eucalypt woodlands associated with sand-loam plains community which were located along the haul road survey area were not represented within the Bremer Range PEC.

The *Allocasuarina globosa* assemblages on greenstone rock PEC was also located approximately 3.5 km south-west of the survey area, and is listed by DBCA as a Priority 1 Ecological Community. These assemblages are only known from the Norseman area and in the Bremer Ranges. None of the floristic communities within the survey area are representative of this PEC.

### *Locally Significant Vegetation*

Eight floristic communities are considered to be significant vegetation as they resemble the floristic values of the Bremer Range Vegetation Complexes PEC. One of these (HS-MWS1) is also significant as it provides habitat for *M. aquilonaris*.

Table 15 summarises the extent of the locally significant vegetation within the survey area. The extent of this locally significant vegetation is shown on Figure 50.

**Table 15: Locally significant vegetation**

| Floristic Community Unit | Reason for significance | Extent in survey area (ha) | Extent in DEs (ha) |
|---|---|---|---|
| CLP-EW1 | Vegetation representative of the Bremer Range Vegetation Complexes PEC | 10,022 | 1,237 |
| CLP-MWS1 | | 1,975 | 464 |
| CLP-MWS2 | | 2,561 | 234 |
| HS-EW1 | | 15 | 5 |

| Floristic Community Unit | Reason for significance | Extent in survey area (ha) | Extent in DEs (ha) |
|---|---|---|---|
| HS-MWS1 | Vegetation representative of the Bremer Range Vegetation Complexes PEC<br>Provides habitat for *M. aquilonaris* (T) | 150 | 63 |
| HS-MWS2 | Vegetation representative of the Bremer Range Vegetation Complexes PEC | 16 | 0 |
| HS-MWS3 | | 96 | 0 |
| HS-OS1 | | 412 | 167 |

### 5.6.5 GROUNDWATER DEPENDENT ECOSYSTEMS

A review of the BoM's Groundwater Dependent Ecosystem (GDE) Atlas completed by GRM (2020a) for an area of 25 km surrounding the DEs indicates that the area is classified as having:

- No identified aquatic or subterranean GDE's within the DEs; and
- A moderate potential within and to the north of the DEs for terrestrial GDE's, and a low potential for terrestrial GDE's to the south of the Project.

292500 295000 297500

6400000 6397500 6395000

CLP-EW1 HS-MWS1 CLP-MWS1 HS-EW1 HS-OS1 HS-MWS2 HS-MWS3 CLP-MWS2 HS-MWS1 HS-MWS3

L 63/75 M 63/556 E 63/1134

0 5 km

LAKE KING - NORSEMAN RD

COOLGARDIE ESPERANCE HWY

## Legend

- Mine Development Envelope
- Haul Road Development Envelope
- Mine Disturbance Footprint
- Haul Road Indicative Disturbance Footprint
- Tenement

Significant Vegetation

- CLP-EW1: Low open woodland of *Eucalyptus salmonophloia* over mixed shrubs on clay-loam plain.
- CLP-MWS1: Mid mallee shrubland of *Eucalyptus* spp. over mid shrubland of *Melaleuca pauperiflora* and mixed low shrubland on clay-loam plain.
- CLP-MWS2: Mid mallee woodland of *Eucalyptus* spp. over mixed low shrubland/ heathland on clay-loam plain.
- HS-EW1: Regrowth of low open forest of *Eucalyptus* sp. (Sterile) on hillslope.
- HS-MWS1: Regrowth mid open mallee woodland of *Eucalyptus livida* over mid open shrubland of *Hakea pendens* and open low shrubland of *Goodia medicaginea* on hillslope.
- HS-MWS2: Regrowth low open mallee shrubland of *Eucalyptus* spp. over low shrubland of *Acacia* spp. and open tussock grassland of *Schoenus breviculmis* on hillslope.
- HS-MWS3: Mid open mallee woodland of *Eucalyptus livida* over heathland of *Allocasuarina/Hakea/Melaleuca* and open low sedge of *Lepidosperma sanguinolentum* on hillslope.
- HS-OS1: Regrowth mixed low shrubland on hillslope.

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DMRS 2020
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE

BOTANICA CONSULTING

0 0.2 0.4 0.6 0.8 1 km

Scale: 1:25,000 @ A3

N

### LOCALITY MAP


| CREATED BY | JOB | DATE | REVISION |
|---|---|---|---|
| ENVIRONMAPS | BOT1 | 19/06/2020 | 0 |

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Environmental Mapping Solutions

Figure 50: Locally significant vegetation

# 5.7 FAUNA

The section below has been sourced from the following reports:

- Harewood, G. (2020a). Medcalf Vanadium Mining Project Fauna Survey (Level 2) - Phase 1 and Phase 2. Prepared for Audalia Resources Limited. November 2017, Version 2;
- Harewood, G. (2020b). Medcalf Vanadium Mining Project Proposed Haul Road Fauna Assessment. Prepared for Audalia Resources Limited. November 2017, Version 2;
- Harewood, G. (2017). Medcalf Vanadium Mining Project Troglofauna Pilot Study. Prepared for Audalia Resources Limited. October 2017, Version 2; and
- Insect visitors to *Marianthus aquilonaris* and surrounding flora Nov 2-4, 2019 (Prendergast, 2019).

A desktop assessment and field survey has been conducted of the Project DEs.

A desktop fauna assessment was undertaken, including searches of the DBCA NatureMap Database, the DAWE EPBC Act Protected Matters Search Tool and a review of previous fauna surveys to provide an indication of what fauna species may be present in the study area.

The field survey effort for the mine area consisted of a two phase Level 2 terrestrial fauna survey, over a study area (Mine Study Area) of approximately 1,850 ha. The Mine Study Area corresponded to Mining Lease M65/656. The Level 2 terrestrial fauna survey included targeted survey of conservation fauna species (Chuditch (*Dasyurus geoffroii*) and Malleefowl (*Leipoa ocellata*)) identified during the desktop review (Harewood, 2020a).

The field survey effort for the haul road consisted of a Level 1 assessment over a study area (Haul Road Study Area) of approximately 17,480 ha. The Haul Road Study Area included the proposed haul road alignment (and associated borrow pits) and a 1 km buffer on either side of the proposed road centreline.

The Critically Endangered (BC Act) plant species *M. aquilonaris* was thought to rely on native bees for pollination as suggested by its comparatively small flowers and floral features (Prendergast, 2019). In order to inform the EIA for the Project an assessment of potential pollinators for *M. aquilonaris* was carried out by Kit Prendergast, a Native Bee Scientist. The assessment was designed to identify insect visitors to *M. aquilonaris* and to determine if they serve as pollinators. At the time of the assessment, *M. aquilonaris* was not in peak bloom however a variety of insect species were collected on and surrounding *M. aquilonaris*.

## 5.7.1 FAUNA HABITAT

***Mine Study Area***

Three fauna habitat types within the Mine Study Area were mapped as part of the botanical survey undertaken (Harewood, 2020a). The fauna habitats are detailed in Table 16 and shown in Figure 51.

The majority of vegetation within the Mine Study Area was in a state of regeneration after having been burnt during a series of fires in 2009/2010 (Botanica, 2020c).

Table 16: Fauna habitats in the Mine Study Area

| Habitat | Extent within study area (ha) | Percentage of study area (%) |
|---|---|---|
| **Clay-Loam Plains** – Eucalypt woodlands or Mallee woodlands over shrublands. | 1,096.5 | 59.1 |
| **Hillslopes** – Eucalypt woodlands or Mallee woodlands over shrublands or shrublands. | 676.7 | 36.5 |
| **Sand-Loam Plains** – Eucalypt woodlands or shrublands. | 81.6 | 4.4 |

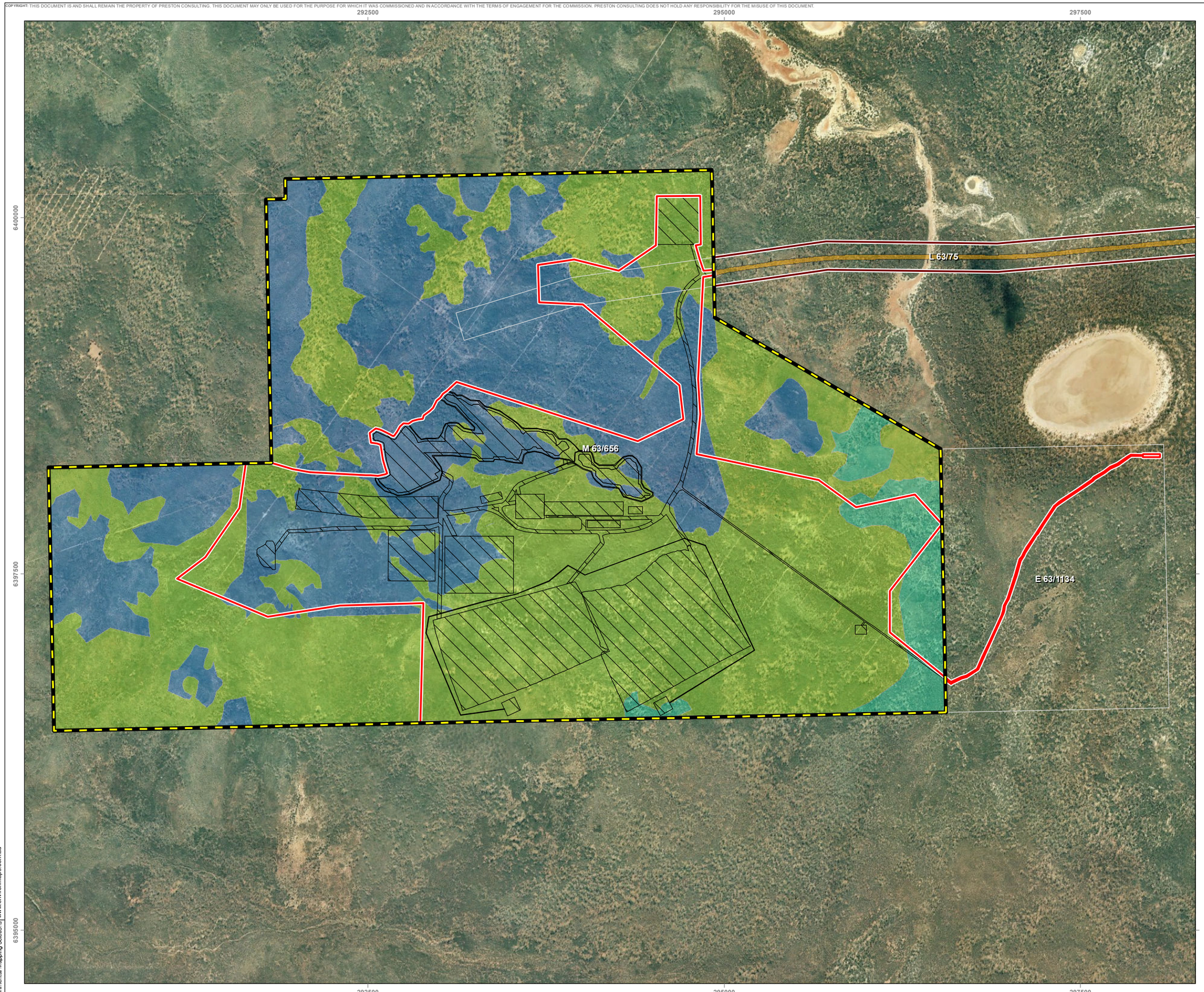
### *Haul Road Study Area*

The Haul Road fauna survey identified five broad fauna habitats within the study area, as detailed in Table 17 (Harewood, 2020b). The broad scale fauna habitats were identified primarily based on landforms; further (often subtle) subdivisions were possible using vegetation structure.

Table 17: Fauna habitats of the haul road study area

| Habitat | Extent within study area (ha) | Percentage of study area (%) |
|---|---|---|
| **Closed Depressions** – Low samphire shrubland over low open forbland on playa/bare playa. | 209 | 1.2 |
| **Clay-Loam Plains** – Eucalypt woodlands or Mallee woodlands over shrublands. | 13,599 | 77.8 |
| **Granite Outcrops** – Heathland over sparse tussock grassland on granite outcrops. | 265 | 1.5 |
| **Hillslopes** – Eucalypt woodlands or Mallee woodlands over shrublands or shrublands. | 349 | 2.0 |
| **Sand-Loam Plains** – Eucalypt woodlands or shrublands. | 3,058 | 17.5 |

Figure 52 provides an overview of the five fauna habitats mentioned in Table 17 and recorded within the Haul Road Study Area. Figure 53 - Figure 55 provide more detailed mapping of these habitats.




**Legend**

- Mine Development Envelope
- Haul Road Development Envelope
- Mine Disturbance Footprint
- Haul Road Indicative Disturbance Footprint
- Tenement
- Mine Study Area

Fauna Habitat

- Clay Loam Plain-Eucalypt Woodland / Mallee Woodland and Shrublands.
- Hillslope - Eucalypt Woodland / Mallee Woodland and Shrublands / Other Shrubland.
- Sand Loam Plain-Mallee Woodland and Shrublands / Other Shrubland.

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DIMRS 2020
- LOCALITY MAP SOURCED LANDGATE
- AERIAL PHOTOGRAPHY OPEN SOURCE

Preston Consulting

0 200 400 600 800 1,000
Meters
Scale: 1:25,000 @ A3

N

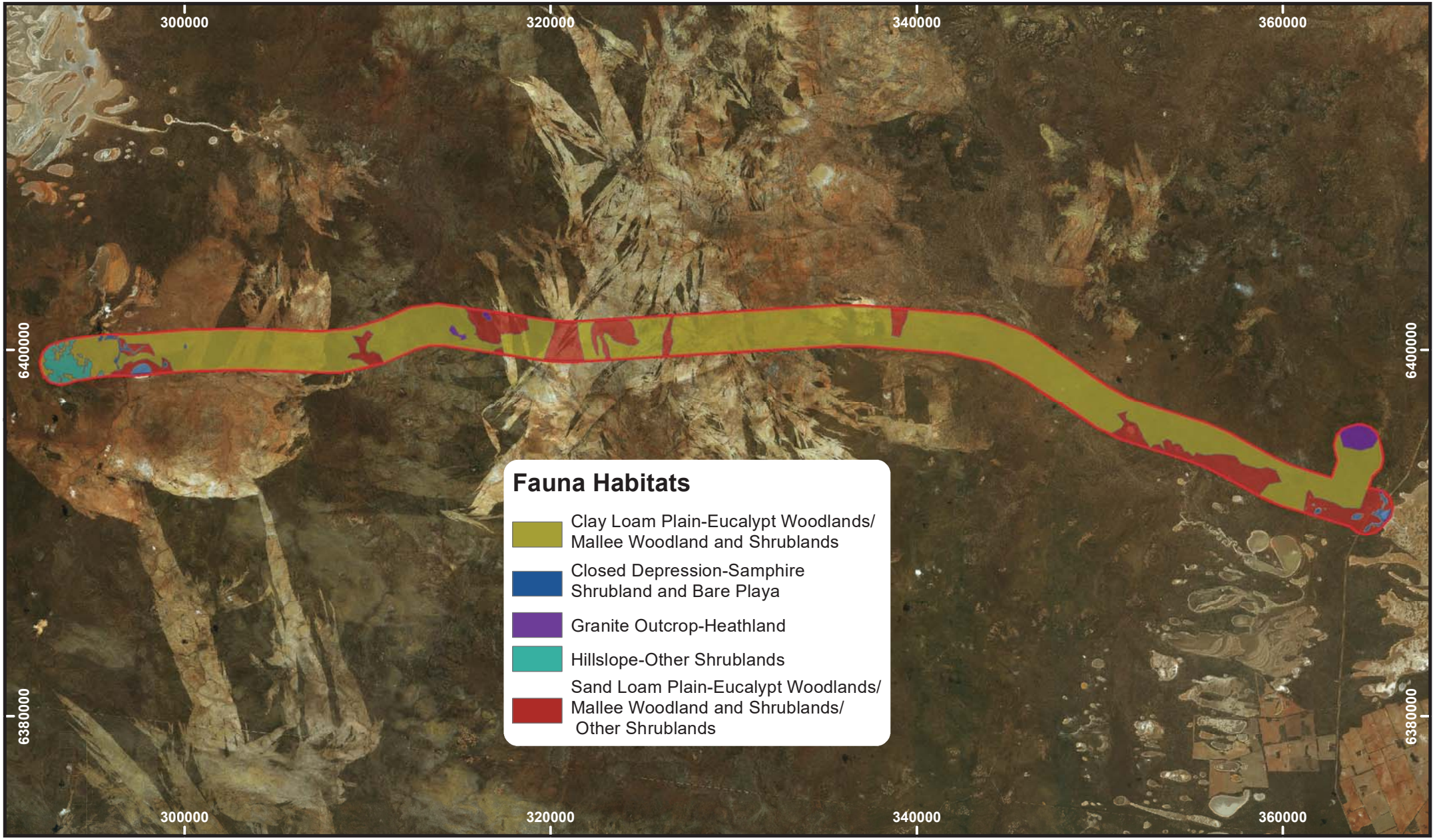
**LOCALITY MAP**


| CREATED BY | JOB | DATE | REVISION |
|---|---|---|---|
| ENVIRONMAPS | PC2900035 | 3/06/2020 | 0 |

audalia resources limited

ENVIRONMAPS | t: 0406 590 006 | Environmental Mapping Solutions | www.environmaps.com.au

Figure 51: Fauna habitats within the Mine Study Area




## Legend

Survey Area

N

0 5 10 15 20

Kilometres

Fauna Survey

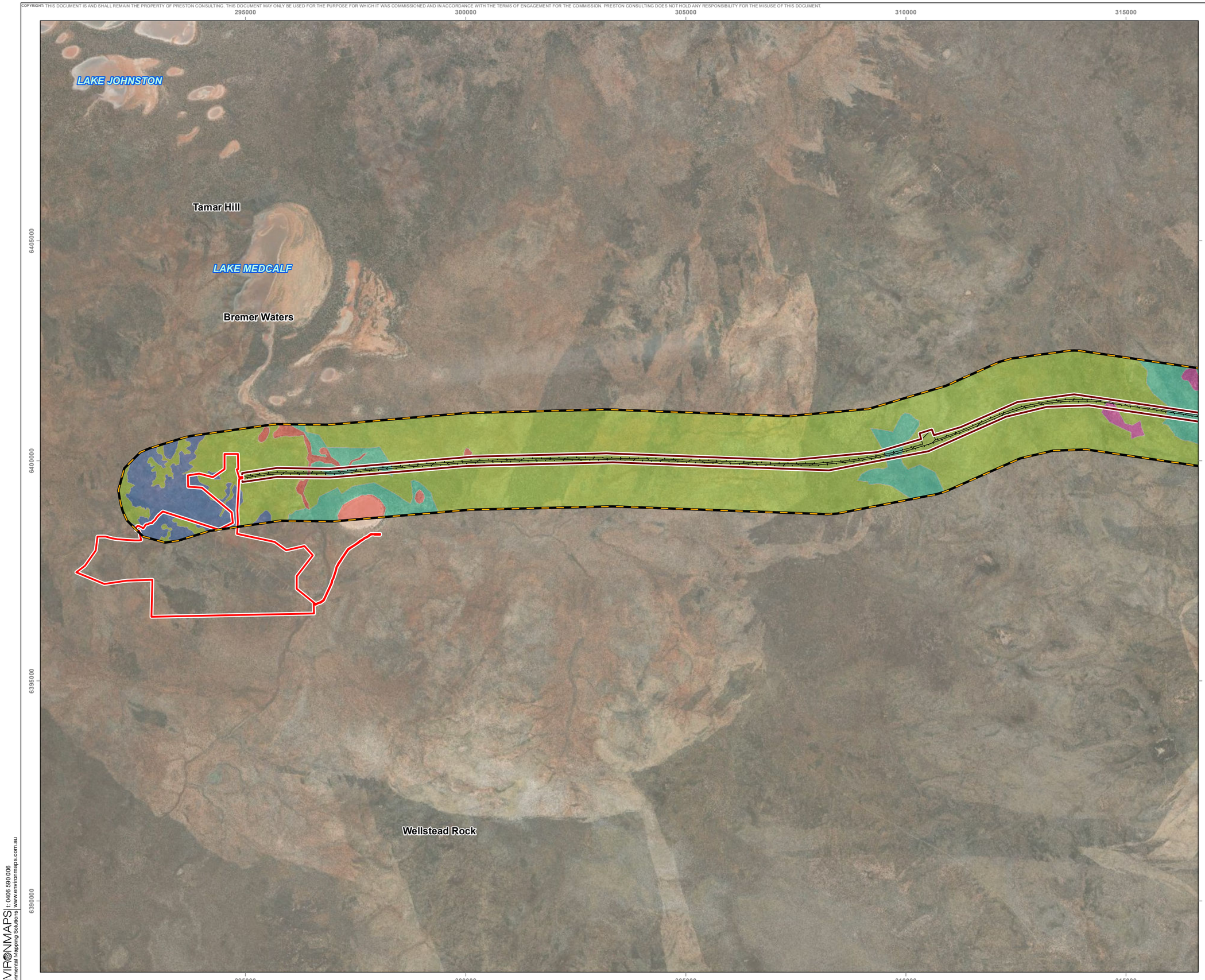
**Audalia Resources Ltd**
**Medcalf Project - Haul Road**

**Fauna Habitats**

(data courtesy Botanica Consulting)

Drawn: G Harewood
Date: Feb 2020
Scale: 1:275,000
Projection/Coordinate System: UTM/MGA Zone 51
Figure: 4

**Figure 52: Fauna habitats of the Haul Road Study Area - overview**




**Legend**

- Mine Development Envelope
- Haul Road Development Envelope
- Haul Road Study Area
- Haul Road Indicative Disturbance Footprint
- Road
- Railway

Fauna Habitat

- Granite Outcrop - Heathland.
- Hillslope - Other Shrublands.
- Closed Depression - Samphire Shrubland and Bare Playa.
- Clay Loam Plain - Eucalypt Woodlands / Mallee Woodland and Shrublands.
- Sand Loam Plain - Eucalypt Woodlands / Mallee Woodland and Shrublands / Other Shrublands.

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DMRS 2020
- LOCALITY MAP SOURCED LANDGATE
- AERIAL PHOTOGRAPHY OPEN SOURCE

Preston Consulting

0 0.5 1 1.5 2 2.5
km
Scale: 1:80,000 @ A3

N

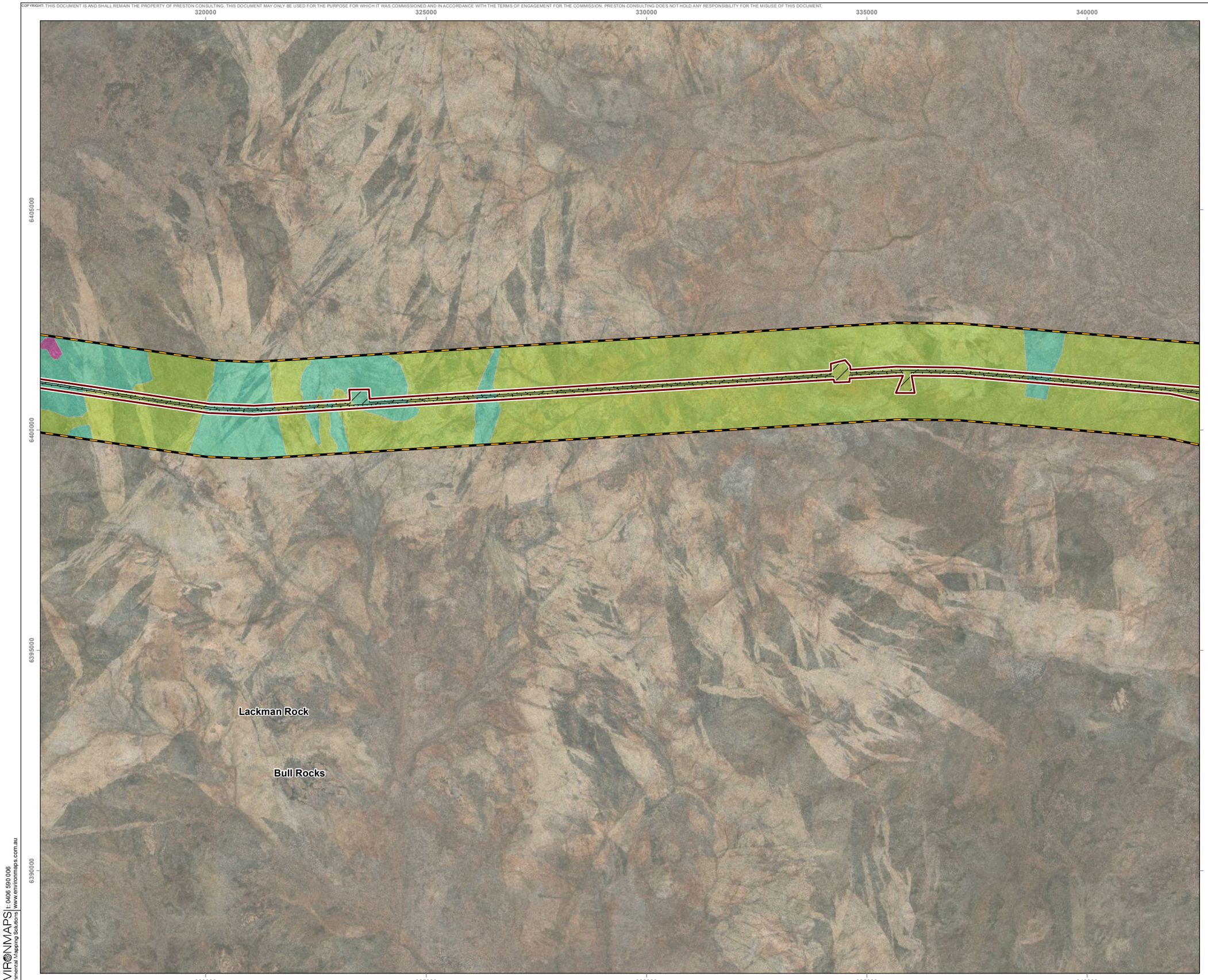
**LOCALITY MAP**


| CREATED BY | JOB | DATE | REVISION |
|---|---|---|---|
| ENVIRONMAPS | PC2900035 | 3/06/2020 | 0 |

audalia resources limited

ENVIRONMAPS | t: 0406 590 006 | Environmental Mapping Solutions | www.environmaps.com.au

Figure 53: Fauna habitats of the Haul Road Study Area – detailed (1 of 3)




## Legend

- Mine Development Envelope
- Haul Road Development Envelope
- Haul Road Study Area
- Haul Road Indicative Disturbance Footprint
- Road
- Railway

Fauna Habitat

- Granite Outcrop - Heathland.
- Hillslope - Other Shrublands.
- Closed Depression - Samphire Shrubland and Bare Playa.
- Clay Loam Plain - Eucalypt Woodlands / Mallee Woodland and Shrublands.
- Sand Loam Plain - Eucalypt Woodlands / Mallee Woodland and Shrublands / Other Shrublands.

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DMRS 2020
- LOCALITY MAP SOURCED LANDGATE
- AERIAL PHOTOGRAPHY OPEN SOURCE

Preston Consulting

0 0.5 1 1.5 2 2.5
km
Scale: 1:80,000 @ A3

N

**LOCALITY MAP**


| CREATED BY | JOB | DATE | REVISION |
|---|---|---|---|
| ENVIRONMAPS | PC2900035 | 3/06/2020 | 0 |

audalia resources limited

ENVIRONMAPS | t: 0406 590 006 | Environmental Mapping Solutions | www.environmaps.com.au

Figure 54: Fauna habitats of the Haul Road Study Area – detailed (2 of 3)


**Legend**

- Mine Development Envelope
- Haul Road Development Envelope
- Haul Road Study Area
- Haul Road Indicative Disturbance Footprint
- Road
- Railway

Fauna Habitat

- Granite Outcrop - Heathland.
- Hillslope - Other Shrublands.
- Closed Depression - Samphire Shrubland and Bare Playa.
- Clay Loam Plain - Eucalypt Woodlands / Mallee Woodland and Shrublands.
- Sand Loam Plain - Eucalypt Woodlands / Mallee Woodland and Shrublands / Other Shrublands.

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DMRS 2020
- LOCALITY MAP SOURCED LANDGATE
- AERIAL PHOTOGRAPHY OPEN SOURCE

Preston Consulting

0 0.5 1 1.5 2 2.5
km
Scale: 1:80,000 @ A3

N

**LOCALITY MAP**


| CREATED BY | JOB | DATE | REVISION |
|---|---|---|---|
| ENVIRONMAPS | PC2900035 | 3/06/2020 | 0 |

audalia resources limited

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Figure 55: Fauna habitats of the Haul Road Study Area – detailed (3 of 3)

### 5.7.2 General Fauna

A summary of the number of fauna species identified in the desktop review and surveys undertaken within the Mine Study Area and Haul Road Study Area is shown in Table 18.

**Table 18: Summary of potential vertebrate fauna species**

| Group | Total no. of potential species from desktop assessment | Potential no. of specially protected species | Potential no. of migratory species | Potential no. of priority species | No. of species observed in Mine Study Area | No. of species observed in Haul Road Study Area |
|---|---|---|---|---|---|---|
| **Amphibians** | 12 | 0 | 0 | 0 | 1 | 0 |
| **Reptiles** | 65 | 0 | 0 | 1 | 32 | 1 |
| **Birds** | 120 | 3 | 0 | 1 | 68 | 40 |
| **Mammals** | 24 | 1 | 0 | 1 | 15 | 6 |
| **Mammals (Bats)** | 9 | 0 | 0 | 1 | 8 | 8 |
| **Total** | **230** | **4** | **0** | **4** | **124** | **55** |

### 5.7.3 Significant Fauna

Harewood (2020a; 2020b) conducted likelihood assessments based on current available information and the presence or absence of suitable habitat identified during the field surveys. Table 19 identifies the significant fauna that were either recorded during the field surveys or listed by Harewood (2020a; 2020b) as possibly occurring in the study areas.

**Table 19: Significant fauna found or that may occur within the study areas**

| Species | Status | Likelihood of occurrence | Potential habitat |
|---|---|---|---|
| **Mammals** | | | |
| Chuditch (*Dasyurus geoffroii*) | Vulnerable – EPBC Act, BC Act | Possible only in the Mine Study Area, though no evidence of current use of habitat | Marginal habitat present in the Mine Study Area only. |
| Western Brush Wallaby (*Notamacropus irma*) | P4 – DBCA Priority | Possible, though no evidence of current use of habitat | Marginal habitat present. |
| Central Long-eared Bat (*Nyctophilus major tor*) | P3 – DBCA Priority | Recorded in both study areas. Known to occur | Habitat present. |
| **Reptiles** | | | |
| Lake Cronin Snake (*Paroplocephalus atriceps*) | P3 – DBCA Priority | Possible, though no evidence of current use of habitat | Marginal habitat present. |
| **Birds** | | | |
| Malleefowl (*Leipoa ocellata*) | Vulnerable – EPBC Act, BC Act | Possible, though no evidence of current or previous use of habitat. | Marginal habitat present. |
| Peregrine Falcon (*Falco peregrinus*) | S7 – BC Act | Possible, though no evidence of current use of habitat. | Marginal habitat present. |

| Species | Status | Likelihood of occurrence | Potential habitat |
|---|---|---|---|
| Western Rosella (Inland ssp.) (*Platycercus icterotis xanthogenys*) | P4 – DBCA Priority | Recorded in the Mine Study Area. Known to occur. | Habitat present. |
| Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) | Endangered – EPBC Act, BC Act | Possible within the Mine Study Area, though no evidence of current use. | Marginal habitat present. |
| Fork-tailed Swift (*Apus pacificus*) | Migratory – EPBC Act, BC Act | Possible, flyover only. | Habitat present, however flyover only. |

*"S" prefix = Schedule, "P" prefix = Priority*

The significant fauna listed in Table 19 that potentially utilise the study area have relatively wide ranging distributions and there is extensive areas of similar habitat adjacent to the study area.

### 5.7.4 *M. AQUILONARIS* POLLINATOR ASSESSMENT

In a separate study, Prendergast (2019) surveyed insect visitors to *M. aquilonaris* and surrounding vegetation in the mine study area. A total of 47 species of native bees were collected with only six species (including undescribed species) collected in the vicinity of *M. aquilonaris* (Table 20).

The vast majority of individuals and species were collected on *Eucalyptus livida*, which hosted a prolific number of native bees as well as other insects.

**Table 20: Insect visitors collected on *M. aquilonaris* flowers**

| Species | Total no. recorded visiting *M. aquilonaris* | Sex | Number of individuals | *M. aquilonaris* sub-population | Date of collection |
|---|---|---|---|---|---|
| **Bees** | | | | | |
| *Lasioglossum (Chilalictus) florale* | 2 | M | 1 | d | 3/11/2019 |
| | | F | 1 | d | 3/11/2019 |
| *Xanthesma sp* | 1 | M | 1 | a | 4/11/2019 |
| *Lasioglossum (Chilalictus) castor* | 1 | F | 1 | a | 4/11/2019 |
| *Megachile 66 "shelf clypeus"* | 1 | F | 1 | a | 4/11/2019 |
| *Megachile maculosipes* | 1 | M | 1 | a | 4/11/2019 |
| *Megachile 65 "prongs"* | 1 | F | 1 | c | 4/11/2019 |
| **Flies** | | | | | |
| *Syrphidae Sp.1* | 1 | | | a | 4/11/2019 |
| *Bombyliidae Geron sp.1* | 2 | | | a | 4/11/2019 |

The two halictids collected - *Lasioglossum (Chilalictus) florale* and *Lasioglossum (Chilalictus) castor* - are both described, and there is existing published information on their biology. Both species have a wide range; *L. castor* occurs throughout south-west WA, and the geographic range of *Lasioglossum (Chilalictus) florale* encompasses most of mid-west, south-west and southern Australia, and it is known to be locally abundant in some locations (Walker, 1995).

The sole euryglossine bee that was collected on *M. aquilonaris* was an undescribed *Xanthesma* species; consequently whilst this species specific range and habitat requirements are unknown, this genus is known to nest in soil (Houston, 1969).

Three of the native bee species collected foraging on *M. aquilonaris* are undescribed, and potentially even new to science, and as such their range and potential conservation status is entirely unknown. A similar situation exists for *Megachile maculosipes* as it is not officially recognised, having been named and published in a thesis (King, 1986).

In addition, three flies (Diptera) were observed visiting *M. aquilonaris*: two tiny flies (*Geron* sp., *Bombyliidae*) were collected on the flowers in the afternoon at sub-population a, and a hoverfly (*Syrphidae*) at sub-population d (Table 20). Whether these fly taxa serve as pollinators is unknown, as although flies can potentially be pollinators (Inouye, Larson, Ssymank, & Kevan, 2015), they can also be nectar thieves and are generally less effective at pollinating than bees (Willmer, Cunnold, & Ballantyne, 2017).

The numbers of bees collected in bee bowls next to *M. aquilonaris* far exceeded the number that were recorded actually foraging on the plants. This highlights a pitfall of bee bowls in that they cannot demonstrate that bees are actually foraging on the plants (Prendergast et al., 2020).

The relative paucity of insect visitors to *M. aquilonaris* observed during these surveys cannot be taken as conclusive evidence that few insects visit this species. Due to Prendergast visiting well after peak flowering, the few scattered flowers did not represent an attractive foraging resource for bees, which are known to target larger, clumped patches of flowers (Cresswell & Osborne, 2004; Sih & Baltus, 1987).

The native bee taxa were small to medium-sized, and therefore have limited flight ranges (Zurbuchen et al., 2010). As bees are central-place foragers, their foraging and nesting resources must be within flight range (Michener, 2007). With genetic data on *M. aquilonaris* suggesting limited pollen exchange between the sub-populations, it appears that the sub-populations are isolated from the perspective of these pollen vectors (Prendergast, 2019).

### 5.7.5 Short-range Endemic Fauna

A total of 25 invertebrate species were collected during the Level 2 fauna survey of the Mine Study Area. No invertebrate species were confirmed as being short-range endemic (SRE fauna), however five were classified as potential SREs because some members of the same genus are known as SREs (Harewood, 2020a). Without additional information, particularly on regional distributions, their actual SRE status is impossible to determine. The potential SREs are detailed in Table 21.

Table 21: Potential SRE invertebrates

| Higher Taxon | Species | Recorded in fauna habitat type |
|---|---|---|
| **Mygalomorphae** (trapdoor spiders) | | |
| Nemesiide | *Aname* 'WYG398' | **Hillslopes** – Eucalypt woodlands or Mallee woodlands over shrublands or other shrublands<br>**Clay-Loam Plains** – Eucalypt woodlands or Mallee woodlands over shrublands |
| | *Aname* 'WYG399' | **Hillslopes** – Eucalypt woodlands or Mallee woodlands over shrublands or other shrublands |
| | *Aname* sp. Indet. | **Hillslopes** – Eucalypt woodlands or Mallee woodlands over shrublands or other shrublands |
| **Scorpiones** (scorpions) | | |
| Buthidae | *Urodacus armatus*-group | **Clay-Loam Plains** – Eucalypt woodlands or Mallee woodlands over shrublands |
| **Isopod** (slaters) | | |
| Armadillidae | *Buddelundia* '85' | **Clay-Loam Plains** – Eucalypt woodlands or Mallee woodlands over shrublands |

### *Mygalomorphae (trapdoor spider) – Aname*

Members of the mygalomorph spider family Nemesiidae are represented in WA by several genera, including *Aname, Chenistonia, Yilgarnia, Stanwellia, Teyl, Swolnpes* and *Kwonkan* (Main & Framenau, 2009). They usually dig burrows in the soil, and do not cover their burrow entrances with lids.

The genus *Aname* currently includes 37 named species in Australia and is well represented by four named and numerous unnamed species from many different regions in WA. *Aname* currently represent a highly diverse array of species of very small to large spiders. Many *Aname* species appear to have restricted distributions as shown by two studies from northern Australia, including the Pilbara (Harvey et al., 2012; Raven, 1985). Therefore, unidentifiable specimens are considered potential SREs.

### *Scorpiones (scorpions) – Urodacus armatus*

Scorpions is a relatively small order of arachnids, with approximately 1,700 described species (Fet & Lowe 2000). Currently, 23 species of *Urodacus* are described; however, this may represent as little as 20% of the real diversity of this genus in Australia. *Urodacus* appears to be most diverse in WA and few species are recorded east of the Great Dividing Range in eastern Australia.

*Urodacus* species associated with *Urodacus armatus* represent relatively small and pale scorpions. The taxonomy of this group and therefore the distribution patterns of species within this group are poorly resolved. Based on distribution patterns of species within *Urodacus*, a genus that includes widespread in addition to range-restricted species, members of the *Urodacus armatus*-group are considered potential SREs (Harewood, 2020a).

***Isopod (slaters) – Buddelundia***

Members of the genus *Buddelundia* belong to the most common terrestrial isopods in WA and the genus was well represented in the study area.

*Buddelundia* '85' is morphologically similar to *Buddelundia sulcatus* and *Buddelundia* '39', both known from the Goldfields region of WA. The species has so far only been found at L. Medcalf and is therefore considered a potential SRE based on known distribution patters of species within the genus, which includes widespread and range-restricted species (Harewood, 2020a; Harewood, 2020b).

### 5.7.6 SUBTERRANEAN FAUNA

The information in this section has been sourced from 'Medcalf Project: Assessment of Subterranean Fauna Values' (Bennelongia, 2020).

***Troglofauna***

In contrast to expectations of a depauperate community based on desktop information, sampling for troglofauna yielded 11 species of troglofauna, including two species of centipede (Chilopoda), one species of millipede (Diplopoda), three species of beetle (Coleoptera), four species of isopod (Isopoda) and one species of symphylan (Symphyla) (Table 22). The collection locations of all species are shown in Figure 56. With the exception of the beetle *Gracilanillus* `BCO193`, which was collected in a scrape sample, all troglofauna specimens were collected in traps.

Based on morphological characters, the species of troglofauna collected at the Project are troglobitic (obligate subterranean). This is further supported by collection depths (based on trap depth) of between 10 - 49 m below the surface. All the species are new and have not been recorded outside the area sampled.

The trapping period of approximately six months is likely to have increased trapping success compared to the usual period of 6 - 8 weeks specified by sampling guidelines (k). However, the relatively small spatial extent of sampling means that data with which to establish the ranges of species are limited. The uneven distribution of holes between impact and reference locations may have led to a bias towards collecting troglofauna in the impact areas, while reducing the likelihood of collecting the same species outside proposed mine pit footprints. The number of reference samples was limited by the availability of holes, with most exploration drilling coinciding with target orebodies. A further limitation is the lack of samples within or near the proposed Pinatubo pit. Sampling is now underway.

Table 22: Species of troglofauna collected at the Project

| Higher Classification | Lowest Identification | Impact | | | | | | | Reference | | | Confirmed minimum linear range |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MDD | MDD | MDD | MRC0 | MRC1 | MRC1 | MRC1 | MRC0 | MRC0 | MRC1 | |
| **Arthropoda** | | | | | | | | | | | | |
| **Chilopoda** | | | | | | | | | | | | |
| Scolopendrida | | | | | | | | | | | | |
| **Cryptopidae** | *Cryptops* `BSCOL062` | | 1 | | | | | | | | | – |
| | *Cryptops* `BSCOL063` (*spinipes* sl) | | | 1 | | | | | | 1 | | 0.98 km |
| **Diplopoda** | | | | | | | | | | | | |
| Polyzoniida | | | | | | | | | | | | |
| **Siphonotidae** | Siphonotidae `BDI066` | | | 1 | | | | 1 | | | | 0.28 km |
| **Insecta** | | | | | | | | | | | | |
| Coleoptera | | | | | | | | | | | | |
| **Carabidae** | *Gracilanillus* `BCO193` | 2 | | | | | | | | | | – |
| **Staphylinidae** | Pselaphinae `BCO205` | | | 1 2 | 2 | | | | 1 | | | 0.41 km |
| | Coleoptera `BCO206` | | | | | | 2 | | | | | – |
| **Malacostraca** | | | | | | | | | | | | |
| Isopoda | | | | | | | | | | | | |
| **Armadillidae** | Armadillidae gen. indet.`BIS370` | | | 1 | 1 | | | | | | | 0.08 km |
| **Philosciidae** | Philosciidae `BIS371` | | | 1 | 2 | | | | | | | 0.08 km |
| | Philosciidae `BIS372` | | | | | 1 | | | | | 1 | 1.75 km |
| **Platyarthridae** | *Paraplatyarthrus* `BIS373` | | 8 | | | | | | | | | – |
| **Symphyla** | | | | | | | | | | | | |
| Cephalostigmata | | | | | | | | | | | | |
| **Scutigerellidae** | *Hanseniella* `BSYM096` | | | | | | | | | 1 | | – |

Numbers are number of specimens. Impact holes are those inside proposed mine pit footprints.

Details of each recorded species of troglofauna are outlined below.

Cryptops species

The taxonomy framework of the centipede genus *Cryptops* is poorly understood. Two species of *Cryptops* were collected in the survey, *Cryptops* `BSCOL062` and *Cryptops* `BSCOL063` (*spinipes* sl). The latter species is morphologically similar to the described species *Cryptops spinipes*, however this species is currently considered a complex and is likely to consist of multiple lineages.

*Cryptops* `BSCOL062` is known from a single bore (MDD006) within the proposed footprint of Vesuvius pit (Figure 56), where it was collected in a trap at a depth of 49 m. *Cryptops* `BSCOL063` (*spinipes* sl) is known from impact bore MDD009 from trap at a depth of 21 m and reference bore MRC023 from a trap at a depth of 18 m. These holes are approximately 1 km apart (Figure 56).

Siphonotidae `BDI066`

Species of the millipede family Siphonotidae are rarely collected and there is an extremely limited framework for their identification, although it is understood that species within the family are likely to have small ranges (Car *et al.,* 2012). Siphonotidae `BDI066` is known from hole MDD009 within the proposed footprint of Vesuvius pit, where it was collected in a trap at a depth of 21 m, as well as hole MRC133, approximately 80 m to the east of Vesuvius where it was collected in a trap at a depth of 15 m. These holes are approximately 280 m apart (Figure 56).

*Hanseniella* `BSYM096`

Symphylans are a group of small myriapods related to centipedes and millipedes and are commonly recorded in surveys of troglofauna communities. The symphylan *Hanseniella* `BSYM096` was recorded from a single reference bore (MRC023) in a trap at a depth of 10 m. The taxonomic framework for troglofaunal symphylans is underdeveloped and the ranges of species, though likely to be small, are poorly understood.

*Gracilanillus* `BCO193`

Troglobitic species of the genus *Gracilanillus*, from the extremely diverse beetle family Carabidae, have been recorded from the Pilbara and Goldfields regions. Six species collected in the Pilbara have been described (Baehr and Main, 2016) and there is some framework for separating new species based on morphology. The described species are each known from few locations (often single bores). Two specimens of the new species *Gracilanillus* `BCO193` were collected in a scrape sample within the proposed Vesuvius pit footprint in hole MDD003 (Figure 56). It is not possible to determine a precise collection depth for this species.

Pselaphinae `BCO205`

The sub-family Pselaphinae appears to contain many troglobitic species although there is virtually no framework for their identification. Pselaphinae `BCO205` is a new species and is known from three holes including impact sites MDD009 (in a trap at a depth of 21 m) and MRC041 (in a trap at a depth of 15 m), both in the proposed Vesuvius mine pit footprint, as well as reference site MRC004 (in a trap at a depth of 20 m), approximately 70 m to the south of the proposed Fuji mine pit footprint.

Coleoptera `BCO206`

The taxonomy of the beetle Coleoptera `BCO206` could not be defined beyond the level of order. It was collected from a single hole, MRC112, in a trap at a depth of 41 m within the proposed mine pit footprint of Egmont. Due to collection from just one site the potential range of Coleoptera `BCO206` cannot be determined.

Isopod species

Isopods (slaters) are typical constituents of most troglofauna communities in WA and are often very diverse at the species level. At the Project, four species from three families were recorded (Table 22).

The genus of Armadillidae gen. indet. `BIS370` is probably new. This species was collected from two holes, MDD009 (in a trap at a depth of 21 m) and MRC041 (in a trap at a depth of 15 m),

separated by approximately 84 m in the southern portion of the proposed Vesuvius mine pit footprint (Figure 56).

Two species of the family Philosciidae were recorded. Philosciidae `BIS371` was collected from MDD009 (in a trap at a depth of 21 m) and MRC041 (in a trap at a depth of 15 m), separated by approximately 84 m in the southern portion of the proposed Vesuvius mine pit footprint (Figure 56), while Philosciidae `BIS372` was collected from MRC101 (in a trap at a depth of 25 m) in the proposed Fuji mine pit footprint as well as from MRC115 (in a trap at a depth of 10 m) east of the proposed Egmont mine pit footprint (Figure 56). Philosciidae `BIS172` has the largest known linear range of any of the recorded species with MRC101 and MRC115 separated by approximately 1.75 km.

*Paraplatyarthrus* `BIS373` belongs to a genus of isopods that is well known from Yilgarn calcretes (Javidkar *et al.* 2017). It was collected in a trap at a depth of 15 m in a single bore (MDD006) within the proposed Vesuvius mine footprint (Figure 56).

***Stygofauna***

The desktop search did not identify any records of stygofauna species within the 100 km search area. The closest records of stygofauna are over 130 km southwest of the Project, where 8 - 10 species have been collected, including a nematode, an oligochaete, a syncarid and four species of copepod.

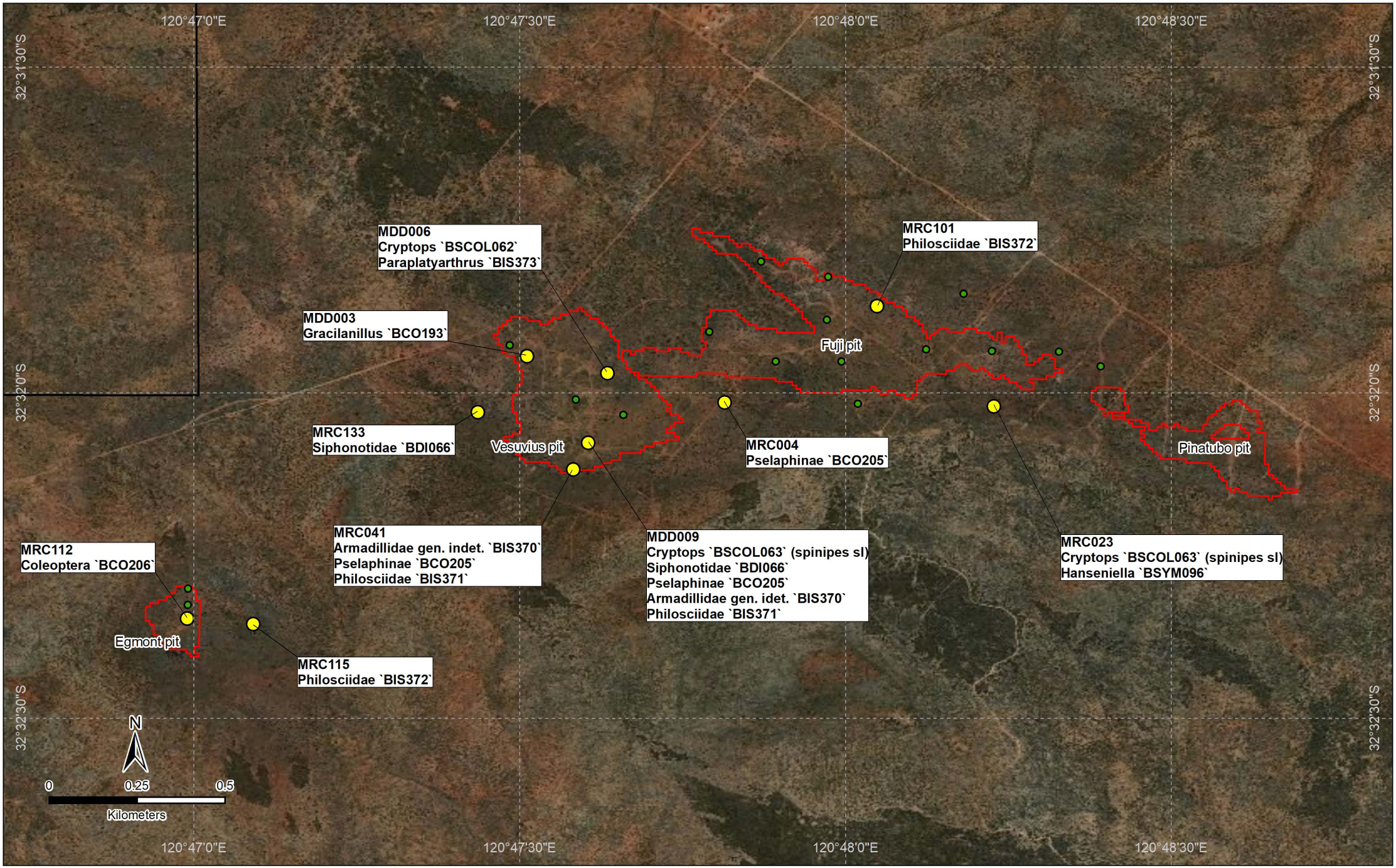
With the exception of a single nematode worm, no stygofauna were collected at the study area. The nematode (*Nematoda* sp.) was collected from MRC088 but belongs to a group for which taxonomic and ecological knowledge is extremely limited in a subterranean context. Nematodes are not considered in impact assessments in WA. The results of stygofauna survey indicate an extremely depauperate stygofauna community in the study area.

With the exception of MWH009 (1,970 µS $cm^{-1}$) all of the bores sampled had hypersaline groundwater at the top of the watertable, further supporting the likelihood of a depauperate community.

Based on the combined results of the desktop review and field survey, it is considered very unlikely that more than a depauperate stygofauna community occurs in the vicinity of the proposed mine pits. Habitat here is primarily limited by great depths to water.

***Listed Species and Communities***

No listed subterranean communities occur in the vicinity of the Project, nor are there records of listed subterranean species.




Bennelongia Environmental Consultants

GCS_GDA_1994
Author: A. Mittra
Date: 26-04-2020

**Legend**

- Pit footprints
- Tenements
- Troglofauna recorded
- Troglofauna sample site

**Figure 56: Location of troglofauna records at the Proposal in relation to proposed mine pit footprints**

# 5.8 DATA ANALYSIS AND IMPLICATIONS FOR MINE CLOSURE

Sections 5.2 to 5.7 have provided the baseline data relevant to closure and rehabilitation for the Project. This section provides a summary of the key points arising from the data and their implications for mine closure and rehabilitation. Planning for closure has identified the information gaps and need to gather additional data to enable detailed planning of the controls to be applied to the closure phase of the Project. The likelihood of occurrence of some of the mechanisms to cause impacts identified in the operational phase will be reduced upon cessation of operations, others may continue through the early closure phase, whilst others, which may be unlikely during the operational phase, are more likely during closure due to the consideration of longer time periods.

The points listed below have been considered in impact assessment for the Project, and are relevant to closure:

- The operation is located in an area with little economic activity or habitation, historically with no particular land use;
- Climate is arid to semi-arid Mediterranean with warm summers and mild winters - revegetation planning needs to consider the amount and timing of rainfall in the area;
- There are few surface water drainage features and they operate sporadically consistent with the climate, landform and soils. Surface water quality is likely to be highly variable, ranging from fresh to hypersaline within the terminal surface water features;
- The biota in nearby lakes is likely to be adapted to the extreme natural variability in water availability and quality;
- The groundwater in the lake playas ranges from fresh to hypersaline, in paleochannels is hypersaline and has no beneficial use; and
- The key disturbance footprint for the Project has been located away from the populations of *Marianthus aquilonaris*, a Threatened Flora Species known only from a small area on the Bremer Range;
- The operational life of the Project provides sufficient time to support the investigation and testing of the closure concepts to provide confidence in their outcomes, practicality and cost.

The implications of the relevant information and information gaps for mine closure are:

- The mine is to be located on UCL in an isolated part of WA, with poor access and hence has no near neighbours;
- The mine is located on a small range (Bremer Range) near the top of the catchment. Ultimately, all drainage from the mining area reports to Lake Medcalf – a small salt lake located approximately 7 km north of the mining operations. The main tributary from the south captures drainage and intersects with the access road approximately 2.5 km north of the mining operations, providing a useful monitoring location for surface water during both operations and closure;
- Groundwater in paleochannel and fractured rock aquifers will be used for water supply. These aquifers are deep and hypersaline, and there are no nearby groundwater users or GDEs. During operations, a desalination plant is required to produce water for processing and potable water supply. Once mining ceases, groundwater levels from water supply areas are expected to trend back toward current levels, and seepage from TSF and Evaporation Ponds will effectively cease. Groundwater monitoring should continue post-closure to confirm this;

- Mining is all above water table (no pit dewatering required), with no waste rock and no particular geochemical risks other than the risk of sodic and dispersive saprolite materials which are to be managed so as not to form the outer surface of constructed features;
- The tailings are benign and may form a useful substrate for plant growth;
- The area is well vegetated, subject to frequent, often large and intense wildfires. The vegetation and species assemblages are unique to the area and have relatively high conservation values. Mining activities are common around the Norseman area, and benchmarking rehabilitation against nearby mining operations will be valuable. The revegetation programme details will require testing and refinement in this environment;
- Species with limited distribution and ecological knowledge (such as *Eucalyptus rhomboidea* and *Stenanthemum bremerense*) will require further investigations if they are to be integrated into rehabilitation prescriptions;
- The Project requires a 74 km private haul road to be constructed. The road potentially provides improved access for the public and feral animals. It is planned to rehabilitate the road following completion of rehabilitation of the mining area;
- The well vegetated surroundings provide extensive habitat for fauna, providing refuge whilst mining and ability to recolonise the cleared areas as rehabilitation proceeds; and
- The protection measures for Threatened Flora will need to continue throughout the closure phase of the Project.

### 5.8.1 WASTE MATERIALS

The geology and mineralisation of the Medcalf sill are well understood, and the sampling undertaken has been sufficient to characterise ore and waste materials in the context of mine closure. In reviewing the deposit geology and modelling it for mine planning, Cube Consulting (2019) stated that "based on the observed low nugget values, relatively long ranges, and the generally large thickness of the mineralisation, the search distances were not considered a limiting factor." This indicates a degree of uniformity and consistency that is important for both resource and reserve calculations and waste characterisation.

Waste material volumes are relatively low, with a strip ratio of approximately 0.15. All waste material is being mined from above the water table, and has been weathering in-situ over geological time scales. The small volumes of waste to be mined are therefore generally geochemically inert and benign, with negligible little potential for AMD (GCA 2020b).

Only pyroxenite from the cover horizon will be utilised for construction purposes. The Fe-rich cover materials within the upper mottled zone will therefore be segregated and stockpiled for later decommissioning and rehabilitation works. The cover fraction of the upper mottled zone is stable, and not prone to clay / sesquioxide dispersion with attendant erosion risks when located on sloped surfaces (GCA, 2020b). Although this material is weathered it remains physically competent, with its overall blocky/rocky nature making it well suited to managing the mottled and saprolite zone waste streams, which are susceptible to erosion. This is evidenced by the naturally self-armouring surficial soils at the Project (Plate 5).

In terms of acidity and salinity the cover (upper mottled) zone is the natural substrate beneath the surficial soil profiles across the various Project activities. Use of the cover material in rehabilitation works will therefore reconfigure the pre-mining soil/substrate profile.



The gabbro and ultramafic materials account for ≈25% and ≈30% of the waste volume, respectively. The majority of these waste materials are present in the oxide (lower mottled and saprolite) waste zone (section 5.8.4). Analysis of samples from drillholes MRC127, MRC130 and MRC137 determined the lower oxide waste material (primarily gabbro and ultramafic, with a small portion of pyroxenite) is not suitable for use as a construction material for external surfaces due to its sodicity, swelling clay (smectites) content and decreasing ferruginisation with depth. Saprolite zone material is also likely to be erosive due to its sodic, saline, and smectitic properties. Lower mottled and saprolite zone waste streams will therefore be backfilled to the borrow pit or used for appropriate internal purposes.

### 5.8.2 TAILINGS

GCA (2020a) assessment of the solubility behaviour of tailings solids separated from supernatant water comprised batch reactor leaching buffered at pH 5 and kinetic testing of unsaturated tailings. The batch reactor leaching represented a 'worst case' pH regime for geochemical stability of minor elements (metals/metalloids). Only Mn and B exhibited increased mobility at pH 5. Neither element represents a significant risk, as the total Mn pool is limited, the elevated B concentrations were a function of feed solution rather than tailings B content, and elevated acidity is not representative of conditions within the TSF.

Due to the strong water retention of the tailings resulting from high fine particle fraction and surface chemical forces, kinetic testing leachate volumes abstracted were small, resulting in higher chemical concentrations (relative to free draining tailings). Kinetic testing leachate pH was ≈ 7-8, typical of barren, NAF tailings, and the leachate assays indicated the geochemical stability of tailings metals/metalloids. The solubility testing undertaken thus shows the geochemical stability of minor elements at circumneutral pH values representative of the in-situ weathering pH regime of the tailings within the TSF.

The Medcalf deposit formed by weathering of the primary silicates and minor element suites characterising the original 'source rock' lithochemistry over geological timeframes. All that remains within the oxide zone to be mined for Ti/V minerals are therefore 'resistates' (i.e. minerals so resistant to hydrolysis/dissolution during weathering that they have persisted to the present day, and become concentrated, as other minerals have weathered from the geology). The tailings mineral suite is therefore comprised of inert 'resistates' (i.e. the same minerals as in ore in situ, save for appreciably less amounts of the Ti/V-minerals recovered as concentrates).

The Medcalf mill will beneficiate ore through comminution, washing, and gravity-separation. Processing will not include wholesale addition of acids/alkalis and the ensuing mineral dissolution/precipitation reactions. Furthermore, the process water will necessarily be of low salinity. Tailings water chemistry within the TSF is therefore controlled by weak interactions between (desalinated) process water and the inert resistates in the ore. Without any major influence from reagent chemistry, tailings water quality is very similar to that of potable water.

An unconfined fractured bedrock aquifer underlies the TSF with the water level ≈ 30-40 mbgl. Groundwater is saline to hypersaline. As the tailings comprises inert resistates and water of potable chemistry, the environmental risk associated with any slow solute generation and leaching into the naturally (hyper)saline groundwaters underlying the TSF is negligible.



### 5.8.3 TAILINGS STORAGE FACILITY AND EVAPORATION POND CLOSURE STRATEGY

***Tailings Storage Facility***

The TSF location and design is subject to site geotechnical investigations and may vary in location to the layouts and conceptual designs presented herein. Mine Earth (2020) developed a conceptual closure design for the Project TSF and EPs (EP1 and EP2) as designed by Golder (2020). Mine Earth (2020) identified appropriate design standards, assessed closure risks, and accordingly developed a TSF design approach. Probable Maximum Precipitation (PMP) and Probable Maximum Flood (PMF) volumes were calculated, a water balance calculated, and a TSF cap designed to contain the total predicted storage volume of 1.04 $Mm^3$. The Mine Earth (2020) TSF closure design report is included as Appendix 5.5

The post-closure TSF landform is designed to meet the following closure outcomes:

- Comply with legally binding obligations, conditions and commitments relevant to rehabilitation and closure;
- Safe, stable and non-polluting;
- Support hydrological flows for 90% percentile rainfall events;
- Generate water runoff and leachate from rehabilitated areas with quality compatible with the maintenance of local environmental values;
- Will not adversely affect surface and groundwater hydrological patterns/flows;
- Feature rehabilitated areas functionally analogous to pre-Project land use;
- Designed to enhance revegetation; and
- No unacceptable down-gradient impacts of erosion from TSF surfaces.

The key post-closure risks to be managed to achieve the above outcomes for the TSF are:

- Management of incidental rainfall and upstream runoff that reports to the TSF top surface and the TSF embankment;
- If evaporites are buried within the TSF, manage potential salt-rise from the evaporites;
- Erosion of TSF embankments;
- Drainage management and erosion of the TSF top surface; and
- Generation of tailings dust.

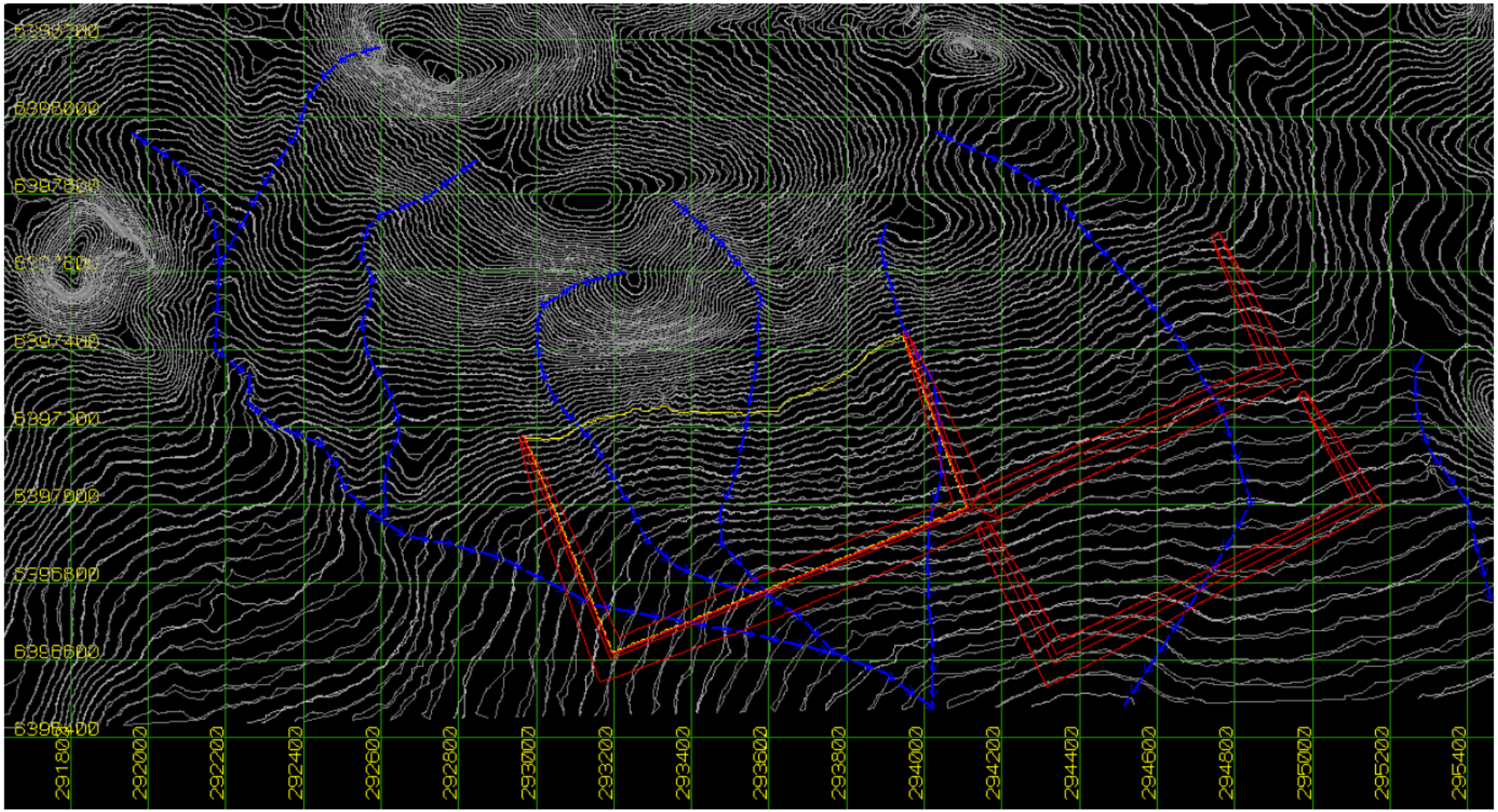



Figure 57: Inferred pre-mining drain lines relative to the TSF and Evaporation Ponds

The post-closure TSF landform has been designed with an internally draining top surface. This approach capitalises on the life-of-mine tailings surface, which drains internally with a predicted beach angle of 0.5%. It will be engineered to contain the Probable Maximum Precipitation event with a starting water level aligning with the maximum water level in a 90% percentile wet year whilst maintaining a 300 mm freeboard.

The conceptual closure design has avoided reliance upon drainage conveyance features where practicable. To function effectively, drainage features such as diversion drains and spillways require ongoing inspection and maintenance, which is typically undesirable for a passive closure solution. It has therefore been assumed that the diversion drain at the landform/natural slope interface fails at some point and the upstream catchment reports to the TSF.

The conceptual closure design surface is presented in Figure 58 to Figure 61. Closure embankment material will be sourced from evaporation pond embankments. A total cap thickness (including topsoil) of up to 0.95 m (not significantly different from pre-disturbance soil profiles pre-mining) has been adopted for the conceptual design. Deeper topsoil encourages gullying and formation of erosion features, and ultimately the loss of topsoil. Standard industry practise is to apply no more than 0.3 m of topsoil over top of a ripped, bunded and backsloped landform to minimise potential for run off in a rainfall event. Where there is significant erosion risk, competent rock is to be included in the top layer to provide erosion protection. The conceptual TSF landform, including the total cap thickness of 0.95 m as described in section 5.8.3 in the interim MCP, has been designed to prevent erosion as well as provide sufficient growth medium to meet completion criteria for re-vegetation.

Figure 58 shows a typical section of the closure embankment, required to retain upgradient surface water flows and incident rainfall and prevent overtopping.

The key specifications for the cover (top surface) of the TSF are:

- 0.3 m (+ 0.2 m loss through tailings surface) capillary break layer (coarse material with low fines sourced from the borrow pit) at the TSF top surface over any EP precipitates and/or residues stored within the TSF;
- 0.5 m cover (sourced from EP embankments) over TSF top surface; and 0.15 m layer of topsoil (on TSF top surface and embankments, excluding the top surface of the crest bund).

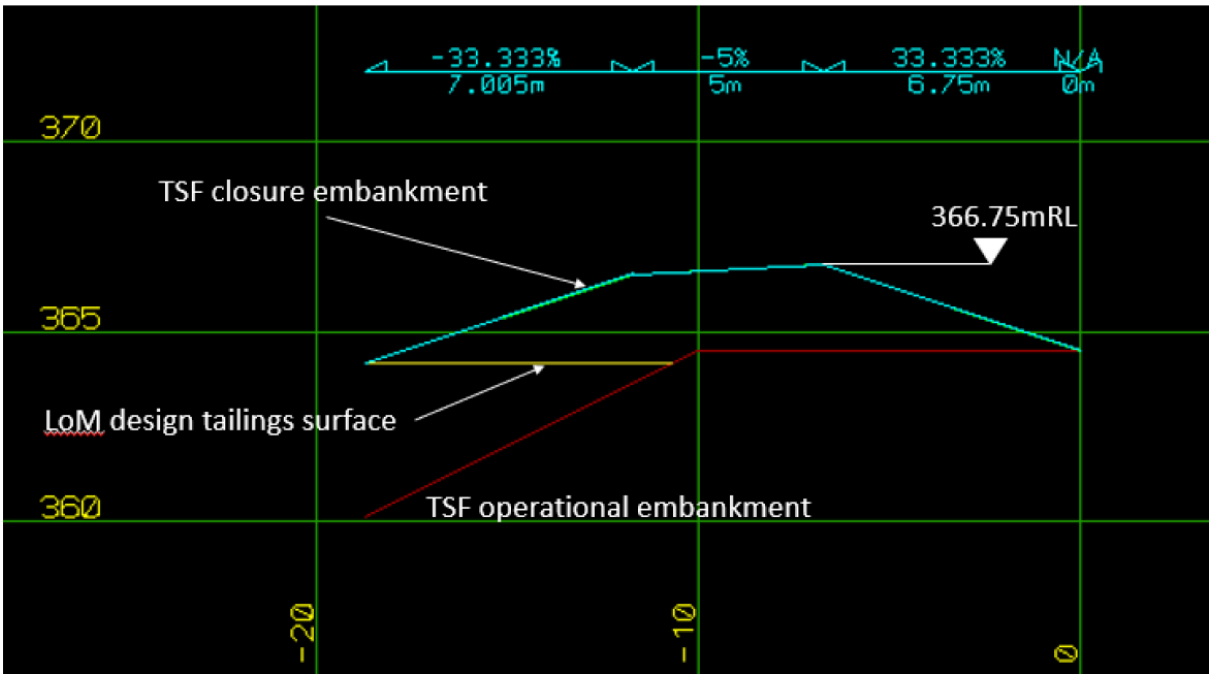



Figure 58: TSF embankment conceptual design cross-section

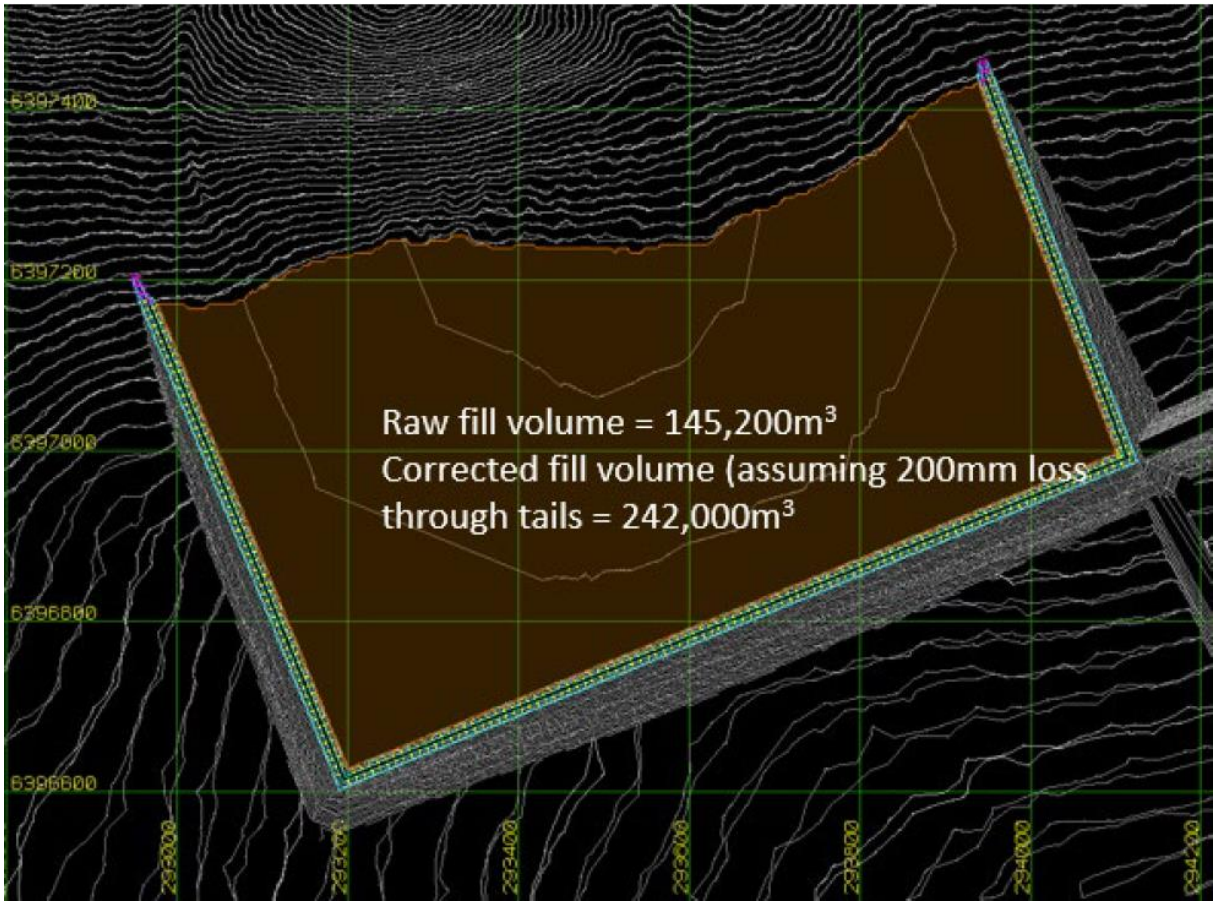



Figure 59: TSF conceptual closure surface, after construction of capillary break layer (0.3 m + 0.2 m loss through tailings surface)

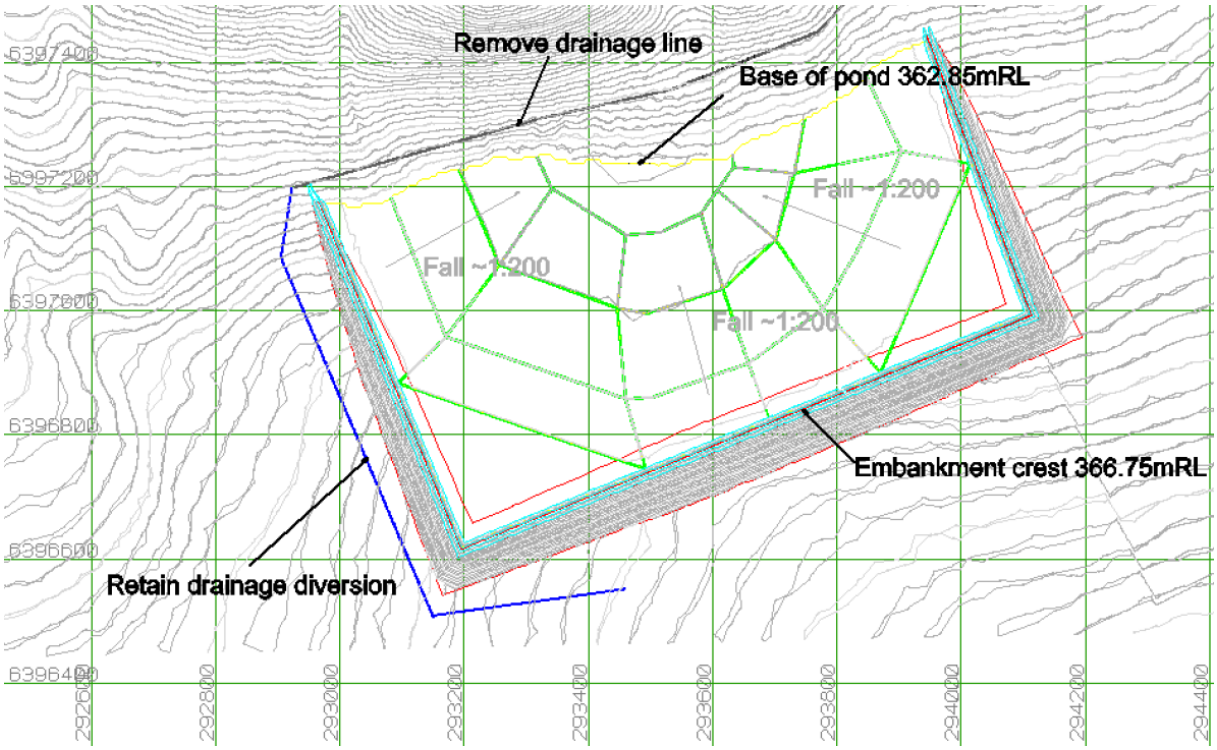



Figure 60: TSF cover conceptual design surface

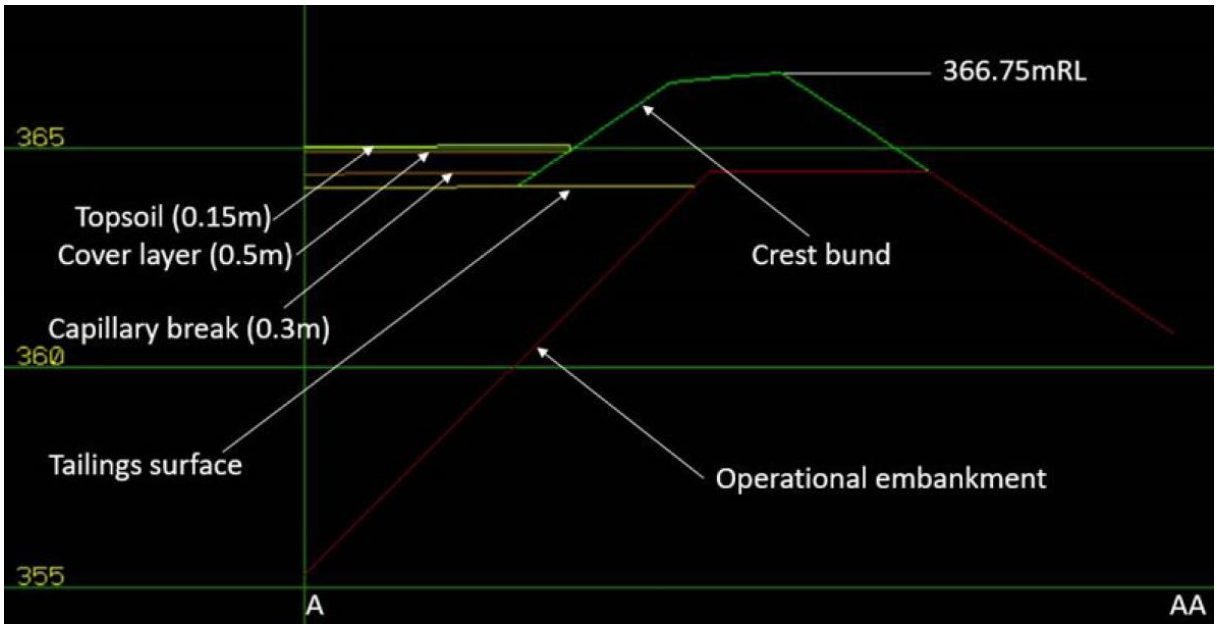



Figure 61: TSF crest bund and cover detailed section

TSF top surface cell bunding has been included to partition water during more frequent rainfall events to reduce the potential for ponding at the low point, improve the water balance for the TSF by increasing infiltration and evaporation losses, and increase water availability for vegetation across the TSF. Cell bunds will be constructed from locally pushed up cover material to a nominal height of 0.75 m so as to not impact upon the storage of extreme rainfall events within the TSF.

For the purpose of calculating a materials balance it has been assumed that a 450 m length of the western embankment will require rock armouring to a height of 1 m. It has been assumed that the rock armour will be basalt sourced from the borrow pit.

Mine Earth (2020) calculated a water balance for the conceptual TSF closure design to confirm it will meet the selected design standards. When the PMP was applied to the maximum 90th percentile water level, the water balance predicted a maximum water level of 366.4 mRL, 50 mm below the maximum design water level. The conceptual closure design for the TSF therefore meets the design standards for water storage

***Evaporation Ponds***

The key post-closure risks to be managed for the EPs are:

- Salt impacts to the environment;
- Long term stability of the EP embankments; and
- Scour from concentrated flows over the EP footprint, especially in the event of concentrated flows that may result from the failure of the upstream drainage diversion.

The design approach for the EPs consists of:

- Remove the EP diversion drains;
- Remove contaminants such as residue and salt impacted soils to manage the vertical migration of salt;
- Remove the EP embankments;
- Construct a cover over the impacted pond area to manage vertical migration of salt;
- Rock armour drainage concentration areas within the EP footprint; and
- Apply topsoil to the EP footprint.

The conceptual EP closure design surface is presented in Figure 62.

Saline EP evaporites will be removed from the pond base at closure and stored and/or disposed of such that Project closure objectives are met. A series of options have been identified, materials requirements identified and considered. The storage/disposal options for the evaporites include:

- Storage in the adjacent TSF (beneath a capillary break layer forming part of the TSF top surface cap);
- Storage in the borrow pit or one of the completed mine pits; or
- Removal to an appropriate offsite facility.

Final selection of an EP evaporite management strategy will consider further waste characterisation (salinity and volumes), logistics (e.g. availability of appropriate offsite disposal facilities and transport arrangements) and cost.

The remaining EP embankment material will be reprofiled to form a minimum 1 m cover over the EP disturbance area (section 5.8.4). Where upstream drainage reports to the cover area, the cover will be tied into these areas at a grade of 1% to prevent ponding and form a free-draining surface at the interface of the cover and natural ground. Downstream facing areas will be graded to tie in with the surrounding areas (e.g. ≈ 20%). Drainage concentration areas within the EP footprint and at the upstream interface between natural ground and the EP footprint cover will be rock-armoured. A minimum 150 mm of topsoil will then be applied to the EP disturbance area. The drainage diversions around the north and east of the EPs will be backfilled.

***Integrated Tailings Storage Facility and Evaporation Pond Landform***

The final post-closure integrated TSF and EP landform conceptual design surface and sections are presented in Figure 62 to Figure 65.

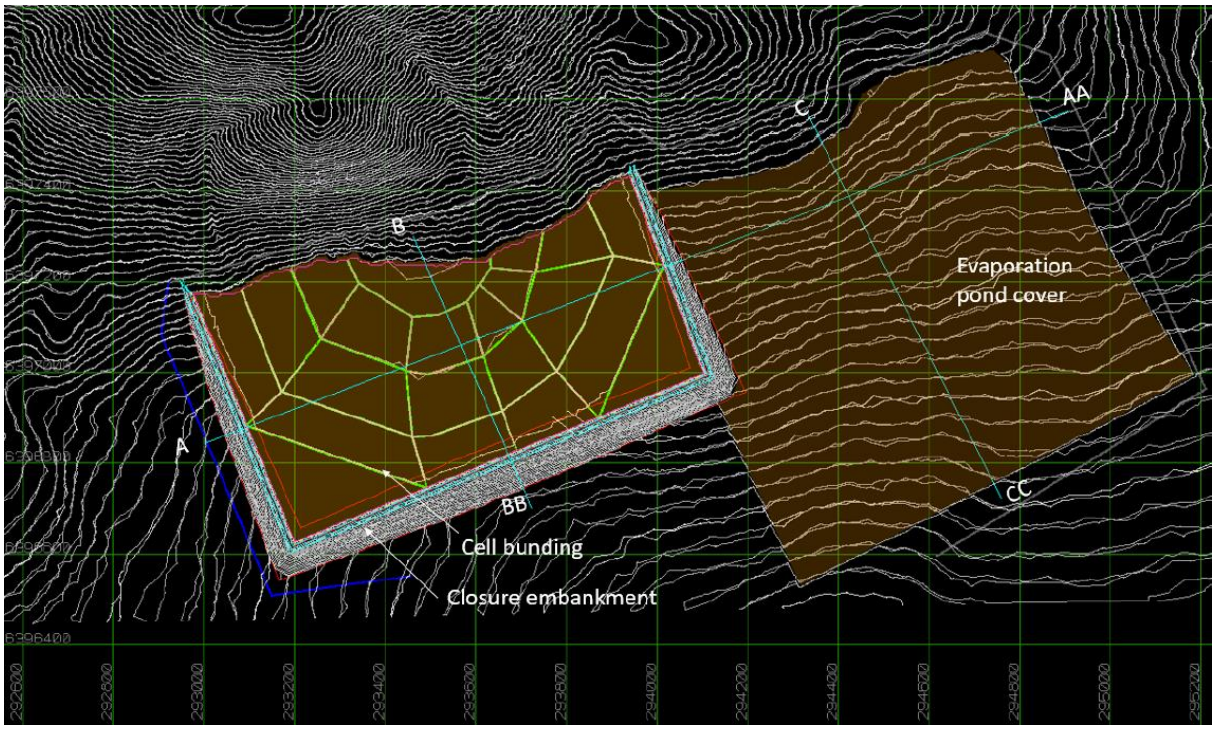



Figure 62: Integrated Tailings Storage Facility and Evaporation Pond Post-Closure Design

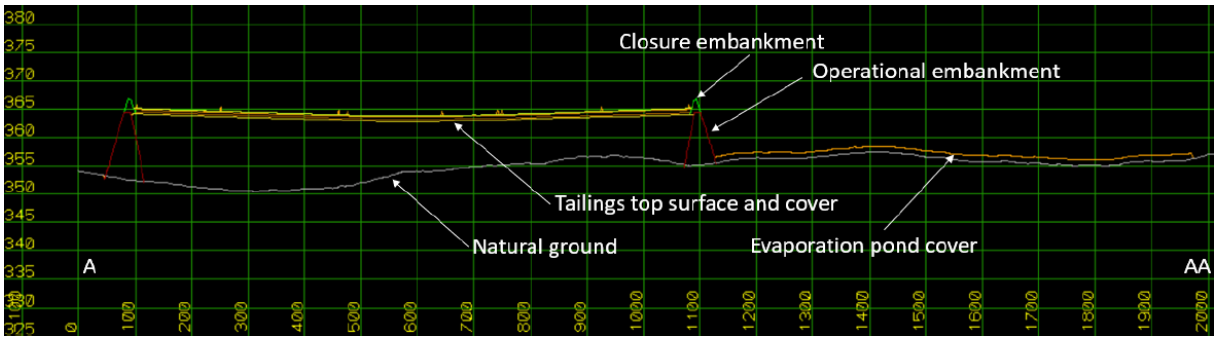



Figure 63: Integrated Post-Closure Design Section A (x10 vertical exaggeration)

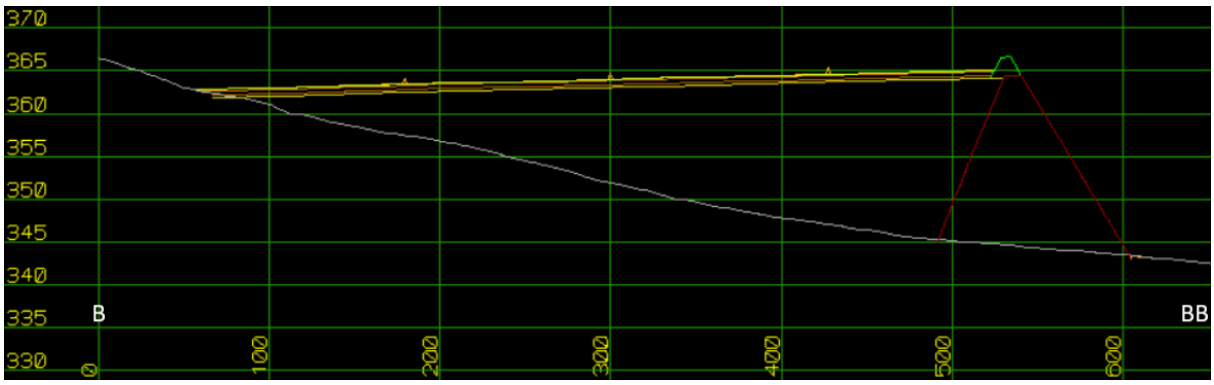



Figure 64: Integrated Post-Closure Design Section B (x5 vertical exaggeration)

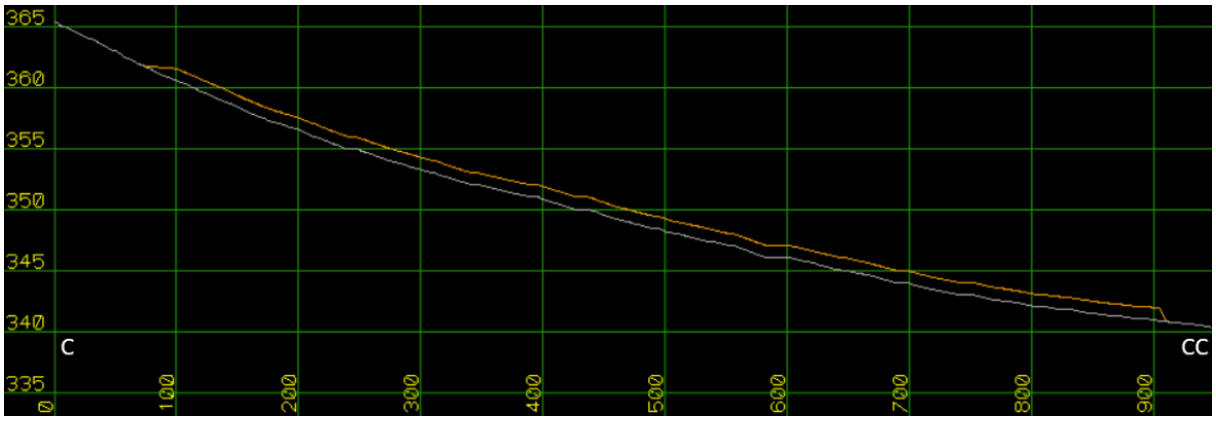



Figure 65: Integrated Post-Closure Design Section C (x10 vertical exaggeration)

## 5.8.4 MATERIALS BALANCE

### *Construction Materials*

Construction materials are required during the Project construction and operation phases for the TSF and EP embankments. There is not enough waste material suitable for construction available from the mine pits alone, due to the low strip ratio (Table 23). Pyroxenite waste (the only waste rock type considered suitable for construction) only contributes to 21% of the waste materials. Construction materials will therefore mostly be sourced from an onsite borrow pit (basalt), potentially supplemented with cover horizon pyroxenite sourced from the mine pits (sections 5.4.2 and 5.8.1) depending on staging. Up to 2,938,000m$^3$ of fresh basalt construction material is potentially available from a borrow pit immediately south of the Vesuvius pit (Table 24).

Table 23: Mine Pit Waste Volumes

| **Waste Volumes from Mine Pits** | | | | |
|---|---|---|---|---|
| **Regolith** | **Code** | **Rock type** | **Volume (m$^3$)** | **Use** |
| Cover | Cover | Gabbro | 72,000 | Backfill |
| | | Pyroxenite | 595,000 | Construction |
| | | Ultramafic | 29,000 | Backfill |
| Oxide | Mottled zone | Gabbro | 115,500 | Backfill |
| | | Pyroxenite | 0 | Backfill |
| | | Ultramafic | 106,500 | Backfill |
| Transitional | Saprolite | Gabbro | 115,500 | Backfill |
| | | Pyroxenite | 9,500 | Backfill |
| | | Ultramafic | 235,500 | Backfill |
| **Total** | | **-** | **1,278,500** | **-** |

Table 24: Borrow Pit Construction Material Volumes

| Waste Volumes from TSF borrow pit | | | | |
|---|---|---|---|---|
| **Regolith** | **Code** | **Rock type** | **Volume (m3)** | **Use** |
| Fresh | Fresh | Basalt | 2,938,000 | Construction |
| **Total** | | | **2,938,000** | |

Construction materials will be required during closure for abandonment bunds, TSF closure crest bunds, and TSF top surface cell bunds, and armouring of TSF embankments and the western drainage channel. In addition to fresh basalt construction material sourced from the borrow pit, the EP embankment material will be reformed into construction material for the integrated TSF and EP closure landform. Waste rock other than cover pyroxenite and borrow pit basalt will be used for borrow pit backfill.

A construction materials balance for operations and closure is provided in Table 25. Sourcing construction material from the borrow pit in addition to the mine pits provides the Project with 3,533,000 $m^3$ of construction material in total. 3,062,18 $m^3$ of waste rock is required providing a positive waste rock balance of 470,820 $m^3$.

The EP embankments will be removed during closure and the EP embankment construction material repurposed for use in the TSF top closure crest bund, TSF cover layer, and EP cover.

As closure planning progresses, the TSF design may be further developed to incorporate storage of EP residues / precipitates. In that case fresh basalt additional to that used in the current materials balance may be required for a larger / thicker capillary barrier. Alternatively, a smaller / shallower borrow pit may be possible, depending on further development of waste storage and other strategies. The construction materials balance also shows a positive balance of +129,220 $m^3$ of EP embankment material. This may be utilised to form a ticker TSF cover than that designed at this preliminary stage, or may be utilised as borrow pit backfill at closure.

Topsoil will be stripped to a depth of 0.1 m from most mine activity disturbance areas and stockpiled at various locations adjacent to disturbance. Topsoil excavated from the access road and bore field will be stockpiled in windrows at the perimeter of these disturbance areas. Topsoil from the access road and bore field are accounted for separately and are not included in the materials balance tables below. It will be re-spread back on to these areas (which may be retained post-closure, depending on stakeholder agreements) for rehabilitation. These disturbance areas are therefore not included in the topsoil materials balance.

Rehabilitation materials (topsoil) will be required during closure to rehabilitate the TSF top surface and embankments, and the footprints of the EP, Camp, Process Water Dam, Workshop, ROM Pad, Admin Office, Plant Site, Pit Surround, Overburden Stockpile, Settlement Pond, and eastern section of the Diversion Drain. Topsoil will generally be reapplied at a thickness of 0.1 m, with the exception of 0.15 m on the TSF top surface and embankments, and EP footprint.

The mine pits and pit abandonment bunds will not be rehabilitated with topsoil. The northern and western sections of the TSF/EP diversion channel also will not require topsoil application, as they will be rock armoured at closure (section 5.8.3). The eastern section will be rehabilitated with topsoil. The topsoil material balance is summarised in Table 26. There is no waste rock landform to rehabilitate as the waste generated from the pits will be backfill for the borrow pit reducing the borrow pit volume by ≈23% (Table 27).



Table 25: Operations and Closure Construction Materials Balance

| Operations | | | | | | | Closure | | |
|---|---|---|---|---|---|---|---|---|---|
| **Source** | **Regolith** | **Code** | **Rock Type** | **Volume ($m^3$)** | **Destination** | **Construction Volume ($m^3$)** | **Source** | **Destination** | **Construction Volume ($m^3$)** |
| Mine Pits | Cover | Cover | Pyroxenite | 595,000 | TSF | 1,550,000 | Borrow Pit (volume taken as required) | Abandonment Bunds | 55,680 |
| Borrow Pit | Fresh | Fresh | Basalt | 2,938,000 | Evaporation pond 1 | 585,000 | | Capillary break (0.3 m + 0.2 m loss through tailing surface) | 242,000 |
| | | | | | Evaporation pond 2 | 590,000 | | TSF interface rock armour | 5,000 |
| | | | | | | | | TSF embankment rock armour | 30,000 |
| | | | | | | | | EP interface rock armour | 4,500 |
| | | | | | | | EP embankments (585,000 + 590,000 $m^3$)) | TSF crest bund | 56,220 |
| | | | | | | | | TSF Cover layer (0.5 m) | 242,120 |
| | | | | | | | | EP cover | 747,440 |
| **TOTAL WASTE ROCK** | | | | **3,533,000** | **TOTAL CONSTRUCTION MATERIAL** | **3,062,180** | **TOTAL CLOSURE MATERIAL** | | **1,382,960** |
| **WASTE ROCK CONSTRUCTION AND CLOSURE BALANCE** | | | | | | **+ 470,820** | **EP EMBANKMENT CLOSURE MATERIAL BALANCE#** | | **+ 129,220** |

#Excess of 129,220 $m^3$ based on using EP embankments to cover EP pond and TSF footprint. Excess to Borrow pit.

Table 26: Rehabilitation Material (Topsoil) Balance (excluding access road and bore field)

| Mine Activity | Area (ha) | Topsoil Depth (m) | Topsoil Excavated ($m^3$) | Topsoil Cover (m) | Topsoil Reapplied ($m^3$) |
|---|---|---|---|---|---|
| Camp | 10.0 | 0.10 | 10,050 | 0.10 | 10,050 |
| Process Water Dam | 1.2 | 0.10 | 1,171 | 0.10 | 1,171 |
| Workshop | 0.7 | 0.10 | 750 | 0.10 | 750 |
| ROM Pad | 3.4 | 0.10 | 3,400 | 0.10 | 3,400 |
| Admin Office | 0.5 | 0.10 | 500 | 0.10 | 500 |
| Pinatubo Pit | 5.8 | 0.05 | 2,903 | 0.00 | 0 |
| Egmont Pit | 2.0 | 0.05 | 978 | 0.00 | 0 |
| Bore Field | 0.8 | 0.10 | 760 | 0.10 | 760 |
| Evaporation Pond | 75.2 | 0.10 | 75,155 | 0.15 | 113,213 |
| Plant Site | 5.3 | 0.10 | 5,335 | 0.10 | 5,335 |
| Vesuvius/ Fuji Pit | 31.5 | 0.10 | 31,509 | 0.00 | 0 |
| Tailings Storage Facility | 65.2 | 0.15 | 97,875 | 0.15 | 94,258 |
| Pit Bund | 3.0 | 0.00 | 0 | 0.00 | 0 |
| Pit Surrounds | 12.5 | 0.10 | 12,534 | 0.10 | 12,534 |
| Borrow Pit | 14.7 | 0.10 | 14,684 | 0.10 | 14,684 |
| Topsoil Stockpile | 11.6 | 0.00 | 0 | 0.00 | 0 |
| Overburden Stockpile | 19.3 | 0.10 | 19,272 | 0.10 | 19,272 |
| Settlement Pond | 2.0 | 0.10 | 1,999 | 0.10 | 1,999 |
| Roads | 25.3 | 0.10 | 25,341 | 0.10 | 25,341 |
| Diversion Drain | 2.0 | 0.10 | 2,006 | 0.10 | 501 |
| **TOTAL** | **292.1** | | **306,220** | | **303,767** |
| | | | | **BALANCE** | **+2,452** |

Table 27: Borrow Pit Waste Rock Backfill Volumes

| Backfill volume for TSF borrow pit | |
|---|---|
| **Rock type** | **Volume ($m^3$)** |
| Gabbro | 303,000 |
| Ultramafic | 371,000 |
| Pyroxenite SP | 9,500 |
| **Total backfill** | **683,500** |

### 5.8.5 Topsoil and Subsoil

Soil studies by Western Horticultural Consulting (2019) have determined that the topsoil materials within the mining area are generally sandy loams, non-saline (with the exception of the subsoil of the 'Alkaline red shallow loamy duplex' soil), not sodic, with moderate to high levels of organic carbon. Some soils are rocky, and all soils generally contained between 20 - 50% gravel, with some soils containing up to 80%. The topsoils represent valuable materials for rehabilitation as they will not only provide a valuable seed bank, but their gravelly and stony nature will assist in resisting erosion.

Topsoil and mottled zone materials from the top 4 - 5 m of the profile have been characterised as non-dispersive (Emerson Class Number of 6 and are non-dispersive – GCA, 2020b) and are noted represent useful erosion resistant materials for rehabilitation of built landform slopes. The deeper mined materials (saprolite) are noted to be sodic, and typically highly dispersive with Emerson Class Numbers of either 1 or 2 as expected from their general elevated salinity. Swelling clays (smectites) were also reported by GCA (2020b). Saprolite materials represent an erosion risk and will need to be managed to ensure that they do not form the surface of any rehabilitation of built structures.

Investigations to date have not indicated any need to segregate different types of topsoils or mottled zones.

Further investigations are required to identify the locations of dispersive saprolite materials so that they can be stripped and stored or used appropriately. The Mining Proposal will consider the material properties and detail how they will be salvaged and stored. The revised MCP (to be submitted with the Mining Proposal) will detail how they will be used.

### 5.8.6 Haul Road

Linear infrastructure features such as the Haul Road can lead to erosion of soils, particularly where inadequate allowance is made for drainage. Raiter (2016) reviewed the occurrence of soil erosion associated with linear infrastructure in the Great Western Woodlands (GWW) and identified a high level of association between linear infrastructure and erosion frequency and severity. Many of the linear infrastructure features in the GWW have been constructed with very basic approaches and machinery.

NSW Office of Environment and Heritage (2012) have prepared guidance on erosion and sediment control on unsealed roads. The principles of this guidance have been adopted as the design basis for the road drainage to reduce the risk of causing erosion.

No soil investigations specific to rehabilitation have been conducted for the Haul Road. Investigations will be conducted to confirm road design, locations and characteristics of borrow material for road construction and maintenance. These investigations, together with maintenance of the road will be used to inform rehabilitation.

### 5.8.7 SIGNIFICANT FLORA

The development of specific measures for the re-establishment of impacted significant flora species during rehabilitation has commenced. The *Medcalf Project Rehabilitation Plan* (Botanica, 2022) provides details on these measures (Appendix 3.13). The *Medcalf Project Rehabilitation Plan* reviewed available data on the re-vegetation of significant flora relevant to the Project as well as the learnings from other mines nearby.

Further investigations will be undertaken to improve and refine the specific measures in the *Medcalf Project Rehabilitation Plan* and this will be incorporated into revisions of the MCP. Areas of historical disturbance within *M. aquilonaris* critical habitat and within the mining tenement are limited to exploration disturbance – blade up clearing for access and drill pads, exploration drill holes. These are proposed to be rehabilitated using existing exploration rehabilitation techniques such as scarifying and seeding if necessary. All exploration drill holes will be permanently capped and rehabilitated. Any sumps or other disturbance will be landformed to match existing levels prior to rehabilitation. Rehabilitation will be monitored with species, plant densities and erosion quantified. The learnings from this rehabilitation will help to inform future revisions of the MCP.

## 5.9 KNOWLEDGE GAPS

This MCP is the first of what will be a series of MCP revisions over the life of mine that are updated as more information becomes available during Project implementation. Key information gaps identified that will enable appropriate risk management and effective closure of the Project are summarised in Table 28.

**Table 28: Knowledge gaps**

| Knowledge gap | Action / research | Timeframe / status |
|---|---|---|
| Seed collection, storage and application for optimising vegetation cover | Knowledge of seed collection, storage and seeding rates, seeding times and germination requirements | Many years of research required to develop breadth of knowledge across key conservation significant species |
| *M aquilonaris* ecology and biology | Offsets to address understanding of how to reproduce plants, further searches for populations and improve understanding of water relations. Identify pollinators and their habitat requirements | During operations |
| Species with limited distribution (such as *Eucalyptus rhomboidea* and *Stenanthemum bremerense*) about which there is limited ecological knowledge | Further investigations to collect seed and establish whether they are to be integrated into rehabilitation prescriptions | Life of mine |
| Location of hostile saprolite materials | Further definition in infill and grade control drilling to inform real time management | Prior to mining |
| Tailings capacity to support plant growth | Test plant growth in tailings. Check for contamination risks | During operations |

| Knowledge gap | Action / research | Timeframe / status |
|---|---|---|
| Disposal strategy for residual salts in evaporation ponds | Review of options, risks and costs | First MCP revision |
| Retained infrastructure | Identify any retained infrastructure for mine closure, including new "owner" | Prior to mine closure |

### 5.9.1 Other Closure Related Data

Closure related data will be captured as mining proceeds and operational monitoring, analysis and reporting is completed. In particular, control plots in undisturbed native vegetation will be established and monitored for aspects and attributes identified for completion criteria. These will be monitored to establish natural variation and targets for completion.

# 6 POST MINING LAND USE

Post-mining land uses (PMLU) have been considered and assessed early on in the planning stage through a three-step process, in accordance with DMIRS (2019):

1. Identification of potential PMLUs;
2. Factors to consider in the selection of PMLUs; and
3. A systematic decision-making process.

Project tenements are located within UCL. In a general sense, UCL is maintained with little management as native vegetation for no particular purpose. It is assumed that post-mining, the land will be returned to UCL and henceforth UCL will be used as the identified post-mining land use.

With UCL relying on native vegetation, soil and land needs to be able to be retained in a condition that protects the land from becoming degraded. Rehabilitated areas need to be sufficiently safe, stable and non-erodible to allow for the re-establishment of native vegetation appropriate to the area.

The Mine DE and the western portion of the Haul Road DE lie within the proposed Bremer Range Nature Reserve which has a total area of 50,920 ha. The proposal for a Bremer Range Nature Reserve by Henry-Hall *et al.* (1990) was formally adopted by the South Coast Region Regional Management Plan (Department of Conservation and Land Management, 1992). The proposal to create the Bremer Range Nature Reserve has yet to be enacted by Government (predominantly due to mineralisation in the area), and it is not listed under the EPA (1993) recommendations for Conservation Reserves. In the event that the previously proposed Bremer Range Nature Reserve is enacted by the Government after the completion of the Project, it is expected that the post-mining management requirements will be similar to that of UCL. Further planning of a Bremer Range Nature Reserve may exclude the mining area.

Audalia recognises that UCL and conservation reserve land uses rely upon sustainable native vegetation and may include a broad range of landforms, soils and habitat. Audalia also recognises that the PMLU should be consistent with the expectations of the traditional landowners.

# 7 CLOSURE RISK ASSESSMENT

## 7.1 RISK ASSESSMENT

Audalia has completed a single holistic risk assessment for the risks associated with the rehabilitation and mine closure activities proposed in this MCP. The Risk assessment was conducted on the basis provided in the MCP Guidelines (DMIRS, 2020b). The risk assessment tables are provided in Attachment 1.

### 7.1.1 RISK ASSESSMENT FRAMEWORK

A rehabilitation and closure risk assessment was conducted for the Project. The purpose of the risk assessment was to:

- Identify environmental and regulatory risks and opportunities when planning for rehabilitation and closure; and
- Identify management measures to be implemented to ensure the defined completion criteria can be achieved.

Management controls were selected so that the identified rehabilitation and closure risks would be reduced to as low as reasonably practicable. In determining management controls, the following hierarchy of control was adopted:

- Elimination of the hazard;
- Substitution with a lower risk activity or product;
- Engineering solutions to reduce the impact of the hazard; and
- Implementation of administrative procedures to control the hazard.

In undertaking the risk analysis component of the overall assessment, the approach focussed on addressing the 'credible worst-case consequence of the risk and the likelihood of the credible worst-case consequence occurring'. This approach was deemed the most appropriate due to the scale of the project and the lack of potential for significant environmental impacts to occur.

The approach taken in the Environmental Risk Register (Appendix 9) was to quantify the risk using a combination of its likelihood (Table 29) and consequences (Table 30) to determine the risk rating (Table 31). The likelihood and consequences are rated for both the inherent risks (i.e. before the application of risk mitigation measures) and residual risks (i.e. after consideration of the change in likelihood and/or consequence that the risk mitigation measures).

The definitions used to determine the likelihood of an event occurring are provided in Table 29 below. These range from 'Almost Certain' to 'Very Unlikely'.

Table 29: Likelihood Definitions

| Descriptor | Expected Frequency | Probability |
|---|---|---|
| Rare | Once in 15 years | Highly unlikely, but it may occur in exceptional circumstances. |
| Unlikely | At least once in 10 years | Not expected, but there's a slight possibility it may occur at some time. |
| Possible | At least once in 3 years | The event might occur at some time as there is a history of infrequent occurrence of similar issues with similar projects / activities. |
| Likely | At least once per year | There is a strong possibility the event will occur as there is a history of frequent occurrence with similar projects / activities. |
| Almost certain | More than once per year | The event is expected to occur at some time as there is a history of continuous occurrence with similar projects / activities. |

Consequence definitions for each of the environmental factors identified are provided in Table 30. These range from 'Minor' through to 'Severe'.

Table 30: Consequence Definitions

| Environmental Factor | Minor | Moderate | Serious | Major | Severe |
|---|---|---|---|---|---|
| **Biodiversity / Flora / Fauna / Ecosystem** | No or insignificant impact | Minor – moderate onsite impact<br>Minor offsite impact at a local scale | Long-term onsite impact<br>Moderate offsite impact at a local scale<br>Minor and short-term impact to an Environmentally Sensitive Area (ESA) or area of high environmental value | Long-term impact to ESA or area of high environmental value<br>Long-term impact on a broad scale<br>Adverse impact to listed species | Irreversible impact to ESA or area of high environmental value<br>Irreversible and significant impact on a broad scale<br>Total loss of a listed species |
| **Water Resources** | No or insignificant impact to surface water and groundwater resources | Contained low impact with negligible effect on surface water and groundwater resources | Uncontained impact that will affect surface water and groundwater resources in the short-term | Extensive hazardous impact that will require long-term remedial works | Uncontained hazardous impact with residual effects |
| **Land Degradation** | Negligible impact to isolated area | Contained low impact, not impacting on any environmental value | Uncontained impact, able to be rectified in short-term | Extensive hazardous impact that will require long-term remedial works | Uncontained hazardous impact with residual effects |
| **Air Quality** | Negligible impact to isolated area | Contained low impact, not impacting on any environmental value | Uncontained impact, able to be rectified in short-term | Extensive hazardous impact that will require long-term remedial works | Uncontained hazardous impact with residual effects |
| **Mine Closure** | Site is safe, stable and non-polluting<br>Post mining land use is not adversely affected | The site is safe, all major landforms are stable, and any stability or pollution issues are contained and require no residual management. | The site is safe, and any stability or pollution issues require minor, ongoing maintenance by end land-user | The site cannot be considered safe, stable or non-polluting without long-term management or intervention. Agreed post mining land-use | The site is unsafe, unstable and / or causing pollution or contamination that will cause an ongoing residual affect. The post-mining land use |

| Environmental Factor | Minor | Moderate | Serious | Major | Severe |
|---|---|---|---|---|---|
| | | Post-mining land use is not adversely affected | | cannot proceed without ongoing management. | cannot be achieved. |

Once a consequence and likelihood have been determined for a hazard, the Risk Rating Matrix as illustrated in Table 31 calculates a risk rating for the hazard being assessed.

Table 31: Risk rating matrix

| | | CONSEQUENCE | | | | |
|---|---|---|---|---|---|---|
| LIKELIHOOD | | Insignificant | Minor | Moderate | Major | Severe |
| | Almost Certain | M | H | Cr | Ca | Ca |
| | Probable | L | M | H | Cr | Ca |
| | Possible | L | M | H | H | Cr |
| | Unlikely | L | L | M | M | H |
| | Very Unlikely | L | L | L | L | M |

*Ca – Catastrophic. Cr – Critical. H – High. M – Moderate. L - Low*

### 7.1.2 Closure Risk Assessment

The identification of mine closure related risks at the Project was informed by consultation with key stakeholders and experienced mining, environmental and rehabilitation professionals. Controls to mitigate and manage risks were identified and incorporated into closure actions and controls. It should be noted that the risk assessment process may be changed and improved periodically as the Project develops.

Closure risk assessments at the Project will be reviewed at least every three years, in parallel with the triennial MCP reviews. These risk reviews may include a formal risk assessment workshop with selected internal stakeholders, including site managers and environmental personnel. Experienced personnel who are familiar with the issues concerned will be responsible for assigning likelihood and consequence ratings to closure risks.

## 7.2 Closure Risks

The key issues Audalia will need to manage to successfully rehabilitate and close the Project have been identified as part of a preliminary risk assessment exercise and are listed in the Rehabilitation and Closure Risk Register in Attachment 1.

Nine key closure-related risks (those with an inherent risk rating of moderate or above) were identified during the risk assessment:

1. Vehicles and earthmoving equipment may transport, spread or introduce weeds;
2. Driving outside existing tracks or approved disturbance areas;
3. Vehicle and machinery movements resulting in fauna strikes, roadkill attracts scavengers and leads to additional fauna strikes;
4. Dust emissions from unrehabilitated areas, vehicle and earth moving equipment leading to reduced vegetation health and habitat quality;

5. Project activities such as hot work of vehicle movements trigger a site fire resulting in loss of conservation significant fauna habitat;
6. Surface water quality and flows are modified by the presence of constructed landforms;
7. Low quantities of quality topsoil, erosion and instability of landform surfaces and insufficient or unviable seed stock resulting in poor establishment of plants in rehabilitation;
8. Residual salt or tailings exposed to surface or root zone of plants; and
9. Unfinished rehabilitation of Project due to unplanned closure.

Without risk management measures, the above risk pathways are considered to be generally more likely to occur, with consequences that range up to 'High'. With the application of control measures, the residual risk ratings give a worst overall risk rating of 'Moderate'.

The following sections provide a discussion of each of these risk issues, including consideration of the significance of the adverse impact associated with each risk and the identification of potential causes.

### 7.2.1 Spread or Introduction of Weeds

This section relates to Closure Risk 1 described above.

Rehabilitation activities using that use uncleaned equipment may introduce weeds to the site, or weeds may be spread by vehicle movements and the relocation of material. Without control measures, any new weeds may spread throughout the rehabilitation site and establish new populations. The spread or introduction of weeds has the potential to reduce productivity in rehabilitation areas, increase weed diversity and density, increase competition with native flora and vegetation and reduce pastoral or native fauna habitat values.

Risk management measures identified for weeds include:

- Workforce education on the identification and reporting of weeds continuing on from operations phase;
- Mandatory requirement that any equipment brought to site be clean and weed free;
- Equipment inspections will be undertaken to check hygiene of earthmoving equipment and vehicles prior to arrival on site;
- Restrict off-road driving;
- Rehabilitation areas will be seeded with local native species sourced from reputable suppliers as clean seed;
- Inspect cleared and rehabilitated areas annually to determine if new weed species have established;
- If annual inspections show new weed species are established, weed control and mapping to determine the effectiveness of control measures will be commenced;
- Report new weed infestations that cannot be immediately eradicated as an Environmental Incident;
- Weed related incidents will be reported in Annual Environment Report (AER); and
- Weed spraying to control weeds so they do not outcompete rehabilitation, if required.

### 7.2.2 OFF-ROAD DRIVING

This section relates to Closure Risk 2 described above.

Rehabilitation activities may result in off-road driving that occurs outside of existing tracks and approved disturbance areas. Without control measures, off road driving may result in additional or unauthorised disturbance of flora and vegetation. The impacts may include a reduction in the extent of native vegetation, direct impacts to threatened and priority flora species, a reduction in the extent of the Bremer Range PEC and direct impacts to the Western Rosella *(Platycercus icterotis xanthogenys),* Rainbow Bee-eater *(Merops ornatus)* and a loss of general fauna habitat.

Risk management measures identified for off-road driving include:

- Workforce education to restrict driving to existing tracks and approved disturbance areas;
- Vehicles and equipment shall use existing tracks unless permitted otherwise;
- No off-road driving outside of approved disturbance envelope;
- Clearing boundaries shall be pegged, geo referenced and maintained;
- All clearing (including proposed access) will be managed under a Ground Disturbance Permit (GDP) system;
- Conduct regular ground disturbance audits;
- Report all incidents;
- Regular AER and Mine Rehabilitation Fund (MRF) reporting; and
- Follow Environmental Management System (EMS) process and reporting.

### 7.2.3 VEHICLE STRIKE

This section relates to Closure Risk 3 described above.

Rehabilitation activities will require the movement and operation of vehicles and machinery. Without control measures, vehicle and machinery movements may result in an increase in vehicle strikes resulting in native fauna injuries and deaths. The impacts of vehicle strikes may include a reduction in the number of native fauna species and conservation significant species, to the extent that there is a localised population decline.

Risk management measures identified for vehicle strikes include:

- Workforce education on avoiding vehicle strikes, speed limits and incident reporting;
- Implement speed limit restrictions;
- Majority of earthworks and driving will be completed during daylight hours;
- Drive on existing tracks only;
- No driving outside of approved disturbance areas;
- Roadkill to be collected, recorded and disposed of appropriately;
- External incident reports for vehicle strikes with significant fauna; and
- Follow EMS process and reporting.

### 7.2.4 DUST

This section relates to Closure Risk 4 described above.

Mine closure will include earth moving, vehicle movements and areas of exposed, unrehabilitated land causing dust emissions. Without control measures, dust emissions may result in a reduction

in the local air quality and smother flora and vegetation. Smothering flora and vegetation may cause a measurable decline in vegetation health and fauna habitat quality.

Risk management measures identified for erosion include:

- Workforce education on the impacts of dust and incident reporting;
- Avoid earth moving activities in high wind conditions;
- Reduce the extent of disturbed areas;
- Utilise existing tracks where possible;
- Vehicle movements and speeds are restricted to reduce dust emissions;
- Progressive rehabilitation of temporary disturbance;
- Implement dust controls (water carts, reduce or stop work if needed);
- Conform with Environmental Protection (Unauthorised Discharge) Regulations 2004;
- Monitoring of significant flora for dust impacts;
- Follow EMS process and reporting;
- Conduct regular audits; and
- Record and report all incidents.

### 7.2.5 FIRE

This section relates to Closure Risk 5 described above.

Rehabilitation activities will include vehicle movements and may include hot work. Without control measures, hot work and vehicle movements have the potential to create a site fire. A site fire has the potential to impact significant fauna, flora and vegetation through mortality and the loss of habitat. A site fire would also result in the reduction of the success and rate of rehabilitation.

Risk management measures identified for fire include:

- Workforce education on off-road driving, the implications of hot work and the mitigation of fire;
- Avoid hotwork and driving off-road where practicable;
- Implement hot work permits;
- Ensure fire suppression equipment is available;
- Water carts available for fire control;
- Re-seed any areas burnt within five years of seeding;
- Develop and implement an Emergency Management Plan;
- Integrated planning with DBCA to reduce risk and effects of fire;
- Document and report all incidents;
- Regular AER and MRF reporting; and
- Follow EMS process and reporting.

### 7.2.6 SURFACE WATER FLOWS

This section relates to Closure Risk 6 described above.

Mine closure will include the decommissioning, rehabilitation and management of constructed landforms. Without control measures, mine closure of constructed landforms may result in drainage shadowing, erosion, sedimentation and the discharge of pollutants from road surfaces.



Drainage shadowing may occur if constructed landforms are not appropriately managed. This effect has the potential to reduce the water availability which can impact the health and condition of flora and vegetation. Erosion may occur if constructed landforms are not properly managed. This may lead to instability and failure of the constructed landform, reducing the success of rehabilitation. Erosion of exposed, unrehabilitated landforms may also result in sedimentation or discharge of pollutants (haul road) which could contaminate inland waters and the terrestrial environment. This may further reduce the success of rehabilitation and the environmental values of the land post-mining.

Risk management measures identified for surface water flows include:

- TSF closure design to incorporate options to retain significant rainfall events and reduce the need for permanent surface water diversions;
- TSF cover design to be conservative, with knowledge gaps to be addressed during operations;
- Materials balances to maintain closure options for as long as they are required;
- All depressions will be shaped to prevent the formation of new semi-permanent water sources;
- All surface water drainage diversions will be rehabilitated to a natural form;
- All surface water crossings will be reinstated by removing drainage infrastructure and reshaping as required.
- Water flows to be considered in rehabilitation, concentrated flow areas to receive erosion protection;
- Water storage ponds backfilled and reshaped to the surrounding landform;
- Spills will be controlled, contained and cleaned up;
- Document and report all incidents; and
- Follow EMS process and reporting.

### 7.2.7 TOPSOIL, SEEDING AND LANDFORM MANAGEMENT

This section relates to Closure Risk 7.

Successful rehabilitation during the mine closure phase is dependent on the availability of sufficient quantities of good quality topsoil and seed. Topsoil replacement and seeding will be managed via the following:

- Seed will be collected from the priority flora known to occur within the planned disturbance areas: *Eucalyptus rhomboidea* or *Stenanthemum bremerense, Hakea pendens, Acacia mutabilis subsp. stipulifera, Microcybe sp. Windy Hill (G.F. Craig 6583)*, *Teucrium diabolicum* individuals recorded within the proposed ground disturbance area during the pre-clearance survey;
- Germination trials are to be conducted during the life of the Project to target the successful establishment of the above species into rehabilitation areas by defining germination and seeding rates;
- Other Priority Flora will be included in the rehabilitation seed mix if viable and germinable seed is available;
- Flowering plants will be included in seeding to ensure pollinator habitat is adequately reinstated;
- Workforce education to ensure adequate quantities of quality topsoil are stored for rehabilitation;

- Disturbance of topsoil once removed will be minimised as far as practicable;
- All topsoil removed ahead of construction and stockpiled separately for replacement after completion of operations;
- Topsoil to be stripped to a depth of approximately 150 mm;
- Stripped topsoil and vegetation to be stockpiled in piles no greater than 2 m in height;
- Topsoil stockpiles to be located outside of high risk flood areas;
- Topsoils will be in close proximity to area of stripping and reapplied to same area to ensure soil profile is correctly reconstructed;
- Rehabilitation of temporarily disturbed areas completed progressively;
- Two seed mixes will be established for use in rehabilitation to reflect the different flora species found in the Clay Loam Plain and Hillslope habitats;
- Seed rehabilitation areas with local native species from reputable suppliers (certified seed purity); and
- Annual reporting of topsoil / subsoil volumes, disturbed areas and rehabilitated areas.

Seedlings are not to be planted in rehabilitation areas due to the risk of introducing new soil pathogens into the rehabilitation.

### 7.2.8 Residual Salt and Tailings

This section relates to Closure Risk 8 described above.

Improper closure of the TSF and evaporation ponds may result contamination of the soil surface and root zone. Without control measures, the TSF and evaporation ponds may experience elevated levels of seepage. As a result, the soils downstream of the TSF and evaporation ponds may experience elevated levels of trace elements and salinity which could impact the health of flora and vegetation if it is maintained within the plant root zone, and taken up by the plants. At rates and concentrations that are above their tolerance levels.

Risk management measures identified for uncontrolled residual salt and tailings discharges include:

- Detailed engineering design will incorporate closure requirements for evaporation ponds and TSF;
- Any residual salt within the evaporation ponds will be excavated and either placed in a specifically prepared disposal trench within the footprint of the evaporation ponds, the bottom of a mine or borrow pit, TSF or taken off site;
- Materials balances will account for closure options;
- Tailings will be assessed for their potential to support plant growth;
- The MCP will be revised every three years;
- Cover specifications in MCP to be tested in the field; and
- Audit and inspection prior to tenement relinquishment.

### 7.2.9 Unplanned Closure

This section relates to Closure Risk 9 described above.

Unfinished Rehabilitation due to unplanned closure may occur as a result of unfavourable market trends or commercial outcomes of the Project. Without control measures, unplanned closure will

result in reduced visual amenity of the landscape, a reduction in suitability of the area for the planned post mining land use and an increase in the potential for weed invasion, erosion and sedimentation.

Risk management measures identified for unplanned closure include:

- The site will be progressively maintained and rehabilitation where possible;
- Early construction of abandonment bunds;
- MRF system requires annual contributions and reporting;
- Enter care and maintenance phase until prices recover; and
- Rehabilitation cost estimation and provisioning to International Financial Reporting Standards.

# 8 CLOSURE OUTCOMES AND COMPLETION CRITERIA

## 8.1 CLOSURE OUTCOMES

The overarching outcome for the closure and rehabilitation of the Project is to make the disturbed area safe, stable, non-polluting and capable of sustaining the agreed PMLU.

More detailed closure outcomes have been developed based on the current understanding of the Disturbance Envelopes, the proposed mining activities and materials characteristics using the structure proposed in the MCP Guidelines (DMIRS, 2020b). The outcomes may be further refined following additional stakeholder engagement, completion of further activities to address information gaps, and in the event that the Project is expanded.

***Compliance***

1. Binding obligations and conditions shall be met.

***Landforms and Soils***

2. All constructed landforms shall be made physically safe and stable.
3. Target landforms and rehabilitation surfaces shall be planned and implemented for broad-scale rehabilitated areas (excluding retained infrastructure).

***Revegetation***

4. Re-establish vegetation that provides a self-generating ecosystem comprising local native vegetation which resembles the surrounding environment as closely as practical.
5. Direct seeding of significant flora species for which seed is able to be collected to be included into the seed mix for rehabilitation.
6. Weed species are not introduced by closure activities.

***Fauna***

7. Rehabilitated areas provide similar habitat function for local native fauna as surrounding areas.

***Surface Water***

8. Integrated TSF/EP landform supports hydrological patterns and flows for 90th percentile 72-hour PMP storm events.

***Infrastructure and Waste***

9. To leave the site in a safe, stable, non-polluting and tidy condition with no remaining plant or infrastructure that is not required for post operational use or agreed use by other stakeholders with standing.
10. All bores, pipes, tanks and other ancillary infrastructure will be decommissioned and made safe or else legal responsibility will be assumed by a third party.

***Waste***

11. Waste materials shall be identified and removed to a licensed recycling / disposal facility during decommissioning / closure.

***Contamination***

12. Any identified site contamination reported in accordance with the CS Act.
13. No contaminated soils at the Project post-closure.

## 8.2 PRELIMINARY COMPLETION CRITERIA

Completion criteria are preliminary and will be refined over the life of the Project. The first stage of refinement will be based on post-mining land use and closure outcomes, baseline environmental data, environmental obligations and the expectations of relevant stakeholders to enable rehabilitation success to be quantified and to demonstrate that closure objectives have been met. The criteria have been prepared in accordance with the *Western Australian Biodiversity Science Institute Framework for Developing Mine-Site Completion Criteria in Western Australia* (Young et. al., 2019), which is provided by DMIRS as specific guidance for developing completion criteria.

The criteria will be the subject of further consultation and development over the life of this MCP and will be reviewed, updated and transferred through to the final MCP revision for the closure of the Project.

The preliminary completion criteria developed for the Project are provided in Table 32.

Table 32: Completion criteria

| Aspect | Closure Outcome | Completion Criteria | Measurement Tools | Evidence of Completion |
|---|---|---|---|---|
| Compliance | Binding obligations and conditions shall be met. | Site obligations fulfilled, infrastructure liability transferred to third party, or new owner identified and accepted. | Letters of acceptance for responsibility, tenure or ownership evidence for any retained infrastructure.<br>Post-closure audit of legal obligations, conditions and commitments.<br>Monitoring will continue until criteria are met. | Post-closure audit report |
| Landforms and soils | Constructed landforms shall be made physically safe and stable. | TSF has been contoured for water retention and percolation, inward sloping top, crest bunds, cell bunds batter slopes < 20°, spread with top soil, ripped, mean stability rating ≥ 50%, mean infiltration rating ≥ 20%.<br>Abandonment bunds constructed in accordance with the DoIR (1997) abandonment bund guidelines. | Vehicle access to pits and TSF is physically constrained.<br>Post closure physical survey of TSF.<br>Ecosystem Function Analysis (EFA) on TSF surfaces. | As built survey report.<br>EFA monitoring report. |
| | Target landforms and rehabilitation surfaces shall be planned and implemented for broad-scale rehabilitated areas (excluding retained infrastructure). | Mine closure domains include planned rehabilitation designs.<br>Constructed rehabilitation areas are implemented according to design specifications. | Annual reporting of topsoil / rehabilitation material volumes, developed areas and rehabilitated areas.<br>Routine reporting of rehabilitation progress.<br>As-built survey for new landforms.<br>Monitoring will continue until targets are met. | Rehabilitation plan.<br>As-built survey report.<br>Rehabilitation report. |
| Revegetation | Re-establish vegetation that provides a self-generating ecosystem comprising local native vegetation | Revegetated areas are well established and represent a self-sustaining vegetation community (based on at least two seasons of seed production) and are similar to the surrounding | Revegetation monitoring designed and conducted by suitably qualified professional in the first year post closure and then at least biennially following | Site inspection records and / or rehabilitation report. |

| Aspect | Closure Outcome | Completion Criteria | Measurement Tools | Evidence of Completion |
|---|---|---|---|---|
| | which resembles the surrounding environment as closely as practical. | environment in terms of floral compositions at analogue sites (60-80% species richness, >50% stems cover/density) and <10% weed cover.<br><br>Implement consistent with the rehabilitation strategy in Table 3-2 of the Medcalf Project Rehabilitation Plan (Appendix 3.13 of this Interim MCP) implemented for Clay Loam Plain Floristic Communities and Hillslope Floristic Communities. | completion of rehabilitation earthworks, or until completion targets are achieved.<br><br>Plot-based vegetation monitoring within rehabilitation and analogue sites (plots to be determined by contracted revegetation specialist during progressive rehabilitation).<br><br>EFA monitoring on rehabilitated TSF/EP borrow pit, topsoil stockpile and overburden stockpile areas.<br><br>Monitoring will continue until targets are met. | EFA monitoring report. |
| | Inclusion of significant flora species into rehabilitation. | Conservation significant flora species are within the disturbance footprint with viable and germinable seed are re-established in rehabilitation | Germination tests on available seed.<br><br>Seed quantities and seeding rates recorded.<br><br>Annual monitoring of rehabilitation. | Rehabilitation report<br><br>EPA monitoring report |
| | Weed species are not introduced by closure activities. | Revegetation areas have a weed infestation less than 20% above the proportion of analogue sites (i.e. 2% increase if the analogue sites have a 10% weed infestation).<br><br>No new weed species. | Plot-based assessment within rehabilitation and analogue sites (plots determined prior to completion of rehabilitation).<br><br>Weed assessment designed and conducted by suitably qualified professional within first year of rehabilitation, second within 5 years and additional monitoring if required to confirm completion criteria are met. If not, follow up surveys are to continue until completion criteria are met.<br><br>Presence of new weed species will trigger the need for weed mapping and management controls. | Site inspection records and / or rehabilitation report. |



| Aspect | Closure Outcome | Completion Criteria | Measurement Tools | Evidence of Completion |
|---|---|---|---|---|
| Fauna | Rehabilitated areas provide similar habitat function for local native fauna as surrounding areas. | Revegetation areas contain structural microhabitat (including returned logs and rocky habitat) providing opportunities for native fauna recolonisation. | Post-closure audit. | Post-closure audit report. |
| Surface Water | Integrated TSF/EP landform supports hydrological patterns and flows for 90th percentile 72-hour PMP storm events. | Integrated TSF/EP landform incorporates water and drainage management measures to mitigate erosion of final surfaces and slopes as per Mine Earth (2020) concept design.<br>Revegetation success assessed (by EFA) as not being significantly affected by erosion. | As-built survey.<br>EFA monitoring on rehabilitated Integrated TSF/EP landform.<br>Monitoring will continue until criteria are met. | As built survey.<br>Rehabilitation report. |
| Infrastructure | To leave the site in a safe, stable, non-polluting and tidy condition with no remaining plant or infrastructure that is not required for post operational use or agreed use by other stakeholders with standing.<br>All bores, pipes, tanks and other ancillary infrastructure will be decommissioned and made safe or else legal responsibility will be assumed by a third party. | All pipes, tanks and other ancillary infrastructure have been decommissioned, or legal responsibility agreement finalised. | Post-closure audit. | Post-closure audit report. |
| | | All haul roads and tracks have been rehabilitated with natural drainage lines re-established except where approved agreements are in place for retention. | Post-closure audit. | Record of agreements for any remaining roads and tracks |
| | | All bulk hydrocarbon storage tanks have been emptied and removed. | Post-closure audit. | Decommissioning records |
| Waste | Waste materials shall be identified and removed to a licensed recycling / disposal facility during decommissioning / closure. | Waste disposal plan drafted prior to decommissioning and closure.<br>All waste materials have been removed to a licensed recycling / disposal facility. | Waste disposal plan.<br>Post-closure audit. | Waste transport certificates<br>Waste disposal certificates<br>Post-closure audit report. |
| Contamination | Any identified site contamination reported in accordance with the CS Act. | Site contamination assessment undertaken in accordance with the *National Environment Protection (Assessment of Site Contamination)* | Soil, surface water and groundwater analysis using accredited laboratory analysis and field measurements. | Fieldwork records.<br>Certificates of analysis. |

| Aspect | Closure Outcome | Completion Criteria | Measurement Tools | Evidence of Completion |
|---|---|---|---|---|
| | | *Measure 1999* and DER (2014) contaminated site assessment and management guidelines.<br><br>Any identified site contamination reported in accordance with the DER (2017) contamination reporting guidelines. | | Site contamination Form 1: Report of a known or suspected contaminated site assessment report. |
| | No contaminated soils at the Project post-closure. | Identified contaminated soil disposed off site to licensed waste disposal facility or remediated.<br><br>Validation testing shows soil chemical concentrations < DER (2014) EIL assessment levels or otherwise within 20% of background concentration (for naturally elevated constituents)<br><br>Groundwater quality at nearest offsite down gradient receptor does not exceed the 95th percentile of annual monitoring data for monitored groundwater parameters. | Soil, surface water and groundwater analysis using accredited laboratory analysis and field measurements.<br><br>Groundwater monitoring program including offsite bore/s. | Fieldwork records.<br><br>Certificates of analysis.<br><br>Site contamination assessment report.<br><br>Validation testing certificates of analysis.<br><br>Waste transport and acceptance certificates |

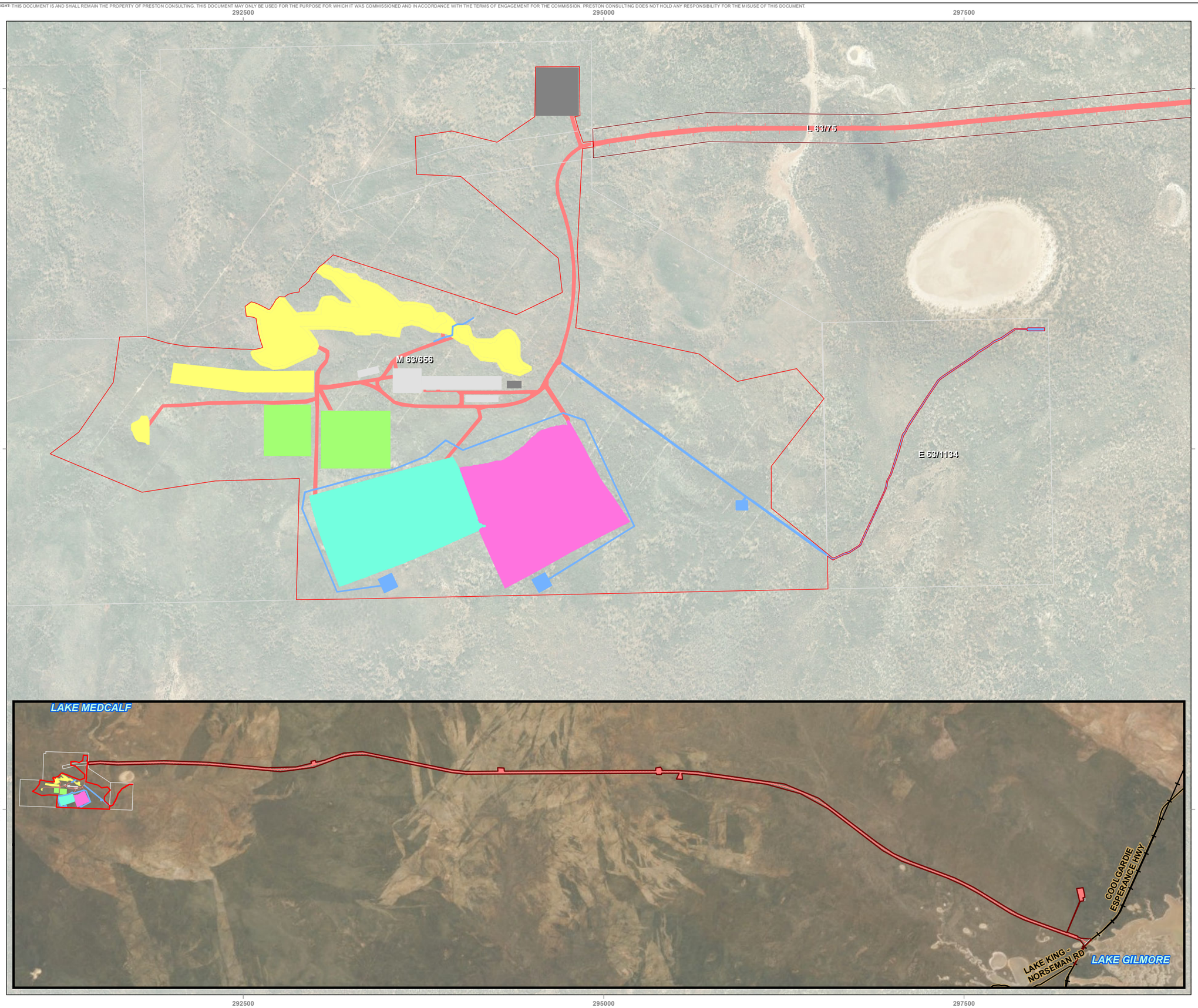
# 9 CLOSURE IMPLEMENTATION

## 9.1 DOMAIN SPECIFIC CLOSURE WORKS

For the purpose of planning rehabilitation and closure, and consistent with industry standard closure planning process, the DEs have been divided into specific domains. Each domain includes items that have similar rehabilitation and closure requirements. For the Project, the following domains have been identified and are shown in Figure 66.

- Domain 1: Open Pits;
- Domain 2: Processing Facility and Workshops;
- Domain 3: Evaporation Ponds;
- Domain 4: TSF;
- Domain 5: Infrastructure;
- Domain 6: Stockpiles;
- Domain 7: Water Infrastructure; and
- Domain 8: Access Road and Tracks.

The closure objectives allow for some flexibility in target landforms for some of the Project domains, consistent with the early stages of closure planning. The closure work programs will vary according to the selected target landform option as the identified knowledge gaps are addressed. The domain specific closure works in the section below identify the likely tasks associated with the currently identified target landform options. These will be clarified over time as the knowledge gaps are addressed and ensure closure objectives remain consistent with industry standards.




**Legend**

- Mine Development Envelope
- Haul Road Development Envelope
- Tenement

Indicative Domains

- Domain 1: Open Pits
- Domain 2: Processing Facility and Workshops
- Domain 3: Evaporation Ponds
- Domain 4: Tailings Storage Facilities
- Domain 5: Infrastructure
- Domain 6: Stockpiles
- Domain 7: Water Infrastructure
- Domain 8: Access Road

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- TENEMENTS SOURCED DMRS 2020
- LOCALITY MAP SOURCED LANDGATE
- AERIAL PHOTOGRAPHY OPEN SOURCE

Preston Consulting

0 200 400 600 800 1,000
metres
Scale: 1:25,000 @ A3

N

**LOCALITY MAP**


| CREATED BY | JOB | DATE | REVISION |
|---|---|---|---|
| ENVIRONMAPS | PC2900035 | 9/07/2020 | 0 |

audalia resources limited

ENVIRONMAPS | t: 0406 590 606
Environmental Mapping Solutions | www.environmaps.com.au

Figure 66: Closure Domains

# 9.2 CLOSURE WORK PROGRAM

The domains are further broken down into sub-domains and specific tasks in the following sections to enable planning to be carried out at a suitable scale and level of detail.

## 9.2.1 DOMAIN 1: OPEN PITS

The mine pits will be retained as voids, with further potentially economic ore located deeper than the current mine plan. At closure, all infrastructure will be removed, the pit ramps will be barricaded to prevent vehicle access, the edges of each pit, inclusive of the ramps, will be battered and drainage into the pits will be managed appropriately. These will be the subject of a post-closure audit.

The sub-domains under Open Pits and relevant tasks have been provided in Table 33.

**Table 33: Open Pits task list**

| Sub-domain | Task | Verification |
|---|---|---|
| Open Mine Pits | • Remove all infrastructure and scrap material from pit area and surrounds<br>• Finalise construction of abandonment bund outside of zone of instability to prevent inadvertent vehicle access<br>• Ensure no sediment or water diversion from abandonment bunds is affecting sub-populations of *M. aquilonaris*<br>• Implement post mine monitoring and external completion report process | Completion report covering landform, soils, retained infrastructure and surface water<br>Closure audit including photography |
| Borrow Pit | • Remove all infrastructure and scrap material from pit area and surrounds<br>• Finalise construction of abandonment bund outside of zone of instability to prevent inadvertent vehicle access or batter slopes to less than 20 degrees, spread topsoil, rip and seed with local native species;<br>• Implement post mine monitoring and external completion report process. | Completion report covering landform, soils, retained infrastructure and surface water<br>Closure audit including photography |
| Ramps | Block vehicle access to any pit ramps. | Closure audit including photography |
| Drainage | • Establish drainage diversions and shallow windrows to control water flows where required<br>• Access to drainage works rehabilitated | Closure audit including photography |
| All Areas | Implement post-mining monitoring and external completion report processes. | Audit |

## 9.2.2 DOMAIN 2: PROCESSING FACILITY AND WORKSHOPS

The sub-domains under Processing Facility and Workshops and relevant tasks have been provided in Table 34.

**Table 34: Processing Facility and Workshops task list**

| Sub-domain | Task | Verification |
|---|---|---|
| Processing Facilities | • Obtain quotations for demolition and removal<br>• Complete residual hydrocarbon and contamination assessment<br>• Decommission all facilities, clean and make safe | Audit<br>Rehabilitation monitoring report |

| Sub-domain | Task | Verification |
|---|---|---|
| | • Isolate and disconnect services as no longer required<br>• Remove mobile/fixed infrastructure for re-use or approved disposal<br>• Remove remaining structural materials and concrete pad as necessary for approved disposal<br>• Back-fill to bury to approved depth any materials to be left in-situ<br>• Re-surface to match surrounding ground levels<br>• Re-establish drainage<br>• Revegetate in accordance with the Revegetation Process | |
| Workshop Area | • Remove structural materials and concrete pad<br>• Complete residual hydrocarbon and contamination assessment<br>• Decommission all facilities, clean and make safe<br>• Isolate and disconnect services as no longer required<br>• Remove mobile/fixed infrastructure for re-use or approved disposal<br>• Bury to approved depth any materials to be left in-situ<br>• Landform, topsoil, rip and seed<br>• Implement post-mine monitoring and external completion report process | Audit<br>Rehabilitation monitoring report |
| All Areas (unless otherwise specified) | • Return topsoil<br>• Rip and seed with local native species<br>• Implement post-mining monitoring and external completion report processes<br>• All rubbish and scrap being progressively disposed of in a suitable manner<br>• Retain infrastructure according to any subsequent owner agreements | Audit<br>Rehabilitation monitoring report |

### 9.2.3 DOMAIN 3: EVAPORATION PONDS

Evaporation ponds are required to store the reject water from the reverse osmosis plant (RO plant). The process plant requires 850 kL/day of fresh water, which will be obtained from the RO plant through treatment of groundwater. Given the high salinity of the groundwater in Medcalf, a 40% conversion rate has been assumed by Audalia to estimate the volume of reject water that will need to be stored in an evaporation pond. Assuming a 40% conversion rate, a total of about 1,200 kL/day will be discharged into the evaporation ponds.

Two evaporation ponds have been designed to provide storage for the life of mine (LOM) (approximately 500,000 $m^3$ per annum). Audalia will investigate alternatives for water disposal during operations.

The evaporation ponds will require removal of any residual crystallised salts from the ponds, for burial, followed by earthworks to create the post-mine landform.

The sub-domains under Evaporation Ponds and relevant tasks have been provided in Table 35.

**Table 35: Evaporation Ponds task list**

| Sub-domain | Task | Verification |
|---|---|---|
| Evaporation Ponds | Remove EP diversion drains<br>Remove contaminants such as residue and salt impacted soils<br>Allow soil drying period to ensure trafficability<br>Remove EP embankments;<br>Construct a cover over the impacted pond area to manage vertical migration of salt; | Audit.<br>Rehabilitation monitoring report. |

| Sub-domain | Task | Verification |
|---|---|---|
| | Rock armour drainage concentration areas within the EP footprint<br>Apply topsoil to the EP footprint<br>Scarify and seed with local native species<br>Monitor and maintain | |
| All areas (unless otherwise specified) | Implement post-mining monitoring and external completion report processes<br>All rubbish and scrap being progressively disposed of in a suitable manner<br>Re-establish infrastructure according to land owner agreements | Audit.<br>Rehabilitation monitoring report. |

### 9.2.4 DOMAIN 4: TAILINGS STORAGE FACILITIES

The following basic design parameters are planned as a minimum for the construction and rehabilitation of the TSF to minimise the chance of erosion, sedimentation and batter slope failure. These have been sourced from the ERD and supporting documentation for the design and construction of the TSF raises produced by Golder (2020). They are shown in Figure 8.

The design approach for the TSF consists of:

- Retain the existing TSF downstream embankment slope angle (≈ 18°);
- Remove the upstream diversion drains to the north of the TSF. Retain the diversion drain to the west of the TSF;
- Expand the TSF embankment height to contain incidental rainfall and upstream runoff, accounting for a TSF surface cover;
- Construct a cover system over the TSF surface to stabilise the surface to reduce surface water erosion and dust generation, and support revegetation (and manage vertical migration of salt if the evaporites are stored within),;
- Manage water on the TSF top surface to enhance revegetation outcomes via cell bunding;
- Apply topsoil to the TSF top surface;
- Stabilise TSF embankments where required; and
- Apply topsoil to the TSF embankments.

The downstream batter slopes of confining embankment have been assumed to be constructed at a slope of 1V:3H, about 18°. This relatively flat batter will allow the slopes to be trafficked during closure. The upstream batter slopes have been assumed to be constructed at a slope of 1V:2H, about 27°. The assumed batter slopes are likely to provide a satisfactory factor of safety against instability, depending on the available construction materials and the strength of the foundation. However, this will need to be confirmed as part of future studies, after completion of a geotechnical investigation.

A crest width of 10 m has been allowed for, providing sufficient room for a tailings delivery pipe (upstream safety barrier) on the upstream crest margin and vehicle traffic along the crest. A cross-section of the TSF is presented in Figure 9. It is expected that refinements to the geometry of the confining embankment, and hence the volume of fill required, will be made during future stages of design.

The TSF has been designed with slope batters of 1V:3H (~20°). Placing the material at this angle allows for trafficking of the slopes at closure, facilitating placement of cover materials. Erosion control will be required on the slopes, which may be achieved through placement of durable, erosion-resistant materials from a borrow area located to the north of the TSF.



Tailings storage infrastructure such as pipelines, water storage ponds and the temporary slurry storage area will be decommissioned and rehabilitated. The liner from the ponds will be removed and the embankments regraded to tie into surrounding natural ground.

The sub-domains and tasks required for TSF closure are shown in Table 36.

**Table 36: TSF task list**

| Sub-domain | Task | Verification |
|---|---|---|
| TSF | **Cover design**<br>• Determine if evaporite/residues to be stored – design capillary break if required<br>**Topsoil recovery**<br>• Topsoil removed during site clearing and construction of the TSF embankment and associated infrastructure will be stockpiled to assist with future rehabilitation<br>• Assessment of suitable topsoil will be carried out as part of rehabilitation planning<br>**Decommissioning**<br>• Water at the decant will be allowed to evaporate<br>• Monitoring and recovery bores will be plugged and decommissioned as required<br>**Perimeter embankment batters**<br>• 20 degree maximum outer batter slope at completion of all raises<br>• Batters will be sheeted with ⩾150 mm-thick topsoil layer as a vegetation growth medium, ripped and seeded with local species<br>• Mix 50% competent rock with topsoil applied to batter slopes, to improve erosion resistance<br>**Top surface**<br>Placement of topsoil (and any other required layer) onto tailings as a vegetation growth medium.<br>**At final closure, the decant structure will be sealed by:**<br>• Removal of the slotted concrete pipes and filter rock to a level between 2 - 5 m below the surrounding tailings<br>• Backfilling of the remaining slotted concrete pipe with dried tailings<br>• Covering of the excavated rock layer (i.e. the rock surrounding the decant structure) with geo-fabric to prevent movement of fine material through the rock voids<br>• Backfilling of the excavation with tailings to the adjacent tailings level<br>• Decant access way dozed down to surrounding tailings surface prior to placement of mine waste cover<br>• Capping of the decant area of the TSF using ⩾500 mm EP embankment material<br>• Decant surface covered with topsoil ripped and seeded with local species | • Revised MCP<br>• Completion report covering landform, soils, retained infrastructure and surface water<br>• Closure audit including photography |
| All areas | Implement post-mining monitoring and external completion report processes.<br>Fence and re-establish infrastructure in all areas according to landowner requirements. | Audit |



### 9.2.5 DOMAIN 5: INFRASTRUCTURE

Some infrastructure may be retained post-closure to provide services for the rehabilitation team while other facilities may remain in place through stakeholder agreements, e.g. with a responsible Agency or Traditional Owners.

The sub-domains under Infrastructure and relevant tasks have been provided in Table 37.

**Table 37: Infrastructure task list**

| Sub-domain | Task | Verification |
|---|---|---|
| Accommodation camp | • Identify post-mining owner or remove and rehabilitate<br>• Utility services disconnected and removed<br>• Remove footings and bury locally or in landfill<br>• Landform area, spread topsoil, scarify and seed | Audit to confirm removal<br>Rehabilitation monitoring report |
| Communication Towers | • Identify post-mining owner or remove<br>• Scarify disturbance area | Ownership documentation or Audit to confirm removal |
| Drains and sumps | • Prepare post-mining drainage plan to identify retained features<br>• Fill and rehabilitate areas not to be retained<br>• Scarify rehabilitation areas as required | Post-mining drainage plan or audit<br>Rehabilitation monitoring report |
| Fuel storage and dispensing areas | • Complete residual hydrocarbon and contamination assessment<br>• Report under Contaminated Sites Legislation if required<br>• Remove structural materials and concrete pad<br>• Remove mobile/fixed infrastructure for re-use or approved disposal<br>• Bury to approved depth any materials to be left in-situ<br>• Landform, topsoil, rip and seed<br>• Implement post-mine monitoring and external completion report process | Hydrocarbon contamination assessment report<br>Audit to confirm removal |
| Mining offices/crib rooms/ | • Remove structural materials and concrete pad<br>• Remove mobile/fixed infrastructure for re-use or approved disposal<br>• Bury to 300 mm any materials to be left in-situ<br>• Landform, topsoil, rip and seed<br>• Implement post-mine monitoring and external completion report process | Audit to confirm removal |
| Topsoil Stockpiles | • Utilise stockpile material for land surface preparation in accordance with the Landform Restoration Process<br>• Landform, topsoil, rip and seed | Completion report covering landform, soils, retained infrastructure, surface and groundwater |
| Landfill | • Back-fill landfill cell with stockpiled specified cover thickness and topsoil material<br>• Re-contour to match surrounding ground levels and re-establish drainage<br>• Rip and seed with local native species<br>• Remove fencing | Audit to confirm removal<br>Rehabilitation monitoring report |
| All Areas | • Implement post-mining monitoring and external completion report processes<br>• Re-establish infrastructure according to land owner agreements | Audit<br>Rehabilitation monitoring report |

### 9.2.6 DOMAIN 6: STOCKPILES

Materials required for capping the TSF and topsoil will need to be stored to support site rehabilitation. The area used for topsoil storage will not be stripped of topsoil itself. The closure materials area will be stripped of topsoil.

The sub-domains under Stockpile Areas and relevant tasks have been provided in Table 38.

**Table 38: Stockpile Areas task list**

| Sub-domain | Task | Verification |
|---|---|---|
| Topsoil Stockpiles | • Remove and bury road surface<br>• Re-contour<br>• Replace topsoil, rip and seed (in accordance with dieback management procedures)<br>• Or leave in a condition agreed with Agency | Audit<br>Rehabilitation monitoring report |
| Closure Materials Stockpile | • Re-contour<br>• Replace topsoil, rip and seed<br>• Or leave in a condition agreed with Agency | Audit<br>Rehabilitation monitoring report |
| All Areas | • Implement post-mining monitoring and external completion report processes<br>• Re-establish infrastructure according to Agency requirements | Audit.<br>Rehabilitation monitoring report |

### 9.2.7 DOMAIN 7: WATER INFRASTRUCTURE

All water infrastructure will be decommissioned and rehabilitated, except water diversion drains around the TSF, Evaporation Ponds and Pinatubo pit. Some water infrastructure will need to be retained in support of rehabilitation related activities for the site, before being decommissioned and rehabilitated. Agencies will be consulted regarding water infrastructure to determine if they require any to be retained, with written agreement to take responsibility for them required.

The sub-domains under Water Infrastructure and relevant tasks have been provided in Table 39.

**Table 39: Water Infrastructure task list**

| Sub-domain | Task | Verification |
|---|---|---|
| Diversion drains | • Identify all diversion drains for retention post-closure<br>• Check condition and capability to manage design flood event<br>• Upgrade to closure design standard if required<br>• Include rock armour/scour protection if required<br>• Where revegetation is required, scarify and seed or allow natural re-seeding<br>• Monitor water quality at Lake Medcalf tributary crossing | Future MCP revisions<br>Audit<br>Rehabilitation monitoring report<br>Inspect and report condition after flood events until relinquishment |
| Pumps and Pipelines | • Power sources to be removed<br>• Pumps to be removed for re-use, recycling or disposal<br>• Any footings to be either removed and buried locally or at landfill<br>• Pipelines to be cleaned with fresh water if required<br>• Residual water to be drained from pipes and contained to prevent damage to vegetation<br>• Pipelines to be dismantled<br>• Pipe to either be:<br>  ○ Disposed of at licensed landfill; or<br>  ○ Removed and resold/recycled. | Audit to confirm removed<br>Rehabilitation monitoring report |

| Sub-domain | Task | Verification |
|---|---|---|
| Water supply bores | • Identify all bores for retention and establish written agreement with new owner<br>• Other bore holes are to be filled and capped or rehabilitated as approved most likely to be cut beneath ground level, remove collars and any concrete for burial locally or at landfill | Audit to confirm capped and filled<br>Rehabilitation monitoring report |
| Monitoring bores | • Identify any monitoring bores for retention and establish written agreement with new owner<br>• Other bore holes are to be filled and capped or rehabilitated as approved most likely to be cut beneath ground level, remove collars and any concrete for burial locally or at landfill | Audit to confirm capped and filled<br>Rehabilitation monitoring report |
| All Areas | • Implement post-mining monitoring and external completion report processes<br>• Re-establish infrastructure according to Agency requirements | Audit<br>Rehabilitation monitoring report |

### 9.2.8 Domain 8: Access Road and Tracks

All roads and tracks will be rehabilitated once they are no longer required for mining operations. Some roads and tracks will be retained for ongoing site access post-closure in support of rehabilitation related activities. Agencies will be consulted regarding access roads and tracks to determine if they require any to be retained, with written agreement to take responsibility for them required.

Where the road surface has become contaminated, such as from the use of saline water from dust suppression or hydrocarbon spills, the contaminated material will be removed and appropriately disposed of (into the TSF, licenced landfill, landfarm area or as backfill into the borrow pit).

The sub-domains under Access Road and Tracks and relevant tasks have been provided in Table 40.

**Table 40: Access Road and tracks task list**

| Sub-domain | Task | Verification |
|---|---|---|
| Haul Road (including culverts) | • Remove and bury road surface , and disposal of contaminated soils<br>• Re-contour<br>• Replace topsoil, rip and seed (in accordance with dieback management procedures)<br>• Or leave in a condition agreed with Agency | Audit<br>Rehabilitation monitoring report |
| Tracks | • Re-contour<br>• Replace topsoil, rip and seed<br>• Or leave in a condition agreed with Agency | Audit<br>Rehabilitation monitoring report |
| All Areas | • Implement post-mining monitoring and external completion report processes<br>• Re-establish infrastructure according to Agency requirements | Audit.<br>Rehabilitation monitoring report |

## 9.3 Environmental Controls During Closure

This section details the key environmental controls that will be applied during the closure implementation phase for the Project. Compliance with relevant approval conditions will continue as required and be reported to regulators through AERs. The final step in decommissioning and closing a mining operation will be relinquishment of the tenements. It is

anticipated that the Mining Act would therefore be the final statute dictating any required controls during the latter stages of closure.

### 9.3.1 Use of Rehabilitation Materials

At the completion of the Project the site will be rehabilitated to reinstate native vegetation. Key rehabilitation controls are summarised below:

- Rocky and blocky material from laterite/limonite deposits, and topsoils will be retained separately from other subsoil materials and used for erosion protection during rehabilitation;
- All disturbance areas (except mine pits) will be landformed to slopes consistent with surrounding landforms, respread with topsoil and rehabilitated;
- Saprolite materials will not be used as the outer surface for built structures;
- Rehabilitation slopes above ten degrees will be sheeted with competent materials to provide erosion protection based on erosion testwork and modelling of representative topsoils;
- Rehabilitation areas will be seeded with local native species; and
- Research will be conducted into how to establish and maintain conservation significant species in site rehabilitation.

### 9.3.2 Air Quality

During closure, Audalia will implement the following dust management activities as required:

- Cover and rehabilitate high dust risk areas as soon as possible;
- Visual monitoring of dust emissions will continue;
- Use of water carts to dampen soils on roads or during rehabilitation earthworks;
- Cease any dust creating works (i.e. earthmoving activities) on high dust risk days;
- Use of materials such as magnesium chloride, mulches or clay fines to stabilise soils; and
- Finalising works and seeding all revegetation areas to minimise the risk of dust emissions.

### 9.3.3 Noise

Earthmoving during closure is not expected to result in higher noise emissions than what would occur during construction and operation of the Project. No particular noise management measures are expected to be required.

### 9.3.4 Surface Water

The following controls may be employed, as applicable, to ensure surface water is managed during closure:

- Apply rock armour to the interface between the TSF cover and natural ground as required;
- Rock armour the embankment in areas that will be impacted by upstream flows;
- Rock armour any low stability materials on the final TSF embankment surface as required.
- Backfill the drainage diversion to the north of the TSF and EPs. The western drain shall be retained as an adaptive measure for the TSF to facilitate the establishment of vegetation by minimising losses of topsoil from scour;

- Rock armour drainage concentration areas within the EP footprint and at the upstream interface between natural ground and the EP footprint cover;
- Use of temporary sumps during rehabilitation;
- Minimising soil disturbance;
- Revegetation of rehabilitated areas as soon as practicable; and
- Removal or covering of potential sources of contamination.

### 9.3.5 GROUNDWATER

The following controls may be employed to ensure groundwater is managed during closure:

- Remove potential sources of contamination such as hydrocarbons; and
- Monitoring to measure aquifer recoveries.

### 9.3.6 COMMUNITY COMMENTS AND COMPLAINTS

Audalia will respond to community comments and complaints received during rehabilitation operations in the following manner:

- Collect details of the complainant and issue;
- Document the issue;
- Determine and implement appropriate immediate actions to stop or modify the situation; and
- Plan and implement any actions required to address the comment or complaint in the longer term.

## 9.4 CONTAMINATED SITES

WA has a comprehensive legal framework for the identification and management of contaminated sites under the *Contaminated Sites Act 2003* (CS Act). The legislation, in summary, provides for the:

- Definition and identification of contaminated sites;
- Investigation of contamination;
- Publicly available reporting of contaminated sites;
- A classification system for contaminated sites with a hierarchical basis for action based on risk;
- Registration of contamination on the title of the land; and
- Ownership and liability for contamination.

The CS Act is administered by the Contaminated Sites Branch of DWER. DWER has produced and operates under an extensive set of guidelines and standards for managing contaminated sites under the CS Act. In these documents, DWER recommends that contaminated sites should be investigated and managed in a staged manner as illustrated in Figure 67 (DWER, 2014).

According to the Project closure risk assessment, the operational activities identified as being most likely to lead to contamination are:

- Residues from hydrocarbon storage;
- Hydrocarbon spills during rehabilitation activities;

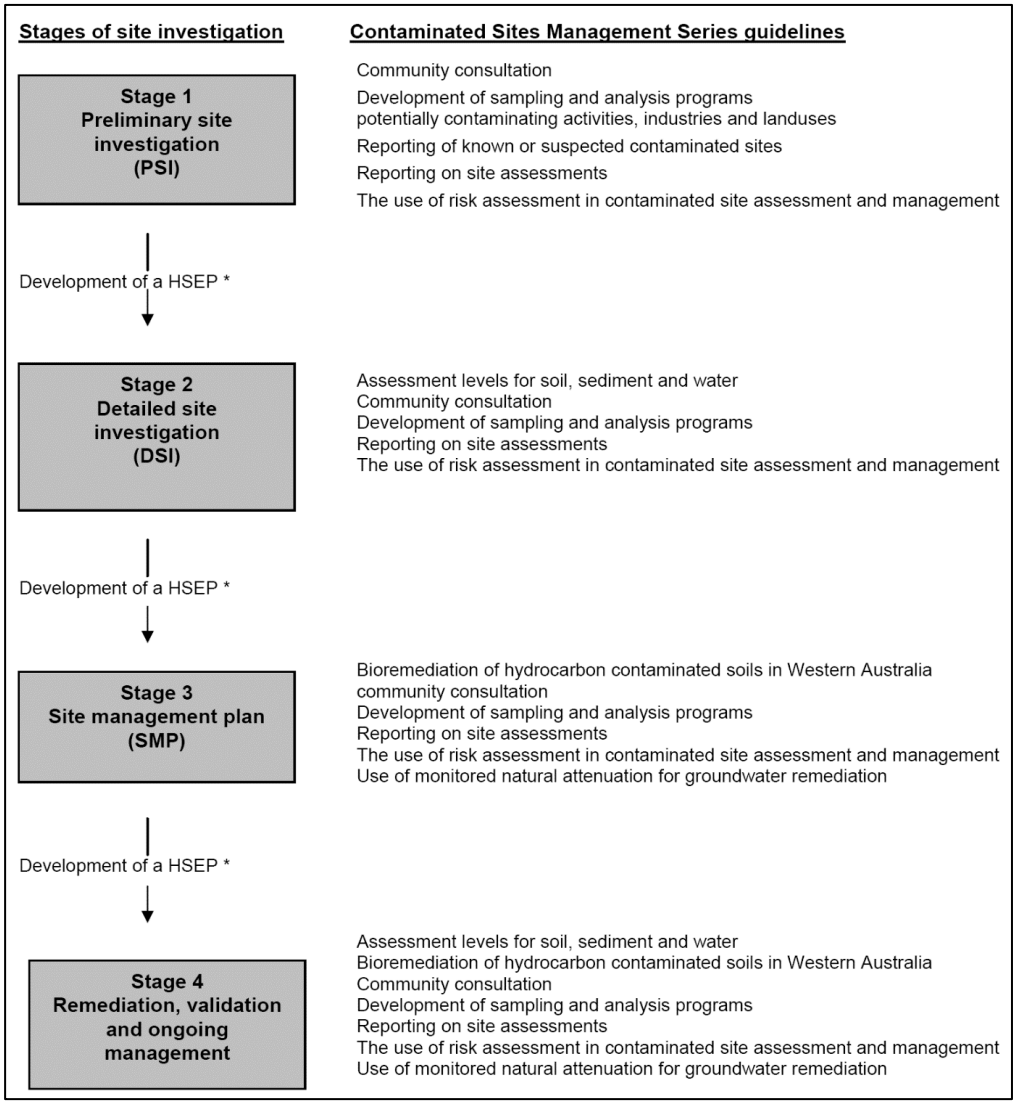


- Spillage, leakage or inappropriate disposal of reagents or dangerous goods stored on site (including laboratory waste); and
- Workshop activities (hydrocarbon residues).

The closure risk assessment for the Project has considered the history of these activities onsite and rated the residual risk (after the application of controls) as low.

Most controls to prevent contamination will apply during the operational phase of the Project. Control measures include reporting spillages and environmental incidents, licencing conditions (operational licence, Dangerous Goods licence), regulatory inspections and site clean-up procedures. The closure risk assessment for the Project will consider the history of these activities onsite toward the end of mine life and will re-rate the risk.

Audalia will manage any contaminated sites at the Project in accordance with the requirements of the CS Act which is independent of this MCP and Mining Act responsibilities. Progress against the CS Act requirements will be reported in the AER, with known and suspected contaminated sites identified and described.




* Health, Safety and Environment Plan. Refer to *Guidance Note Occupational Safety and Health Management and Contaminated Sites Work* (Commission for Occupational Safety and Health, 2005).

**Figure 67: Staged approach to site investigations (DWER, 2014)**

## 9.5 Research, Investigation and Trials

Research is required to better understand the biology and ecology of the Threatened Flora species *M. aquilonaris*, as well as Priority Flora species *E. rhomboidea* and *S. bremerense* that will be impacted by the Project. This work has been committed to in the ERD and is likely to be required by future Ministerial Conditions as part of an Offset Strategy. The work will greatly assist in developing a knowledge base to better manage these species, including informing any trial work designed to develop rehabilitation capability with these species.

Investigations to confirm tailings geochemical behaviour will be required to confirm attributes prior to completing detailed TSF capping and closure designs.

Trials of rehabilitation prescriptions will help to optimise rehabilitation outcomes. With most areas required to be kept open until closure, discrete areas of the borrow pit will be identified for completion of rehabilitation trials.

## 9.6 Progressive Rehabilitation

The Project affords limited opportunity for progressive rehabilitation as all the areas proposed for development are likely to be simultaneously utilised until closure. As identified above, areas of the borrow pit are most likely to be completed once TSF embankment materials are sourced and any longer term storage requirements are clarified.

Progressive rehabilitation of historic access tracks on Audalia leases will be implemented for areas that are no longer required.

## 9.7 Early Closure – Permanent Closure or Suspended Operations under Care and Maintenance

Audalia understands that there is potential for unexpected closure or suspension of operations or for a period of care and maintenance. In the event of unexpected closure or suspension of operations, DMIRS will be notified in accordance with the requirements of the Mining Act. If suspension of operations is necessary, a Care and Maintenance Plan will be prepared and submitted to DMIRS within three months of notification. If unexpected closure of the Project is necessary, the following works will be conducted:

- The site will be secured and signposted to discourage entry;
- The MCP will be revised to address the state of the operations at the point of unexpected closure; and
- Closure of the Project will be conducted as per the requirements of the revised MCP.

All of the closure requirements listed in this MCP are expected to remain applicable in an unexpected closure. In general:

- Disturbed surfaces not required for any other purpose will be rehabilitated to a stable target landform;
- All pipelines, bore pumps, generators and any other infrastructure will be removed;
- The required monitoring, auditing and reporting will be completed; and
- The Project land area will be returned to pre-mining land use.

## 9.8 DECOMMISSIONING

Decommissioning of Project infrastructure will be undertaken at the end of the Project life in accordance with Table 41. A risk assessment will be undertaken prior to commencing significant decommissioning to address potential safety and contamination risks.

**Table 41: Decommissioning of processing and infrastructure areas**

| Item | Task | Verification |
|---|---|---|
| Services | Disconnect power, water, communications and sewage services to ensure areas are safe for demolition. | Risk Assessment |
| Structures | Remove buildings and footings. Undertake a risk assessment for hazards. | Risk Assessment |
| Dangerous goods | Dangerous goods facilities are to be removed by responsible contractors when no longer required. | Areas ready for rehabilitation or managed by Audalia. |
| Contaminated areas | Complete contaminated sites investigations for areas of potential contamination.<br>Complete remedial works during closure. | Contaminated sites reports |
| Hazards | Remove access and/or provide signage to identify hazards and hazardous areas | Audit prior to leaving site in closure mode |

# 10 CLOSURE MONITORING, MAINTENANCE AND REPORTING

This section provides an overview of monitoring and maintenance activities planned to support the closure process and demonstrate progress towards meeting completion criteria. Monitoring results, remedial actions and maintenance activities for the Project will be reported to DMIRS as part of approval reporting requirements.

## 10.1 MONITORING STANDARDS AND FREQUENCY

Closure and rehabilitation performance will be monitored against closure objectives and criteria. It is assumed that some closure and rehabilitation areas will require some maintenance interventions to ensure objectives and outcomes are met. The post-closure monitoring and maintenance planned to be undertaken is summarised in Table 42.

Monitoring requirements during operations are defined by legal obligations, such as tenement conditions and conditions of environmental approvals, licences and permits. This monitoring provides a useful 'baseline' data set and forms a logical basis for continued monitoring as the operations are closed and rehabilitated. Some of the monitoring will be targeted towards risks that are only active during operations, and will logically cease when the risk is no longer active, and some will still be relevant during the closure phases.

Specific monitoring and data capture will be designed to support the case for completion of rehabilitation and closure obligations with a view to enabling tenement relinquishment for the site. The monitoring programme is described in more detail in the following section.

**Table 42: Post-closure monitoring program**

| Aspect | What is being monitored / why? | Method | Frequency | Timing / duration |
|---|---|---|---|---|
| Landform | Geotechnical stability – TSF, Evaporation Ponds and back-filled or rehabilitated sites | • Included in Ecosystem Function Analysis (EFA)<br>• Visual inspection | At least once | • Within first year of rehabilitation<br>• At 5 years if required |
| | Overall surface water management – site drainage | • Included in EFA<br>• Visual inspection | • Upon completion of drainage works<br>• Following major rainfall events | • One-off inspections – annual until relinquishment<br>• Dependent on weather events<br>• Until completion |

| Aspect | What is being monitored / why? | Method | Frequency | Timing / duration |
|---|---|---|---|---|
| Soils | Soil degradation - loss / erosion / waterlogging / salinity | • Included in EFA<br>• Visual inspection<br>• Quantitative assessment (only if visual monitoring suggests necessary) on areas of concern | Annually | First within 12 months of rehabilitation, annually until completion criteria are met |
| General rehabilitation | Topsoil depth | • Visual by manual excavation at several sample locations | • At least once | • Once while spreading topsoil<br>• As investigation if rehabilitation is poor |
| Existing native vegetation (Threatened Flora, adjacent to Pits, TSF and Evaporation Ponds) | Vegetation health (risk of rehabilitation activities affecting health of surrounding vegetation – particularly conservation significant species/vegetation) | • Visual inspection<br>• Use of quadrats or transects established whilst operating to monitor plant numbers, cover, species diversity and plant health | Annual | For five years after rehabilitation of TSF and Evaporation Ponds |
| Native vegetation rehabilitation | Vegetation establishment and survival on significant rehabilitation areas | Included in EFA will be plot based assessments of:<br>• Seedling counts (plot based assessment)<br>• Survivor counts (plot-based assessment)<br>• Plant numbers, species, cover in rehabilitation and control quadrats<br>• Site/issue specific investigation/monitoring failed areas | Annual for five years, then every 5 years | Spring survey season<br>Until able to confirm completion criteria are met |
| | Weed distribution and density on significant rehabilitation areas | Included in EFA will be plot based assessments of:<br>• Weed species and numbers | Annual for five years, then every 5 years | Spring survey season<br>Until able to confirm completion criteria are met |
| | Fauna habitats on significant rehabilitation areas | Fauna habitat assessment | At least once | Immediately after completion of rehabilitation |



| Aspect | What is being monitored / why? | Method | Frequency | Timing / duration |
|---|---|---|---|---|
| Surface water | Runoff into Lake Medcalf (at causeway crossing location) monitored for pH, EC, TSS and standard major anions, cations and metals suite | AS 5667.1, 1998.<br>NATA accredited laboratory | Opportunistic, at least twice | First after first significant rainfall, second at 5 years if required to confirm completion criteria are met. If not, follow up surveys are to continue until completion criteria are met |
| Groundwater | Groundwater levels from operational monitoring bores to ensure return to pre-mine conditions | Dip meter | • Licence frequency until recover trajectory established<br>• Quarterly until satisfactory recovery | Until completion criteria achieved |
| | Groundwater level and quality in TSF and Evaporation Pond monitoring bores and piezometers monitored for pH, EC, TSS and standard major anions, cations and metals suite | Dip meter and sampler<br>AS 5667.1, 1998.<br>NATA accredited laboratory | • Licence frequency until recover trajectory established<br>• Quarterly until satisfactory recovery | Until completion criteria achieved |

### 10.1.1 LANDFORM AND EROSION MONITORING

There is no waste rock landform due to the very low strip ratio and use of waste for construction purposes. Key landforms that are susceptible to erosion post-rehabilitation are the TSF and Evaporation Ponds, constructed drains and any retained roads.

Under the circumstances, the rehabilitation performance will be assessed using EFA methods. Suitable transects and quadrats will be established on both rehabilitation and control sites to enable data capture.

Visual monitoring of these areas will be conducted following completion of rehabilitation works. Such areas will be traversed, looking for signs of subsidence and erosion. These traverses will include inspections of drainage control features such as sumps and drains. Should visual monitoring of erosion indicate significant gullies (>10 cm deep) or erosion of large areas (>1 ha) further and more quantitative investigations and remedial actions will be implemented.

### 10.1.2 SURFACE WATER MONITORING

Ongoing surface water monitoring will be conducted on an opportunistic basis where the access road crosses the watercourse into Lake Medcalf. Sampling will be completed in accordance with



Australian Standard 5667.1:1998. Sampling will necessarily be restricted to the periods following flood events.

### 10.1.3 GROUNDWATER MONITORING

Post-closure groundwater monitoring is expected to essentially be an extension of monitoring conducted during operations, but with progressively reduced frequencies once operations cease. Groundwater monitoring (groundwater quality and levels) at the Project will continue post-closure according to licence specifications until such time as it is determined that it can be reduced, or completion criteria are met.

### 10.1.4 VEGETATION MONITORING

EFA methods include a component of vegetation monitoring. Suitable transects and quadrats will be established on both rehabilitation and control sites to enable data capture. Baseline conditions for weeds will be recorded by identifying weed species and cover. Vegetation monitoring will be used to track the progress of revegetation towards local provenance vegetation. Post-closure revegetation monitoring at rehabilitated sites will principally comprise of aspects such as:

- Seed germination, recruitment and root formation;
- Species diversity;
- Vegetation density or percentage cover, and
- Presence of weeds and percentage cover or density.

The aspects above will be compared with reference to suitable local undisturbed analogue sites which will be chosen on basis of similar soil type and landform. The location and number of monitoring sites will be determined by a suitably qualified professional prior to the completion of operations at the Project.

## 10.2MAINTENANCE

Closure maintenance includes works to avoid failure or damage to rehabilitation areas, and may require remediation of rehabilitated areas that would not otherwise meet completion criteria. Maintenance activities may include artificially supporting natural processes (such as leaching, plant establishment) until they can become self-supporting.

Maintenance activities likely to be undertaken during and after closure implementation include:

- Remediating landforms to control erosion;
- Improving drainage and works to prevent erosion;
- Controlling feral animals;
- Maintaining necessary infrastructure such as roads, tracks, power and water supplies;
- Replanting unsuccessful revegetation areas;
- Controlling weeds in rehabilitation areas;
- Liaising with DBCA regarding fire;
- Maintaining land management practices until completion criteria are signed off; and
- Maintaining access control and signage.

Financial provisioning and resources will be made available for post-closure monitoring and maintenance, including provisioning for remedial work if monitoring shows that completion criteria are not being met.

## 10.3 REPORTING

Reporting of rehabilitation performance will be undertaken in accordance with regulatory requirements. Rehabilitation reporting will include details of:

- Rehabilitation monitoring results for the reporting period;
- Maintenance / remedial actions completed or planned; and
- New rehabilitation that has been undertaken on-site.

The results of monitoring will be used internally to assess rehabilitation performance and identify whether alternative management strategies are required or if completion criteria require review.

# 11 FINANCIAL PROVISIONING FOR CLOSURE

While it is not a requirement under the Guidelines to provide a provisional cost estimate for mine closure at this stage of the Project, Audalia nevertheless recognises the importance of ensuring adequate funds are set aside for the rehabilitation and closure of the Project.

The mine closure Financial Provision accounting obligations generally represents the public disclosure to support statutory accounting and reporting requirements as defined by the International Financial Reporting Standard (IFRS). It is generally based on any legal liability or compliance as a minimum, and represents: "a net present value estimation for the closure and rehabilitation costs of the current "On-The-Ground" disturbance footprint and decommissioning of the mine infrastructure at the time of reporting (usually annually) over the remaining life of the asset."

The IFRS principle International Accounting Standard 37 - Provisions, Contingent Liabilities and Contingent Assets, provides guidance on how to account for closure and environmental liabilities. The closure and environmental costs are provided for in the accounting period when the obligation arising from the related disturbance occurs (whether this occurs during mine development or during the production phase). These costs are based on the net present value of the estimated future costs to rehabilitate / restore the damage caused to date.

The closure costing methodology, assumptions and financial processes used to assess provisional costs is based on planned disturbance initially, and then actual disturbance as a Project proceeds into implementation and needs to make provision for closure in its accounts. Costing will be based on the information provided in reporting made to the Mine Rehabilitation Fund (MRF), addressing the legal requirements for closure and the closure objectives and targets.

The following costs are included within the LOM closure cost estimates:

- All earthworks costs associated with rehabilitating all disturbed footprints. This specifically includes:
  - Costs for removal and disposal of any HDPE liners in ponds and containment facilities;
  - Landfill or trenches that may need to be excavated to bury redundant HDPE liners;
  - Backfilling all non-permanent excavations;
  - Decommissioning and rehabilitating groundwater production bores not retained;
  - Landforming areas requiring battering, earth fill or other to provide as suitable rehabilitation surface;
  - Placement of any capping materials, abandonment bunds and other closure features;
  - Replacement of topsoil, ripping and seeding on disturbance areas requiring revegetation;
- Costs are also included for maintenance and repair earthworks during the passive closure period as the rehabilitated site stabilises;
- All decommissioning and demolition costs for dismantle and removal of all infrastructure from the site, breakup and burial of demolition rubble, rubbish and non-recyclable materials;
- All costs associated with contamination investigation, removal and reporting;



- All consultant costs associated with the active and passive closure periods (excluding consultant costs required during operations - included in operating budgets as a part of the closure planning function);
- All mobilisation and demobilisation of equipment and personnel required during all closure periods;
- All project management costs including engineering, procurement, management and supervision, Quality Assurance (QA)/Quality Control (QC), owners' costs, travel (Fly In – Fly Out (FIFO)) and accommodation costs associated with each of the closure periods;
- All costs associated with any and all contracted services obligations such as power supply contract agreements, land access and tenure agreements, and any other contractual commitments including stake holder agreements and communication contracts, and supply contracts required during the various closure periods including fuel, general supplies, camp, and commute costs etc.;
- All inventory and asset disposal costs;
- All environmental and mineral tenement licence monitoring and reporting obligations during the closure periods;
- All corporate costs including insurances, levies, equipment leasing payments, and overhead costs;
- All employee costs including salaries and wages and on-costs (workers compensation, payroll taxes, annual and long service leave obligations, severance and retrenchment obligations, superannuation obligations etc.); and
- Any contingencies that may be applied to any and all of the costs.

Closure cost estimates are required on an annual basis to be based on the disturbance footprint and location of materials as they are at the time of the estimate. Audalia will use the LOM plan to identify opportunities to expedite progressive rehabilitation and closure efficiencies.

## 11.1 PROCESS AND METHODOLOGY

The cost estimates for site closure are based on the application of unit rates to areas, distances or items (i.e. TSF, mine pit); a methodology that is considered appropriate for initial cost estimates. Where available, the actual earthmoving costs are calculated, providing an additional level of confidence about likely costs. Audalia will use actual earthmoving costs, as well as costs of mobilisation, accommodation, food, workforce transport and personnel for the site as the basis for estimation. As required under the International IFRS, the salvage value of infrastructure at mine closure will not be offset against closure costs.

The cost estimate will be developed with regard to the following:

- Consideration of all closure obligations, regulatory requirements, including mining tenement conditions;
- Closure domains having similar landform disturbance characteristics and, therefore, similar rehabilitation requirements, closure tasks and unit rates;
- Identification of areas which may require potentially contaminated materials to be reclaimed and disposed at a licensed waste disposal / treatment facility;
- Identification of infrastructure requiring decommissioning works;
- Calculation of the volumes of closure materials (including concrete, earth, topsoil) for movement, transfer or disposal;



- Personnel, plant and/or equipment required to complete the closure tasks by quantity, area or volume;
- Closure task rates, including the application of earthmoving equipment rates per hour; and
- Additional costs for the use of consultants, task supervision, accommodation and messing of personnel, transportation of items and personnel, monitoring, reporting etc.

Closure cost estimates will be updated annually (as required by IFRS), based on actual disturbance areas and the most recent copy of the MCP, and included in the annual accounts of Audalia and will form the basis for provisioning for closure. Provisioning will be based on the amount of disturbed land at the time of the estimate and will identify the timing of expenditure. The estimate will utilise assumptions as required, where quantities are not readily identifiable.



# 12 MANAGEMENT OF INFORMATION AND DATA

Management and storage of all rehabilitation and closure information and data will be undertaken in accordance with Audalia's EMS. The EMS will include provisions for document control, file structures and information capture and storage procedures as well as review and improvement.

This MCP will be updated initially as a requirement of the Mining Act – to accompany a detailed Mining Proposal seeking permission to mine. The next version of this MCP will benefit from more detailed mine planning, geotechnical and other investigations required for approval to construct and operate the TSF, Evaporation Ponds and Processing Plant.

The Mining Act also requires MCPs to be reviewed and updated every three years, or in association with any significant Project changes. This requirement mandates the capture of any changes that may be required as the Project evolves. Examples of such changes include:

- Changes to rehabilitation and closure actions;
- Completion criteria and performance indicators may need to be refined;
- Changes to management measures based on monitoring results; and
- Changes to proposed monitoring strategies.

Audalia will store and maintain information relevant to the closure of the Project, including:

- Aerial photographs;
- Areas of disturbance;
- Inventories of rehabilitation materials available, required and used;
- Records of significant spills, and details of clean-up;
- Data from studies, operations monitoring, closure studies, contaminated sites investigations, and post-closure monitoring; and
- Photographs from pre- and post-closure inspections and monitoring rounds.

# GLOSSARY

| Term | Meaning |
|---|---|
| AERs | Annual Environmental Reports |
| ASRIS | Australian Soil Resource Information System |
| ASS | Acid Sulfate Soils |
| Audalia | Audalia Resources Limited |
| BIF | Banded iron formation |
| BoM | Bureau of Meteorology |
| CR | Critically Endangered |
| CS Act | *Contaminated Sites Act 2003* |
| Cube | Cube Consulting Pty Ltd |
| D-Tailings | Deslimed Tailings |
| DAWE | Department of Agriculture, Water and the Environment |
| DBCA | Department of Biodiversity, Conservation and Attractions |
| DEC | Department of the Environment and Conservation |
| DEs | Development Envelopes |
| Depauperate | Lacking in numbers or variety of species |
| DMIRS | Department of Mines, Industry Regulation and Safety |
| DMP | Department of Mines and Petroleum (Now DMIRS) |
| DotEE | Department of the Environment and Energy |
| DPIRD | Department of Primary Industries and Regional Development |
| DWER | Department of Water and Environmental Regulation |
| Duricrust | Surface or near-surface hardened accumulation of silica ($SiO_2$), alumina ($Al_2O_3$), and iron oxide ($Fe_2O_3$), in varying proportions. Admixtures of other substances commonly are present and duricrusts may be enriched with oxides of manganese or titanium within restricted areas. |
| EFA | Ecosystem Function Analysis |
| EGS | Environmental Group Site |
| EMS | Environmental Management System |
| EP | Evaporation pond |
| EP Act | *Environmental Protection Act 1986* (WA) |
| EPA | Environmental Protection Authority |
| EPBC Act | *Environment Protection and Biodiversity Conservation Act 1999* |
| ERD | Environmental Review Document |
| ESA | Environmentally Sensitive Area |
| ESP | Exchangeable sodium percentage |
| Felsic | Rocks that are rich in silicon and feldspar. Typically light in colour and enriched in aluminium and silicon along with potassium and sodium. Less dense than mafic rocks. |
| FIFO | Fly In – Fly Out |
| Gabbro | Gabbro is a phaneritic, mafic intrusive igneous rock formed from the slow cooling of magnesium-rich and iron-rich magma into a holocrystalline mass deep beneath the Earth's surface. Slow-cooling, coarse-grained gabbro is chemically equivalent to rapid-cooling, fine-grained basalt. |
| GDE | Groundwater Dependant Ecosystem |

| Term | Meaning |
|---|---|
| GDP | Ground Disturbance Permit |
| Golder | Golder Associates Pty Ltd |
| GR-Tailings | Gravity Reject Tailings |
| GRM | Groundwater Resource Management |
| Guidelines | *Statutory Guidelines for Mine Closure Plans* (DMIRS, 2020a) |
| GWW | Great Western Woodlands. The largest remaining area (over 16 million hectares) of Mediterranean-climate woodland. https://www.dpaw.wa.gov.au/management/off-reserve-conservation/the-great-western-woodlands. |
| ha | Hectares |
| Haul Road DE | Haul Road Development Envelope |
| IFRS | International Financial Reporting Standards (standards that apply to costing closure and rehabilitation of mine sites) |
| Igneous | Rock that has solidified from lava or magma |
| Indicated | An Indicated Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics are estimated with sufficient confidence to allow the application of Modifying Factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit. |
| Inferred | An Inferred Mineral Resource is that part of a Mineral Resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling. |
| Komatiite | A type of ultramafic mantle-derived volcanic rock defined as having crystallised from a lava with ≥ 18 wt% MgO. Komatiites have low silicon, potassium and aluminium, and high to extremely high magnesium content. |
| LFA | Landscape function analysis |
| LOM | Life of mine |
| M | Mining Lease |
| Mafic | Mafic is an adjective describing a silicate mineral or igneous rock that is rich in magnesium and iron, and is thus a portmanteau of magnesium and ferric. Most mafic minerals are dark in colour, and common rock-forming mafic minerals include olivine, pyroxene, amphibole, and biotite. |
| MCP | Mine Closure Plan |
| MCP Guidance | *Mine Closure Plan Guidance – How to prepare in accordance with Part 1 of the 'Statutory Guidelines for Mine Closure Plans.* (DMIRS, 2020b) |
| Mine DE | Mine Development Envelope |
| Mining Act | *Mining Act 1978* |
| $Mm^3$ | Million cubic metres |
| MRF | Mining Rehabilitation Fund |
| Mt | Million tonnes |
| Mtpa | Million tonnes per annum |
| NAF | Non acid forming |
| N/A | Not applicable |
| PEC | Priority Ecological Community |
| Plutonic | Igneous rock formed by solidification at considerable depth beneath the earth's surface. |
| PMLU | Post-mining land use |
| PMP | Probable Maximum Precipitation |
| PoW | Programme of Works |



| Term | Meaning |
|---|---|
| Project | Medcalf Vanadium Project |
| Pyroxenite | Pyroxenite is an ultramafic plutonic igneous rock with more than 90% of the rock comprised of magnesium and iron-rich minerals |
| QA | Quality Assurance |
| QC | Quality Control |
| Regolith | The layer of unconsolidated solid material covering the bedrock of a planet |
| RO plant | Reverse osmosis plant |
| ROM | Run of mine |
| Saprolite | Chemically weathered rock. Saprolites form in the lower zones of soil profiles and represent deep weathering of the bedrock surface |
| SRE | Short-range endemic |
| SSWFW | Southern and South-Western Flatlands West |
| TDS | Total dissolved solids |
| TSF | Tailings storage facility |
| TSSC | Threatened Species Scientific Committee |
| UCL | Unallocated Crown Land |
| Ultramafic | Igneous and meta-igneous rocks with a very low silica content (less than 45%), generally >18% MgO, high FeO, low potassium, and are composed of usually greater than 90% mafic minerals (dark coloured, high magnesium and iron content). |
| WA | Western Australia |
| WIR | Water Information Resource |
| WRL | Waste rock landform |

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# APPENDICES

**Appendix 1 - 6 are available as appendices to the Environmental Review Document available to download from WA Environmental Protection Authority website (Assessment Number: 2156)**

**Appendix 1: Geotechnical Desktop Study of Pit North Shell Stability Memorandum (Knight Piesold, 2019)**

**Appendix 2: Soils of the Audalia Medcalf Area (Western Horticultural Consulting, 2019)**

**Appendix 3: Flora and Vegetation reports**

- 3.1 Geomorphology of the *Marianthus aquilonaris* sub-populations. Bremer Range West Australia (Word Technical Services Group Pty Limited, 2019)
- 3.2 Component 2 Report. Assessment of genetic diversity in sub-populations of *Marianthus aquilonaris* (DBCA, 2019a)
- 3.3 *Marianthus aquilonaris* demographic monitoring: spring 2018 - spring 2019 (Botanica, 2020a)
- 3.4 *Marianthus aquilonaris* landform monitoring: spring 2018 (Botanica, 2019)
- 3.5 Deposition Study (Ramboll, 2020a)
- 3.6 Haul Road Dust Deposition Study (Ramboll, 2020b)
- 3.7 CFD Wind Study (Ramboll, 2020c)
- 3.8 Germination memo (Botanica, 2020b)
- 3.9 Detailed Flora & Vegetation Survey Medcalf Vanadium Mining Project & Proposed Haul Road (Botanica, 2020c)
- 3.10 Flora and Vegetation Impact Assessment (Botanica, 2020d)
- 3.11 Summary on ecology of *Marianthus aquilonaris* (Botanica, 2020e)
- 3.12 Detailed maps of significant flora records
- 3.13 Medcalf Project Rehabilitation Plan (Botanica, 2022)

**Appendix 4: Fauna reports**

- 4.1 Fauna survey. Medcalf Vanadium Mining Project (Harewood, 2020a)
- 4.2 Assessment of Subterranean Fauna Values (Bennelongia 2020)
- 4.3 Fauna Assessment. Medcalf Vanadium Mining Project. Proposed Haul Road (Harewood, 2020b)
- 4.4 Insect visitors to *Marianthus aquilonaris* and surrounding flora (Prendergast, 2019)

**Appendix 5: Terrestrial Environment reports**

- 5.1 Geochemical Characterisation of Slurry Samples of Deslimed-Tailings and Gravity-Reject-Tailings and Implications for Tailings Management (GCA, 2020a)
- 5.2 Characterisation of Mine-Waste Samples from Vesuvius, Fuji and Egmont Pits – Implications for Mine-Waste Management (GCA, 2020b)
- 5.3 Brief description of Medcalf geology Memo (Butler, 2020a)
- 5.4 Tailings Storage Facility Design Concept (Golder, 2020)
- 5.5 Tailings Storage Facility Closure Design Report (Mine Earth, 2020)
- 5.6 Technical Memorandum: Response to EPA Comments on Waste Rock Sampling. Unpublished memorandum prepared for Audalia Medcalf Project (Butler, 2020b)

**Appendix 6: Hydrology Reports**

6.1 Medcalf Hydrogeological and Hydrological Study Surface Water Assessment (GRM, 2020a)

6.2 Groundwater Supply Investigation Audalia Resources Limited Medcalf Vanadium Project (GRM, 2020b)

6.3 Medcalf Hydrogeological and Hydrological Study Characterisation of *Marianthus aquilonaris* Habitat (GRM, 2020c)

6.4 Medcalf Vanadium Project – Haul Road Water Supply. Technical Memorandum (GRM, 2020d)

**Appendix 7: Closure Risk Register**