

# PROGRESSIVE REHABILITATION AND CLOSURE PLAN

## AGATE CREEK GOLD MINE

## LANEWAY RESOURCES LTD

## ENVIRONMENTAL AUTHORITY: EPSL03068015
## MINING LEASE: ML100030



**SEPTEMBER 2022**


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# 1. Introduction

The Agate Creek Gold Mine (Agate Creek) is owned by Laneway Resources Limited (Laneway) and operates under Environmental Authority (EA) EPSL03068015. Laneway is currently seeking approval from the Department of Environment and Science (DES) for an expansion of Agate Creek for the mining of 250,000 tonnes per annum (tpa) of gold ore. The expansion will result in Agate Creek being regulated under a site-specific EA.

Wulguru Technical Services Pty Ltd (WTS) has been engaged by Laneway to prepare a Progressive Rehabilitation and Closure Plan (PRCP) for the mine expansion. This PRCP relates to rehabilitation and land management of Mining Lease (ML) ML100030.

This document summarises the technical components and supporting information relating to rehabilitation and closure of the Project and has considered the following Department of Environment and Science (DES) guideline:

- Guideline ESR/2019/4964 – *Progressive rehabilitation and closure plans (PRC plans)*, Version 2.00 – 17 March 2021.

The PRCP outlines the Project planning and post-closure requirements, community consultation, post-mining land use, rehabilitation methods, risk assessment, monitoring and maintenance, and rehabilitation schedule.

# 2. Purpose of Plan

The purpose of this document is to assess the existing environmental values and plan for rehabilitation. This PRCP will:

- Outline how Laneway will meet landholder expectations for final land use;
- Outline how Laneway will achieve a decommissioned site that is safe, fit for purpose, and non-polluting;
- Outline how Laneway will eliminate residual impact or liability for community and future land holders following rehabilitation;
- Outline how Laneway will restore the mine footprint to an agreed Post Mine Land Use; and
- Outline how Laneway will conduct rehabilitation monitoring to demonstrate achievement of agreed milestones.

# 3. Rehabilitation Planning

## 3.1 Project Description

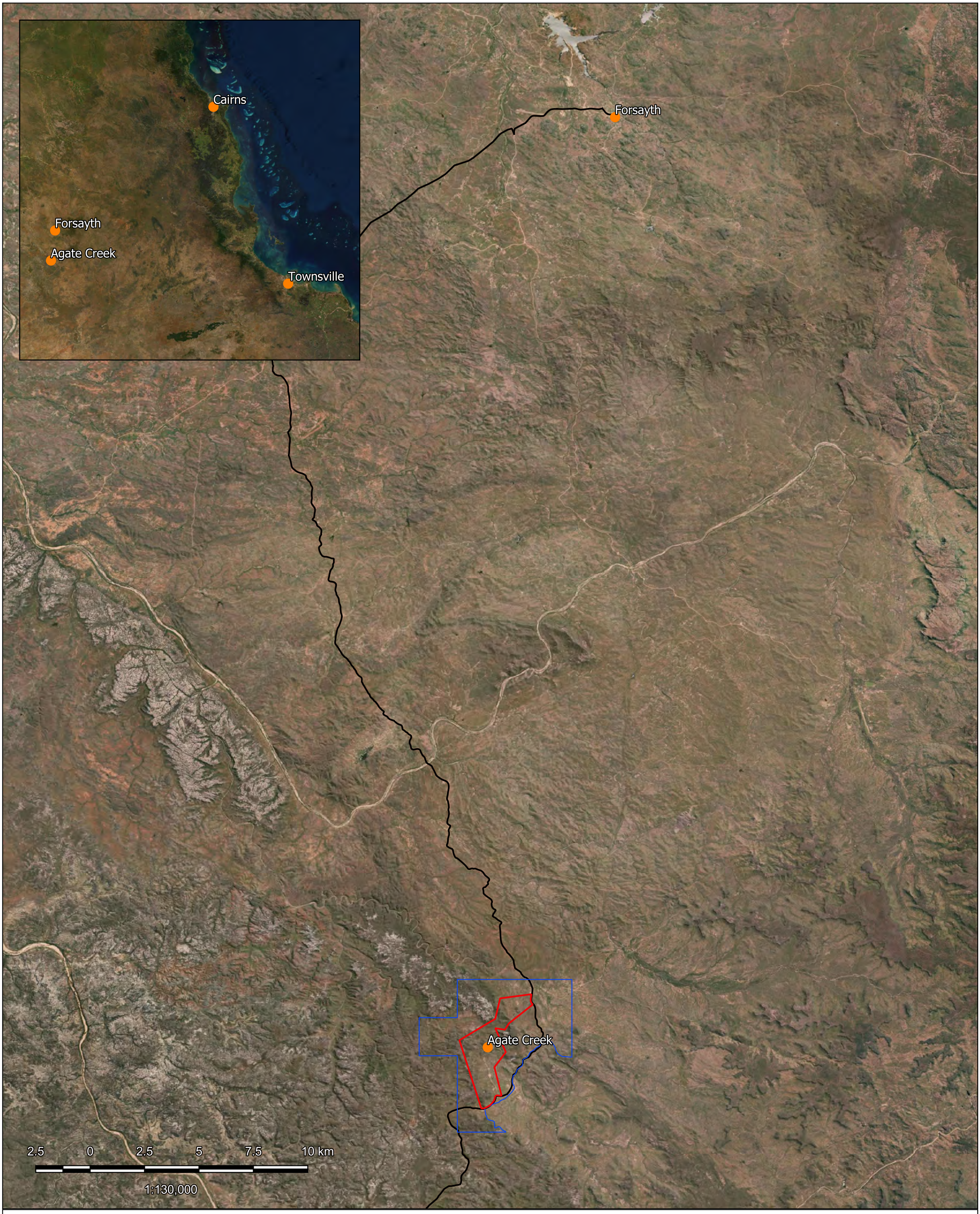
Agate Creek is in northwest Queensland, approximately 40 km southwest of Forsayth within the Etheridge Shire Council.

Agate Creek commenced production in 2019 with the establishment of the Sherwood open cut pit within the Sherwood Resource area. Ore is transported to the Run of Mine (ROM) pad prior to being exported offsite for processing. Associated mining domains includes the Sherwood open cut waste rock dump, and other Mine Infrastructure Areas (MIA) including haul roads/access tracks, camp, administration facilities and a core shed.

An expansion has been proposed to ensure the longevity of the Agate Creek project. The proposed expansion will consist of:

- Six open cut pits;
- Four Non-Acid Forming (NAF) Waste Rock Dumps (WRDs);
- Topsoil stockpiles;
- 0.4 Ha expansion of the existing ROM pad;
- Water storage dam; and
- Sediment ponds.

Ore is to be transported off site to the Kempton Minerals Pty Ltd (a subsidiary of Laneway) Georgetown gold processing plant.




Client: Laneway Resources Ltd
Project number: 2021.09001
CRS: GDA2020 EPSG: 7844
Date: 11 July 2022

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# Figure 1. Agate Creek Gold Project Locality

Legend

- Key Features
- Access Road
- Mineral Development Licence
- Mining Lease

ESRI Satellite

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Digital data for this report is available on the Queensland Government Spatial Portal at https://qldspatial.information.qld.gov.au.

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## 3.2 Mining Tenements

Agate Creek is located off Rungulla Road, 40km south-west of Forsayth and is bound by Mine Development License MDL402, also owned by Laneway. Land covered under MDL402 is currently used for cattle pasture. The property details are provided in Table 1.

**Table 1 Property Description**

| | |
|---|---|
| **Company Name - ABN** | Laneway Resources Pty Ltd – 75 003 049 714 |
| **Lot on Plan** | Lot 2 on SP242983 and Lot 7 on SP275179 |
| **Mining Lease** | ML100030 |
| **Property Size** | 689.3 ha |
| **Local Government Area** | Etheridge Shire Council |
| **Zoning Information** | Rural |

## 3.3 Primary Mine Features and Infrastructure

The proposed mine features for the Project are defined in Table 2.

**Table 2. Domains of the Project.**

| Domain | Subdomain | Subdomain Area |
|---|---|---|
| Exploration | Exploration tracks | 1.44 ha |
| | Rehabilitated exploration tracks | 1.90 ha |
| Infrastructure | Haul road | 4.79 ha |
| | Landowner tracks | 7.28 ha |
| | Other tracks | 0.19 ha |
| | Accommodation village | 0.51 ha |
| | Administration buildings | |
| | Core shed | |
| | Workshop and maintenance area | |
| | Run of Mine pad | 0.98 ha |
| | Northwest waste rock dump | 5.61 ha |
| | North waste rock dump | 5.88 ha |
| | Southwest waste rock dump | 3.04 ha |
| | South waste rock dump | 11.35 ha |
| Water Storage and Management | Water storage dam | 4.50 ha |

| Domain | Subdomain | Subdomain Area |
|---|---|---|
| | Sediment pond A | 0.21 ha |
| | Sediment pond B | 0.15 ha |
| | Sediment pond C | 0.34 ha |
| | Sediment pond D | 0.43 ha |
| | Sediment pond E | 0.28 ha |
| | Sediment pond F | 0.34 ha |
| | ROM Pad pond | 0.24 ha |
| Open Cut Pits | Pit 1 | 1.37 ha |
| | Pit 2 | 1.03 ha |
| | Pit 3 | 0.49 ha |
| | Pit 4 | 0.94 ha |
| | Pit 5 | 0.64 ha |
| | Pit 6 | 4.46 ha |

## 3.4 Pre-mining Land Use

Agate Creek is located on Howlong Station pastoral lease. Prior to the development of the operation, the area was used for cattle grazing.

## 3.5 Communities

Agate Creek is located within the Etheridge Goldfields which is characterised by mineral exploration, mining and pastoral activities. Forsayth is the closest township, located ~40km northeast of Agate Creek. Forsayth has a small population of 129 people with the primary industry being cattle grazing. The nearest regional centre is Georgetown, located 80km north of Agate Creek. Georgetown has a population of 348 and is the largest township within the Etheridge Shire.

The nearest residential area is Old Robin Hood Station occupied by Dave and Dot Terry. The Agate Creek ML area does not contain any areas of regional interest (priority living areas, priority agricultural areas, strategic cropping land and strategic environmental areas) protected under the Regional Planning Interests Act 2014 (QLD, 2021).

## 3.6 Type of Operations

Agate Creek is an open cut gold operation in the Sherwood and Sherwood West Resource areas. Agate Creek uses conventional haul truck and shovel operations supported by traditional drill and blast activities. Ore is graded and stored as low or high grade on the ROM prior to being transported to Georgetown for processing.

Exploration drilling also occurs within the mining leases and on the mineral development lease. There is no other mining activity conducted on the mineral development lease.

## 3.7 Duration Of Operation

Agate Creek has a current Life of Mine (LOM) estimated to be 3 years (i.e., 2025). Exploration activities are underway to increase this LOM.

## 3.8 Native Title

The Ewamian People are the traditional owners of land occupied by the Site, whose country occupies the Gulf of Carpentaria savannah lands in the upper Gilbert and Einasleigh River catchments (Ewamian Aboriginal Corporation, 2021).

All Native Title matters for the Ewamian People are managed by Ewamian Limited. Laneway has successfully negotiated and registered a Cultural Heritage Management Agreement (CHMA) and an Indigenous Land Use Agreement (ILUA) which covers the existing Agate Creek Project area along with any other areas held by Laneway as designated as being traditional landholdings of the Ewamian People. Laneway maintains a good working relationship with Traditional owners which includes employment opportunities where possible (Laneway Resources Limited, 2021).

Cultural heritage artefacts have previously been identified within the ML. These artefacts are outside of the proposed disturbance areas. Laneway will continue to ensure the artefacts remain unimpacted by mining activities.

# 4. Existing Environmental Context

## 4.1 Climate

### 4.1.1 Rainfall and temperature

Agate Creek is located in the dry tropics region and experiences hotter and wetter periods during the summer months (wet season) and drier, cooler periods during the winter months (dry season). The nearest Bureau of Meteorology (BOM) weather station with long-term climate statistics is the Georgetown Post Office station (ID – 030018).

The mean maximum temperatures are 33.4 °C–34.4 °C from January to March and 28.2 °C–30.0 °C from June to August. Mean minimum temperatures are 21.5 °C–22.9 °C from January to March and 12.0 °C–13.1 °C from June to August. Mean annual rainfall recorded at Georgetown Post Office is 820 mm with mean rainfall peaking in January at 224.9 mm (Figure 2).

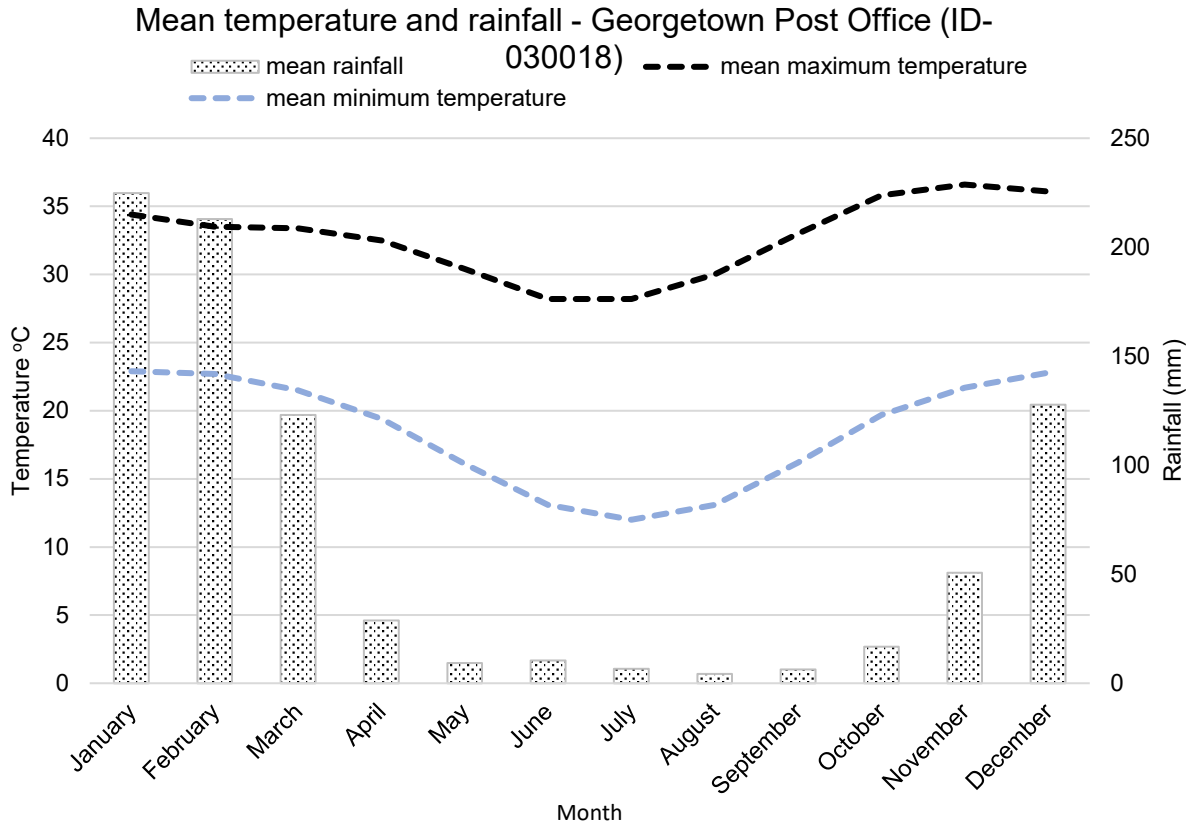



**Figure 2. Mean Temperature and Rainfall at Georgetown Post Office (BOM station ID 030018)**

The predominant wind direction during the year is from the east (SEG, 2022).

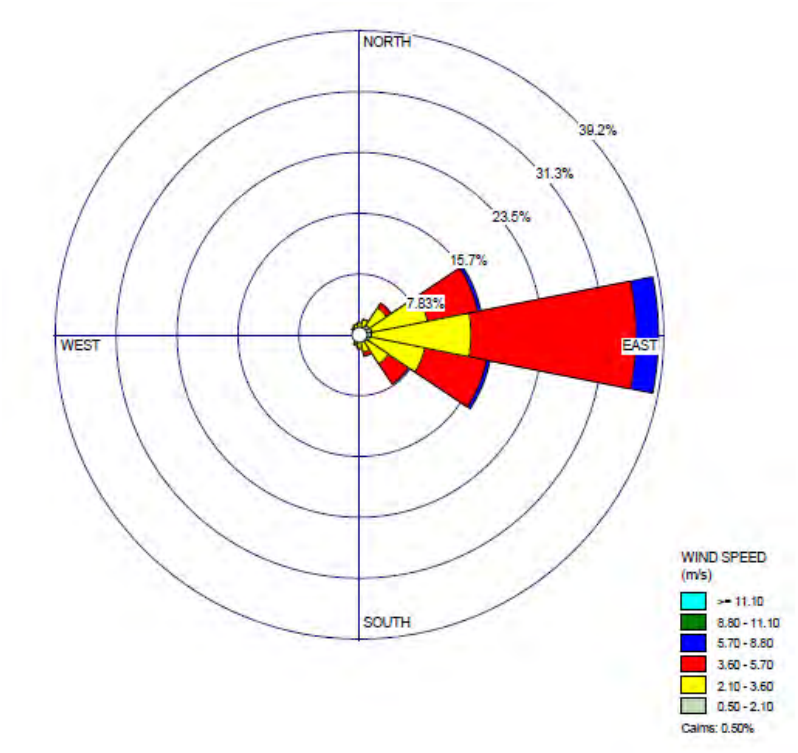



**Figure 3. Wind Rose for Agate Creek - All Hours (SEG, 2022).**

### 4.1.2 Long-term Climate Projections

The 2020 State of the Climate Report (Commonwealth Scientific and Industrial Research Organisation and Bureau of Meteorology, 2020) has predicted that air temperature will continue to rise with increased occurrence of extreme heat days. Dry season rainfall is predicted to reduce however, with an increased likelihood of more intense events across the year. Collectively, these two factors will continue to increase bushfire risk indicated by the change in dangerous fire weather days as illustrated in Figure 4.

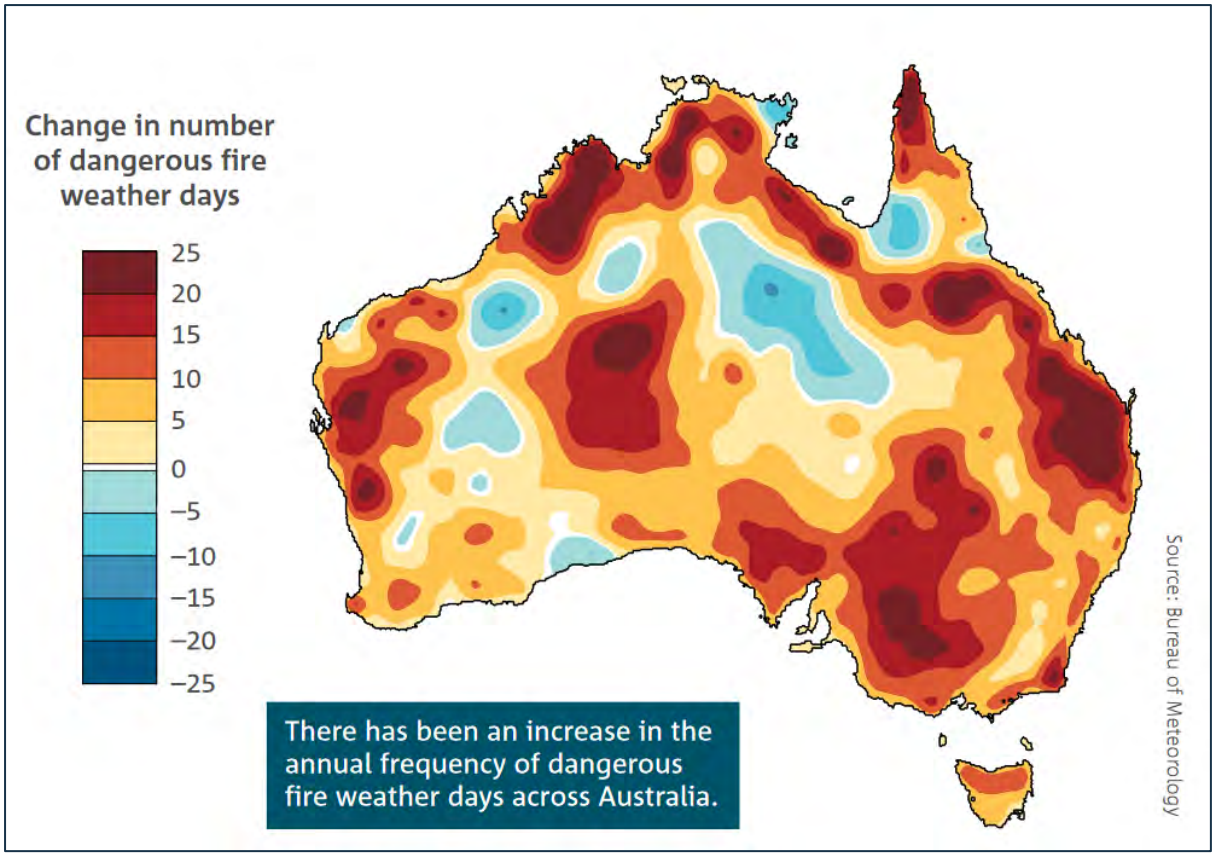



**Figure 4. Excerpt from the 2020 State of the Climate Report Illustrating Change in Dangerous Fire Weather Days (CSIRO & BOM 2020).**

## 4.2 Topography

The topography of Agate Creek includes steep sandstone scarps and formations to the west and steeply undulating hills to gently undulating terrain on the ML. The Project is between 420 m and 550 m Australian Height Datum (AHD) (Queensland Government, 2021).

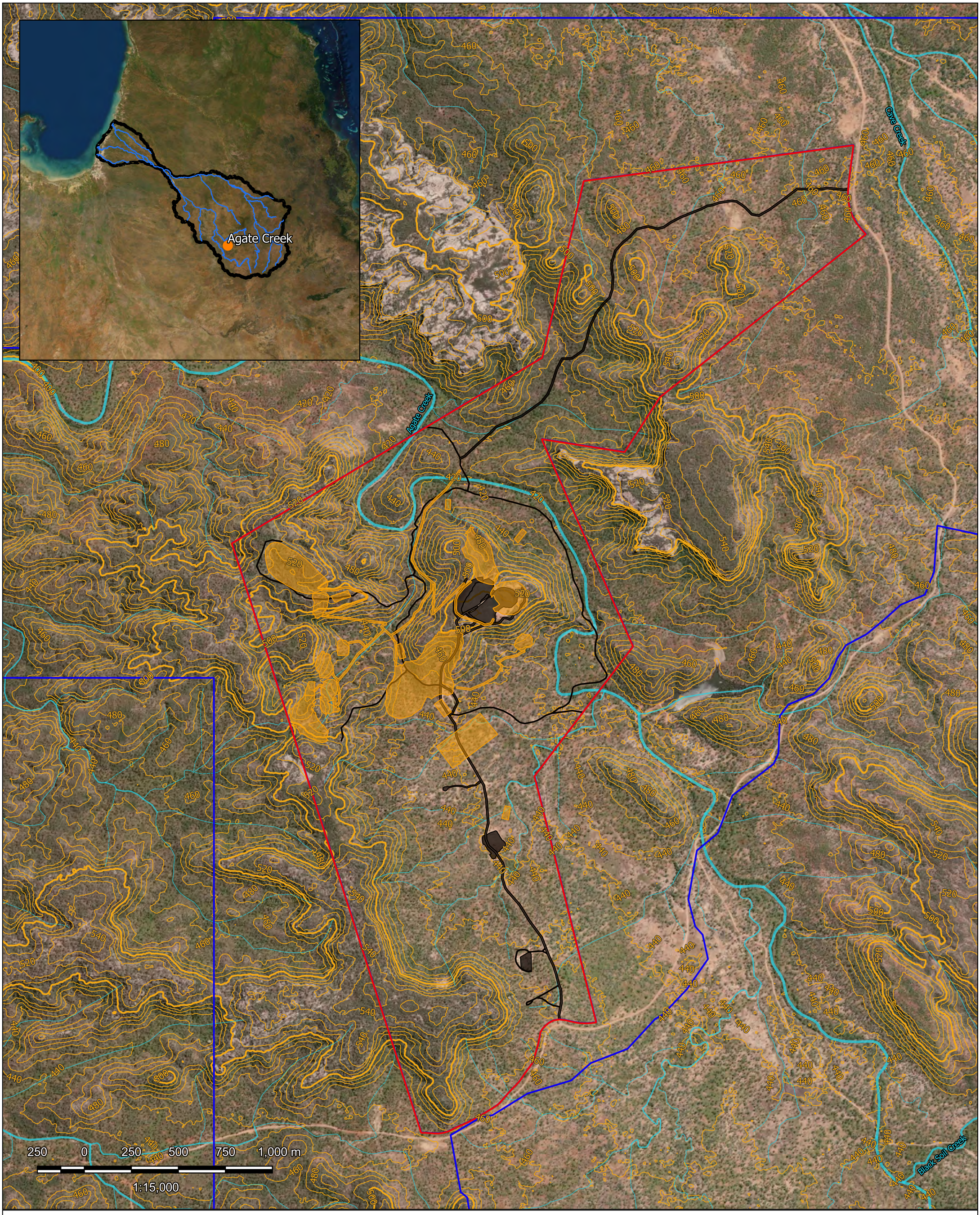
## 4.3 Hydrology

Agate Creek is situated in the Gilbert River Basin (917) and the Gilbert River Sub-basin (9170). The basin generally flows from the south-east to the north-west ending at the Gulf of Carpentaria.

Locally, there are ephemeral watercourses/shallow drainage depressions (unnamed 1st and 2nd order creeks) that flow across the Mine. Most surface water eventually flows into Agate Creek, a 4th order stream that flows approximately south-east to north-west though the central part of the Site (Figure 5). Agate Creek connects to the Robertson River and Gilbert River to the north-west of the Agate Creek locale. A summary of watercourses within Agate Creek and direct surrounds is detailed in Table 3.

**Table 3. Watercourses within the ML.**

| ID | Watercourse | Perennially | Hierarchy | Stream order | Comment |
|---|---|---|---|---|---|
| 1 | Unnamed | Ephemeral | Minor | 1 | Joins 2nd order stream off the ML eventually discharging into Agate Creek. |
| 2 | Unnamed | Ephemeral | Minor | 1 | Joins 2nd order stream off the ML eventually discharging into Agate Creek. |
| 3 | Unnamed | Ephemeral | Minor | 1 | Joins 2nd order stream on the ML eventually discharging into Agate Creek. |
| 4 | Unnamed | Ephemeral | Minor | 1 | Joins 2nd order stream off the ML eventually discharging into Agate Creek. |
| 5 | Agate Creek | Ephemeral | Minor | 4 | Snakes through the central section of the ML flowing south-east to north-west. |
| 6 | Unnamed | Ephemeral | Minor | 1 | Runs off the hill in the centre of the ML into the northern section discharging into Cave Creek off the ML. |
| 7 | Unnamed | Ephemeral | Minor | 1 | Runs off the hill in the centre of the ML into the northern section discharging into Cave Creek off the ML. |
| 8 | Unnamed | Ephemeral | Minor | 1 | Runs off the hill in the centre of the ML into the northern section discharging into Cave Creek off the ML. |




Client: Laneway Resources Ltd
Project number: 2021.08003
CRS: GDA2020 EPSG: 7844
Date: 1 June 2022

Print as A3

# Figure 5. Topography and Hydrology

Legend

- Mineral Development Licence
- Mining Lease
- Existing Mine Features
- Proposed Mine Features
- Gilbert Basin
- Major Rivers
- 10m Contour

Watercourse - Stream Order

- 0
- 1
- 2
- 3
- 4

ESRI Satellite

Disclaimer:
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Digital data for this report is available on the Queensland Government Spatial Portal at https://qldspatial.information.qld.gov.au.

WULGURU TECHNICAL SERVICES

### 4.3.1 Surface Water Environmental Values

The Environmental Protection Policy (Water and Wetland Biodiversity) (EPP Water) details the water quality basins and their specific management intent. The Agate Creek is situated in the Gilbert Drainage Basin (Basin no. 917), which is not included in the EPP Water. Environmental values and water quality objectives have not been formally documented for the Gilbert River Basin, therefore ANZECC Guidelines are applicable. Based on the location and surrounding land use, the environmental values associated with the Gilbert River Basin are:

- **Aquatic ecosystems:** The intrinsic value of aquatic ecosystems, habitat and wildlife in waterways and riparian areas, for example, biodiversity, ecological interactions, plants, animals, key species (such as turtles, platypus, seagrass and dugongs) and their habitat, food and drinking water. Waterways include perennial and intermittent surface waters, groundwaters, tidal and non-tidal waters, lakes, storages, reservoirs, dams, wetlands, swamps, marshes lagoons, canals, natural and artificial channels and the bed and banks of waterways.
- **Farm water supply/use** : Suitability of domestic farm water supply, other than drinking water. For example, water used for laundry and produce preparation.
- **Stock watering**: Suitability of water supply for production of healthy livestock.
- **Primary recreation:** Health of humans during recreation which involves direct contact and a high probability of water being swallowed, for example, swimming, surfing, windsurfing, diving and water-skiing. Primary recreational use, of water, means full body contact with the water, including, for example, diving, swimming, surfing, waterskiing and windsurfing.
- **Secondary recreation**: Health of humans during recreation which involves indirect contact and a low probability of water being swallowed, for example, wading, boating, rowing and fishing. Secondary recreational use, of water, means contact other than full body contact with the water, including, for example, boating and fishing.
- **Visual recreation**: Amenity of waterways for recreation which does not involve any contact with water—for example, walking and picnicking adjacent to a waterway. Visual recreational use, of a water, means viewing the water without contact with it.
- **Drinking water supply:** Suitability of raw drinking water supply. This assumes minimal treatment of water is required, for example, coarse screening and/or disinfection
- **Industrial use**: Suitability of water supply for industrial use, for example, food, beverage, paper, petroleum and power industries, mining and minerals refining/processing. Industries usually treat water supplies to meet their needs.
- **Cultural and spiritual values:** Indigenous and non-indigenous cultural heritage, for example:
    - custodial, spiritual, cultural and traditional heritage, hunting, gathering and ritual responsibilities

- symbols, landmarks and icons (such as waterways, turtles and frogs)
- lifestyles (such as agriculture and fishing).

### 4.3.2 Surface Water Trigger Limits

The EA does not stipulate specific Water Quality Objectives (WQO) or contaminant trigger values for the Agate Creek, therefore given the environmental values for the location, the WQO adopted are ANZECC Guidelines (2000) for Livestock Drinking Water Quality. The proposed water quality and contaminant limits for the project site are outlined in Table 4.

**Table 4. Receiving Environment Trigger and Contaminant Limits**

| Analyte | Unit | WQO | WQO (Dissolved) |
|---|---|---|---|
| pH (field) | pH Unit | 6.0-7.5 | - |
| Total Dissolved Solids @180°C | mg/L | 4000 | - |
| Dissolved Oxygen saturation | % | 90-120 | - |
| Calcium | mg/L | 1000 | - |
| Sulfate | mg/L | 1000 | - |
| Aluminium | mg/L | 5 | 5 |
| Arsenic | mg/L | 0.5 | 0.5 |
| Boron | mg/L | 5 | 5 |
| Cadmium | mg/L | 0.01 | 0.01 |
| Chromium | mg/L | 1 | 1 |
| Cobalt | mg/L | 1 | 1 |
| Copper | mg/L | 1 | 1 |
| Lead | mg/L | 0.1 | 0.1 |
| Mercury | mg/L | 0.002 | 0.002 |
| Molybdenum | mg/L | 0.15 | 0.15 |
| Nickel | mg/L | 1 | 1 |
| Selenium | mg/L | 0.02 | 0.02 |
| Zinc | mg/L | 20 | 20 |

### 4.3.3 Receiving Environment Monitoring Program

Laneway implements a receiving environment monitoring program (REMP), that encompasses event-based surface water sampling, stream sediment sampling and macroinvertebrate sampling. REMP data is characteristic of the ephemeral nature of streams in north Queensland, with limited habitat opportunities for most aquatic organisms. Waterholes dry out too quickly to allow the establishment of

sustained aquatic plant, macroinvertebrate communities. Ephemeral waterholes are also too small and transient to have recreational value or provide watering points for terrestrial fauna.

### 4.3.4 Surface Water Quality

A summary of surface water chemistry is provided in Table 5.

**Figure 6. Surface Water Monitoring Locations**

**Table 5. Surface Water Summary**

| Parameters | | | | | | | Dissolved Major Cations | | | | Total Metals | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site ID | | pH | EC (µS/cm) | TDS (mg/L) | Sulfate (mg/L) | Chloride (mg/L) | Calcium (mg/L) | Mg (mg/L) | Na (mg/L) | K (mg/L) | Al (mg/L) | As (mg/L) | Cd (mg/L) | Cr (mg/L) | Co (mg/L) | Cu (mg/L) | Pb (mg/L) | Mn (mg/L) | Mo (mg/L) | Ni (mg/L) | Se (mg/L) | Zn (mg/L) | B (mg/L) | Fe (mg/L) | Total Mercury (mg/L) | Fluoride (mg/L) |
| SWA01 | Number of records | 9 | | | | | | | | | | | | | | | | | | | | | | | | |
| | Maximum | 8.04 | 334 | 217 | 2 | 21 | 30 | 9 | 30 | 5 | 2.21 | 0.004 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.413 | 0.002 | 0.002 | 0.005 | 0.01 | 0.025 | 1.3 | 0.000 | 1.8 |
| | Minimum | 7.13 | 115 | 75 | 0.5 | 4 | 8 | 2 | 10 | 3 | 0.03 | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.022 | 0.001 | 0.001 | 0.005 | 0.0025 | 0.025 | 0.18 | 0.000 | 0.4 |
| | Mean | 7.639 | 187 | 121.571 | 1.222 | 7.667 | 15.444 | 4.889 | 16.111 | 3.333 | 0.391 | 0.002 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.146 | 0.002 | 0.001 | 0.005 | 0.005 | 0.025 | 0.573 | 0.000 | 1.171 |
| | Median | 7.63 | 203 | 132 | 1 | 6 | 14 | 5 | 13 | 3 | 0.22 | 0.002 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.106 | 0.002 | 0.001 | 0.005 | 0.0025 | 0.025 | 0.38 | 0.000 | 1 |
| SWA02 | Number of records | 6 | | | | | | | | | | | | | | | | | | | | | | | | |
| | Maximum | 8.37 | 304 | 198 | 3 | 8 | 37 | 12 | 15 | 4 | 0.62 | 0.002 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.196 | 0.002 | 0.001 | 0.005 | 0.008 | 0.025 | 0.66 | 0.000 | 0.9 |
| | Minimum | 7.34 | 159 | 103 | 0.5 | 5 | 15 | 4 | 11 | 3 | 0.01 | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.017 | 0.0005 | 0.001 | 0.005 | 0.003 | 0.025 | 0.05 | 0.000 | 0.4 |
| | Mean | 7.782 | 225.333 | 146.333 | 1.417 | 6 | 24.667 | 7.667 | 12.667 | 3.833 | 0.192 | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.066 | 0.001 | 0.001 | 0.005 | 0.004 | 0.025 | 0.232 | 0.000 | 0.683 |
| | Median | 7.77 | 225.5 | 146.5 | 0.75 | 5.5 | 23 | 7 | 12 | 4 | 0.075 | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.052 | 0.001 | 0.001 | 0.005 | 0.003 | 0.025 | 0.09 | 0.000 | 0.75 |
| SWA04 | Number of records | 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| | Maximum | 6.87 | 83 | 54 | 3 | 8 | 3 | 5 | 7 | 2 | 1.4 | 0.002 | 0.000 | 0.001 | 0.001 | 0.004 | 0.001 | 0.053 | 0.001 | 0.002 | 0.005 | 0.003 | 0.025 | 1.39 | 0.000 | 0.3 |
| | Minimum | 6.71 | 53 | 34 | 2 | 4 | 2 | 2 | 5 | 2 | 0.11 | 0.001 | 0.000 | 0.001 | 0.001 | 0.002 | 0.001 | 0.01 | 0.001 | 0.001 | 0.005 | 0.003 | 0.025 | 0.28 | 0.000 | 0.3 |
| | Mean | 6.79 | 68 | 44 | 2.5 | 6 | 2.5 | 3.5 | 6 | 2 | 0.755 | 0.001 | 0.000 | 0.001 | 0.001 | 0.003 | 0.001 | 0.032 | 0.001 | 0.001 | 0.005 | 0.003 | 0.025 | 0.835 | 0.000 | 0.3 |
| | Median | 6.79 | 68 | 44 | 2.5 | 6 | 2.5 | 3.5 | 6 | 2 | 0.755 | 0.001 | 0.000 | 0.001 | 0.001 | 0.003 | 0.001 | 0.032 | 0.001 | 0.001 | 0.005 | 0.003 | 0.025 | 0.835 | 0.000 | 0.3 |
| SWA05 | Number of records | 4 | | | | | | | | | | | | | | | | | | | | | | | | |
| | Maximum | 9.39 | 210 | 136 | 1 | 7 | 22 | 7 | 14 | 4 | 2.1 | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 | 0.002 | 0.016 | 0.001 | 0.002 | 0.005 | 0.006 | 0.025 | 1.37 | 0.000 | 0.7 |
| | Minimum | 7.48 | 130 | 84 | 0.5 | 4 | 12 | 4 | 9 | 4 | 0.07 | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.006 | 0.001 | 0.0005 | 0.005 | 0.003 | 0.025 | 0.08 | 0.000 | 0.4 |
| | Mean | 8.345 | 175.75 | 114 | 0.75 | 5.5 | 17.5 | 5.5 | 12 | 4 | 0.608 | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.009 | 0.001 | 0.001 | 0.005 | 0.003 | 0.025 | 0.517 | 0.000 | 0.55 |
| | Median | 8.255 | 181.5 | 118 | 0.75 | 5.5 | 18 | 5.5 | 12.5 | 4 | 0.13 | 0.001 | 0.000 | 0.001 | 0.001 | 0.0005 | 0.0005 | 0.007 | 0.001 | 0.0005 | 0.005 | 0.003 | 0.025 | 0.1 | 0.000 | 0.55 |
| SWA06 | Number of records | 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| | Maximum | 6.98 | 147 | 96 | 8 | 9 | 7 | 10 | 8 | 3 | 0.45 | 0.001 | 0.000 | 0.001 | 0.001 | 0.003 | 0.001 | 0.054 | 0.001 | 0.001 | 0.005 | 0.003 | 0.025 | 0.37 | 0.000 | 0.7 |

| Parameters | | | | | | | Dissolved Major Cations | | | | Total Metals | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site ID | | pH | EC (µS/cm) | TDS (mg/L) | Sulfate (mg/L) | Chloride (mg/L) | Calcium (mg/L) | Mg (mg/L) | Na (mg/L) | K (mg/L) | Al (mg/L) | As (mg/L) | Cd (mg/L) | Cr (mg/L) | Co (mg/L) | Cu (mg/L) | Pb (mg/L) | Mn (mg/L) | Mo (mg/L) | Ni (mg/L) | Se (mg/L) | Zn (mg/L) | B (mg/L) | Fe (mg/L) | Total Mercury (mg/L) | Fluoride (mg/L) |
| | Minimum | 6.76 | 115 | 75 | 7 | 4 | 5 | 6 | 6 | 3 | 0.03 | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.014 | 0.001 | 0.001 | 0.005 | 0.003 | 0.025 | 0.07 | 0.000 | 0.6 |
| | Mean | 6.87 | 131 | 85.5 | 7.5 | 6.5 | 6 | 8 | 7 | 3 | 0.24 | 0.001 | 0.000 | 0.001 | 0.001 | 0.002 | 0.001 | 0.034 | 0.001 | 0.001 | 0.005 | 0.003 | 0.025 | 0.22 | 0.000 | 0.65 |
| | Median | 6.87 | 131 | 85.5 | 7.5 | 6.5 | 6 | 8 | 7 | 3 | 0.24 | 0.001 | 0.000 | 0.001 | 0.001 | 0.002 | 0.001 | 0.034 | 0.001 | 0.001 | 0.005 | 0.003 | 0.025 | 0.22 | 0.000 | 0.65 |
| SWA07 | Number of records | 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| | Maximum | 6.39 | 119 | 77 | 2 | 23 | 2 | 2 | 16 | 4 | 4.23 | 0.004 | 0.000 | 0.002 | 0.002 | 0.004 | 0.004 | 0.065 | 0.001 | 0.003 | 0.005 | 0.014 | 0.025 | 3.66 | 0.000 | 0.2 |
| | Minimum | 5.57 | 96 | 62 | 2 | 20 | 1 | 2 | 13 | 3 | 0.45 | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.016 | 0.001 | 0.001 | 0.005 | 0.003 | 0.025 | 0.4 | 0.000 | 0.2 |
| | Mean | 5.98 | 107.5 | 69.5 | 2 | 21.5 | 1.5 | 2 | 14.5 | 3.5 | 2.34 | 0.002 | 0.000 | 0.001 | 0.001 | 0.003 | 0.002 | 0.041 | 0.001 | 0.002 | 0.005 | 0.008 | 0.025 | 2.03 | 0.000 | 0.2 |
| | Median | 5.98 | 107.5 | 69.5 | 2 | 21.5 | 1.5 | 2 | 14.5 | 3.5 | 2.34 | 0.002 | 0.000 | 0.001 | 0.001 | 0.003 | 0.002 | 0.041 | 0.001 | 0.002 | 0.005 | 0.008 | 0.025 | 2.03 | 0.000 | 0.2 |
| SWA08 | Number of records | 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| | Maximum | 7.17 | 138 | 90 | 5 | 13 | 9 | 6 | 10 | 4 | 2.68 | 0.002 | 0.000 | 0.001 | 0.001 | 0.002 | 0.002 | 0.013 | 0.001 | 0.002 | 0.005 | 0.008 | 0.025 | 2.22 | 0.000 | 0.3 |
| | Minimum | 6.72 | 102 | 66 | 5 | 9 | 5 | 3 | 8 | 4 | 0.31 | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.01 | 0.001 | 0.001 | 0.005 | 0.003 | 0.025 | 0.13 | 0.000 | 0.2 |
| | Mean | 7.17 | 138 | 90 | 5 | 13 | 9 | 6 | 10 | 4 | 0.31 | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.01 | 0.001 | 0.001 | 0.005 | 0.003 | 0.025 | 0.13 | 0.000 | 0.2 |
| | Median | 6.945 | 120 | 78 | 5 | 11 | 7 | 4.5 | 9 | 4 | 1.495 | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.012 | 0.001 | 0.001 | 0.005 | 0.005 | 0.025 | 1.175 | 0.000 | 0.25 |
| SWA09 | Number of records | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| | Maximum | 7.87 | 238 | 155 | 2 | 8 | 24 | 5 | 21 | 3 | 0.22 | 0.0005 | 0.00005 | 0.0005 | 0.0005 | 0.001 | 0.0005 | 0.004 | 0.0005 | 0.0005 | 0.005 | 0.0025 | 0.025 | 0.12 | 0.00005 | 0.3 |
| | Minimum | 7.87 | 238 | 155 | 2 | 8 | 24 | 5 | 21 | 3 | 0.22 | 0.0005 | 0.00005 | 0.0005 | 0.0005 | 0.001 | 0.0005 | 0.004 | 0.0005 | 0.0005 | 0.005 | 0.0025 | 0.025 | 0.12 | 0.00005 | 0.3 |
| | Mean | 7.87 | 238 | 155 | 2 | 8 | 24 | 5 | 21 | 3 | 0.22 | 0.0005 | 0.00005 | 0.0005 | 0.0005 | 0.001 | 0.0005 | 0.004 | 0.0005 | 0.0005 | 0.005 | 0.0025 | 0.025 | 0.12 | 0.00005 | 0.3 |
| | Median | 7.87 | 238 | 155 | 2 | 8 | 24 | 5 | 21 | 3 | 0.22 | 0.0005 | 0.00005 | 0.0005 | 0.0005 | 0.001 | 0.0005 | 0.004 | 0.0005 | 0.0005 | 0.005 | 0.0025 | 0.025 | 0.12 | 0.00005 | 0.3 |

## 4.4 Groundwaters

### 4.4.1 Environmental Values

There are currently no Environmental Values provided in guidelines relating to the Gilbert Drainage Basin. The most relevant environmental values were derived from the EPP (Water and Wetland Biodiversity) 2019 which include:

- For waters that may be used for agricultural purposes – the suitability of the water for agricultural purposes
- For waters that may be used for recreation or aesthetic purposes – the suitability of water for -
    - Primary recreational use; or
    - Secondary recreational use; or
    - Visual recreational use
- For water that may be used for drinking water – the suitability of the water for supply as drinking water having regard to the level of treatment of the water
- For waters that may be used for industrial purposes – the suitability of the water for industrial use
- The cultural and spiritual values of the water.

### 4.4.2 Groundwater Monitoring Network

Groundwater bore details for the Project are in Table 6 .

**Table 6. Groundwater Monitoring Network**

| | Easting | Northing | Ground Level | Casing Above Ground | Total Depth | Screened Interval |
|---|---|---|---|---|---|---|
| | MGA94 Zone 54 | | m AHD | m | m BGL | m BGL |
| CCWB517 | 768400 | 7896463 | 435.6 | 0.6 | 55 | 49 – 55 |
| CCWB518 | 767768 | 7897706 | 431.4 | 0.6 | 73 | 67 – 73 |
| CCWB519 | 767302 | 7897863 | 517.18 | 0.62 | 85 | 79 – 85 |
| CCWB520 | 767947 | 7897838 | 434.96 | 0.59 | 73 | 67 – 73 |
| CCWB521 | 768701 | 7898079 | 420.94 | 0.6 | 73 | 67 – 73 |
| CCWB522 | 768762 | 7897724 | 434.2 | 0.6 | 73 | 67 – 73 |
| CCWB523 | 768321 | 7897579 | 449.6 | 0.61 | 73 | 67 – 73 |
| CCWB524 | 768174 | 7897670 | 496.06 | 0.64 | 91 | 85 – 91 |
| CCWB525 | 768167 | 7897930 | 498.77 | 0.62 | 103 | 97 – 103 |
| CCWB526 | 767710 | 7896909 | 449.4 | 0.66 | 73 | 67 –73 |
| CCWB527 | 767660 | 7897458 | 461.50 | 0.55 | 31 | 25 – 31 |
| CCWB528 | 767955 | 7898381 | 415.49 | 0.57 | 73 | 67 – 73 |
| CCWB529 | 770217 | 7900144 | 463.85 | 0.54 | 31 | 25 – 31 |
| CCWB530 | 767948 | 7898378 | 422.80 | 0.67 | 7 | 4 – 7 |
| CCWB531 | 767997 | 7898782 | 420.39 | 0.66 | 55 | 49 – 55 |
| CCWB532 | 770221 | 7900138 | 469.62 | 0.55 | 7 | 4 – 7 |
| CCWB533 | 769580 | 7900063 | 473.09 | 0.6 | 25 | 19 – 25 |
| CCWB534 | 768655 | 7895516 | 454.09 | 0.52 | 25 | 19 – 25 |
| CCWB535 | 768681 | 7897248 | 407.91 | 0.6 | 7 | 4 – 7 |
| CCWB536 | 768622 | 7897214 | 440.68 | 0.57 | 19 | 13 – 19 |
| CCWB537 | 768005 | 7898801 | 420.66 | 0.62 | 19 | 13 – 19 |
| CCWB538 | 768651 | 7895513 | 468.83 | 0.6 | 7 | 4 – 7 |

### 4.4.3 Groundwater Quality

Ten established groundwater bores (CCWB517 – CCWB526) were monitored over 13 monitoring events at Agate Creek. Summaries of monitoring results is provided in Table 7.

**Table 7. Summary of Groundwater Monitoring**

| | pH Value | EC (mg/L) | Total Dissolved Solids (mg/L) | Sulfate (mg/L) | Aluminium (mg/L) | Arsenic (mg/L) | Cadmium (mg/L) | Chromium (mg/L) | Cobalt (mg/L) | Copper (mg/L) | Lead (mg/L) | Manganese (mg/L) | Molybdenum (mg/L) | Nickel (mg/L) | Selenium (mg/L) | Zinc (mg/L) | Boron (mg/L) | Iron (mg/L) | Mercury (mg/L) | Fluoride (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CCWB517** | | | | | | | | | | | | | | | | | | | | |
| Min | 7.58 | 2110 | 1370 | 16 | 0.04 | 0.002 | 0.00005 | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 0.09 | 0.002 | 0.0005 | 0.0025 | 0.0025 | 0.22 | 0.08 | 0.00005 | 4.4 |
| Max | 8.18 | 2710 | 1760 | 28 | 3.28 | 0.004 | 0.0004 | 0.002 | 0.002 | 0.004 | 0.002 | 0.721 | 0.027 | 0.002 | 0.005 | 0.07 | 0.44 | 3.37 | 0.00005 | 7.9 |
| Mean | 7.96 | 2376 | 1545 | 22 | 0.51 | 0.003 | 0.0001 | 0.0007 | 0.0010 | 0.0011 | 0.0006 | 0.447 | 0.0103 | 0.0010 | 0.0048 | 0.0182 | 0.32 | 0.58 | 0.00005 | 6.24 |
| Med | 8.01 | 2400 | 1560 | 23 | 0.11 | 0.002 | 0.00005 | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 0.469 | 0.0055 | 0.0005 | 0.005 | 0.013 | 0.31 | 0.145 | 0.00005 | 6.7 |
| **CCWB518** | | | | | | | | | | | | | | | | | | | | |
| Min | 7.16 | 556 | 361 | 78 | 0.04 | 0.024 | 0.00005 | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 0.042 | 0.004 | 0.008 | 0.005 | 0.014 | 0.14 | 0.025 | 0.00005 | 2.6 |
| Max | 7.84 | 827 | 538 | 147 | 0.48 | 0.047 | 0.0002 | 0.0005 | 0.0005 | 0.005 | 0.001 | 0.322 | 0.019 | 0.025 | 0.005 | 0.038 | 0.21 | 0.38 | 0.00005 | 3.3 |
| Mean | 7.56 | 687 | 447 | 105 | 0.15 | 0.037 | 0.00016 | 0.0005 | 0.0005 | 0.0020 | 0.0006 | 0.127 | 0.0093 | 0.0158 | 0.0050 | 0.0245 | 0.17 | 0.090 | 0.00005 | 2.91 |
| Med | 7.61 | 680 | 442 | 100 | 0.075 | 0.035 | 0.0002 | 0.0005 | 0.0005 | 0.002 | 0.0005 | 0.092 | 0.0075 | 0.016 | 0.005 | 0.024 | 0.17 | 0.065 | 0.00005 | 2.9 |
| **CCWB519** | | | | | | | | | | | | | | | | | | | | |
| Min | 6.42 | 130 | 84 | 10 | 0.82 | 0.002 | 0.00005 | 0.001 | 0.006 | 0.002 | 0.0005 | 0.723 | 0.001 | 0.01 | 0.005 | 0.056 | 0.025 | 1.01 | 0.00005 | 0.2 |
| Max | 6.88 | 154 | 100 | 13 | 26.3 | 0.006 | 0.0001 | 0.035 | 0.022 | 0.018 | 0.011 | 1.18 | 0.004 | 0.062 | 0.005 | 0.385 | 0.025 | 40.9 | 0.00005 | 0.3 |
| Mean | 6.63 | 143 | 93 | 11 | 6.52 | 0.003 | 0.00006 | 0.0082 | 0.0094 | 0.0059 | 0.0027 | 0.847 | 0.0019 | 0.02 | 0.005 | 0.1181 | 0.025 | 9.64 | 0.00005 | 0.27 |
| Med | 6.64 | 143 | 93 | 11 | 2.87 | 0.002 | 0.00005 | 0.004 | 0.0075 | 0.004 | 0.001 | 0.77 | 0.002 | 0.013 | 0.005 | 0.075 | 0.025 | 3.66 | 0.00005 | 0.3 |
| **CCWB520** | | | | | | | | | | | | | | | | | | | | |
| Min | 7.68 | 634 | 412 | 46 | 0.41 | 0.01 | 0.00005 | 0.0005 | 0.002 | 0.001 | 0.0005 | 0.134 | 0.016 | 0.001 | 0.005 | 0.032 | 0.14 | 1.13 | 0.00005 | 1.5 |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max | 8.16 | 725 | 471 | 101 | 68.6 | 0.255 | 0.0046 | 0.056 | 0.184 | 0.486 | 0.117 | 9.73 | 0.042 | 0.16 | 0.02 | 7.08 | 0.2 | 363 | 0.00005 | 2.1 |
| Mean | 7.97 | 682 | 444 | 78 | 11.78 | 0.045 | 0.00055 | 0.0067 | 0.0247 | 0.0601 | 0.0148 | 1.502 | 0.0264 | 0.0216 | 0.0064 | 0.9382 | 0.16 | 45.04 | 0.00005 | 1.86 |
| Med | 8.04 | 680 | 441.5 | 81 | 5.86 | 0.023 | 0.00008 | 0.0005 | 0.006 | 0.007 | 0.003 | 0.662 | 0.025 | 0.0055 | 0.005 | 0.426 | 0.16 | 4.88 | 0.00005 | 1.9 |
| **CCWB521** | | | | | | | | | | | | | | | | | | | | |
| Min | 8.26 | 689 | 448 | 60 | 0.6 | 0.016 | 0.00005 | 0.0005 | 0.0005 | 0.0005 | 0.001 | 0.026 | 0.0005 | 0.0005 | 0.005 | 0.0025 | 0.33 | 0.3 | 0.00005 | 11.4 |
| Max | 8.53 | 761 | 495 | 78 | 21.4 | 0.022 | 0.0005 | 0.019 | 0.017 | 0.043 | 0.07 | 0.955 | 0.003 | 0.024 | 0.005 | 0.167 | 0.39 | 21.4 | 0.00005 | 16.6 |
| Mean | 8.41 | 719 | 468 | 70 | 7.08 | 0.018 | 0.00014 | 0.0037 | 0.0035 | 0.0084 | 0.0145 | 0.245 | 0.0017 | 0.0047 | 0.005 | 0.0370 | 0.36 | 4.91 | 0.00005 | 14.29 |
| Med | 8.4 | 720 | 468 | 70 | 4.98 | 0.018 | 0.00005 | 0.002 | 0.002 | 0.004 | 0.006 | 0.118 | 0.002 | 0.002 | 0.005 | 0.016 | 0.36 | 2.165 | 0.00005 | 14.4 |
| **CCWB522** | | | | | | | | | | | | | | | | | | | | |
| Min | 6.76 | 313 | 203 | 24 | 1 | 0.002 | 0.00005 | 0.001 | 0.002 | 0.001 | 0.0005 | 0.59 | 0.002 | 0.003 | 0.005 | 0.011 | 0.13 | 1.6 | 0.00005 | 3.9 |
| Max | 7.37 | 339 | 220 | 28 | 42.7 | 0.029 | 0.0004 | 0.05 | 0.04 | 0.035 | 0.035 | 1.92 | 0.015 | 0.101 | 0.005 | 0.326 | 0.19 | 77.6 | 0.00005 | 4.7 |
| Mean | 7.10 | 324 | 211 | 26 | 10.45 | 0.008 | 0.00013 | 0.0115 | 0.0102 | 0.0081 | 0.0078 | 0.856 | 0.0068 | 0.0235 | 0.005 | 0.0754 | 0.16 | 18.36 | 0.00005 | 4.19 |
| Med | 7.14 | 326 | 212 | 26 | 4.98 | 0.004 | 0.00005 | 0.004 | 0.005 | 0.003 | 0.003 | 0.714 | 0.0055 | 0.012 | 0.005 | 0.028 | 0.16 | 8.185 | 0.00005 | 4.1 |
| **CCWB523** | | | | | | | | | | | | | | | | | | | | |
| Min | 5.45 | 91 | 59 | 6 | 0.02 | 0.0005 | 0.00005 | 0.0005 | 0.003 | 0.0005 | 0.0005 | 0.206 | 0.0005 | 0.003 | 0.005 | 0.05 | 0.025 | 0.23 | 0.00005 | 0.4 |
| Max | 6.76 | 142 | 92 | 9 | 12.9 | 0.008 | 0.0004 | 0.018 | 0.025 | 0.02 | 0.05 | 1.05 | 0.003 | 0.035 | 0.005 | 0.329 | 0.025 | 23.5 | 0.00005 | 1.1 |
| Mean | 6.41 | 113 | 74 | 7 | 1.87 | 0.002 | 0.0001 | 0.0025 | 0.0075 | 0.0025 | 0.0057 | 0.510 | 0.0008 | 0.0082 | 0.005 | 0.0974 | 0.025 | 3.206 | 0.00005 | 0.54 |
| Med | 6.54 | 108 | 70 | 7 | 0.145 | 0.001 | 0.00005 | 0.0005 | 0.006 | 0.0005 | 0.0005 | 0.484 | 0.0005 | 0.006 | 0.005 | 0.071 | 0.025 | 0.855 | 0.00005 | 0.5 |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CCWB524** | | | | | | | | | | | | | | | | | | | |
| Min | 7.11 | 416 | 270 | 64 | 0.12 | 0.001 | 0.00005 | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 0.074 | 0.003 | 0.0005 | 0.005 | 0.006 | 0.025 | 0.09 | 0.00005 | 1.4 |
| Max | 7.72 | 486 | 316 | 83 | 5.33 | 0.01 | 0.0009 | 0.005 | 0.004 | 0.004 | 0.008 | 0.344 | 0.009 | 0.006 | 0.005 | 0.097 | 0.05 | 7.13 | 0.00005 | 1.7 |
| Mean | 7.44 | 460 | 299 | 70 | 0.78 | 0.007 | 0.00015 | 0.0008 | 0.001 | 0.0012 | 0.0012 | 0.139 | 0.0056 | 0.0015 | 0.005 | 0.0257 | 0.031 | 1.046 | 0.00005 | 1.52 |
| Med | 7.46 | 462 | 300 | 69 | 0.40 | 0.007 | 0.00005 | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 0.104 | 0.0045 | 0.001 | 0.005 | 0.015 | 0.025 | 0.46 | 0.00005 | 1.5 |
| **CCWB525** | | | | | | | | | | | | | | | | | | | |
| Min | 6.39 | 615 | 400 | 108 | 0.01 | 0.0005 | 0.00005 | 0.0005 | 0.006 | 0.0005 | 0.0005 | 3.14 | 0.002 | 0.013 | 0.005 | 0.051 | 0.025 | 0.025 | 0.00005 | 0.4 |
| Max | 7.73 | 713 | 463 | 128 | 26.4 | 0.156 | 0.0039 | 0.043 | 0.068 | 0.207 | 0.111 | 4.88 | 0.014 | 0.208 | 0.005 | 2.34 | 0.025 | 95.8 | 0.00005 | 0.6 |
| Mean | 6.97 | 668 | 434 | 120 | 2.50 | 0.0167 | 0.00055 | 0.0041 | 0.0177 | 0.0188 | 0.0098 | 4.01 | 0.006 | 0.0474 | 0.005 | 0.3074 | 0.025 | 8.96 | 0.00005 | 0.54 |
| Med | 6.975 | 666 | 433 | 120 | 0.11 | 0.0035 | 0.0003 | 0.0005 | 0.013 | 0.001 | 0.0005 | 3.94 | 0.006 | 0.034 | 0.005 | 0.115 | 0.025 | 0.2 | 0.00005 | 0.6 |
| **CCWB523** | | | | | | | | | | | | | | | | | | | |
| Min | 7.58 | 1330 | 864 | 87 | 0.05 | 0.001 | 0.00005 | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 0.038 | 0.004 | 0.0005 | 0.005 | 0.006 | 0.5 | 0.025 | 0.00005 | 0.6 |
| Max | 8.59 | 1540 | 1000 | 101 | 0.66 | 0.004 | 0.0005 | 0.0005 | 0.002 | 0.066 | 0.019 | 0.781 | 0.017 | 0.002 | 0.005 | 0.119 | 0.66 | 0.67 | 0.00005 | 1 |
| Mean | 8.03 | 1475 | 9596 | 93 | 0.19 | 0.002 | 0.0001 | 0.0005 | 0.0007 | 0.0062 | 0.0022 | 0.379 | 0.01 | 0.0012 | 0.005 | 0.025 | 0.555 | 0.175 | 0.00005 | 0.81 |
| Med | 8.04 | 1490 | 968 | 93 | 0.13 | 0.002 | 0.00005 | 0.0005 | 0.0005 | 0.001 | 0.0005 | 0.359 | 0.009 | 0.001 | 0.005 | 0.012 | 0.545 | 0.12 | 0.00005 | 0.8 |

## 4.5 Hydrogeology

The 12-month period of monitoring between October 2020 and October 2021 was assessed to determine trends within the Agate Creek groundwaters. Standing Water Levels (SWLs) during the assessment period showed all bores (excluding CCWB526) recorded SWL increases which ranged between 0.17 m (CCWB517) and 3.71 m (CCWB521). An overall average increase of 1.38 m was observed across the network. Increases across the network are likely a result of the extremely low hydraulic conductivities, with the groundwater system continuing to reach equilibrium (C&R Consulting, 2022).

Between December 2020 and February 2021, 765.4 mm of rain fell in the region. All bores within the Agate Creek recorded a positive change in SWL, representing a recharging of the aquifer. This indicates that groundwaters readily respond to rainfall events (C&R Consulting, 2022).

A potentiometric surface of groundwater elevations has been prepared from the groundwater monitoring bore network. It is thought that there is some degree of hydraulic continuity across Agate Creek. The potentiometric surface shows that groundwater flows follow loosely follows topography, with groundwater moving from areas of high elevation towards Agate Creek (C&R Consulting, 2022).

The three bores located in proximity to Agate Creek reflect the areas of lowest groundwater elevations. Elevation differences between the bed of Agate Creek and CCWB521 supports the understanding that the groundwater system does not impact or interact with flow in Agate Creek.

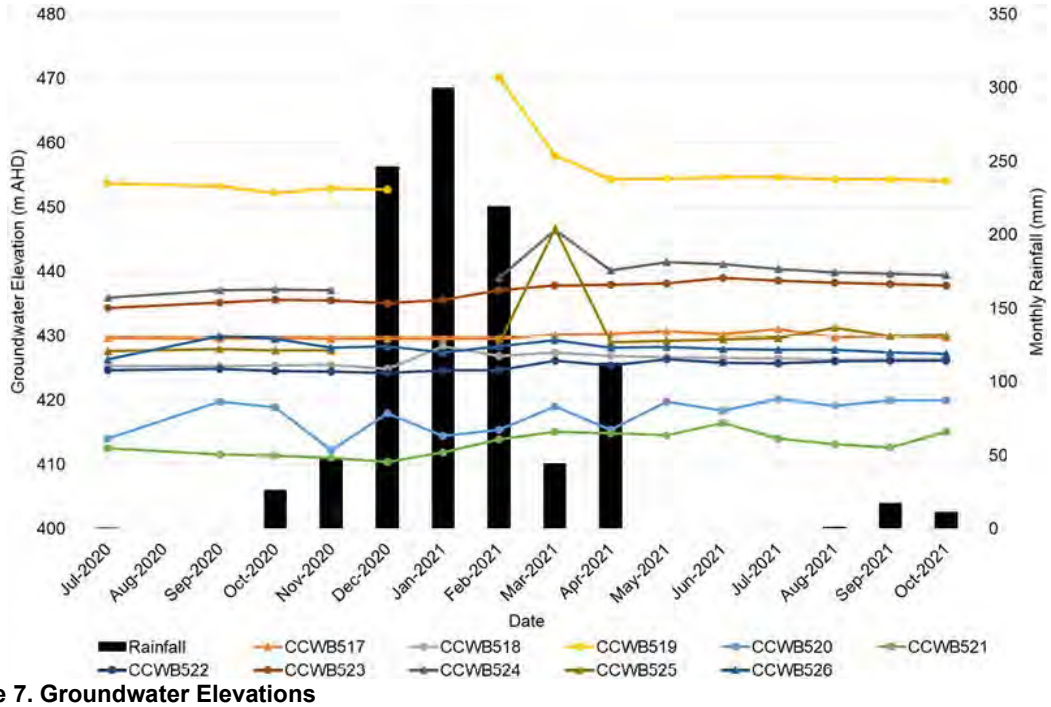



**Figure 7. Groundwater Elevations**

**Figure 8. Potentiometric surface contours**

Legend

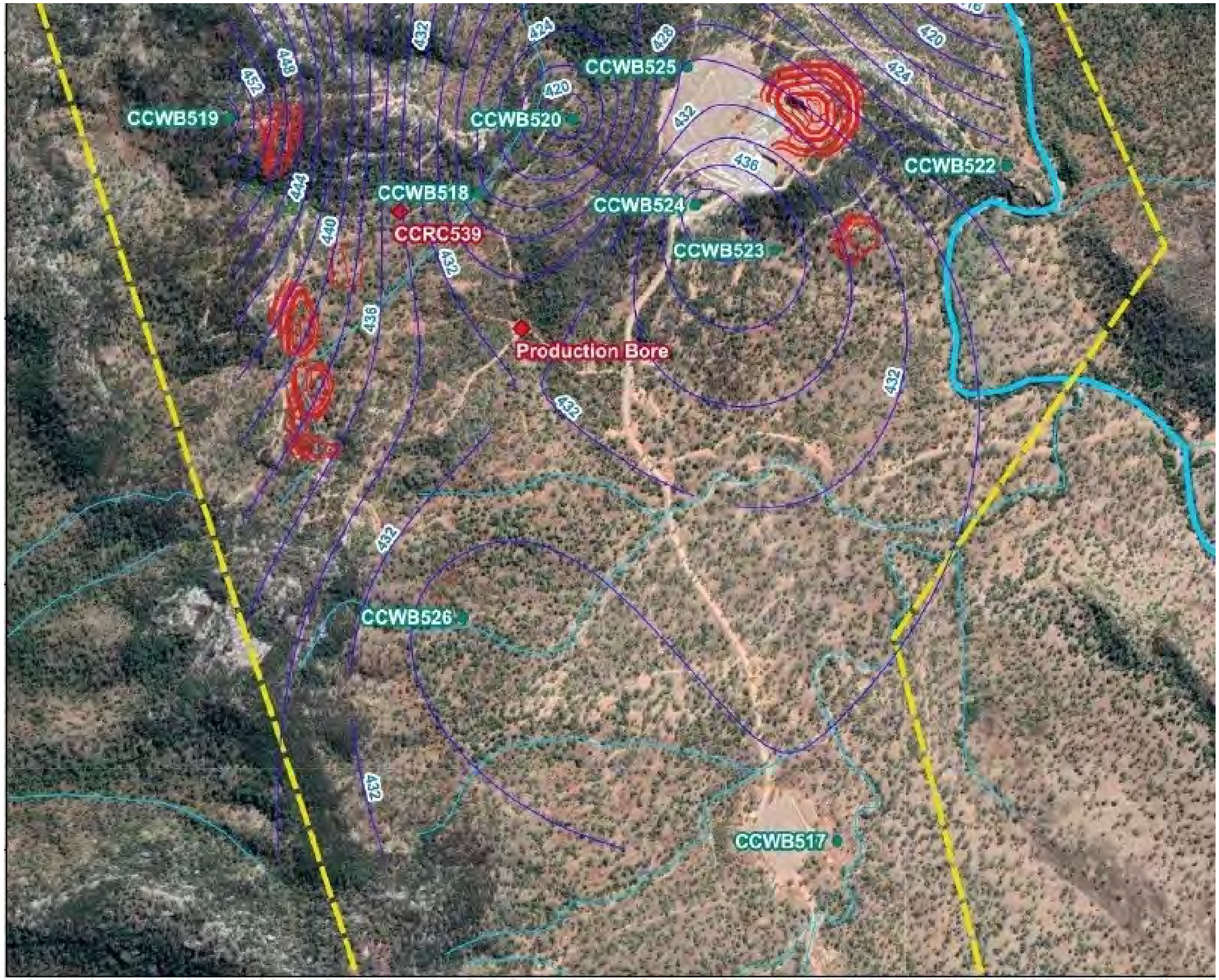
- Agate Creek mining lease
- Void 5-m contours

Bore Network

- Monitoring bore
- Production bores
- Groundwater contours

Watercourse

- Agate Creek
- Minor watercourse




Client: Laneway Reources Ltd
Project number: 2021.08003
Coordinate Reference System: GDA 2020 Z54
Date: 1 June 2022

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## 4.6 Geology

Agate Creek is situated within the Etheridge Goldfield. The region's gold mineralisation is described as predominantly epithermal and meso thermal systems within quartz veining, stockworks and breccias associated with the felsic volcanic units of the Permian Kennedy Igneous Group and the Proterozoic Forsayth Batholith.

State mapping details the surface geologies present within the ML (Queensland Globe, 2021):

- Corbett Formation: Greenish grey mudstone (+/- chloritoid); grades into mica schist (+/- staurolite, andalusite, sillimanite, garnet)
- Hampstead Sandstone: Clayey, commonly pebbly, quartzose sandstone and conglomerate
- Qa-QLD: Clay, silt, sand and gravel; flood-plain alluvium
- Black Soil Andesite: Greyish-green locally sparsely porphyritic augite-hypersthene-basaltic andesite with agate-filled amygdales; probably includes intrusive equivalents
- Cpir-Kennedy Province: Mainly buff, pale grey to dark grey or brown, aphyric to highly porphyritic, intrusive rhyolite; commonly flow-banded; locally grades into microgranite
- Dead Horse Metabasalt: Metabasalt, locally pillowed, hyaloclastic and/or amygdaloidal; minor metadolerite, and metagabbro (unmapped) and interbedded siltstone
- TQr-QLD: Clay, silt, sand, gravel and soil; colluvial and residual deposits (generally on older land surfaces)
- Robin Hood Granodirorite: Pink to grey hornblende-biotite granodiorite with quartz phenocrysts
- Daniel Creek Formation: Mudstone, siltstone, and fine subfeldspathic sandstone, locally calcareous and/or dolomitic. Grades into mica schist, quartzite, and minor calc-silicate rocks

## 4.7 Soil Types, Properties and Suitability

### 4.7.1 Soil types and Properties

WTS was engaged to undertake a soils and land suitability assessment (SLSA) of the ML to inform components of the PRCP (WTS, 2022b). The SLSA focused on areas of minimal disturbance to previously undisturbed land, evaluating resources such as topsoil material availability, suitability for use in rehabilitation and potential constraints to plant growth.

WTS (2022b) identified four soil map units across the ML. Representative soil profiles are described in Table 8.

**Table 8. Representative Soil Profiles Soil Management Unit**

| Soil Management Unit | Reference Site | Area (ha) | Area (%) |
|---|---|---|---|
| Brown Mellic Kandosol | S1 | 232.58 | 34.86 |
| Red Massive Gypsic Vertosol | S3 | 63.97 | 9.32 |
| Brown Bleached Kandosol | S4 | 83.51 | 12.18 |
| Brown Lithsolic Rudosol | S5 | 299.13 | 43.62 |

The laboratory analysis of several soil parameters has been summarised for each soil management unit (Table 9). The soil types currently support native vegetation communities and there are no detrimental elements in the soil expected to limit that capacity in future.

**Table 9. Soil Chemical Properties**

| Soil Type | Depth (cm) | pH | EC (µS/cm) | Nitrite + Nitrate as N (NOx) | TKN (mg/kg) | TN (mg/kg) | TP (mg/kg) | TOC (%w/w) | Colwell K (mg/kg) | Exc. Na (meq/100g) | Exc. K (meq/100g) | Exc. Ca (meq/100g) | Exc. Mg (meq/100g) | Cation Exc. Capacity (meq/100g) | ESP (%) | Ca:Mg Ratio | S (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 - 10 | 6.2 | 20 | 1.0 | 190 | 190 | 144 | 0.23 | 921 | <0.1 | 0.4 | 1.9 | 0.6 | 2.9 | 1.2 | 3.2 | <10 |
| | 10 - 20 | 6.1 | 5 | 1.4 | 150 | 150 | 173 | 0.16 | 575 | <0.1 | 0.3 | 1.0 | 0.6 | 1.9 | 0.8 | 1.7 | <10 |
| | 20 - 30 | 5.9 | 4 | 0.8 | 140 | 140 | 155 | 0.19 | 437 | <0.1 | 0.2 | 0.8 | 0.4 | 1.4 | 0.8 | 2.0 | <10 |
| | 30 - 60 | 5.9 | 4 | 0.2 | 110 | 110 | 129 | 0.14 | 349 | <0.1 | 0.2 | 0.5 | 0.7 | 1.6 | 3.2 | 0.7 | <10 |
| | 60 - 90 | 6.0 | 4 | 0.2 | 110 | 110 | 146 | 0.13 | 280 | 0.1 | 0.2 | 0.5 | 0.9 | 2.4 | 6.2 | 0.6 | <10 |
| 2 | 0-10 | 7.0 | 42 | 0.2 | 780 | 780 | 169 | 1.76 | 1170 | <0.1 | 1.4 | 13.0 | 7.4 | 21.7 | 0.1 | 1.8 | <10 |
| | 10-20 | 6.6 | 10 | 0.3 | 700 | 700 | 138 | 1.29 | 522 | <0.1 | 0.8 | 9.8 | 7.0 | 17.6 | 0.2 | 1.4 | <10 |
| | 20-30 | 6.8 | 5 | <0.2 | 430 | 430 | 117 | 0.76 | 278 | <0.1 | 0.4 | 10.6 | 7.8 | 19.0 | 0.3 | 1.4 | <10 |
| | 30-40 | 6.8 | 6 | <0.2 | 880 | 880 | 294 | 0.60 | 162 | <0.1 | 0.3 | 10.4 | 7.8 | 18.6 | 0.3 | 1.3 | <10 |
| | 40-60 | 6.8 | 4 | <0.2 | 820 | 820 | 219 | 0.47 | 129 | <0.1 | 0.2 | 9.3 | 7.1 | 16.7 | 0.4 | 1.3 | <10 |
| 3 | 0-10 | 6.5 | 18 | 292 | 630 | 630 | 168 | 0.96 | 292 | <0.1 | 0.4 | 3.2 | 0.8 | 4.4 | <0.1 | 4.0 | 292 |
| | 10-20 | 6.7 | 12 | 277 | 390 | 390 | 164 | 0.54 | 277 | <0.1 | 0.4 | 2.2 | 0.6 | 3.1 | 0.3 | 3.7 | 277 |
| | 20-30 | 6.5 | 11 | 270 | 210 | 210 | 116 | 0.32 | 270 | <0.1 | 0.4 | 2.1 | 0.6 | 3.0 | 0.3 | 3.5 | 270 |
| | 30-50 | 6.4 | 8 | 222 | 150 | 150 | 126 | 0.18 | 222 | <0.1 | 0.3 | 1.9 | 0.5 | 2.7 | 0.4 | 3.8 | 222 |
| | 50-80 | 6.4 | 6 | 193 | 120 | 120 | 142 | 0.15 | 193 | <0.1 | 0.2 | 2.1 | 0.8 | 3.1 | 0.8 | 2.6 | 193 |
| | 80-120 | 6.5 | 17 | 308 | 140 | 140 | 125 | 0.23 | 308 | <0.1 | 0.4 | 3.6 | 2.1 | 6.2 | 1.2 | 1.7 | 308 |
| 4 | 0 - 10 | 5.3 | 6 | 0.7 | 510 | 510 | 256 | 0.90 | 224 | <0.1 | 0.3 | 0.5 | 0.5 | 2.1 | 1.2 | 1.0 | <10 |
| | 10 - 20 | 5.3 | 4 | 0.5 | 360 | 360 | 169 | 0.60 | 115 | <0.1 | 0.1 | 0.2 | 0.4 | 2.3 | 2.6 | 0.5 | <10 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20 - 30 | 5.0 | 3 | 0.4 | 280 | 280 | 325 | 0.34 | 109 | <0.1 | 0.2 | 0.2 | 0.4 | 1.9 | 2.4 | 0.5 | <10 |
| | 30 - 40 | 5.3 | 2 | 0.4 | 190 | 190 | 359 | 0.22 | <100 | <0.1 | 0.1 | <0.1 | 0.4 | 1.3 | 2.0 | <0.1 | <10 |

1 = Brown Mellic Kandosol

2 = Red Massive Gypsic Vertosol

3 = Brown Bleached Kandosol

4 = Brown Lithsolic Rudosol

250 0 250 500 750 1,000 m

1:15,000

Client: Laneway Resources Ltd
Project number: 2021.09001
CRS: GDA2020 EPSG: 7844
Date: 11 July 2022

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# Figure 9. Ground-truthed Soils

Legend

Mine Tenure
- Mineral Development Licence
- Mining Lease
- Existing Mine Features
- Proposed Mine Features

Ground-truthed Soils
- Brown Bleached Kandosol
- Brown Lithsolic Rudosol
- Brown Mellic Kandosol
- Red Massive Gypsic Vertosol

ESRI Satellite

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Digital data for this report is available on the Queensland Government Spatial Portal at https://qldspatial.information.qld.gov.au.

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### 4.7.2 Land Suitability Assessment

Land Suitability has been assessed using the methods and criteria provided in the Guideline for Agricultural Land Evaluation (Department of Science Information Technology and Innovation and Department of Natural Resources and Mines, 2015) and Guideline for Land Suitability Assessment Techniques (Department of Mines and Energy, 1995). This assesses how suitable an area of land is for two major rural agricultural enterprises: rainfed broadacre cropping and beef cattle grazing.

The Land Suitability assessment cross-references each soil unit's characteristics with suitability criteria from the Department of Mines and Energy (1995). The Land Suitability assessment uses a five-class system, where Class 1 indicates that the land is most suitable for the enterprise and Class 5 the least suitable. The overall land suitability ranking for each specific soil unit is determined by the most severe limitation, or a combination of the varying limitations. Land is considered less suitable as the severity of limitations for a land use increases. The increasing limitations may reflect any combination of:

- Reduced potential for production;
- Increased inputs to achieve an acceptable level of production; and/or
- Increased inputs required to prevent land degradation.

The Land Suitability Classes are described in Table 10.

**Table 10. Land Suitability Classes**

| Class | Suitability | Limitations | Description |
|---|---|---|---|
| 1 | Suitable | Negligible | Highly productive land requiring only simple management practices to maintain economic production. |
| 2 | Suitable | Minor | Land with limitations that either constrain production or require more than the simple management practices of class 1 land to maintain economic production. |
| 3 | Suitable | Moderate | Land with limitations that either further constrain production or require more than those management practices of class 2 land to maintain economic production. |
| 4 | Unsuitable | Severe | Currently unsuitable land. The limitations are so severe that the sustainable use of the land in the proposed manner is precluded. In some circumstances, the limitations may be surmountable with changes to knowledge, economics, or technology. |
| 5 | Unsuitable | Extreme | Land with extreme limitations that preclude any possibility of successful sustained use of the land in the proposed manner. |

The land use suitability for the 4 soil types is summarised in Table 11.

**Table 11. Summary of Land Suitability**

| Soil Type | Beef Cattle Grazing | Broadacre Cropping | Limitations | Area |
|---|---|---|---|---|
| Brown Mellic Kandosol | 4 | 4 | Severe to Extreme Limitations in plant available water capacity (PAWC), vegetation. | 232.58 |
| Red Massive Gypsic Vertosol | 5 | 5 | Severe to Extreme Limitations in plant available water capacity (PAWC), vegetation. | 63.97 |
| Brown Bleached Kandosol | 3 | 3 | Limitations that constrain production (flooding) | 83.51 |
| Brown Lithsolic Rudosol | 5 | 5 | Severe to Extreme Limitations in plant available water capacity (PAWC), topography and rockiness. | 299.13 |

### 4.7.3 Land Stability

An assessment of soil erosion susceptibility is given in Table 12, which lists influencing factors for all soil types that have been identified.

**Table 12. Soil Erosion Susceptibility**

| Soil Type | Depth (cm) | Texture | ECEC (meq/100g) | Rating | ESP (%) | Rating | Landform | Vegetation Cover | Erosion Susceptibility |
|---|---|---|---|---|---|---|---|---|---|
| Brown Mellic Kandosol | 0 - 10 | Loam | 1.2 | Low | 1.2 | Non-Sodic | Gently undulating. | Sparse *Eucalyptus microneura +/- Terminalia spp. low woodland* | Moderate susceptibility due sparse erosion protection |
| | 10-60 | Loam | 1.5 | Low | 1.6 | Non-Sodic | | | |
| | 60-90 | Loam | 2.4 | Low | 6.2 | Slightly Sodic | | | |
| Red Massive Gypsic Vertosol | 0-20 | Clay Loam | 20 | Moderate | 0.15 | Non-Sodic | Flat to gently undulating | Sparse *Eucalyptus crebra and/or E. whitei +/- Corymbia erythrophloia open woodland*. | Moderate susceptibility due sparse erosion protection |
| | 20-30 | Clay | 19 | Moderate | 0.3 | Non-Sodic | | | |
| | 30-60 | Clay | 17.6 | Moderate | 0.35 | Non-Sodic | | | |
| Brown Bleached Kandosol | 0-10 | Loam | 4.4 | Low | 0.1 | Non-Sodic | Flat to gently undulating. | Sparse *Eucalyptus microneura +/- Terminalia spp. low woodland*. | Moderate susceptibility due sparse erosion protection |
| | 10-50 | Sandy Loam | 2.9 | Low | 0.35 | Non-Sodic | | | |
| | 50-80 | Sandy Loam | 3.1 | Low | 0.8 | Non-Sodic | | | |
| | 80-120 | Sandy Loam | 6.2 | Low | 1.2 | Non-Sodic | | | |
| Brown Lithsolic Rudosol | 0 -20 | Loam | 2.2 | Low | 1.8 | Non-Sodic | Slight to steeply undulated terrain | *Eucalyptus crebra* woodland, +/- *Corymbia pocillum*. | Moderate susceptibility due sparse erosion protection |

### 4.7.4 Erosion Hazard (Average Rainfall)

The International Erosion Control Association's (IECA) Best Practice Erosion and Sediment Control Guidelines (IECA 2008) sets erosion hazard based on average rainfalls for regions around Australia. IECA erosion hazard for Forsayth region is detailed in Table 13.

**Table 13. Erosion Hazard (IECA, 2008)**

| Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H | M | M | VL | VL | VL | VL | VL | VL | VL | VL | M |

*Note: H=High, M = Moderate, L = Low, VL = Very Low.*

## 4.8 Vegetation Communities and Ecological Data

### 4.8.1 Vegetation Communities

Agate Creek is located on the boundary of the Gulf Plains and Einasleigh Uplands bioregion and northeast of the Rungulla National Park and Rungulla Resource Reserve. The ML is covered predominantly by open woodlands of Gilbert River Box and Narrow-Leaved Ironbark with a sparse shrub and grass understory (SLR Consulting, 2021). SLR Consulting (2021) ground-truthed Regional Ecosystems (REs) across the ML which all have a 'least concern' status under the *Vegetation Management Act 1999* (VM Act) and a 'no concern at present' biodiversity status under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), except for REs 9.3.13 and 9.3.26, which both have an 'of concern' biodiversity status. The ground-truthed REs are detailed in Table 14. SLR Consulting (2021) noted minor to moderate cattle grazing and agriculture impacts in all vegetation communities concentrating along watercourses and riparian zones.

Small sections of non-remnant vegetation occur on previously cleared areas for mining operations.

**Table 14. Ground-truthed Regional Ecosystems (SLR Consulting, 2021).**

| RE | VM Act Status | Biodiversity Status | Description | Presence relative to Project location |
|---|---|---|---|---|
| 2.10.5a | Least Concern | No Concern at Present | Dominated by sandstone scarps, outcrops, and plateaus. Vegetation dominated by Paperbark Gums and Lancewood. The sub-canopy and shrub layers dominated by Acacia spp. | Western edges of the ML |
| 9.3.13 | Least Concern | Of Concern | Canopy included *Eucalyptus camaldulensis, Melaleuca fluviatilis,* and *Lophostemon grandiflorus.* | Occurs along several of the State mapped watercourses including Agate Creek within the ML. |
| 9.3.26 | Least Concern | Of Concern | Abundance of black soil. Sparse canopy (primarily Gilbert River Box), woody shrub | South-east of pit. |

| | | | | |
|---|---|---|---|---|
| | | | layers, and variety of grasses. Increased grazing pressure. | |
| 9.5.10a | Least Concern | No Concern at Present | Canopy dominated by Gilbert River Box. Density of sub-canopy varied. Shrub layer was generally sparse, dominated by *Cassia lanceolata*. Significant grazing occurring. | Lower flood plains of ML. |
| 9.11.16 | Least Concern | No Concern at Present | Dominated by Narrow-leaved Ironbark with variable sub-canopy and shrub layer. Groundcover typically dominated by *Aristida spp.* On folded metamorphic surface geology. | North-eastern portion of ML on steep slopes, low undulations, and hill crests. |
| 9.12.11 | Least Concern | No Concern at Present | Dominated by Narrow-leaved Ironbark with variable sub-canopy and shrub layer. Groundcover typically dominated by *Aristida spp.* | Southern and central areas on igneous rocks on steep slopes, low undulations, and hill crests. |

### 4.8.2 Threatened Flora

No threatened flora species as listed under the *Nature Conservation Act 1992* (NC Act) or EPBC Act were identified by SLR Consulting (2021) within the ML.

### 4.8.3 Threatened Fauna

During SLR Consulting's (2021) Flora and Fauna survey, the species observed were mostly common to the region. One Endangered, Vulnerable, or Near Threatened (EVNT) species, *Acanthophis antarcticus* (common death adder), was recorded by SLR Consulting (2021); the exact location the species was spotted is unknown. The common death adder is listed as Vulnerable under the *Nature Conservation Act 1992* (NC Act). There were 14 microbat species identified which are listed as 'least concern' under the NC Act.

All other species identified during the survey are not listed as EVNT species.

The Gilbert Gecko and Silver-eyed Velvet Gecko were identified at Agate Creek, however, both species were described in recent years, poorly known, and have restricted distributions thus are currently not evaluated under the NC Act or EPBC Act.

### 4.8.4 Matters of National Environmental Significance (MNES)

While none were identified during the SLR Consulting (2021) Flora and Fauna survey, desktop analysis indicated some species listed as a MNES that may occur within the ML.

**Table 15. MNES Fauna Potentially Occurring within the Project (SLR Consulting, 2021).**

| Species | NC Act | EPBC Act | Likelihood of | Description |
|---|---|---|---|---|

| | Listing | Listing | occurrence (SLR Consulting, 2021) | |
|---|---|---|---|---|
| Ghost Bat *Macroderma gigas* | Endangered | Vulnerable | Moderate | ML contains suitable foraging habitat. No suitable roost habitat was ground-truthed. Not detected during survey. |
| Koala *Phascolarctos cinereus* | Vulnerable | Vulnerable | Moderate | Not detected during survey. Potentially suitable habitat Desktop analysis indicated records within 20 km. |
| Large-eared horseshoe bat *Rhinolophus robertsi* | Endangered | Vulnerable | Moderate | ML contains some potentially suitable foraging and roosting habitat. No evidence of the species was identified during the survey. |

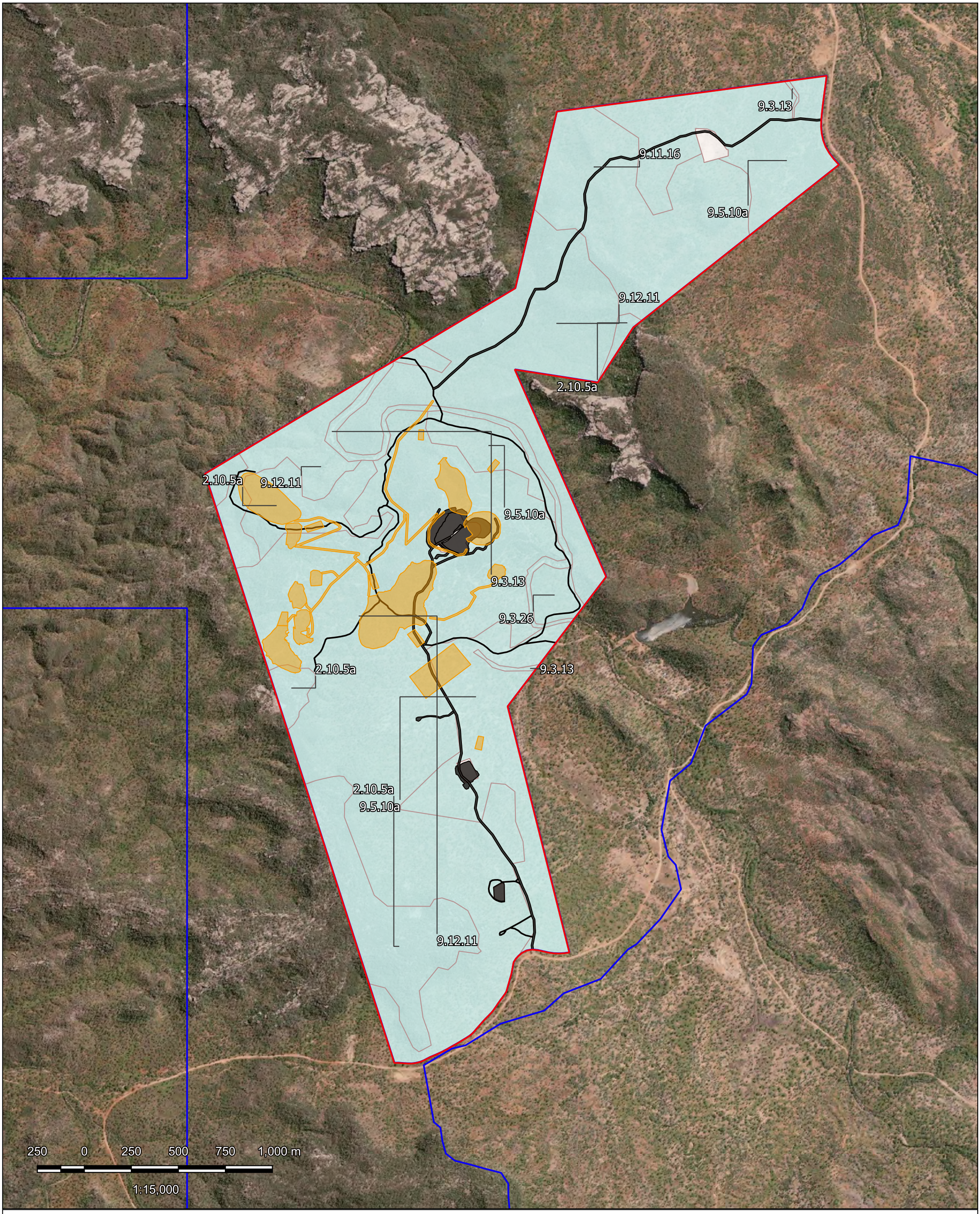
#### 4.8.5 Matters of State Environmental Significance

The Rungulla National Park and Resource Reserve, neighbouring the ML, is considered a Matter of State Environmental Significance (MSES) as well as the riverine ecosystems along the watercourses through the Project (Queensland Globe 2022; SLR Consulting, 2021). No other MSES were identified by SLR Consulting (2021) to occur within the Project.

MSES at the Project are displayed in Figure 11.

#### 4.8.6 Environmentally Sensitive Areas

No Environmentally Sensitive Areas (ESA) were ground-truthed to occur within the Project area. One Category A ESA, the Rungulla National Park, is State mapped to the southwest of the study area and one Category C ESA, is also State mapped to the southwest of the Project (SLR Consulting, 2021).




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Project number: 2021.09001
CRS: GDA2020 EPSG: 7844
Date: 11 July 2022

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# Figure 10. Ground-truthed Regional Ecosystems

Legend

Mine Tenure
- Mineral Development Licence
- Mining Lease
- Mine Features
- Proposed Mine Features

Groundtruthed REs
- Least Concern
- Non-Remnant

ESRI Satellite

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Rungulla Resources Reserve

Rungulla National Park

400 0 400 800 1,200 1,600 m

1:30,000

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Project number: 2021.09001
CRS: GDA2020 EPSG: 7844
Date: 11 July 2022

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# Figure 11. Matters of State Environmental Significance

Legend

- Mineral Development Licence
- Mining Lease
- Existing Mine Features
- Proposed Mine Features

ESRI Satellite

State Significant Matters

- WH - END or VUL
- RV - 100m from Wetland
- RV - Defined Watercourse
- RV - Essential Habitat
- PA - Rungulla National Park
- PA - Rungulla Resources Reserve

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# 5. Design for Closure

## 5.1 Project design

The Agate Creek expansion was designed to minimise the disturbance footprint of the operation as much as practical. Mine features were selectively placed to target the resource efficiently and also to limit haul distances and disturbance areas of roads and waste dumps.

Open cut mining methods will be utilised to maximise the economic viability of the Project. Six smaller pits are proposed, rather than one large pit, to target the resource. As a result, the individual pits can be progressively rehabilitated as the resource is depleted. Associated disturbance areas, such as haul roads, can also be progressively rehabilitated when the pits are no longer required.

Water management infrastructure such as bunding and sediment ponds are included in the Project design to limit the movement of contaminants from impacted areas. These will be retained during operations until areas have achieved the relevant rehabilitation milestones. Agreements are in place with the landholders to retain some tracks and water storages for future use.

A soil assessment was completed to identify topsoil reserves so that adequate topsoil could be salvaged and retained for rehabilitation activities. Topsoil stockpiles have been incorporated into the Project design, to be made available for rehabilitation.

Environmental impacts were assessed in the EA amendment for the expansion, with low impacts expected. Environment monitoring will continue during operations to identify any emerging issues that may impact on the success of rehabilitation. Mine planning will be updated, as required, to ensure long term success during both operation and rehabilitation phases.

## 5.2 Rehabilitation Areas and Milestones

Project activities are grouped in this PRCP by Rehabilitation Areas (RAs), defined under the Progressive Rehabilitation and Closure Plans guideline as "*an area of land in the PMLU to which a rehabilitation milestone for the post-mining use relates".* Each RA will have Rehabilitation Milestones (RMs), defined as *each significant event or step necessary to rehabilitate the land to a stable condition* (Department of Environment and Science, 2021).

The RAs and RMs for the Agate Creek Gold Mine are detailed in Table 16.

**Table 16. Rehabilitation Areas and Rehabilitation Milestones**

| Rehabilitation Area | | Rehabilitation Milestone | |
|---|---|---|---|
| RA1 | Open cut pits 1 - 4 | RM1 | Infrastructure decommissioning and removal |
| RA2 | Open cut pits 5 - 6 | RM2 | Remediation of contaminated land |
| RA3 | Waste Rock Dumps | RM3 | Landform development and reshaping (RA1) |
| RA4 | Mine Infrastructure Area | RM4 | Landform development and reshaping (RA2) |
| RA5 | Water Storages | RM5 | Landform development and reshaping (RA3) |

| | | | |
|---|---|---|---|
| RA6 | Exploration | RM6 | Landform development and reshaping (RA4) |
| | | RM7 | Landform development and reshaping (RA5) |
| | | RM8 | Surface preparation |
| | | RM9 | Revegetation (native ecosystem) |
| | | RM10 | Revegetation (grazing) |
| | | RM11 | Achievement of surface requirements (native ecosystem) |
| | | RM12 | Achievement of surface requirements (grazing) |
| | | RM13 | Achievement of post-mining land use to a stable condition (native ecosystem) |
| | | RM14 | Achievement of post-mining land use to a stable condition (grazing) |
| | | RM15 | Achievement of post-mining land use to a stable condition (water storage) |

400 0 400 800 1,200 1,600 m

1:25,000

Client: Laneway Resources Ltd
Project number: 2021.08003
CRS: GDA2020 EPSG: 7844
Date: 11 October 2022

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# Figure 12. Rehabilitation Areas

Legend

Mine Tenure
- MDL
- Mining Lease

ESRI Satellite

Rehabilitation Areas
- RA1
- RA2
- RA3
- RA4
- RA5
- RA6

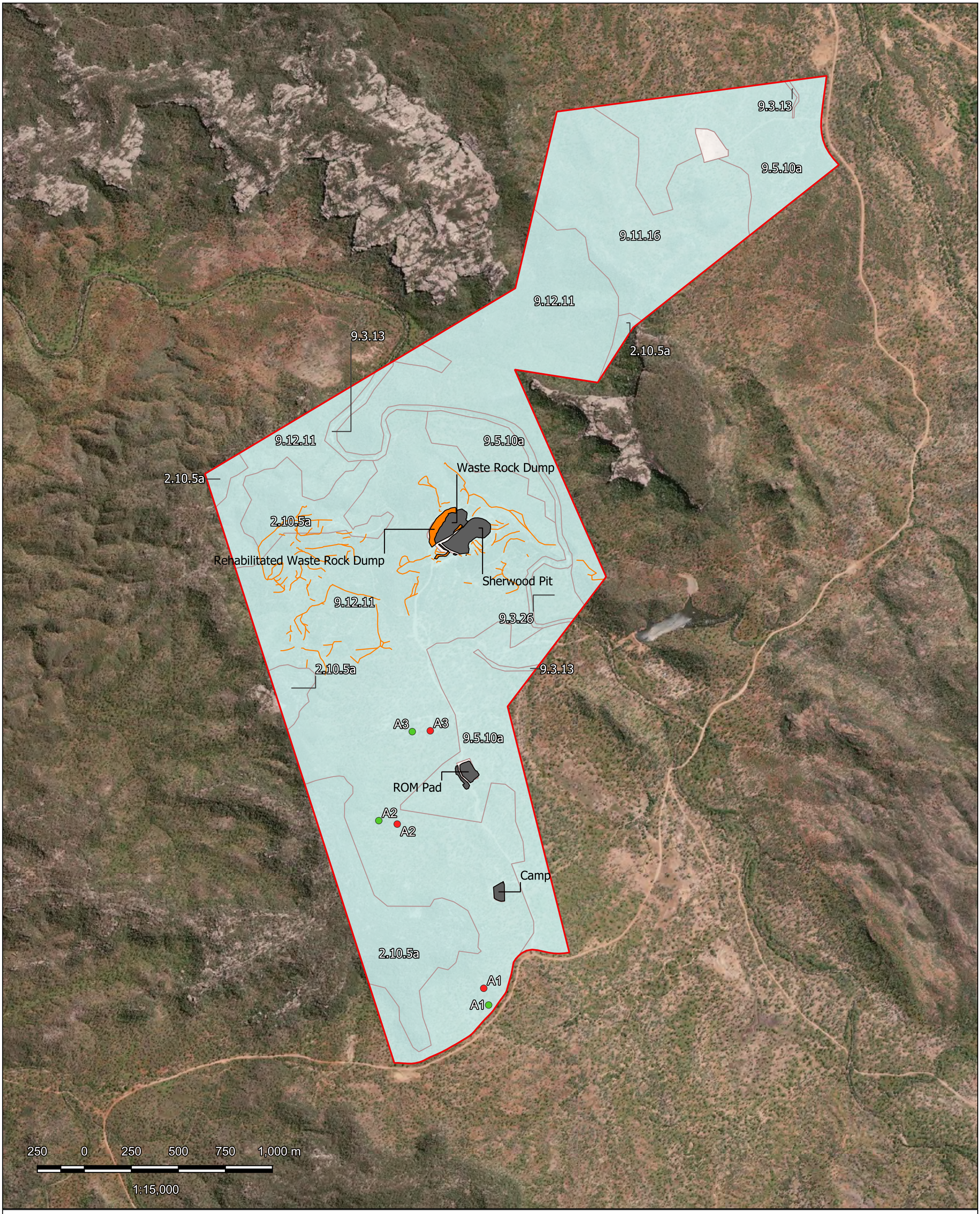
Post Mine Land Use
- Low intensity Grazing
- Native Ecosystem
- Recreation
- Water Storage

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## 5.3 Previous Rehabilitation

Prior to the commencement of operations, extensive exploration activities were undertaken by interested parties, dating back to 1997. A number of historic exploration tracks have previously been rehabilitated as well as a 0.93 ha area of the existing waste rock dump (Figure 13). An assessment was completed for these areas (Appendix I) with the results summarised below.




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CRS: GDA2020 EPSG: 7844
Date: 20 December 2022

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# Figure 13. Previous Rehabilitation

Legend

- Mine Lease
- Existing Disturbance
- Rehabilitated Waste Rock Dump
- Rehabilitated Exploration Track - 2.8m wide

Groundtruthed Regional Ecosystem

- Least Concern
- Non-Remnant

Reference Sites

- START
- FINISH

ESRI Satellite

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### 5.3.1 Historical Exploration Disturbance

The exploration area (Rehab 1) assessment site was chosen as a proxy site for all rehabilitated exploration tracks. Exploration in this area was undertaken in 2014 and rehabilitated in 2015, making it the most recent disturbance of all the locations. As exploration in other locations predates this site, it is expected that rehabilitation in these sites would be in later successional stages of regrowth than the assessment site.

Results of the assessment of the Rehab 1 site indicate that vegetation in the previously disturbed exploration area has recovered sufficiently that it could now be considered remnant vegetation. It is worth noting that the area is also currently mapped as remnant vegetation in the *Vegetation management regional ecosystem map - version 12.02*. The following sections provide discussion regarding the condition of the Rehab 1 site and comparison with the measured attributes of the local reference sites (WTS, 2022a).



*Figure 14 Exploration rehabilitation site*

#### 5.3.1.1 Tree heights

While the median height of the ecologically dominant layer (EDL) of the Rehab 1 site (9 m) is less than the mean for reference sites (12.27 m), it exceeds the 70 % completion criteria value (8.5 m).

Median subcanopy height (3.5 m), however, is similar to the mean value of reference sites (3.6 m) exceeding that of the completion criteria value (2.5 m).

#### 5.3.1.2 Canopy cover

Tree canopy cover of the Rehab 1 site (36 %) is well within the standard error of the mean for the reference sites (41.13 % +/- 11.18) and well above the 50 % completion criteria value (20.5 %). Unfortunately, subcanopy species were (in error) grouped into the shrub layer during the canopy cover assessment leading to an apparent lack of subcanopy cover. However, the results of the shrub cover assessment along with photos of the site would indicate that this strata (8.3 %) is sufficient to exceed the 25 % completion criteria values for subcanopy cover (1.65 %).

#### 5.3.1.3 Ground cover

In all cases (perennial grass cover, native forbs and other cover, and litter cover) ground cover values were equal to or exceeded the completion criteria value for ground cover. Notably, perennial grass cover (18.6 %) exceeded the mean of the reference sites (18.27 %).

#### 5.3.1.4 Stem counts

Both tree (620 stems/ha) and shrub (900 stems/ha) stem counts for Rehab 1 exceeded the mean reference site values and therefore the 70 % completion criteria values for stem counts per hectare (230 stems/ha and 320 stems/ha respectively).

#### 5.3.1.5 Species richness

Species richness in all strata were higher in the Rehab 1 site than in the mean of the reference sites.

### 5.3.2 Waste Rock Dump Area

This section of the waste rock dump was rehabilitated in 2019. The vegetation present is well established, comprised of pioneer species that are expected to provide a pathway to the successful establishment of secondary and climax species. The following sections provide discussion regarding the condition of the Rehab 2 site and comparison with the measured attributes of the local reference sites (WTS, 2022a).



*Figure 15 WRD rehabilitation*

#### 5.3.2.1 Tree heights

Due to the age of the Rehab 2 site there was no representative dominant canopy layer within the range of heights of the reference site mean EDL canopy height, and all species, irrespective of their expected climax strata, appeared in the subcanopy layer. In the subcanopy layer however, the median height (4 m) did exceed that of the mean of the reference sites (3.6 m).

#### 5.3.2.2 Canopy cover

Tree canopy cover has not yet been established in the Rehab 2 site. As mentioned in section 5.3.2.1, the subcanopy is the dominant strata and this is reflected in an extremely high cover for subcanopy of 54.4 %. Shrub cover (5.7 %) is also higher than the mean of the reference sites (1.3 %). These cover values are typical of rehabilitation in the early stage of succession.

#### 5.3.2.3 Ground cover

Native perennial grass (16.2 %) and litter (49 %) cover were both higher than the completion criteria value for these cover attributes (12.5 % and 23 % respectively). Native forb and other cover was low at 1.4 %, however this is not unexpected for a rehabilitation site in the early stages of succession as species in this strata are less typically included in rehabilitation seed mixes and are instead, naturally recruited over time.

#### 5.3.2.4 Stem counts

Tree stems in the subcanopy layer (300 stems/ ha) were within the standard error of the mean for reference sites (333 +/- 108 stems/ ha) and greater than that of the 70 % completion criteria values (230 stems/ ha). Shrub stems per hectare for the Rehab 2 site (500 stems/ ha) were higher than the mean for the reference sites (456 stems/ ha). Higher shrub counts are typically expected in the earlier successional stages of rehabilitation.

#### 5.3.2.5 Species richness

Species richness in all strata within in the Rehab 2 site were equal to or higher than that of the mean of the reference sites. The highest species richness (9 species) occurred in the shrub strata.

## 5.4 Progressive Rehabilitation

Exploration disturbance will be progressively rehabilitated, within 12 months of disturbance activities, in accordance with the Code of Environmental Compliance for Exploration and Mineral Development.

Areas of mining disturbance will be progressively rehabilitated as they become available. A rehabilitation schedule has been developed (Appendix A), however rehabilitation will commence sooner if areas are no longer required for operations.

Where opportunistic progressive rehabilitation occurs, it is expected that at least one wet season will be needed to establish vegetation. As such each rehabilitation campaign is to be completed, at the latest, by October of each year to allow for vegetation establishment prior to the wet season and to minimise erosion potential.

## 5.5 Community

### 5.5.1 Community Profile

The Etheridge Shire Council (the Council) is in far north Queensland in the Savannah gulf region. Forsayth is the closest township to Agate Creek, located approximately 40 km to the north. The 2016 Census recorded 129 people in the population, 51.6 % male and 48.4 % female with a median age of 48. The labour force was recorded to be 58 people, 70.7 % working full time. Beef Cattle Farming (specialised) was the largest employment industry at 58.4 % of the working population (ABS, 2016).

Georgetown is the main township of the Etheridge Shire and is located approximately 80 km north of the Project. As of the 2016 Census, the population was 301, with a median age of 36 with 48.7 % male and 51.3 % female. The largest employment industry was Beef Cattle Farming (specialised) followed by Local Government Administration (ABS, 2016).

The Ewamian People are the traditional owners of land the country that occupies the Gulf of Carpentaria savannah lands in the upper Gilbert and Einasleigh River catchments (Ewamian Aboriginal Corporation, 2021). As of the 2016 Census 5.5% of Etheridge shire identifies as Aboriginal and/or Torres Strait Islander (ABS, 2016).

With operations set to expand in 2022, Agate Creek presents an employment opportunity for locals, as well as potentially boosting local economy through increased demand for basic amenities (food supply, fuel supply etc.), and increased traffic through the region by DIDO workers.

### 5.5.2 Community Consultation Plan

A dedicated Community Consultation Plan (CCP) has been prepared for Agate Creek and is provided in Appendix H. The CCP documents the consultation process to be followed to enable ongoing engagement with relevant stakeholders. The community consultation has been prepared in accordance with Section 126C(1)(c)(iv) of the EP Act and includes details of how Laneway will carry out ongoing consultation.

A community consultation register will continue to be updated throughout the life of mine.

Laneway have strong relationships with the local community and landholders. The nominated Post Mining Land Uses, as discussed in Section 6.2, include areas to be used for low intensity grazing, returned to native ecosystems, and areas to be retained for landholder use. Laneway frequently communicate with landholders and have agreements to retain some mining domains, including water storages and tracks, for landholder use post-closure.

The Post Mining Land Uses have been chosen for the range of benefits provided to the local environment and community. Prior to mining, the land within the ML was used for grazing and is intended to be used for grazing post-closure. Returning the land as well as providing the tracks and water storages, will enhance the landholders capacity for grazing therefore boosting the local economy. The land to be returned to native ecosystem will enhance the aesthetic of the region and allow for native habitat and corridors boosting the natural landscape and tourism appeal.

Further detail is provided in Section 6.

### 5.5.3 Sensitive Receptors

Four sensitive receivers have been identified within 45 km of Agate Creek. However, there is only one sensitive receiver within 2 km, the Agate Creek Campground. Sensitive receptors are detailed in Table 17. Sensitive receptors with the ML are shown on Figure 16.

**Table 17. Sensitive Receptors (SEG, 2022)**

| Receptors (Homesteads) | Distance (km) | Bearing (degrees) |
|---|---|---|
| Camping ground | 1.5 | 120 |
| Old campground | 11 | 125 |
| Homestead 01 (Dave Terry station) | 8 | 55 |
| Homestead 02 | 25 | 330 |
| Forsayth | 45 | 7 |

Agate Creek Camp Ground

Rungulla Resources Reserve

Rungulla National Park

400 0 400 800 1,200 1,600 m

1:25,000

Client: Laneway Resources Ltd
Project number: 2021.09001
CRS: GDA2020 EPSG: 7844
Date: 11 July 2022

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# Figure 16. Sensitive Receptors

Legend

Mineral Development Licence
Mining Lease

ESRI Satellite

Sensitive Receptors
WH - END or VUL
RV - Essential Habitat
Rungulla National Park (Cat A ESA)
Rungulla Resources Reserve (Cat C ESA)
Tourist Area

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# 6. Post Mining Land Use

Land must be rehabilitated to a stable condition as defined in section 11A of the EP Act. Land is in a stable condition if:

- the land is safe and structurally stable, and
- there is no environmental harm being caused by anything on or in the land, and
- the land can sustain a Post Mining Land Use (PMLU).

A PMLU is defined under the EP Act as the purpose for which the land will be used after all relevant activities have ceased. The PMLU must be consistent with the outcome of consultation with the community and any strategies for the land of a local government, the State or Commonwealth (Department of Environment and Science, 2021).

## 6.1 Assessment of PMLU Options

As part of the assessment of PMLUs it is acknowledged that the EP Regulation requires that each PMLU:

a) Is viable having regard to the use of land in the surrounding region, and

b) satisfies at least one of the following:

   a. a. the use is consistent with how the land was used before a mining activity was carried out on the land

   b. the use is consistent with a development approval relating to the land –

   c. the use is consistent with a use of the land, other than a use that is mining, permitted under a State or Commonwealth Act, including, for example, a planning instrument under the Planning Act 2016

   d. the use will deliver, or is aimed at delivering, a beneficial environmental outcome.

The most suitable PMLU for each RA is shown in Table 18. The PMLUs were determined by considering the environmental, economic, and social benefits of each PMLU.

**Table 18. Mine Domains and Agreed PMLU Land Classes**

| | Mine Domain | PMLU |
|---|---|---|
| RA1 | Open Cut Pits (Pits 1 – 4) | Native ecosystem |
| RA2 | Open Cut Pits (Pits 5 – 6) | Water storage |
| RA3 | Waste Rock Dumps | Native ecosystem |
| RA4 | Mine Infrastructure Area | Low intensity grazing |
| RA5 | Water Storages | Water storage |
| RA6 | Exploration | Low intensity grazing |

Table 19 describes how these PMLU's meet the requirements of the EP Regulation.

**Table 19. Requirements of a PMLU**

| Requirement of the PMLU | Justification |
|---|---|
| The land is safe and structurally stable, and | Final landforms will be designed and certified by suitably qualified persons. After initial rehabilitation, structures will continue to be monitored by suitably qualified persons to assess stability. Erosion monitoring will be conducted to assess stability.<br>The slopes of the project will be made safe to support cattle grazing. Fencing will be constructed to prevent cattle ingress to WRD areas. Pits 1-4 will be backfilled with waste rock material and returned to native ecosystem.<br>During rehabilitation, areas may be fenced to prevent cattle grazing until vegetation has established and the landform is unlikely to cause erosion and sedimentation. |
| There is no environmental harm being caused by anything on or in the land, and | All contaminants will be removed from domains and encapsulated within the WRDs. A contaminated land assessment will be conducted following rehabilitation activities to verify the removal of contaminants.<br>All infrastructure will be removed from site during the demolition phase of rehabilitation.<br>The site will be revegetated to reduce the possibility of erosion.<br>Ongoing surface and groundwater monitoring will be conducted to assess the potential for environmental harm. |
| The land can sustain a Post Mining Land Use (PMLU). | The proposed PMLUs of low intensity grazing and native ecosystem are consistent with surrounding land uses.<br>Water dams and residual voids (Pits 5 – 6) will remain as water storages, suitable for stock, consistent with the surrounding PMLU. |
| The PMLU is viable having regard to the use of land in the surrounding region, and | The Etheridge Shire is a significant beef producing region. The proposed PMLU of low intensity cattle grazing is consistent with previous and current land uses in the area. |

| Requirement of the PMLU | Justification |
|---|---|
| | The PMLU of native ecosystem for RA1 and RA3 is consistent with the pre-mining land use of the area.<br>Water dams and residual voids (Pits 5 – 6) will remain as water storages, suitable for stock, consistent with the surrounding proposed PMLU. |
| The PMLU satisfies at least one of the following:<br>a. the use is consistent with how the land was used before a mining activity was carried out on the land<br>b. the use is consistent with a development approval relating to the land –<br>c. the use is consistent with a use of the land, other than a use that is mining, permitted under a State or Commonwealth Act, including, for example, a planning instrument under the Planning Act 2016<br>d. the use will deliver, or is aimed at delivering, a beneficial environmental outcome. | The proposed PMLUs of low intensity cattle grazing and native ecosystem are consistent with how the land was used before a mining activity was carried out on the land. |

### 6.1.1 Community Consultation

The proposed PMLUs of native ecosystem and grazing are consistent with the community consultation conducted to date, in that they are:

- Consistent with the land use prior to the commencement of mining activities
- Consistent with the surrounding land use; and
- Compatible with, and beneficial to, the current underlying landholder activities.

A Landholder agreement is in place with Howlong Station to retain Pit 5, Pit 6, and water management structures for water storage, as well as some access tracks. A copy of the agreement is provided in Appendix D.

### 6.1.2 Regional Planning Integration

Under the Etheridge Shire Planning Scheme, Agate Creek is within the Rural Zone. The purpose of the Rural zone is to:

- *provide for rural uses and activities;*
- *provide for other uses and activities that are compatible with—*
    - *existing and future rural uses and activities;*
    - *the character and environmental features of the zone;*
- *maintain the capacity of land for rural uses and activities by protecting and managing significant natural resources and processes* (Etheridge Shire Council,2020).

Etheridge Shire Council's intended purpose for the Rural zone is to also:

- *ensure the productive capacity of agricultural and associated rural industries is maximised and maintained, while protecting biodiversity values and allowing for farm diversification and value adding industries to occur in the rural area;*
- *recognise the importance of agricultural land identified as Class A or B as shown on SPP mapping - Economic Growth, Agricultural land classification – class A and B whilst balancing environmental considerations;*
- *maintain the character and amenity of the rural and natural environment;*
- *include recognised environmental areas such as national parks and reserves, and give protection to the shire's biodiversity;*
- *encourage tourism development where it can value-add to the viability of rural enterprises, does not diminish biodiversity values and avoids impacts of flooding and bushfire;*
- *ensure that the functional connectivity of the stock route network is maintained and any development within or adjacent to stock routes or reserves provides for their continued function;*
- *ensure development protects extractive industry or potential resource sites for future development, and also protects existing rural uses from impacts of proposed extractive industry and associated activities;*
- *allow for the development of renewable energy facilities, whilst protecting agricultural and environmental interests;*
- *protect existing electricity, telecommunications and emergency services infrastructure* (Etheridge Shire Council,2020).

The proposed PMLUs of native ecosystem and grazing are compatible with the planning scheme.

## 6.2 Proposed PMLUs

### 6.2.1 RA1 – Open Cut Pits (Pits 1-4)

#### 6.2.1.1 Overview

This RA includes Open Cut Pits 1 – 4 and is situated on undulated terrain of the Sherwood and Sherwood West resource areas. RA1 will be backfilled with waste rock and vegetated to a PMLU of native ecosystem.

#### 6.2.1.2 Outcome

The proposed post mine land use for the Open Cut Pits post closure is native ecosystem. The landform will be shaped, where required, to match the surrounding landforms and enhance the aesthetic cohesion to the undisturbed environment. The final landform was determined for the environmental, economic, and social benefits.

#### 6.2.1.3 Environmental Benefit

Pits 1-4 are located on the western boundary of the mining lease. Returning this RA to native ecosystem will provide connectivity to the surrounding environment.

#### 6.2.1.4 Economic Benefit

Once established, native ecosystem will require minimal ongoing maintenance to sustain. This will reduce ongoing rehabilitation costs and ensure stability of the landform.

#### 6.2.1.5 Social Benefit

The social benefit of re-establishing native ecosystem is the visually amenity and cohesion to the surrounding environment.

### 6.2.2 RA2 – Open Cut Pits (Pits 5-6)

#### 6.2.2.1 Overview

This RA includes Open Cut Pits 5 and 6 and is situated on undulated terrain of the Sherwood and Sherwood West resource areas. RA2 will be utilised as water storage on closure and will have fencing installed to prevent cattle/human ingress.

#### 6.2.2.2 Outcome

The proposed post mine land use for the Open Cut Pits post closure is to be water storage, which additionally may provide highwall habitat for some native species.

#### 6.2.2.3 Environmental Benefit

The mean annual rainfall for the project is approximately 820 mm with most rainfall occurring during January. Long term outlooks predict rainfall to reduce however with an increased likelihood of more intense events across the year. This seasonal rainfall impacts on water security for the surrounding land use of cattle grazing. Landholders largely rely upon small farmers dams as well as groundwater resources to support grazing activities.

The PMLU of water storage will support the surrounding PMLU and provide a more consistent water source, throughout the year. It will also reduce the amount of groundwater accessed by graziers.

With the completion of the open cut pits, there is a potential for the residual void highwalls to be used as highwall habitat for fauna. Particularly, the highwalls and benches of the pit maybe be utilised by birds, bats and potentially macropods who can scale the pit benches. The following species have the potential to use the open cut pit high walls as habitat:

- *Falco cenchroides* (Nankeen Kestrel);
- *Falco peregrinus* (Peregrine Falcon);
- *Chalinolobus gouldii* (Gould's Wattled Bat);
- *Chalinolobus picatus* (Little Pied Bat);
- *Miniopterus orianae oceanensis* (Bentwing Bat);
- *Ozimops lumsdenae* (Northern Free-tailed Bat);
- *Scotorepens greyii/sanborni* (Northern Broad-nosed Bat);
- *Setirostris eleryi* (Hairy-nosed Free-tailed Bat); and
- *Vespadelus troughtoni* (Eastern Cave Bat).

The most likely species to utilise the high wall are the Peregrine Falcon and Nankeen Kestrel. Both species are known to use cliff faces/ highwalls as habitat and have been recorded in the region (Atlas of Living Australia, 2021). The Bentwing Bat, Northern Free-tailed Bat, Northern Broad-nosed Bat, and Eastern Cave Bat were all identified at the Project during the SLR Consulting (2021) Flora and Fauna Survey.

#### 6.2.2.4 Economic Benefit

Future landowners of the Project area will likely be pastoralists as per the surrounding land uses. Rehabilitating the open cut pits to water storages will provide an alternative water source, leading to a direct economic benefit to the future landholder.

#### 6.2.2.5 Social Benefit

Future landholders will likely be pastoral holdings. Providing a water source suitable for stock would result in a PMLU that is consistent with surrounding land uses.

### 6.2.3 RA3 – Waste Rock Dumps

#### 6.2.3.1 Overview

The proposed activities include four WRDs within the ML. On closure, material from the WRDs will be backfilled into Pits 1- 4. Any residual material will be reshaped on the WRD to form a stable landform which reflects the surrounding landscape. The WRDs will be topsoiled, and the landform will be left for vegetation to naturally re-establish.

#### 6.2.3.2 Outcome

The proposed PMLU for the RA3 is native ecosystem.

#### 6.2.3.3 Geometrical Design

The WRDs design was engineered by ATC Williams (2022a) to be stable and non-polluting during operation and post-closure. The final landform will be shaped where required to match the surrounding landscape chosen to protect and enhance the aesthetic value of the region.

The WRDs are designed as a low-profile structure located in valleys; this design allows for cohesion to the natural environment. The WRDs require access ramps to allow dumping of waste rock and maintenance access to the structure. Access ramps are located from ridges to limit the road lengths and ramp grades (ATC Williams, 2022a).

Any unexpected PAF material will be encapsulated by NAF material. A NAF base is proposed to be constructed to provide a platform upon which any PAF material can be placed to prevent contaminant migration into the receiving environment (ATC Williams, 2022a).

The external batters will be at the angle of repose (37 degrees). Each 10 m high lift will be stepped inward by 10 m to create an overall batter of approximately 2.3H:1V (ATC Williams, 2022a).

##### 6.2.3.3.1 Method of Construction

As designed by the engineers, ATC Williams (2022a), the construction of the WRDs has three sequential phases:

1. Clearing and stripping;
2. Basal liner placement and compaction; and
3. Placement during operations.

It is anticipated that waste rock will be paddock dumped within the dedicated storage areas for dozers to then push the material and form a smooth-running surface. The dump trucks routed across the surface will provide tyre compaction to the waste rock material. This will likely be the only compaction activities of the waste rock, however, if the conditions require, further compaction or moisture management activities will be investigated.

The rehabilitation works will include armouring, capping, and revegetating in a layered sequential manner to limit erosion and infiltration while promoting the growth of targeted vegetation. Surface water management will continue during rehabilitation to convey runoff and minimise the potential for erosion and weathering.

The design, management, as well as the construction and rehabilitation phases enable the ability for the WRDs to remain safe, structurally stable, and non-polluting during the life of the WRDs. The final landforms will be assessed by a suitably qualified person during rehabilitation efforts to assure it is stable and non-polluting.

#### 6.2.3.4 Environmental Benefit

The pre mining land use includes native ecosystem. Establishment of native vegetation (groundcover) on the WRD as the PMLU is reflective of the current pre-mining land use. Shallow rooting native species will aid in stabilising the landform and ensure the integrity of the cover system is not impacted.

Native vegetation will result in an increase in plant biodiversity and in turn, the habitat for native fauna which would subsequently increase the biodiversity of the region. Habitat consists of groundcover species will produce seed and flowers throughout the seasons, which may be utilised by native fauna, therefore helping support local ecosystems

#### 6.2.3.5 Economic Benefit

The WRDs are to be fenced off to prevent cattle ingress, in turn protecting the native groundcover, and to preventing damage to the WRD surface. Once established, native ecosystem will require minimal ongoing maintenance to sustain.

#### 6.2.3.6 Social Benefit

The social benefit of re-establishing native ecosystem is the visually amenity and cohesion to the surrounding environment.

### 6.2.4 RA4 - Mine Infrastructure Areas

#### 6.2.4.1 Outcome

The proposed post mine land use for RA4 is low intensity grazing. The exception to this is Landholder tracks, which will be retained for future use.

#### 6.2.4.2 Landform Design

The preferred PMLU for the rehabilitation areas is to be reflective of the current pre-mining landform characterised by undulating hills, and relatively flat land draining towards Agate Creek.

To achieve the final landform:

- Infrastructure will be decommissioned and removed from the Project;

- Sediment dams and the water storage dam will be desilted, with material removed to the WRDs;
- Domains will be shaped by plant to drain similarly to the pre-mining landform;
- Topsoil will be spread to a thickness of 0.15cm for vegetation establishment.
- Native grasses and groundcover species will self-establish. If monitoring identifies that the vegetation has not sufficiently established, the areas will be seeded.

#### 6.2.4.3 Environmental Benefit

The establishment of low intensity grazing will provide a good coverage of vegetation, which will minimise the chance of erosion due to runoff. The establishment of pasture on the domains will also limit the amount of fuel load, reducing the impact of potential bushfires.

The pasture covered PMLU may also provide a food source for native fauna. The pasture cover will produce seed and flowers throughout the seasons, which may be utilised by native fauna, therefore helping support local ecosystems.

Additionally, other than occasional watering during closure, no further activities would be required to form a stable landform consistent with grazing.

#### 6.2.4.4 Economic Benefit

Establishing grazing pastures will result in a lower cost of direct seeding and a quicker establishment of adequate vegetation cover, potentially leading to an earlier relinquishment of Mine Leases.

Future landowners of the Project area will likely be pastoralists as per the surrounding land uses. Rehabilitating the Mine Infrastructure Areas to low-intensity grazing will provide an additional grazing area, leading to a direct increase in the economic benefit to the future landholder.

Additionally, other than occasional watering during closure, no further activities would be required to form a stable landform consistent with grazing.

#### 6.2.4.5 Social Benefit

Future landholders will likely be pastoral holdings. Returning the land to grazing pastures will be preferential as this would result in a PMLU that is consistent with surrounding land uses.

### 6.2.5 RA 5 - Water Storage

A Landholder agreement is in place with Howlong Station to retain water management structures for water storage. A copy of the agreement is provided in Appendix D. Water quality monitoring throughout operations will determine if treatment or removal of water and sediment is required. The structures will be made safe and non-polluting for being given to the landholder.

#### 6.2.5.1 Outcome

The proposed PMLU for the RA5 is water storage.

#### 6.2.5.2 Environmental Benefits

Similar to RA2, the PMLU of water storage will support the surrounding PMLU and provide a more consistent water source, throughout the year. It will also reduce the amount of groundwater accessed for grazing activities.

#### 6.2.5.3 Economic Benefits

Future landowners of the Project area will likely be pastoralists as per the surrounding land uses. Provide an additional water source, will lead to a direct economic benefit to the future landholder.

#### 6.2.5.4 Social Benefit

Future landholders will likely be pastoral holdings. Providing a water source suitable for stock would result in a PMLU that is consistent with surrounding land uses.

### 6.2.6 RA6 – Exploration

Exploration disturbance is rehabilitated, within 12 months of disturbance activities, in accordance with the Code of Environmental Compliance for Exploration and Mineral Development.

#### 6.2.6.1 Outcome

The proposed post mine land use for RA5 is low intensity grazing.

#### 6.2.6.2 Environmental Benefit

The establishment of low intensity grazing will provide a good coverage of vegetation, which will minimise the chance of erosion as a result of runoff. The establishment of pasture on the domains will also limit the amount of fuel load, reducing the impact of potential bushfires.

The pasture covered PMLU may also provide a food source for native fauna. The pasture cover will produce seed and flowers throughout the seasons, which may be utilised by native fauna, therefore helping support local ecosystems

Additionally, other than occasional watering during closure, no further activities would be required to form a stable landform consistent with grazing.

#### 6.2.6.3 Economic Benefit

Establishing grazing pastures will result in a lower cost of direct seeding and a quicker establishment of adequate vegetation cover, potentially leading to an earlier relinquishment of Mine Leases.

Future landowners of the Project area will likely be pastoralists as per the surrounding land uses. Rehabilitating the exploration areas to low-intensity grazing will provide an additional grazing area, leading to a direct increase in the economic benefit to the future landholder.

Additionally, other than occasional watering during closure, no further activities would be required to form a stable landform consistent with grazing.

#### 6.2.6.4 Social Benefit

Future landholders will likely be pastoral holdings. Returning the land to grazing pastures will be preferential as this would result in a PMLU that is consistent with surrounding land uses.

## 6.3 PMLU Completion criteria

Completion criteria is used to determine if the PMLU has been achieved and shows if the mining domain has been rehabilitated to a point that the Final Landform PMLU has been achieved at surrender.

The Rehabilitation Milestones (RM) are outlined below.

**Table 23. PMLU completion criteria**

| Rehabilitation milestone | | Milestone criteria | Justification of completion criteria | Verification of milestone achievement |
|---|---|---|---|---|
| RM1 | Infrastructure decommissioning and removal | • All buildings and associated infrastructure dismantled and removed offsite<br>• All hardstand and concrete areas decommissioned removed<br>• Pipelines removed<br>• Waste removed<br>• Drillholes, sediment ponds and sumps decommissioned<br>• Machinery/ equipment not required for rehabilitation removed from site | Infrastructure is required to be removed from site to enable surface treatment of areas. | Documented inspection following infrastructure decommissioning and removal. |
| RM2 | Remediation of contaminated land/sediment | • Contaminated land assessment is completed by a suitably qualified person<br>• Identified contaminated material removed<br>• Validation sampling determine that contaminant removal has been successful | • Contaminated material is required to be removed to minimise potential for environmental harm.<br>• A validation report will provide verification that contaminants have been removed and landform shaping can commence. | Validation sampling report accepted by a suitably qualified Contaminated Land Auditor. |
| RM3 | Landform development and reshaping / re-profiling (RA1) | • Pits backfilled with waste rock and suitably compacted<br>• RA1 determined to be geotechnically stable by a suitably qualified geotechnical engineer | Landform is made safe to wildlife and humans | Inspection and report by a suitably qualified geotechnical engineer.<br>QAQC report detailing that works were completed in accordance with design plans. |
| RM4 | Landform | • RA2 determined to be geotechnically stable by a suitably | The final landform must be | Inspection and report by a suitably |

| Rehabilitation milestone | | Milestone criteria | Justification of completion criteria | Verification of milestone achievement |
|---|---|---|---|---|
| | development and reshaping / re-profiling (RA2) | qualified geotechnical engineer<br>• Safety bunding in constructed<br>• Fencing and signage is erected | made stable and safe to humans and wildlife. | qualified geotechnical engineer. |
| RM5 | Landform development and reshaping / re-profiling (RA3) | • Landform is shaped as per design<br>• RA3 determined to be geotechnically stable by a suitably qualified geotechnical engineer | The final landform must be consistent with the surrounding land and profiled to limit erosion. | Inspection and report by a suitably qualified geotechnical engineer.<br>QAQC report detailing that works were completed in accordance with design plans. |
| RM6 | Landform development and reshaping / re-profiling (RA4) | • Landform is shaped to be gently sloping, characteristic of the natural landform<br>• Landform ripped parallel to landform<br>• RA4 determined to be geotechnically stable by a suitably qualified geotechnical engineer | The final landform must be consistent with the surrounding land and profiled to limit erosion. | QAQC report detailing that works were completed in accordance with design plans. |
| RM7 | Landform development and reshaping / re-profiling (RA5) | • HPDE Liner removed<br>• RA5 determined to be geotechnically stable by a suitably qualified geotechnical engineer. | The final landform must be made stable and safe to humans and wildlife. | QAQC report detailing that works were completed in accordance with design plans. |
| RM8 | Surface preparation | • Compacted soil ripped to at least 300mm<br>• Topsoil placement of a minimum 15cm, where required | • Ripping and application of growth media will encourage establishment of vegetation. | QAQC report detailing that works were completed in accordance with design plans. |

| Rehabilitation milestone | | Milestone criteria | Justification of completion criteria | Verification of milestone achievement |
|---|---|---|---|---|
| RM9 | Revegetation (native ecosystem) | • Natural revegetation strikes creates a groundcover >30% of analogue sites<br>• Seeding rate of 4 – 10 kg/ha achieved where native species does not achieve >30% of analogue sites.<br>• Where natural vegetation strike is not achieved to >30% of analogue sites, direct seeding of native species achieves >30% of analogue sites. | • Monitoring will assess success of natural revegetation and determine if intervention measures are required eg. further application of seed is required.<br>• Vegetation species have been selected based on PMLU of grazing. | Report summarising regular rehabilitation monitoring, utilising techniques such as the BioCondition Assessment Manual (or similar). The report will include data over a suitable period, considering seasonality. |
| RM10 | Revegetation (grazing) | • Natural revegetation strikes creates a groundcover >30% of analogue sites<br>• Seeding rate of 4 – 10 kg/ha achieved (if natural revegetation unsuccessful)<br>• Pasture vegetation seeding creates cover >30% of analogue sites of analogue sites. | • Monitoring will assess success of natural revegetation and determine if intervention measures are required eg. further application of seed is required.<br>• Vegetation species have been selected based on pre mine Regional Ecosystems. | Report summarising regular rehabilitation monitoring, utilising techniques such as the BioCondition Assessment Manual (or similar). The report will include data over a suitable period, considering seasonality. |
| RM11 | Achievement of surface requirements (native ecosystem) | • Weed species in densities less than 10% total coverage<br>• Vegetation is comparable to established reference sites.<br>• Average erosion rate of <5 t/ha/y with the maximum erosion | • Excessive rilling is unlikely to occur at erosion rates of | • Report summarising regular rehabilitation monitoring, utilising techniques such as the |

| Rehabilitation milestone | | Milestone criteria | Justification of completion criteria | Verification of milestone achievement |
|---|---|---|---|---|
| | | rate at any point on the landform of <10 t/ha/y.<br>• Surface water quality measured at REMP sites complies with ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality<br>• Stream sediment at REMP sites complies with ANZECC/ARMCANZ (2000) Interim Sediment Quality Guidelines – low<br>• Groundwater monitoring complies with ANZECC/ARMCANZ (2000) Table 4.3.2 for livestock drinking water | <5t/ha/y.<br>• Livestock drinking water values have been selected based on surrounding land use of grazing<br>• Monitoring sites have been selected to capture all areas of disturbance<br>• RA will be compared to reference sites to account for seasonal fluctuations. | BioCondition Assessment Manual (or similar). The report will include data over a suitable period, considering seasonality.<br>• Report summarising water and sediment quality monitoring. The report will include data over a suitable period, considering seasonality. |
| RM12 | Achievement of surface requirements (grazing) | • Weed species in densities less than 10% total coverage<br>• Vegetation is comparable to established reference sites.<br>• Average erosion rate of <5 t/ha/y with the maximum erosion rate at any point on the landform of <10 t/ha/y.<br>• Surface water quality measured at REMP sites complies with ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality<br>• Stream sediment at REMP sites complies with ANZECC/ARMCANZ (2000) Interim Sediment Quality Guidelines – low<br>• Groundwater monitoring complies with | • Site specific vegetation completion criteria will be determined based on reference site monitoring.<br>• Excessive rilling is unlikely to occur at erosion rates of <5t/ha/y.<br>• Livestock drinking water values have been selected based on | • Report summarising regular rehabilitation monitoring, utilising techniques such as the BioCondition Assessment Manual (or similar). The report will include data over a suitable period, considering seasonality.<br>• Report summarises water and sediment quality monitoring. The report will include data over a suitable period, considering seasonality. |

| Rehabilitation milestone | | Milestone criteria | Justification of completion criteria | Verification of milestone achievement |
|---|---|---|---|---|
| | | ANZECC/ARMCANZ (2000) for livestock drinking water | surrounding land use of grazing<br>• Monitoring sites have been selected to capture all areas of disturbance<br>• RA will be compared to reference sites to account for seasonal | |
| RM13 | Achievement of post-mining land use to a stable condition (native ecosystem) | • Vegetation is comparable to established reference sites.<br>• Native fauna observed or indicators of these species have been recorded.<br>• Certification from an REPQ that the domain has achieved stable condition<br>• Certification from an AQP that the landform achieved a factor of safety 1.5.<br>• Surface water quality measured at REMP sites complies with ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality<br>• Stream sediment at REMP sites complies with ANZECC/ARMCANZ (2000) Interim Sediment Quality Guidelines – low<br>• Groundwater monitoring complies with ANZECC/ARMCANZ (2000) for livestock drinking water | • Site specific vegetation completion criteria will be determined based on reference site monitoring.<br>• Excessive rilling is unlikely to occur at erosion rates of <5t/ha/y.<br>• Livestock drinking water values have been selected based on surrounding land use of grazing<br>• Monitoring sites have been selected to capture all areas of | • Report summarising regular rehabilitation monitoring, utilising techniques such as the BioCondition Assessment Manual (or similar). The report will include data over a suitable period, considering seasonality.<br>• Report summarises water and sediment quality monitoring. The report will include data over a suitable period, considering seasonality.<br>• Inspection and report by a suitably qualified geotechnical engineer. |

| Rehabilitation milestone | | Milestone criteria | Justification of completion criteria | Verification of milestone achievement |
|---|---|---|---|---|
| | | | disturbance<br>• RA will be compared to reference sites to account for seasonal | |
| RM14 | Achievement of PMLU to a stable condition (grazing) | • RA has maintained a stable, safe condition.<br>• Vegetation is comparable to established reference sites.<br>• Surface water quality measured at REMP sites complies with ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality<br>• Stream sediment at REMP sites complies with ANZECC/ARMCANZ (2000) Interim Sediment Quality Guidelines – low<br>• Groundwater monitoring complies with ANZECC/ARMCANZ (2000) for livestock drinking water | • Site specific vegetation completion criteria will be determined based on reference site monitoring.<br>• Excessive rilling is unlikely to occur at erosion rates of <5t/ha/y.<br>• Certification from a AQP is required for relinquishment.<br>• Livestock drinking water values have been selected based on surrounding land use of grazing<br>• Monitoring sites have been selected to capture all areas of disturbance<br>• RA will be compared to | • Report summarising regular rehabilitation monitoring, utilising techniques such as the BioCondition Assessment Manual (or similar). The report will include data over a suitable period, considering seasonality.<br>• Report summarises water and sediment quality monitoring. The report will include data over a suitable period, considering seasonality.<br>• Inspection and report by a suitably qualified person to verify that the area has maintained a stable condition. |

| Rehabilitation milestone | | Milestone criteria | Justification of completion criteria | Verification of milestone achievement |
|---|---|---|---|---|
| | | | reference sites to account for seasonal | |
| RM15 | Achievement of PMLU to a stable condition (water storage) | • RA has maintained a stable, safe condition.<br>• Pit water quality sampling complies with ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality | • Certification from a AQP is required for relinquishment.<br>• Livestock drinking water values have been selected based on surrounding land use of grazing | • Report summarising water quality monitoring. The report will include data over a suitable period, considering seasonality.<br>• Inspection and report by a suitably qualified person to verify that the area has maintained a stable condition. |

# 7. Non-use management areas

There are no proposed non-use management areas.

# 8. Voids in Floodplains

The six Agate Creek Pits are situated on undulating terrain in the centre areas of ML 10003. To assess whether the voids will be impacted by flooding, ATC Williams (2022b) conducted a hydraulic assessment using TUFLOW, a two-dimensional finite difference program. The results of the assessment are summarised below and provided in full in Appendix E.

## 8.1 Flood Depths

Flooding of Agate Creek overtops the creek's banks and generally follows the watercourse alignment. The 0.1% event maximum flood depths vary from shallow depths on the outer banks to approximately 6-8 m in deeper areas of the creek. Flow predominately runs along the eastern extents of the proposed mine development area and flows to the northwest. Pit 5 within the southern portion of the mine development area was found to have the least freeboard to the estimated flood levels at approximately 6 m. All remaining pit voids were well clear of the of the floodplain (ATC Williams, 2022b).

## 8.2 Flow velocity

Agate Creek stream is modelled to experience high magnitude event velocities due to the relatively narrow channel and high peak flows. For the 0.1 % AEP event, velocity over the inundated Agate Creek floodplain varies between 0.5 - 5 m/s. Flow velocities from gullies were of less magnitude at only 0.5 m/s to 1.5 m/s (ATC Williams, 2022b).

## 8.3 Flooding of Voids

Modelling indicates that floodwaters from Agate Creek during events will not intrude on voids, with the majority of floodwaters being confined to the Agate Creek floodplain. Model results are displayed in Figure 17 to Figure 19.

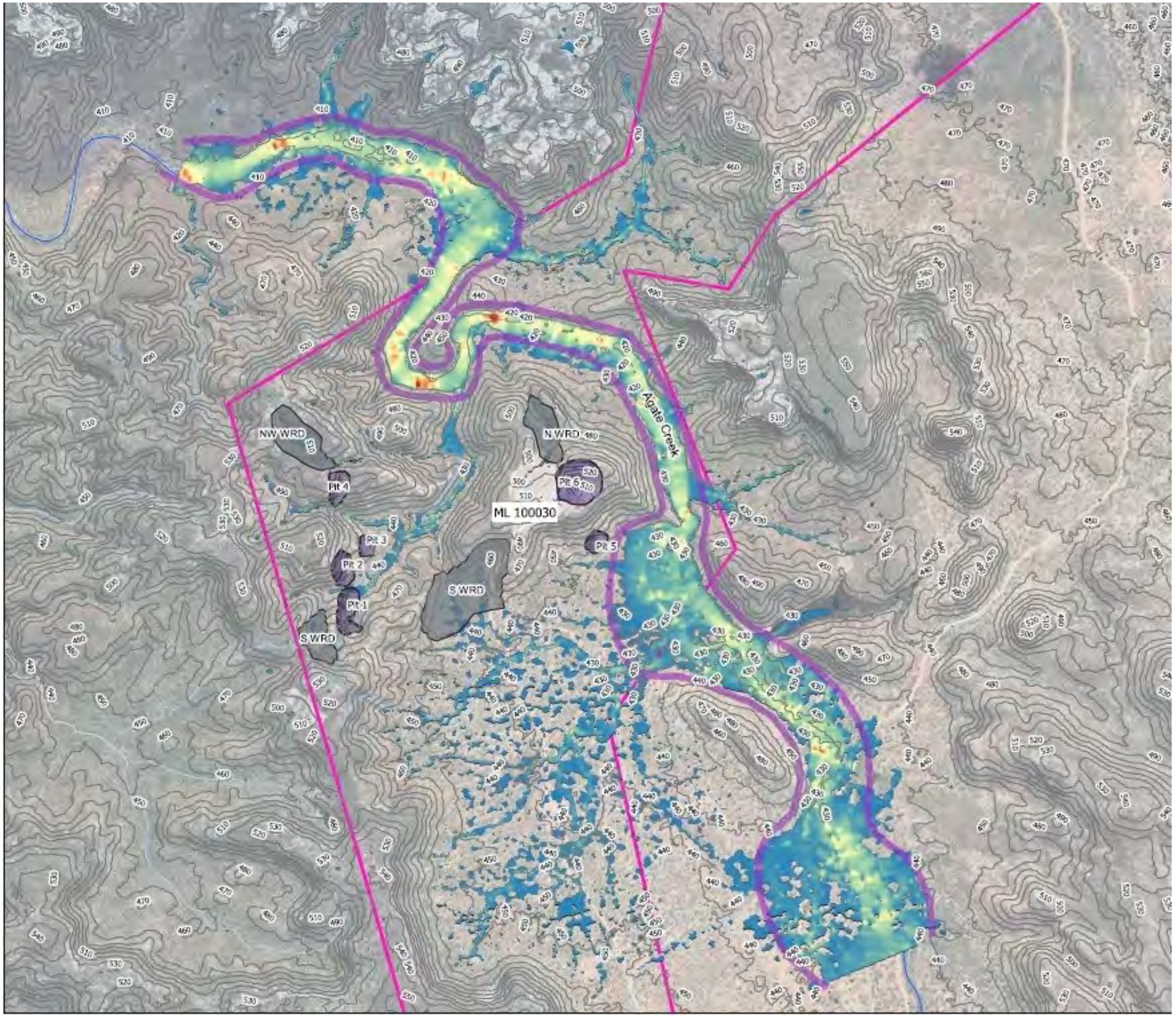
# Figure 17. 0.1% AEP Maximum Velocity

LEGEND

- MINE LEASE
- EXISTING SITE CONTOURS 10m
- ASSUMED FLOODPLAIN EXTENTS

MAXIMUM VELOCITY (m/s)

- 0.0
- 1.0
- 2.0
- 3.0
- 4.0
- 5.0
- 6.0




Client: Laneway Reources Ltd
Project number: 2021.08003
Coordinate Reference System: GDA 2020 Z54
Date: 1 June 2022

Print as A3

Source: ATC Williams
Issued for Reporting

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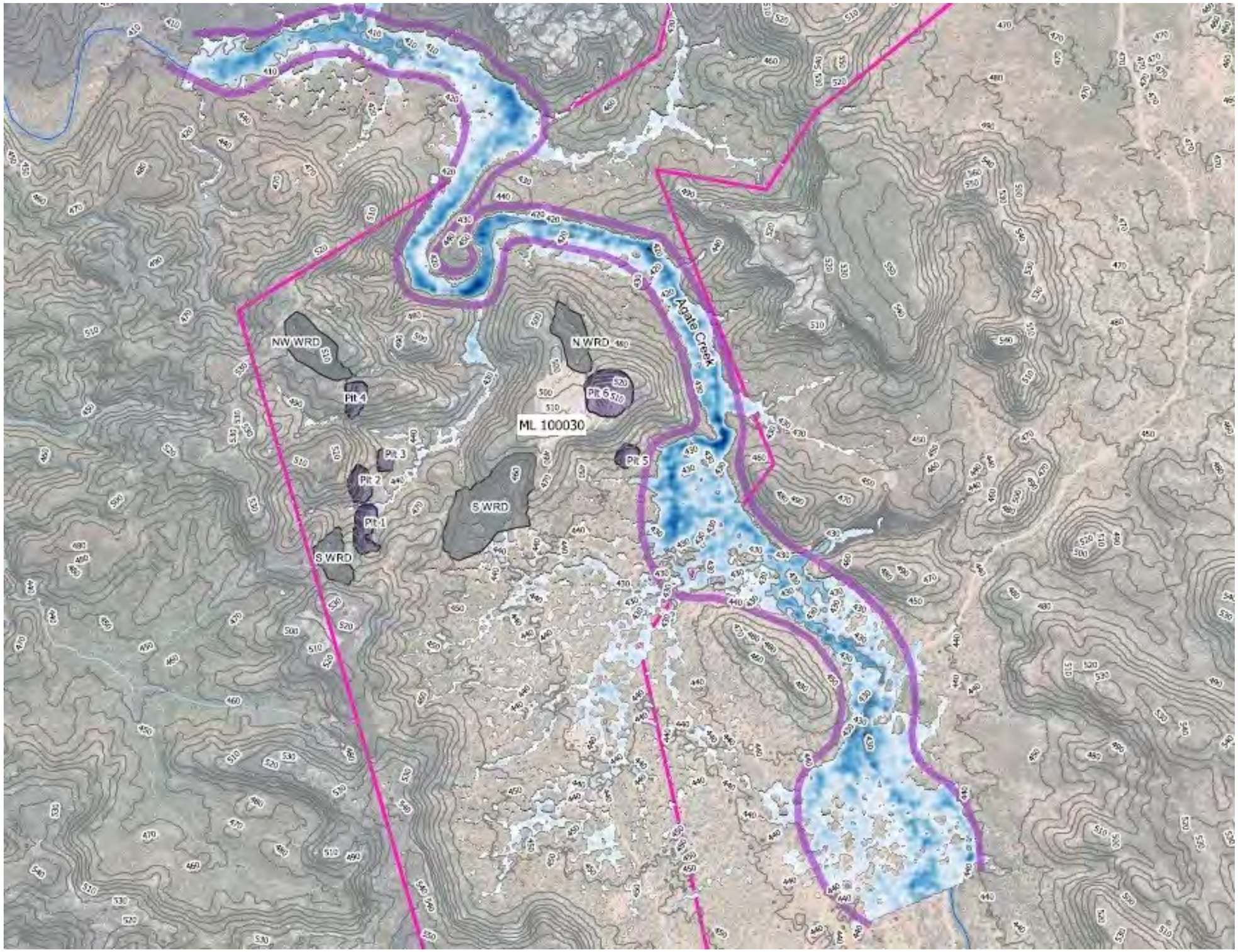
# Figure 18. 0.1% AEP Maximum Water Depth

LEGEND

- MINE LEASE
- EXISTING SITE CONTOURS 10m
- ASSUMED FLOODPLAIN EXTENTS

MAXIMUM WATER DEPTH (m)

- < = 0.1
- 0.1 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8




Client: Laneway Reources Ltd
Project number: 2021.08003
Coordinate Reference System: GDA 2020 Z54
Date: 1 June 2022

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Source: ATC Williams
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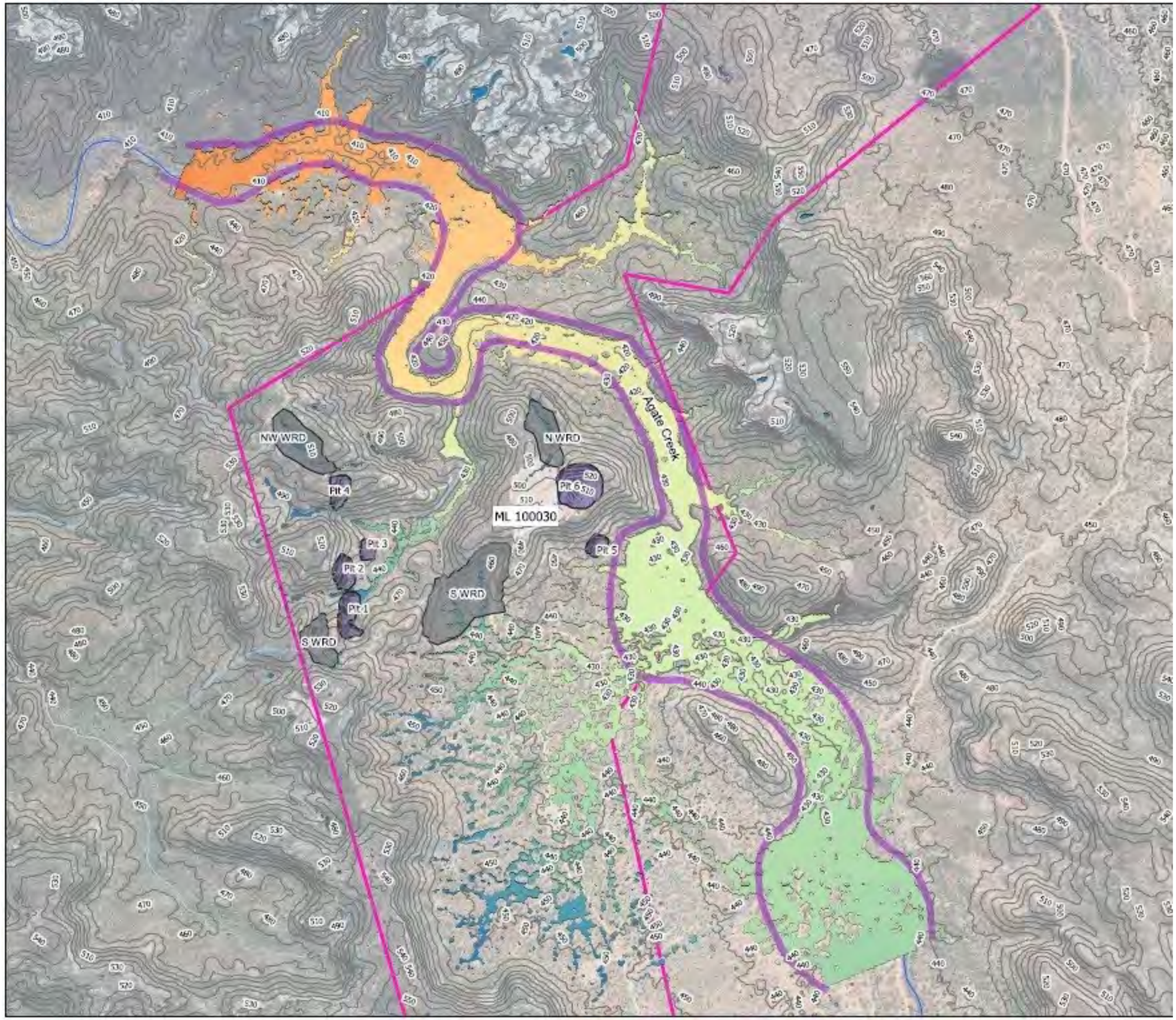
**Figure 19. 0.1% AEP Maximum Water Elevation**

LEGEND

- MINE LEASE
- EXISTING SITE CONTOURS 10m
- ASSUMED FLOODPLAIN EXTENTS

MAXIMUM WATER ELEVATION (RL m)

- 400
- 410
- 420
- 430
- 440
- 450




Client: Laneway Reources Ltd
Project number: 2021.08003
Coordinate Reference System: GDA 2020 Z54
Date: 1 June 2022

Print as A3

Source: ATC Williams
Issued for Reporting

WULGURU TECHNICAL SERVICES

# 9. Rehabilitation and Management Methodologies

## 9.1 General rehabilitation principles

### 9.1.1 Site Services

To ensure site safety, all services will be terminated, disconnected and isolated. Generators will be decommissioned and removed from site. Licenced contractors will remove sewage to a licensed offsite facility. Telecommunication services will be disconnected and removed. The infrastructure at the Project site will be decommissioned, removed, dismantled, or salvaged. Landholder roads be left in a serviceable condition.

### 9.1.2 Contaminated Land Assessment

A contaminated land assessment is to be completed by a suitably qualified person, at all rehabilitation areas. Any contaminated material will be disposed of within the WRDs, or offsite. Validation sampling will be completed to determine if the contaminant removal has been completed appropriately.

### 9.1.3 Site Preparation

Once all infrastructure and any contaminated material has been removed from site, the surface will be prepared to promote establishment of vegetation. Compacted surfaces will be deeply ripped to at least 300mm.

### 9.1.4 Soil Capping and Material Assessment

Topsoil will be required to supplement the growth of vegetation, reducing erosion, and helping to sustain the PMLU. Waste rock will be utilised to backfill Pits 1-4.

A preliminary materials balance is provided in Table 20.

**Table 20. Material balance**

| RA | Area (ha) | Volume of topsoil required ($m^3$) | Volume of NAF required ($m^3$) |
|---|---|---|---|
| RA1 | 3.83 | 5,740 | 87,000 |
| RA2 | 3.44 | 0 | 0 |
| RA3 | 25.88 | 38,820 | 0 |
| RA4 | 13.93 | 20,900 | 0 |
| RA5 | 6.49 | 0 | 0 |
| RA6 | 3.34 | 5,010 | 0 |
| Total | 60.11 | 70,470 | 87,000 |
| Available | | 1,076,210* | 2,729,000 |

*Includes available topsoil across whole of ML100030 which may be utilised via borrow pits for use in rehabilitation

### 9.1.5 Topsoil Striping

Where available, topsoil was stripped during the construction phase of the project. Prior to new ground disturbance, topsoil will be stripped and stockpiled within the RA3 domain. Stockpiles are to be surveyed annually, and the total volume recorded in the Topsoil Stockpile Register.

**Table 21.Stockpiles Topsoil Volumes**

| Soil Type | Description | Estimated Volume($m^3$)* |
|---|---|---|
| Brown Mellic Kandosol | Brown loamy A1 horizon with coarse sand. Light brown loamy B1 horizon with coarse sand | 15,213 |
| Red Massive Gypsic Vertosol | Redish brown clay loam A1 horizon. Light redish brown clay B horizon with gypseous nodules | 975 |
| Brown Bleached Kandosol | Brown loamy sand A1 horizon. Light brown sandy loam B horizon with no segregations | 351 |
| Brown Lithsolic Rudosol | Unsuitable topsoil due to shallow A1 horizon and rock content | 0 |
| **Total** | | **16,539** |

*Only includes volumes of topsoil to be stripped during construction. Additional topsoil is available outside current mining domains and may be accessed in future via borrow pits

### 9.1.6 Topsoil Stockpiling

Once stripped, topsoil is stored at a maximum height of 2m, and only in locations that have been previously designated by site plans. A register of topsoil stockpiles is kept and maintained on-site, recording stockpile number, placement date, source location, soil type, and any relevant comments. Stockpiles are designed and located to minimise topsoil loss through runoff and erosion and are marked and identifiable with signage. Active stockpiles are inspected as part of ongoing environmental inspections.

### 9.1.7 Topsoil Application

Topsoil will be spread at depths of approximately 0.15m. There is a limited volume of high-quality topsoil at Agate Creek within mining domain areas. If required, additional topsoil may be accessed via borrow pits within ML 100030. Topsoil application will be prioritised to areas which pose more of a risk of erosion (bare and/or compacted areas) such as the WRDs and infrastructure areas.

Where land is adequately prepared for rehabilitation, the application of topsoil will occur in essentially the reverse sequence to topsoil stripping. The process for the application of topsoil to surfaces is as follows:

- Infrastructure will be removed.

- A contaminated land assessment will be undertaken and any contaminated material will be removed.
- The landform will be shaped to the final landform design
- Landform will then be ripped. Ripping will occur via dozer with ripper attachment parallel to surface contours.
- Topsoil will be applied and ripped to promote vegetation strike.
- After application, the topsoil will be stabilised with a sterile cover crop, pasture grasses and/or native species to establish revegetation cover as early as possible.
- Appropriate erosion and sediment control measures will be installed.

### 9.1.8 Erosion and Sediment Control

Permanent erosion and sediment controls have been incorporated into the operational Project design, based on catchment characterisation. Additional erosion and sediment control measures will be implemented at rehabilitated sites, as required. Rehabilitation monitoring will identify merging erosion risk during operations and rehabilitation.

An allowance has been made to retain four additional sediment controls post mine closure, with some minor earthworks required to ensure these controls are safe and effective. The site runoff dam is the primary sediment control on the Project. Site affected water will continue to be directed to this structure.

Revegetation will minimise erosion and act as a sediment control, and ensure landforms are both geochemically and geo-physically stable.

Erosion and sediment control plans should be considered when conducting rehabilitation activities, and should include the following:

- Contours and drainage lines;
- Disturbance limits;
- Earthwork extents;
- Control measure locations;
- Order of work schedule;
- Construction details and notes; and
- Specific operating procedures.

### 9.1.9 Revegetation

Surfaces will be ripped to a depth of 300mm, where practical, and allowed to revegetate naturally. If annual monitoring identifies that natural revegetation has not been successful (natural vegetation

strike <30% surface coverage compared to reference site), areas will be seeded with appropriate plant species. Plant species have been selected considering the pre-clearance regional ecosystem. Shallow rooting species have been selected for the WRDs to maintain the integrity of WRD cover system. The proposed target species are provided in Table 22.

**Table 22. Vegetation seed mix**

| RA2 | | RA1 | RA3, RA4, RA5 |
|---|---|---|---|
| Target Regional Ecosystem | | 9.12.11<br>2.11.1a | 9.5.10a/9.12.11 |
| Dominant species | N/A | Eucalyptus crebra | Eucalyptus microneura |
| | | Eucalyptus whitei | Eucalyptus crebra |
| | | Corymbia erythrophloia | Eucalyptus leptophleba |
| | | Corymbia dallachiana | Eucalyptus whitei |
| | | Denhamia cunninghamii | Corymbia pocillum |
| | | Gardenia vilhelmii | Corymbia erythrophloia |
| | | Grevillea glauca | Corymbia dallachiana |
| | | Heteropogon contortus | Denhamia cunninghamii |
| | | Aristida spp | Petalostigma banksii |
| | | | Gardenia vilhelmii |
| | | | Grevillea glauca |
| | | | Heteropogon contortus |
| | | | Aristida spp |
| | | | Themeda triandra |

### 9.1.10 Weed Management

Weed hygiene practices will be implemented at all stages of closure. All mobile plant, machinery, heavy vehicles and earthmoving equipment will be inspected upon entry to site. If weeds or seeds are identified, vehicles and equipment will be cleaned in the site wash bay. Weed density will be monitored as part of rehabilitation monitoring, and appropriate treatment controls will be implemented as required.

### 9.1.11 Water Management

The operational water management strategy for the Project is to separate clean stormwater from potentially affected site water. The water management structures are described in Table 23. Structures such as runoff dams and sediment dams will be retained onsite whilst rehabilitation works are occurring. Controlled releases of water will occur when required and when water quality meets the release criteria stipulated in the EA.

**Table 23 Water Management Structures (ATC Williams, 2022)**

| Domain | Management Structure |
|---|---|
| Bunding | Will separate mine affected water and runoff from clean surface water. Mine impacted water will be directed into the water storages across the Project for reuse on site. |
| Water storage dam | The Dam will contain site impacted runoff from the Open Cut Pits and dirty water from the sediment ponds. The operating objective for this storage is to maintain sufficient capacity to contain site water and limit overflow, as well as to provide make-up water for site water demands, namely dust suppression. |
| Pits | It is proposed that water contained within the Open Cut Pits is pumped to the Dam over the operational period of the project (when required for mining operations). |
| Sediment ponds | Seven (7) sediment ponds are proposed to be operational on site, to capture and treat sediment-laden runoff from the WRDs. The objective with respect to water contacting these surfaces is to capture sediment within the sediment ponds, with the potential to release this water directly off-site, subject to water quality testing. |
| Evaporation | Water stored in water management structures will readily evaporate at an average rate of 6.95mm/m2/day. Additional evaporation will be achieved by the implementation of forced evaporation (accelerated evaporation systems or similar) |

#### 9.1.11.1 Potential Contaminant Sources

The potential contaminant sources at Agate Creek are the extracted waste rock and ore from the open cut pits. Other potential contaminant sources include roads and tracks, fuel storage, administration areas, and workshops.

Potential contaminants have been determined from the results of WRD characterisation and the proposed design of the Project (Table 24).

**Table 24. Possible Contaminant Sources (ATC Williams, 2022)**

| Possible Contaminate Source | Likely Contaminant |
|---|---|
| Water Storages | pH, EC, metals, sulphate |

| | |
|---|---|
| ROM Pad | Suspended solids, metals, sulphate |
| Waste Rock Dump | Suspended solids, metals, sulphate |
| Open Cut Pit | Arsenic, metals, sulphate |
| Administration offices and workshops | Hydrocarbons and chemicals |

#### 9.1.11.2 Contaminant Transport and Fate

Any potential contaminants in site affected water will be directed to either the water storage dam, open cut pits and sediment ponds. These storages have been assessed to have spill probabilities of <1% (water storage dam and open cut pits) and <20% (sediment ponds) during operations (ATC Williams, 2022). Any uncontrolled release of water will likely occur during a significant wet weather event, where the assimilation capacity of the receiving environment (Agate Creek) is high.

Surface and groundwater monitoring will continue during operations to identify any migration of contaminants outside of the proposed water management structures. Additionally, the REMP will be utilised to investigate any potential impact in the receiving environment.

#### 9.1.11.3 Receiving Environment

Agate Creek is located within the Gilbert Basin (917) and the Gilbert River Sub-Basin (9170). There are ephemeral watercourses (unnamed 1st and 2nd order creeks) that flow across the Project. Most surface water eventually flows into Agate Ck, a 4th order stream that flows approximately south-east to north-west though the central part of the ML. Agate Ck is a tributary of the Robertson River which flows into the Gilbert River which connects to the Gulf of Carpentaria.

Groundwater flows loosely follows the topography, with groundwater moving from areas of high elevation towards Agate Creek (C&R Consulting, 2022). The three bores located in proximity to Agate Creek reflect the areas of lowest groundwater elevations. Elevation differences between the bed of Agate Creek and CCWB521 supports the understanding that the groundwater system does not impact or interact with flow in Agate Creek (C&R Consulting, 2022).

#### 9.1.11.4 Expected Water Quality

The current EA does not stipulate specific Water Quality Objectives (WQO) or contaminant trigger values for the Agate Creek. ATC Williams (2022) Water Management Plan details WQOs derived from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality Guidelines for Slightly to Moderately Disturbed systems. However, these WQO are lower than measured background water quality for Agate Creek. Therefore, the WQO adopted for the Project are the ANZECC Guidelines (2000) for Livestock Drinking Water Quality. These WQO are also referred to in the Receiving Environment Monitoring Program of which monitoring has commenced in preparation of the Agate Creek expansion. The proposed water quality and contaminant limits for the project site are outlined in Table 25.

**Table 25. Receiving Environment Trigger and Contaminant Limits**

| Analyte | Unit | WQO | WQO (Dissolved) |
|---|---|---|---|
| pH (field) | pH Unit | 6.0-7.5 | - |
| Total Dissolved Solids @180°C | mg/L | 4000 | - |
| Dissolved Oxygen saturation | % | 90-120 | - |
| Calcium | mg/L | 1000 | - |
| Sulfate | mg/L | 1000 | - |
| Aluminium | mg/L | 5 | 5 |
| Arsenic | mg/L | 0.5 | 0.5 |
| Boron | mg/L | 5 | 5 |
| Cadmium | mg/L | 0.01 | 0.01 |
| Chromium | mg/L | 1 | 1 |
| Cobalt | mg/L | 1 | 1 |
| Copper | mg/L | 1 | 1 |
| Lead | mg/L | 0.1 | 0.1 |
| Mercury | mg/L | 0.002 | 0.002 |
| Molybdenum | mg/L | 0.15 | 0.15 |
| Nickel | mg/L | 1 | 1 |
| Selenium | mg/L | 0.02 | 0.02 |
| Zinc | mg/L | 20 | 20 |

#### 9.1.11.5 Infiltration and Seepage Intervention and Collection Controls

##### 9.1.11.5.1 During Operation and Progressive Rehabilitation Works

During operations, disturbance areas will be minimised and water management and contaminant controls will be implemented to optimise the potential for successful rehabilitation.

Seven sediment ponds are proposed downstream of the proposed WRDs to contain sediment laden runoff and any other site water contaminants. Water collected within the sediment ponds will be pumped into the Water Storage Dam. Sediment will settle in the ponds and be routinely excavated and removed, as part of pre-wet maintenance works.

The Water Storage Dam, proposed to be located southwest of the southern WRD, has been designed to contain water for site demands, including dust suppression, and will receive pumped transfers of water from the Pits and sediment ponds.

Bunding will also be implemented across the site to convey water flows and isolate site water.

#### 9.1.11.5.2 Post-Closure and Long-Term Management Requirements

With the exception of the Pits and water storages agreed to be retained for landholder use, little water management infrastructure will be retained following closure. The final landforms of the domains are to be free-draining and non-polluting achieved through sufficient capping, reshaping to low gradient structures, and revegetation. Some bunding will be retained across the site in order to convey or divert surface water movement and prevent any potential sediment laden runoff.

Closure objectives for Agate Creek stipulate final landforms are to be geochemically stable and will not generate seepage or leach to surface water or groundwater. Contaminated land validation sampling will verify that contaminated material has been removed or if additional work is required to prevent the release of contaminants to waters.

Water quality monitoring will continue to be measured at REMP sites and groundwater bores to assess the success of rehabilitation works. The relevant rehabilitation milestones area that both surface and groundwater quality complies with the ANZECC/ARMCANZ (2000) guideline for Livestock Drinking Water Quality.

### 9.1.11.6 Dewatering

Dewatering of the Pits and Sediment Ponds will be necessary during operation; pumps will be implemented for water transfers to the Water Storage Dam.

Dewatering of Pits 1-4 may be required prior to backfilling activities during progressive rehabilitation. If required, the water will be transferred to the Water Storage Dam.

Other water storages and Pits 5 and 6 are to be retained post closure for landholder water storage, as such, dewatering is unlikely to be necessary. Other water treatment or desilting may be required, this will be determined by water quality monitoring during operations.

All other domains will be reshaped to be free-draining and non-polluting, as such, no dewatering post-closure will be necessary.

### 9.1.11.7 Ongoing water management and reduction

Groundwater and pit water quality will be assessed throughout the life of the operations to quantify any potential emerging risk. Annual inspections will be completed for any regulated structure and the appropriate DSA will be met prior to the commencement of the wet season.

The long term water management of the residual voids is discussed below in Section 729.2.

### 9.1.11.8 Flooding

The result of flood modelling is included in Section 8. Flood modelling indicates that the mining operations and infrastructure are located above Agate Creek 0.1% AEP event levels. The risk of flooding is not expected to impact upon the success of rehabilitation activities.

### 9.1.12 Subsidence Management

There are no underground workings proposed at Agate Creek. Subsidence management is not required.

### 9.1.13 Waste characterisation

C&R Consulting (2022) conducted a geochemical waste rock characterisation (WRC) study. The initial results suggest that waste rock is predominantly benign lithology of mostly felsic volcanics, as such, most waste rock samples are in the slightly acidic range. This is in line with the underlying lithologies present. A summary of the study is provided below.

#### 9.1.13.1 Methodology

The waste rock sampling programme for the six proposed open-cut pits was guided by the Australian technical guidelines for the geochemical assessment of mining wastes (Department of Mines and Energy [DME], 1995; Department of Environment and Heritage Protection [DEHP], 2013; Commonwealth of Australia [COA], 2016). The DME (1995) guideline recommends that the tonnage of mined material determine the sampling interval, whereas the more recent guidelines favour a risk-based approach.

The waste characterisation sampling strategy for the Agate Creek stage 2 expansion open-cut pits incorporated the collection of samples from regular intervals (every 3 m) in selected RC drill holes. These selected drillholes were chosen to represent a cross-section of the rock profile in each proposed open-cut pit.

The interval spacing was selected to cover all areas anticipated to have acid rock drainage (ARD) potential – including around the ore bodies, alteration zones, transitional material and fresh rock. This sampling methodology was adopted with the aim to provide a good statistical and spatial representation of the waste rock profile in each pit.

A total of 260 rock samples were collected from 27 drill holes across the six proposed pits (Table 26).

**Table 26. Summary of Samples Taken Across Proposed Pits (C&R Consulting, 2022a).**

| Proposed Pit | Waste tonnes | Number of holes | Hole ID | Number of samples | Number of samples/pit |
|---|---|---|---|---|---|
| Pit 1 | 750,195 | 4 | CCGC338 | 7 | 22 |
| | | | CCGC339 | 1 | |
| | | | CCGC340 | 7 | |
| | | | CCGC341 | 7 | |
| Pit 2 | 348,570 | 3 | CCGC321 | 9 | 22 |
| | | | CCGC343 | 7 | |
| | | | CCGC344 | 6 | |

| | | | | | |
|---|---|---|---|---|---|
| Pit 3 | 51,627 | 2 | CCGC323 | 5 | 14 |
| | | | CCGC324 | 9 | |
| Pit 4 | 229,591 | 5 | CCGC316 | 9 | 34 |
| | | | CCGC319 | 11 | |
| | | | CCGC345 | 7 | |
| | | | CCGC346 | 1 | |
| | | | CCGC347 | 6 | |
| Pit 5 | 157,318 | 2 | CCGC326 | 7 | 18 |
| | | | CCGC329 | 11 | |
| Pit 6 | 2,236,780 | 11 | CCGC302 | 3 | 150 |
| | | | CCGC303 | 9 | |
| | | | CCGC306 | 11 | |
| | | | CCGC308 | 11 | |
| | | | CCGC309 | 1 | |
| | | | CCGC311 | 21 | |
| | | | CCGC334 | 6 | |
| | | | CCGC336 | 1 | |
| | | | CCGC349 | 14 | |
| | | | CCGC354 | 25 | |
| | | | CCGC356 | 48 | |
| **Total** | **3,774,081** | **27** | **-** | **260** | **260** |

#### 9.1.13.2 Static Tests

All 260 samples underwent static geochemical testing to evaluate the risk associated with the potential oxidation of sulphides, acid generation, and the presence of metals/metalloids and salts.

Each sample underwent static geochemical testing for:

- pH;
- Electrical conductivity (EC);
- Total sulphur;
- Acid neutralising capacity (ANC);
- Net acid generation (NAG);

- Net acid production potential (NAPP);
- Major dissolved anions for Cl, F and SO4; and
- Total metals/metalloids for Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se, V and Zn.

Further information is provided in Appendix B.

#### 9.1.13.3 Kinetic Leach Column Tests

Kinetic leach column (KLC) tests accelerate the weathering of samples and provide information on the magnitude and/or effects of dynamic processes that result from weathering. Unlike static tests, KLC tests measure the varying geochemical characteristics of sample effluent over a prolonged period of time.

Four samples were dispatched to a NATA-accredited laboratory for KLC tests: one from Pit 1, one from Pit 4 and two from Pit 6. These large KLC samples (>25 kg) represent a considerable proportion of the waste rock profile of each pit

Each kinetic leachate column underwent kinetic geochemical testing for:

- pH;
- EC;
- Total dissolved solids (calculated);
- Hardness;
- Acidity;
- Alkalinity;
- Major cations for Ca, Mg, Na and K;
- Major anions for Cl, F and SO4; and
- Dissolved metals/metalloids for Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mo, Mn, Ni, Pb, Sb, Se, Te, Th, U, V and Zn.

Further information is provided in Appendix B.

#### 9.1.13.4 Geochemical Analysis Results

##### 9.1.13.4.1 Acid Base Account

***pH Value***

Of the 260 waste rock samples, the median pH value was neutral (6.7) with values ranging from slightly acidic (4.5) to slightly basic (8.8). As demonstrated in Figure 20, the majority of the samples were in the neutral range, however, slightly acidic samples were prevalent, indicative of the waste rock lithology.

Due to the method of testwork (fluid extract from crushed samples with a very high surface area to solution ratio) it is noted that both low and high pH results in the waste rock are expected to be a worst case scenario. Further, for significant runoff to occur at Agate Creek, the expected rainfall dilution factor would be greater than 1:5 (sample:water) ratio utilised in analysis thus counteracting the resulting acidity or alkalinity (C&R Consulting, 2022a).

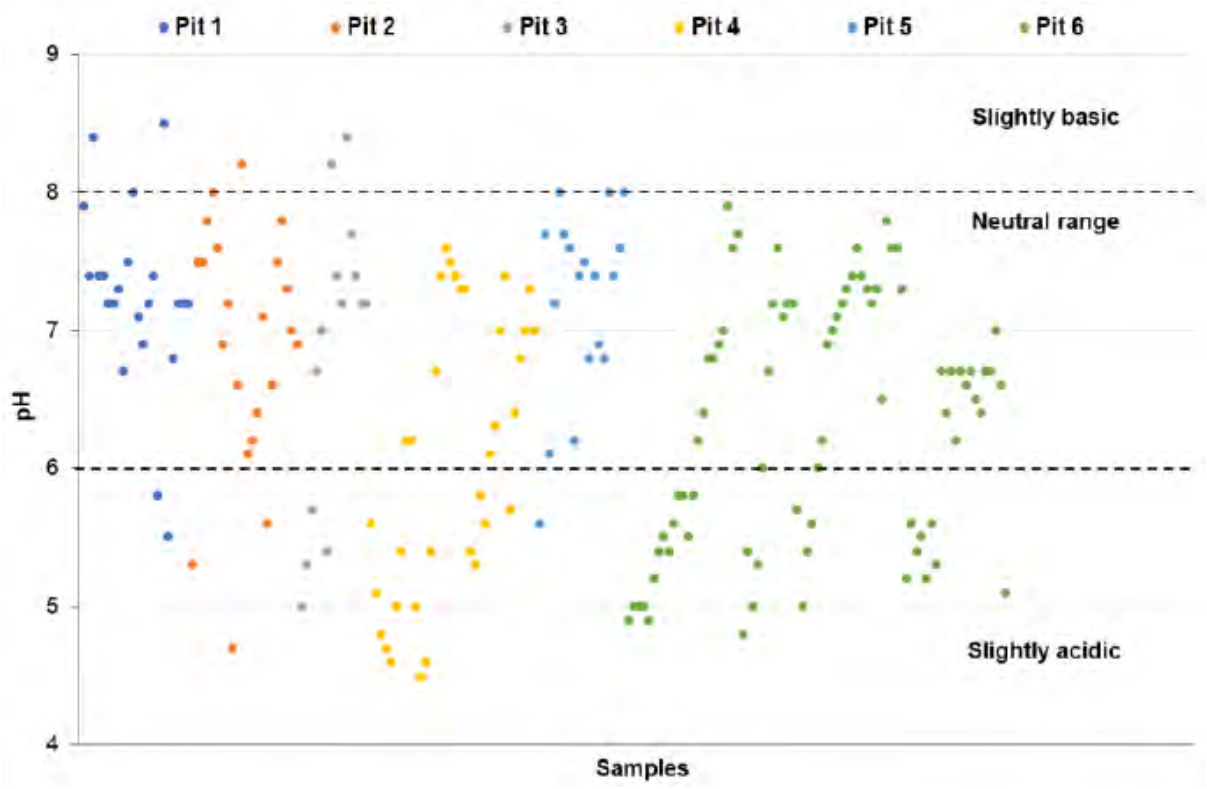



**Figure 20. pH Values for Agate Creek Waste Rock Samples (C&R Consulting, 2022a).**

***Electrical Conductivity***

The majority of the waste rock samples have low electrical conductivity (EC) values (<300 µS/cm). The results range from 7 µS/cm to 1,680 µS/cm with a low median of 46 µS/cm. With the exception of an outlier from Pit 2 (1,680 µS/cm), all EC results were below 500 µS/cm.

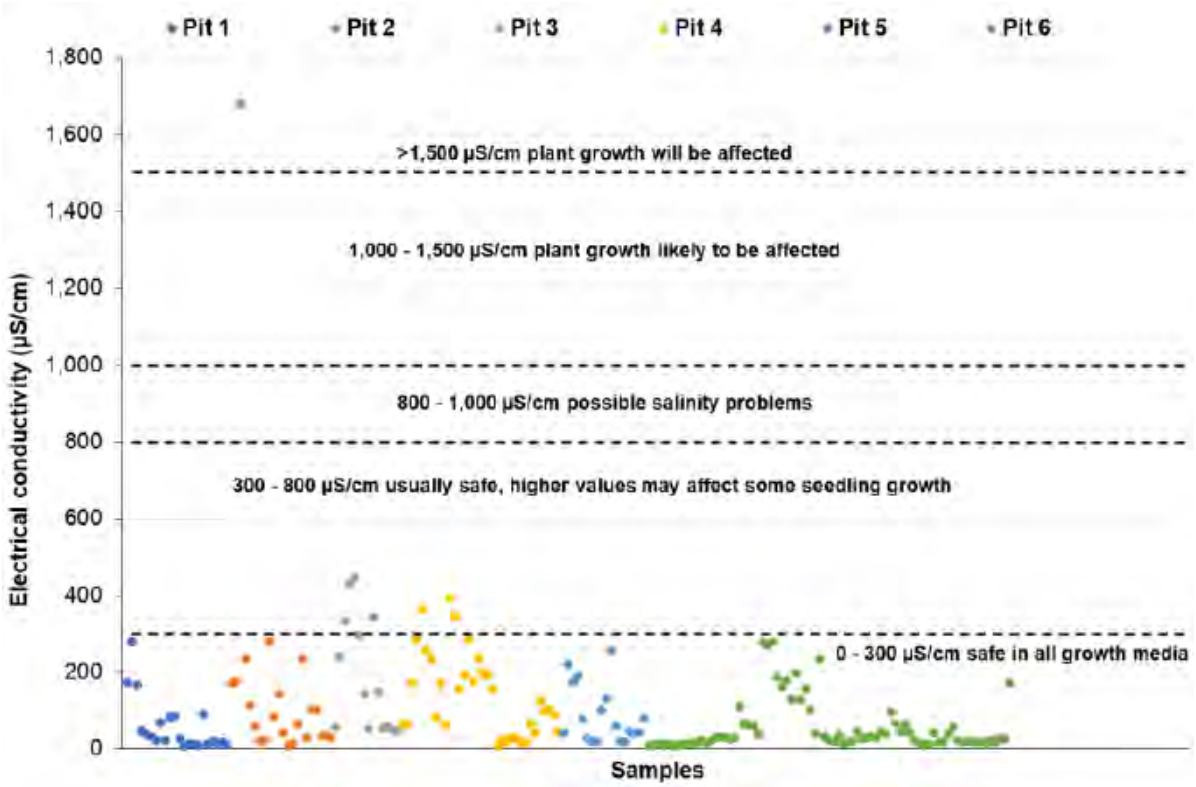



**Figure 21. Electrical Conductivity for Agate Creek Waste Rock Samples (C&R Consulting, 2022a).**

### *Total Sulphur*

Sulphur levels measured in the waste rock samples were extremely low with majority of the samples being below the limit of reporting (<0.01%) with the highest result being 3.05%. Resultingly, the majority of the waste rock is considered barren with respect to total sulphur (Figure 22).

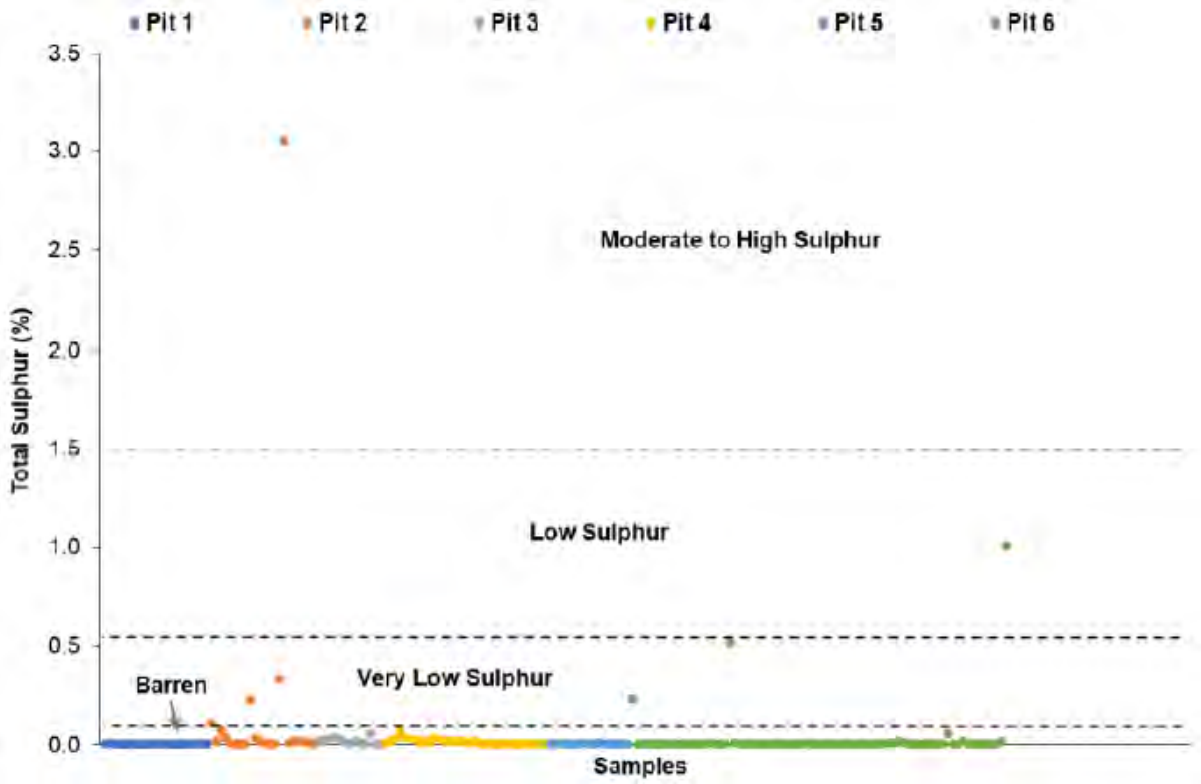



**Figure 22. Total Sulphur Concentration for Agate Creek Waste Rock Samples (C&R Consulting, 2022a).**

***Maximum Potential Acidity (MPA)***

MPA is the maximum amount of acid that can be produced by the oxidation of sulphur-bearing minerals in the waste rock material. MPA is calculated from the total sulphur content. The MPA – that could be generated by the 260 Agate Creek waste rock samples – ranges from 0.15 to 93.3 kg $H_2SO_4$/t and has a low median value of 0.2 kg $H_2SO_4$/t. (C&R Consulting, 2022a).

***Acid Neutralising Capacity (ANC)***

ANC is related to the amount of acid neutraliser (usually carbonate minerals) in the waste rock sample. ANC is determined experimentally by reacting a standardised acid mixture with a known amount of waste rock sample – and is reported as kg $H_2SO_4$/t eq. (equivalent). The ANC of the 260 Agate Creek waste rock samples ranges from 0.25 to 28.0 kg $H_2SO_4$/t eq., with a low median of 3.0 kg $H_2SO_4$/t eq. (C&R Consulting, 2022a).

***ANC:MPA Ratio***

The ANC:MPA ratio can assist in classifying the potential for waste rock samples to generate acid. The low and negligible risk samples contain more acid-neutralising than acid-generating minerals, whereas the potential and increased risk samples contain more acid-generating than acid-neutralising minerals. To summarise the Agate Creek waste rock sample ANC:MPA ratio results:

- 204 samples are considered to be of negligible to low risk;
- 41 samples are deemed to be a potential risk; and

- 15 samples are regarded as an increased risk.

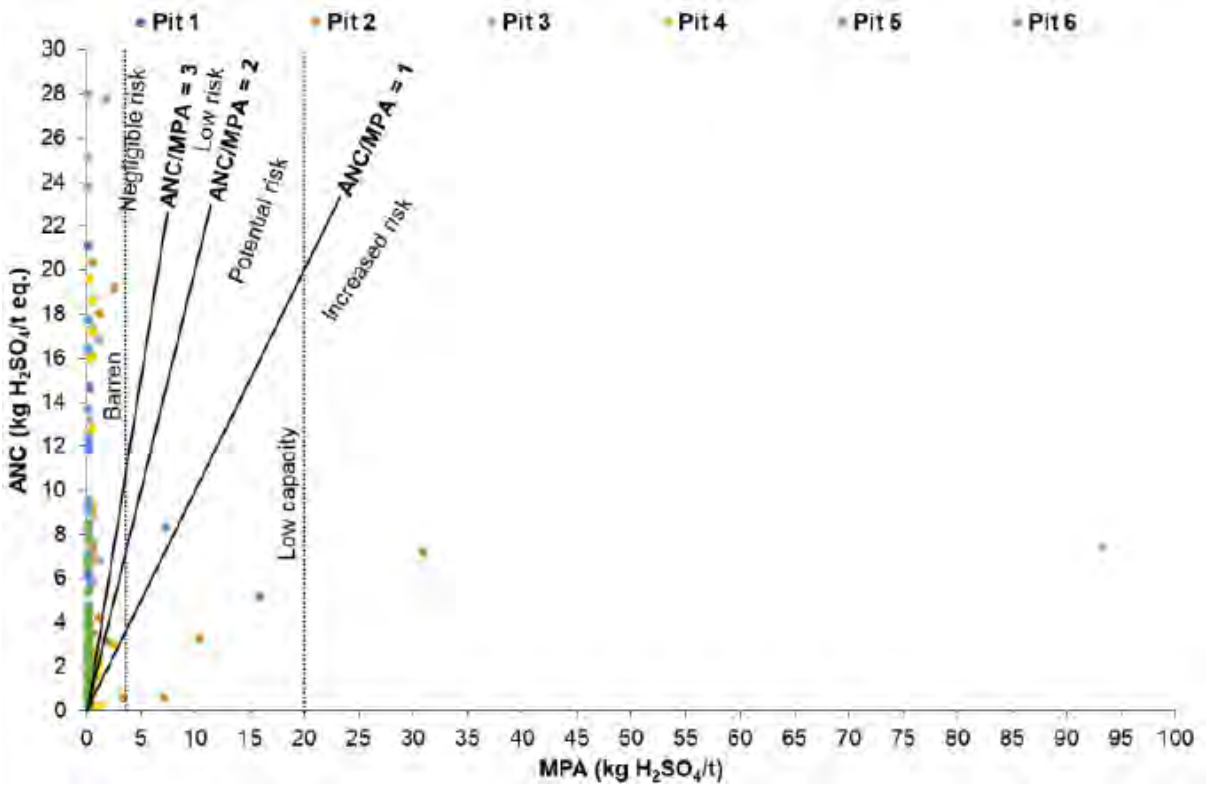



**Figure 23. ANC:MPA Results for Agate Creek Waste Rock Samples.**

### *Net Acid Production Potential (NAPP)*

NAPP is a theoretical calculation of the net acid producing (or consuming) value of a rock sample. The NAPP values provide classify the acid forming potential of a material (C&R Consulting, 2022a).

**Table 27. NAPP Classification Categories (C&R Consulting, 2022a; Miller, 1997).**

| ARD Classification | NAPP Value (kg $H_2SO_4$/t) |
|---|---|
| Potentially Acid Forming (PAF) | >10 |
| Uncertain | 0 to 10 |
| Non-Acid Forming (NAF) | -50 to 0 |
| Acid Consuming Material | < -50 |

Of the 260 waste rock samples, 45 have positive NAPP values. However, most of these positive samples are in the uncertain range, with only three samples having values greater than 10. These are associated with either Pit 2 or Pit 6 (C&R Consulting, 2022a).

### *Net Acid Generation (NAG) Test*

The NAG test is used to directly measure the net amount of acid produced by a waste rock sample.

Generally speaking, samples with a $NAG_{(pH)}$ (oxidised pH) below 4.5 may be acid generating and samples with a $NAG_{(pH)}$ equal or greater than 4.5 (≥4.5) are unlikely to be acid producing. However, the NAG test does not estimate acid neutralisation potential, therefore the combined use of the NAPP values and the NAG results were utilised for a more detailed classification of acid generation.

Figure 24 demonstrates that most Agate Creek waste rock samples have a $NAG_{(pH)}$ greater than 4.5 and a NAPP value below 0. Therefore, they are not acid generating. In contrast, one sample has a negative NAPP value and $NAG_{(pH)}$ below 4.5. In addition, several samples have NAPP values slightly above 0 that coincide with $NAG_{(pH)}$ in excess of 4.5. Both groups are classified as uncertain PAF. Five samples are certainly PAF, having a $NAG_{(pH)}$ less than 4.5 and a positive NAPP value. (C&R Consulting, 2022a).

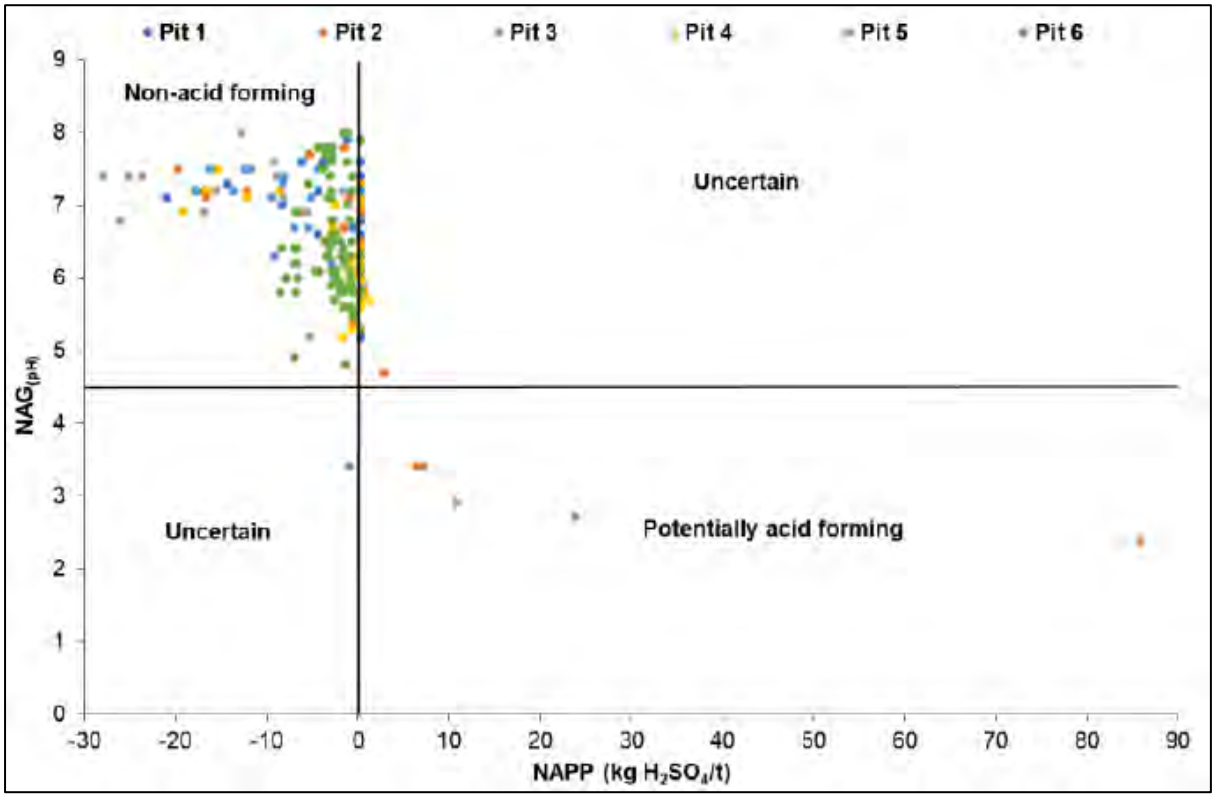



**Figure 24. NAG(pH) versus NAPP for Agate Creek Waste Rock Samples (C&R Consulting, 2022a).**

Applying the NAG(pH) and total sulphur geochemical classification criteria (Table 28), it can be shown that most waste characterisation samples are NAF.

Of the 260 Agate Creek waste rock samples, there are only six samples that could be categorised as PAF:

- Three samples in Pit 2;
- One sample in Pit 5; and
- Seven samples in Pit 6.

However, these samples make up less than 14% of total samples and sulphur values are still very low to low (with the exception of Pit 2). It is therefore expected that only one of these six samples presents an acid drainage issue because:

- The amount of produced acid would be negligible; and
- Any acid produced by the samples will be buffered by the surrounding NAF rock that makes up more than 90% of the waste rock.

**Table 28. Geochemical Classification Criteria for Agate Creek Waste Rock Samples (C&R Consulting, 2022a).**

| Geochemical Classification | Total Sulphur (%) | $NAG_{(pH)}$ | Pit 1 | Pit 2 | Pit 3 | Pit 4 | Pit 5 | Pit 6 |
|---|---|---|---|---|---|---|---|---|
| NAF (barren) | ≤0.1 | - | 22 | 18 | 14 | 34 | 17 | 142 |
| NAF (very low sulphur) | >0.1 to ≤0.55 | ≥4.5 | 0 | 1 | 0 | 0 | 0 | 1 |
| NAF (low sulphur) | 0.55 to 1.5 | ≥4.5 | 0 | 0 | 0 | 0 | 0 | 0 |
| PAF (very low sulphur) | 0.1 to ≤0.55 | <4.5 | 0 | 2 | 0 | 0 | 1 | 6 |
| PAF (low sulphur) | 0.55 to 1.5 | <4.5 | 0 | 0 | 0 | 0 | 0 | 1 |
| PAF (moderate to high sulphur) | >1.5 | <4.5 | 0 | 1 | 0 | 0 | 0 | 0 |
| Percentage of NAF samples | | | 100% | 86.4% | 100% | 100% | 94.4% | 95.3% |
| Percentage of very low sulphur PAF samples | | | 0% | 9.1% | 0% | 0% | 6% | 4.0% |
| Percentage of low sulphur PAF samples | | | 0% | 0% | 0% | 0% | 0% | 0.7% |
| Percentage of moderate to high sulphur PAF samples – actionable levels | | | 0% | 4.5% | 0% | 0% | 0% | 0% |

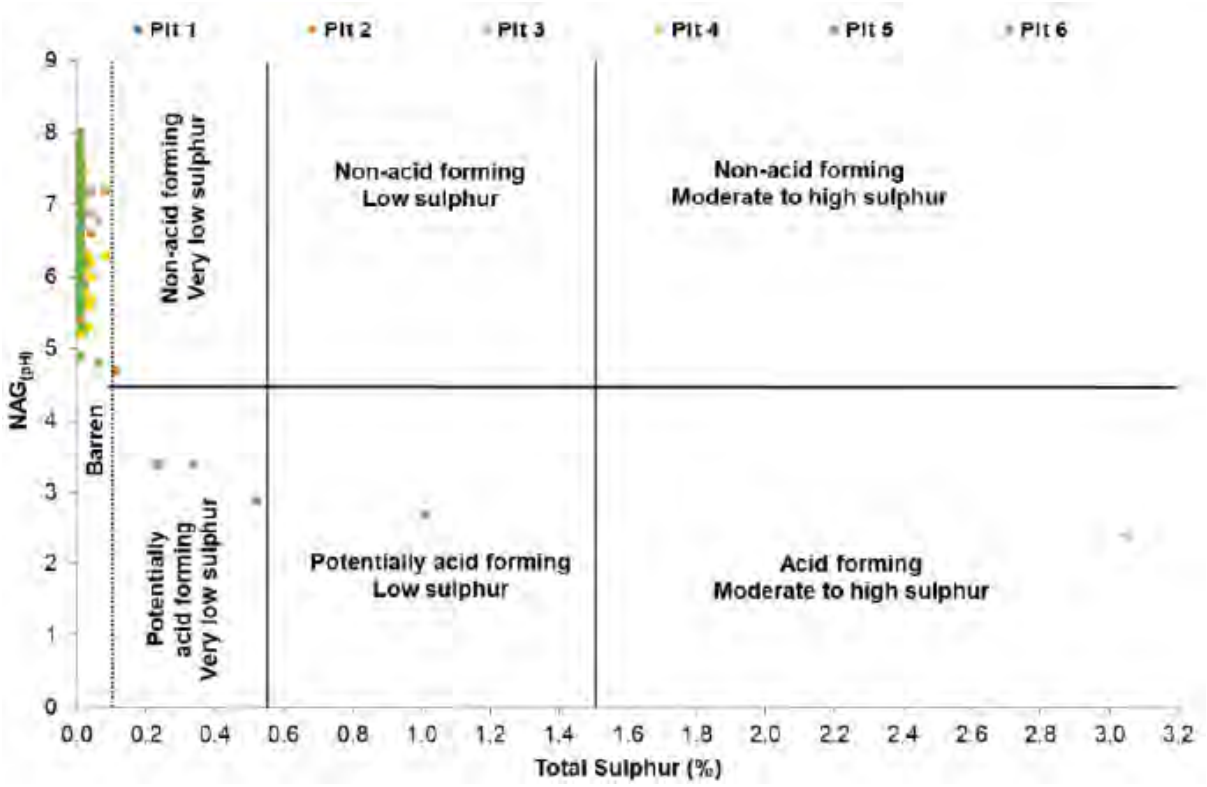



**Figure 25. $NAG_{(pH)}$ versus Sulphur for Agate Creek Waste Rock Samples (C&R Consulting, 2022a).**

#### 9.1.13.5 Metal / Metalloid Analyses

Metal and Metalloid analyses indicate that levels of fluoride were above the guideline level of 2 mg/L in many of the waste rock samples (static tests). Results ranged from >0.5 mg/L to 63 mg/L. Fluoride values are not uncommon for the Agate Creek area which is a volcanic province where fluorine enrichment is not unexpected. The possibility of a high ambient level implies that the overall risk associated with fluoride is low. In the KLC results, fluoride trended down to the compliance level of 2 mg/L by the 4th leach, supporting the overall proposition that the overall environmental risk from fluoride is low (C&R Consulting, 2022a).

Dissolved sulphate levels in the static test results from waste rock samples range from 5 mg/L to 1760 mg/L with a low median value of 20 mg/L. Only one sample from Pit 2 is above the ANZECC and ARMCANZ (2000) Livestock Drinking Water Guideline of 1000 mg/L. Sulphate values in the Kinetic Leach Tests were all within compliance levels. Based on these results the environmental risk from sulphate is considered low (C&R Consulting, 2022a).

KLC tests indicate concentrations of aluminium, boron, copper and zinc above guideline values. These exceedances were relatively low and were probably associated with adsorbed species on colloids being included in the “dissolved” analyses. As such, these exceedances are considered to impact only a very low to low environmental risk to the Agate Creek waste rock dumps (C&R Consulting, 2022a).

Results of Metal and Metalloid analyses are detailed in Appendix B.

#### 9.1.13.6 Risk of Waste Rock Impacts

The waste rock across the 6 proposed pits at Agate Creek is considered to be of low risk to the receiving environment given the results of Static and Kinetic analyses (Appendix B).

### 9.1.14 Management of Waste Rock

#### 9.1.14.1 Waste Rock Classification

Waste rock material is initially classified by the Laneway geologist using the geological model. Following firing and stockpiling of waste, the geologists inspects the material and confirms the initial classification as either NAF or PAF.

#### 9.1.14.2 Material Segregation

During operation, any PAF material identified will be segregated and placed on an impermeable NAF liner within the WRD footprint area to prevent contaminant migration. Material identification and recording will occur in accordance with the Waste Rock Management Plan during operation to ensure all waste rock material, particularly any PAF material encountered, can be managed, capped, and rehabilitated appropriately. Management may include:

- Survey control as required based on material movement records;
- Maintaining a current waste rock block model;
- Mapping of put walls and mined faces according to lithological domains;
- Blast hole logging assisting waste characterisation;
- Keeping records of each waste rock type; and
- Visual inspections and sampling by suitably qualified geologists and other personnel to differentiate NAF and PAF material.

This methodology provides control and data of the types of waste rock mined as well as the movement and storage of waste rock types.

#### 9.1.14.3 WRD Surface Water Management

The surface of the WRDs will be graded to shed water from the placed material during operation. The final landform surface will be crowned to promote directed surface water runoff to the outer perimeter of the WRD. The final surface will be topsoiled and revegetation to prevent erosions and runoff of sediment laden water to the receiving environment.

#### 9.1.14.4 Ongoing Waste Rock Monitoring

Suitably qualified mine geologists will conduct regular visual inspections on each area of the waste rock dumps to evaluate the performance and condition of the facilities. The toe sections of the waste rock dumps will be assessed for seepage, and if seepage is observed, the specific location and flow

rate will be recorded. A sample shall be collected for water quality analysis in accordance with the Water Management Plan.

### 9.1.15 Landform Design

#### 9.1.15.1 Determining Final Landform Design

The final landforms were determined based on community, economic and environmental factors, as well as the PMLU of each domain. Final designs will be refined closer to closure, utilising information gathered over the course of operations. This includes the results of ongoing waste characterisation, regulated structure inspections, surveys and environmental monitoring results.

RA1, RA3 and RA6 have a PMLU of native ecosystem. These RAs will be reshaped, to ensure the landform is stable and not susceptible to erosion. The final landform design will consider the nearby Rungulla National Park and Reserve and undisturbed areas. The natural environment, conservation, and aesthetic are clear values of the local community and as such the RAs will be reshaped to achieved cohesion with the surrounding landscape.

RA2 and RA5 will be retained as water sources to enhance the land's capability for grazing. As the water will likely be accessed by grazing cattle and native wildlife, the structures will be inspected for stability and reshaped, where required, to make safe. The final landform design will be based on the results of inspections and survey closer to closure.

RA4 and RA6 will be shaped to support a PMLU of low intensity grazing. Minor reshaping will be required to ensure the landform is stable and not susceptible to erosion. The final landform will be designed based on survey results prior to rehabilitation activities commencing.

#### 9.1.15.2 Landform Structures

Final landform structures for the Project are detailed in Table 29.

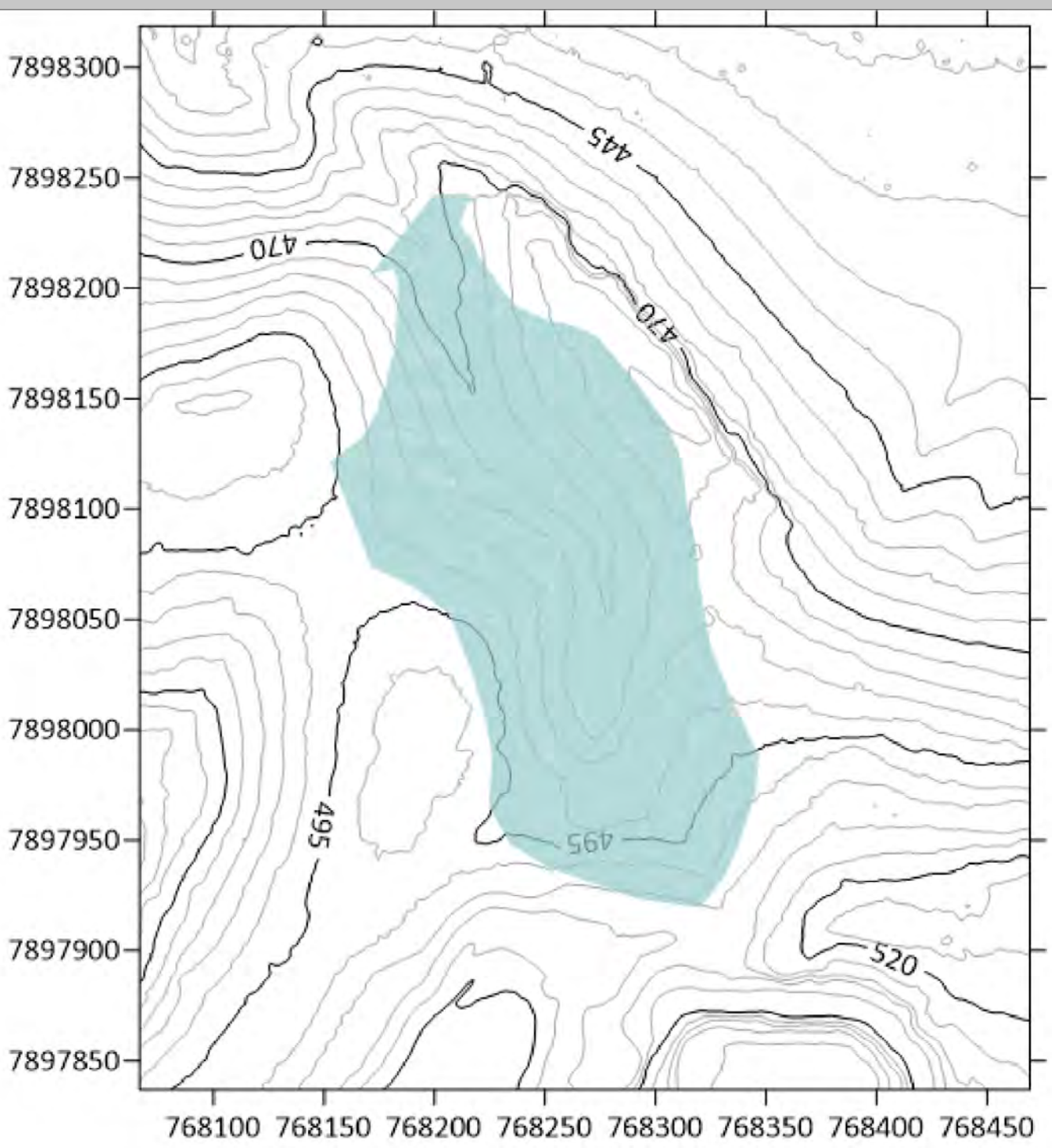
**Table 29. Landform structures for the Project**

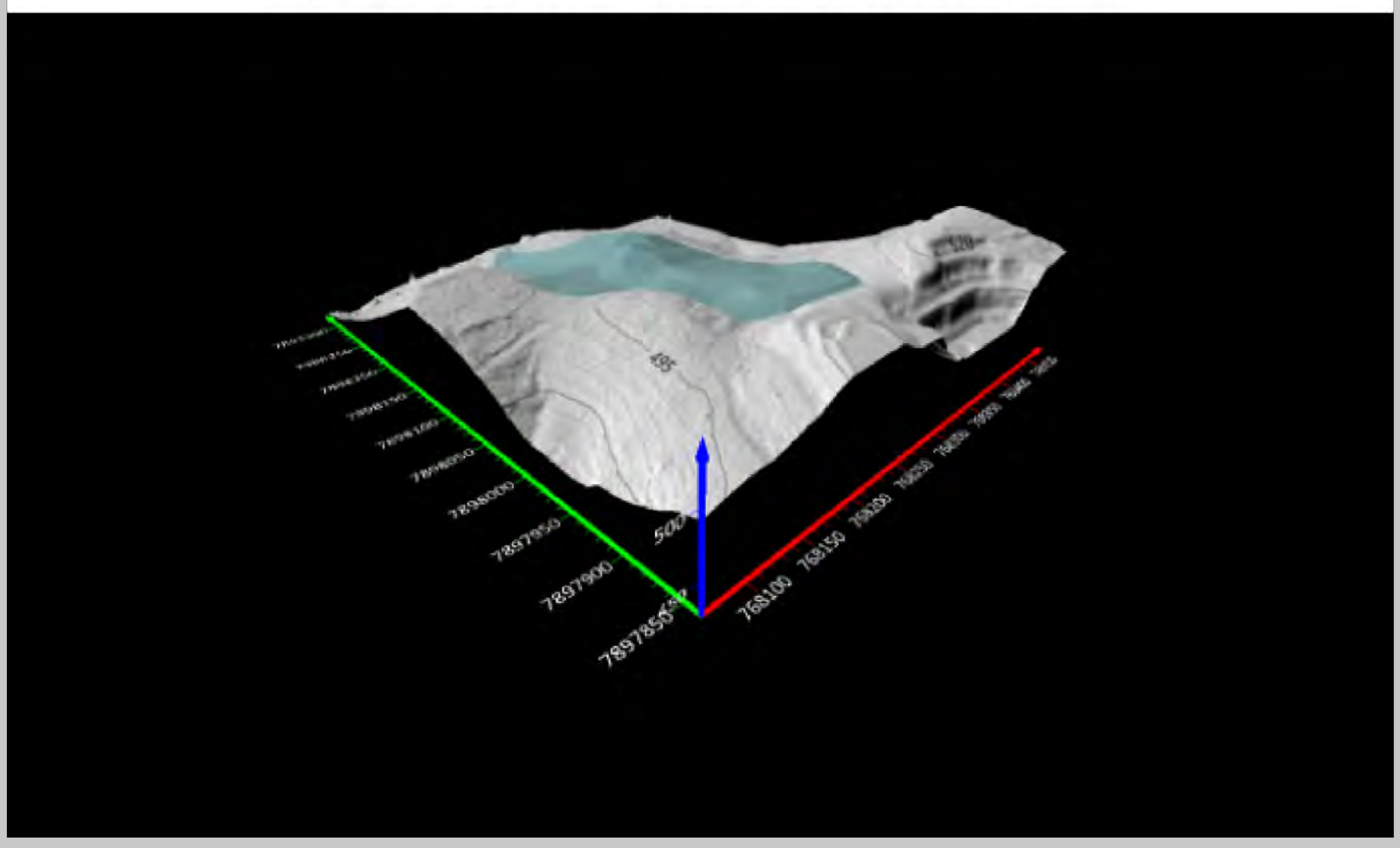
| RA | Landform Design and Rehabilitation |
|---|---|
| **RA1** | • Pits are to be backfilled with waste rock, approximately 87,000 $m^3$.<br>• The surface will be shaped to ensure a safe, stable landform.<br>• Landform will be topsoiled (0.15m) and ripped to promote vegetation growth.<br>• Landforms will be seeded with species relevant to the regional ecosystem.<br>• Domain to be monitored for rehabilitation success. |
| **RA2** | • Pits are to be stabilised by securing the highwalls to ensure a safe, stable landform.<br>• Once deemed stable, a bund and fencing will be erected around the open cut to prevent ingress. |
| **RA3** | • Landforms to be shaped to a stable landform.<br>• Topsoil will be applied (0.15m) to bring the domain to final landform elevation.<br>• Topsoil will be ripped parallel to the contour to promote vegetation strike.<br>• Landforms will be seeded with pasture species<br>• Domain to be monitored for rehabilitation success. |

| RA | Landform Design and Rehabilitation |
|---|---|
| **RA4** | • Areas to be progressively rehabilitated during time domains are no longer required.<br>• Infrastructure is to be decommissioned and removed from site. Access tracks, fence lines and hardstands required for the PMLU to be retained.<br>• Landform to be shaped with subsoil to become free draining.<br>• Topsoil will be applied (0.15m) to bring the domain to final landform elevation.<br>• Topsoil will be ripped parallel to the contour to promote vegetation strike.<br>• Landform will be seeded with pasture and native species.<br>• Domain to be monitored for rehabilitation success. |
| **RA5** | • All associated infrastructure is to be removed from the domain.<br>• Mine affected material is to be disposed of the in WRDs.<br>• HPDE Liner removed<br>• If required, landforms will be shaped to ensure a safe, stable landform. |
| **RA6** | • Infrastructure (if any) is to be removed from exploration tracks and pads.<br>• Exploration tracks and pads are to be ripped parallel to the contours (where possible).<br>• Personnel are to be excluded from rehabilitation exploration areas to allow for self-establishment of native vegetation. |

#### 9.1.15.3 WRD Conceptual Design

The WRD conceptual design for operations is described in Section 6.2.3. On closure, any remaining waste rock material at the WRDs will be reshaped to a low-gradient landform, reflecting the surrounding environment. The final landforms have been conceptualised for each WRD as shown in



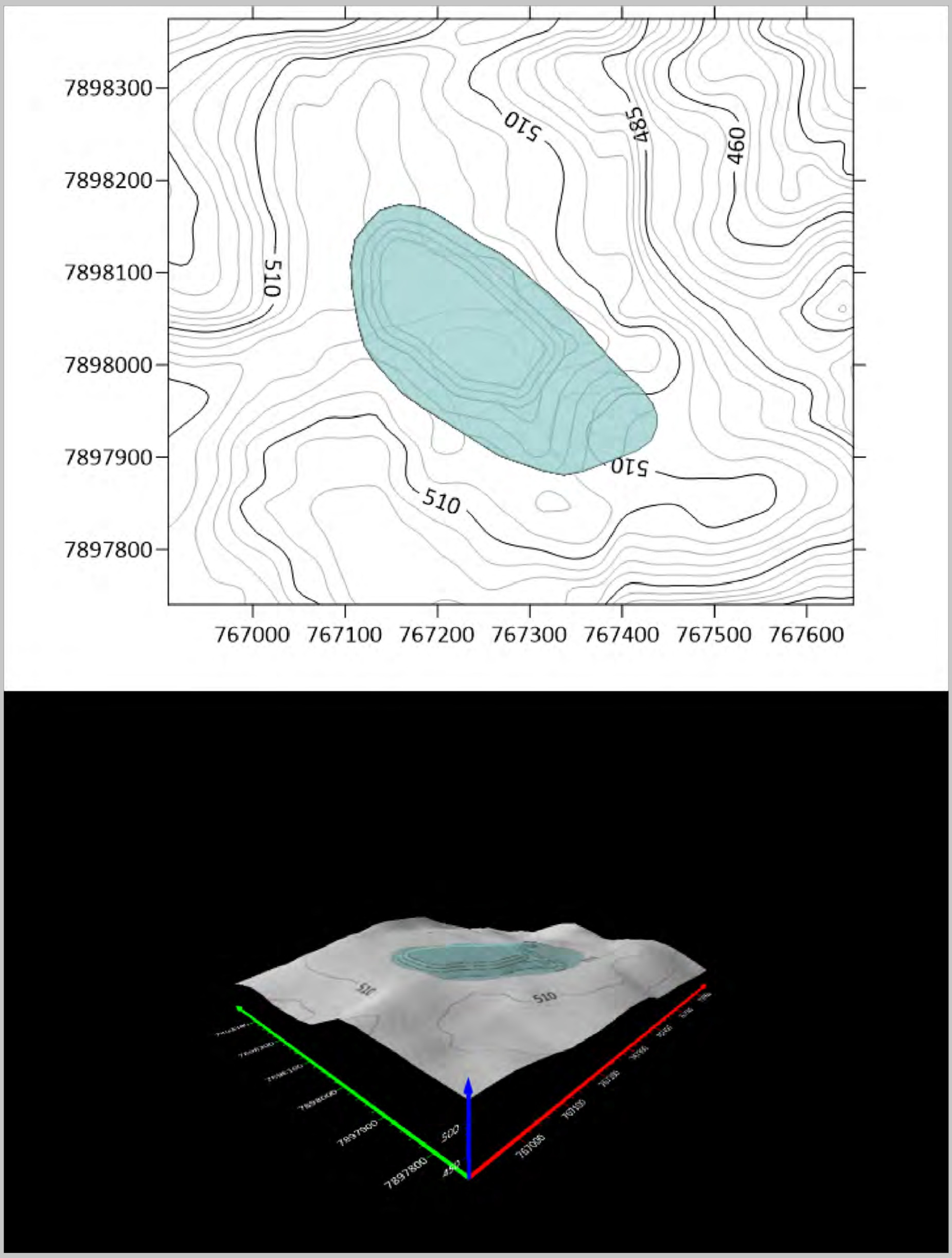

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# Figure 26. North WRD Final Landform

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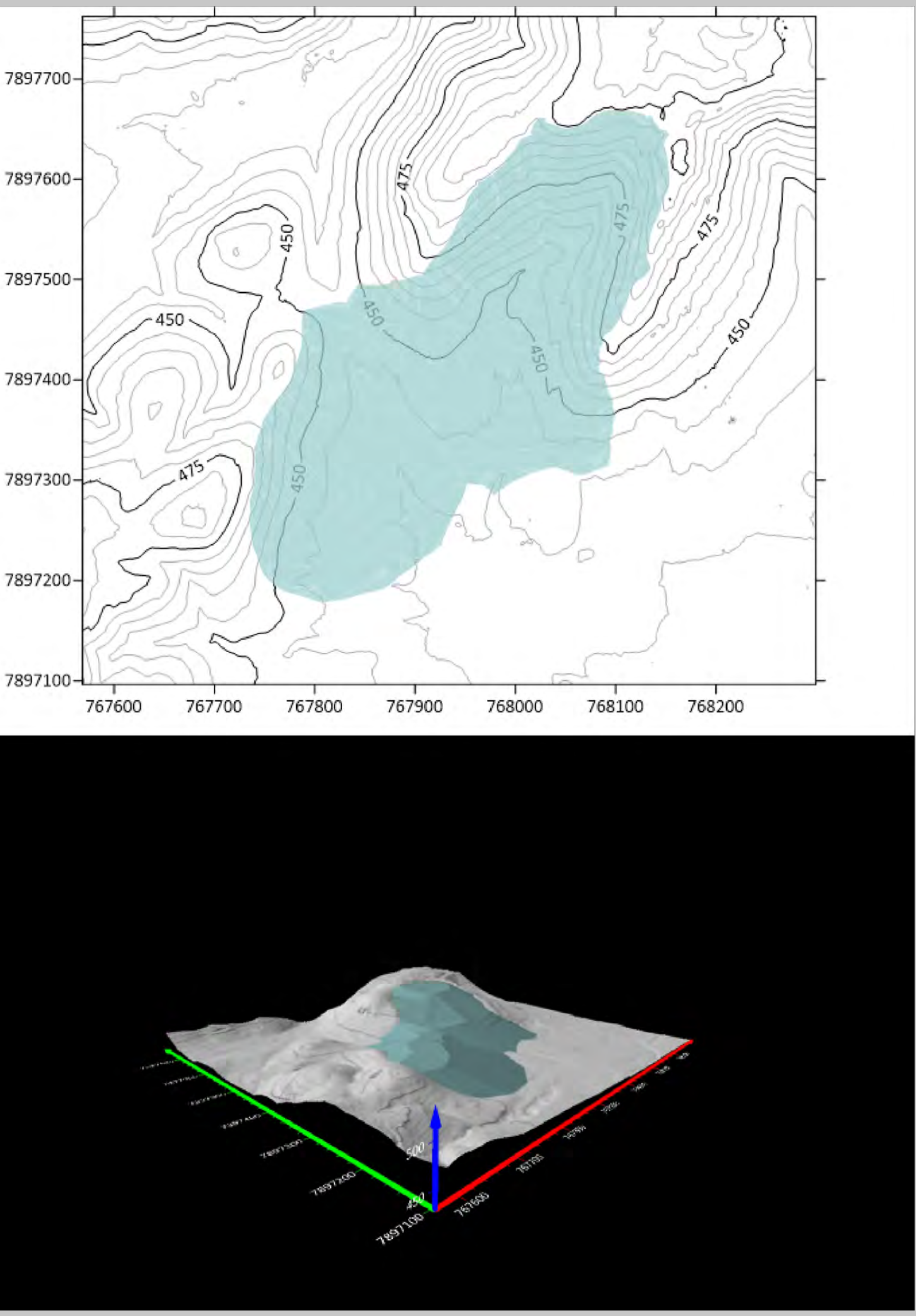

# Figure 27. NorthWest WRD Final Landform

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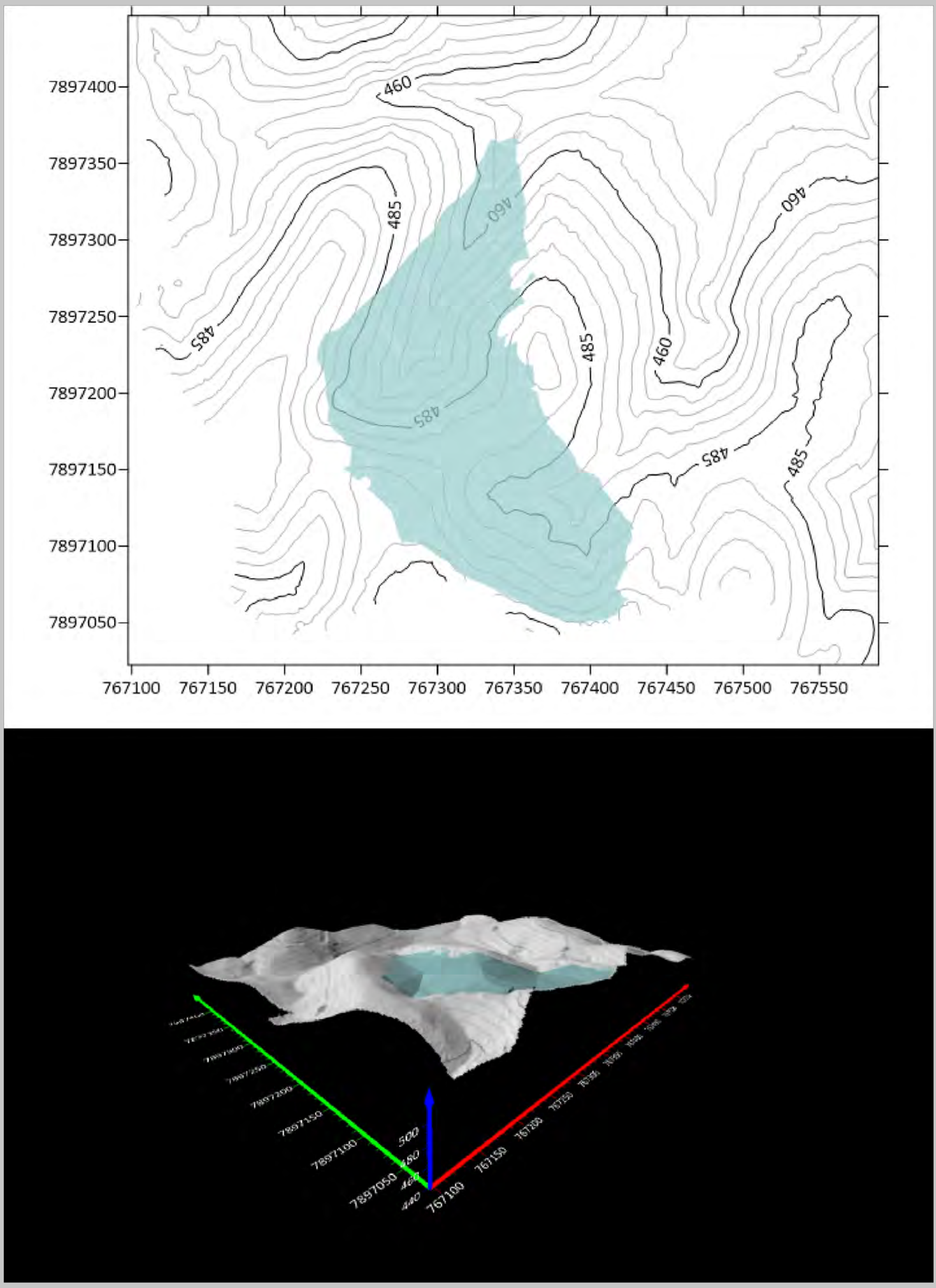

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# Figure 28. South WRD Final Landform

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# Figure 29. SouthWest WRD Final Landform

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#### 9.1.15.4 WRD Cover Design

After shaping, WRDs will be covered to ensure that any PAF material is sufficiently capped to prevent exposure of potentially reactive materials to weathering and atmospheric conditions. The cover design has been developed considering the results of the geochemical characterisation (Section 9.1.13), as well as best practice methods, as described in the current Mining Estimated Rehabilitation Cost (ERC) Calculator (DES, 2022).

The principal objectives for the cover design are to ensure:

- WRDs are safe and structurally stable;
- WRDs are non-polluting; and
- Final landform structure and use is consistent with the region and community's needs.

The final landform and cover design for the WRDs is as follows:

- Any PAF material will be selective placed within the WRD and encapsulated with NAF material.
- PAF will be covered with a rock layer, minimum of 0.5 m thickness. Due to the small amount of PAF material on site, it is anticipated this volume will be encapsulated with significantly more NAF material than the minimum requirement.
- Growth media of 0.15 m thickness will be applied, to support vegetation growth.
- Seeding with appropriate species ie. Shallow rooting species relevant to the target RE.

#### 9.1.15.5 Material Volumes

As discussed in Section 9.1.13.4, the geochemical characterisation indicates very little waste rock is expected to be PAF material. The estimated total amount of waste rock expected to be mined from Agate Creek is 2.7 million cubic metres as summarised in Table 30.

**Table 30. Estimated Waste Rock Volumes (ATC Williams, 2022).**

| Waste Rock Dump | Concept Volume ($m^3$) |
|---|---|
| North WRD | 330,000 |
| North-West WRD | 450,000 |
| South WRD | 1,720,000 |
| South-West WRD | 229,000 |
| Total | 2,729,000 |

Approximately 38,820 $m^3$ topsoil is required to cap the WRDs. The estimated volume of topsoil reserved is 124,000 $m^3$ which will be stored in the dedicated topsoil stockpiles within the proposed disturbance areas.

Soil health will monitored after application and during ongoing rehabilitation monitoring. Ameliorants will be applied, as required for soil health.

#### 9.1.15.6 Landform stability

A stability analysis was completed for the SW WRD (ATC Williams, 2022). This WRD was selected as it represents the highest potential risk, due to the dump height and relatively steep slopes of the natural ground surface. The assessment demonstrated that the waste dump currently meets the recommended minimum factor of safety for both the modelled static and pseudo-static loading conditions.

On closure, the WRDs will be reshaped to a low-gradient landform which will further improve the long-term stability of the landform. Landform evolution modelling (LEM) will be completed, prior to closure, to assess the long term stability. The results of the LEM will be incorporated into the final landform design of the WRDs.

The WRDs will be covered with 0.15m of topsoil, which has been assessed as having moderate erosion susceptibility. The landform will be seeded to protect the topsoil and minimise the erosion potential of the landform.

Risks associated with soil loss from the WRDs have been estimated using the Revised Universal Soil Loss Equation (RUSLE). The RUSLE equation is recommended by the International Erosion Control Association (IECA) as a risk based approach to predicting soil loss (IECA, 2008). The RUSLE considers soil erodibility, slope length, slope angle, climate, and surface condition to estimate soil loss rates as t/ha/yr. RUSLE calculations for the Project were prepared (Table 31) based on worst case conditions for the landforms and included the following assumptions:

- Final landform surfaces will be track walked with surface roughening along the contour to minimise potential for gully and rill formation;
- Vegetative ground cover benchmarks are consistent with the immediate surrounding environment (i.e. 18% ground cover);
- Calculations assumed the longest and steepest slope on the landform based on spatially derived slope analyses;
- No additional ameliorants have been applied (i.e. application of soil stabilisers, gypsum, etc.)

**Table 31 RUSLE Calculation**

| Landform | Soil Loss Estimate (t/ha/yr) | Risk (IECA, 2008) |
|---|---|---|
| NWRD | 148 | Low |
| NWWRD | 353 | Medium |
| SWWRD | 353 | Medium |
| SWRD | 265 | Medium |

RUSLE calculations determined that low risk of soil loss from NWRD is expected, whilst the NWWRD, SWWRD, and SWRD were determined to be medium risk.

For landforms that present a risk greater than “low”, further stabilization measure will be considered prior to closure, based on topsoil condition and requirements for additional fertilizer and nutrient applications. Erosion monitoring will be completed as part of the rehabilitation monitoring program described in Section 11.

#### 9.1.15.7 Quality Assurance

Some of the key risks associated with final landform construction are failing to follow the design, non-conformance of construction materials to specifications, inadequate quality of construction, failure to correctly implement a Quality Assurance / Quality Control (QA/QC) procedure to identify construction inadequacies. Construction management, technical supervision, and QA/QC of final landforms will be done by an AQP, to ensure that construction aligns with the design plan. An AQP will prepare a QA/QC document to verify landform design is stable and has been constructed in accordance with the design plan.

#### 9.1.15.8 Determining Landform Establishment Success

Final landforms will be both geochemically and geotechnically stable, and have a self-sustaining vegetation cover, in alignment with designated PLMUs. Rehabilitation milestones and monitoring programs will provide objective measurement of these requirements.

Waste dumps will be progressively rehabilitated as the resource is depleted. Early rehabilitation will be used as a trial to verify the success of the rehabilitation methods. Any learnings from rehabilitation monitoring will be incorporated into successive rehabilitation.

The achievement of early rehabilitation milestones (RM1 – RM8) will be demonstrated by the monitoring described in Table 16. A detailed monitoring program has been developed to assess achievement of RM9 – RM15. This program is described below in Section 11.

#### 9.1.15.9 Limitations

Limitations of final landform design are as follows:

- Accuracy of soil quality and availability at closure;
- Future impacts of climate change on rainfall event intensity, duration, and frequency; and
- The nature of final waste material

The following assumptions have been made for the final landform design:

- sufficient cover material is available;
- cover and waste material nature are conformant to current assessments; and
- progressive rehabilitation will commence as soon as land becomes available.

400 0 400 800 1,200 1,600 m

1:25,000

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# Figure 30. Final Landform and Post Mine Land Use

Legend

- Mineral Development Licence
- Mining Lease
- Maximum Disturbance Footprint
- Flood Plain Extent - 2022 ATC Williams

ESRI Satellite

Post Mine Land Used

- Low intensity Grazing
- Native Ecosystem
- Recreation
- Water Storage

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## 9.2 Void Closure Plan

### 9.2.1 Minimising Final Voids

There are six proposed open pits covering a total surface area of 8.93 ha. Pits 1-4 will be backfilled with waste rock to minimise the final voids for the project. Pits 5-6 will be retained as voids for use as water storage. The proposed dimensions for the residual voids are detailed in Table 32.

**Table 32 Proposed void dimensions**

| | Length (m) | Width (m) | Depth (m) | Area (ha) | Storage capacity (ML) |
|---|---|---|---|---|---|
| Pit 5 | 110 | 80 | 418 | 0.64 | 28.7 |
| Pit 6 | 180 | 180 | 42 | 4.46 | 751.3 |

### 9.2.2 Voids in floodplains

As discussed in 9.1.11.7, the results from the flood impact assessment (ATC Williams, 2022b) indicate that the Agate Creek floodplain traverses through the mine lease, however the major mine features are outside of the floodplain extents. Specifically, it was found that the proposed open cut pits are not impacted by the 0.1% Annual Exceedance Probability (AEP) flood event.

### 9.2.3 Geotechnical stability

Geotechnical studies will be completed, on closure, based on the final landform after mining ceases. These studies will determine if additional earthworks are required to ensure the long-term stability and safety of the final voids. The studies will consider long term erosion, weathering, and the effects of significant hydrological events.

### 9.2.4 Geochemical stability

A waste rock characterisation study was completed for the project, with a detailed summary discussed above (See 9.1.13). A total of 18 (Pit 5) and 150 (Pit 6) samples were collected from the proposed voids. Approximately 95% of all samples from Pit 5 and Pit 6 were NAF. A summary of the NAG (pH) versus total sulphur geochemical classification criteria for the waste rock samples is provided in Table 33. Overall, the waste rock associated with the project is relatively benign and considered of very low to low risk of environmental harm (C&R Consulting, 2022a). Pit water quality will be assessed throughout the life of the operations to quantify any potential emerging risks to achieving the PMLU.

**Table 33 Waste rock characterisation for proposed voids**

| Geochemical classification | Total Sulphur (%) | NAG (H) | Pit 5 | Pit 6 |
|---|---|---|---|---|
| NAF (barren) | ≤0.1 | - | 17 | 142 |
| NAF (very low sulphur) | >0.1 to ≤0.55 | ≥ 4.5 | 0 | 1 |
| NAF (low sulphur) | 0.55 to 1.5 | ≥ 4.5 | 0 | 0 |
| PAF (very low sulphur) | 0.1 to ≤0.55 | < 4.5 | 1 | 6 |
| PAF (low sulphur) | 0.55 to 1.5 | < 4.5 | 0 | 1 |
| PAF (moderate to high sulphur) | >1.5 | < 4.5 | 0 | 0 |
| Percentage of NAF samples | | | 94.4% | 95.3% |
| Percentage of very low sulphur PAF samples | | | 6% | 4.0% |
| Percentage of low sulphur PAF samples | | | 0% | 0.7% |
| Percentage of moderate to high sulphur PAF samples – actionable levels | | | 0% | 0% |

### 9.2.5 Water balance

A water balance assessment was completed for a post closure scenario, with the results presented in Appendix F.

The maximum spill probability was modelled as ~20% for Pit 5 and <1% for Pit 6, respectively. Pit 5 has the potential to spill in a rare event, due to the shallow wall level. As the site is in a rural region, there is limited local infrastructure in proximity to the pit. The nearest residential area is Old Robin Hood Station, approximately 8km to the northeast of Pit 5. The impacts to people from a spill from Pit 5 are considered low risk.

Pit 6 gradually increases in storage before fluctuating around a relatively consistent water level. Pit 6 achieves a less than 1% spill risk as the pit has a large volume available as well as a small contributing catchment, combined with high evaporation rates for the region.

Water quality in the pits will be monitoring throughout operations to determine the potential risk to the environment in the event of a spill from either void.

### 9.2.6 Groundwater resource

The groundwater census completed within the 10 km buffer from Agate Creek found no registered groundwater bores. Accordingly, the impact to other groundwater users within proximity to Agate Creek is negligible (C&R Consulting, 2022b).

### 9.2.7 Groundwater modelling

The relationship between groundwater flows and Pit 6 were calculated, assuming that all flow is directed to Pit 6. Hydraulic conductivities of all rocks within the Agate Creek site are very low to low (10-8 to 10-7 m/sec) which implies that inflows into the Pit 6 will also be low – 11.329 L/min to 16.201 L/min on a worst-case scenario or 4.828 to 7.686 L/min on a more likely scenario. As discussed in Section 4.3, elevation differences between the bed of Agate Creek and CCWB521 supports the understanding that the groundwater system does not impact or interact with flow in Agate Creek.

Groundwater and pit water quality will be assessed throughout the life of the operations to determine if there are any outflows from either pit to the groundwater resource.

### 9.2.8 Predicted water quality

In general, the Agate Creek groundwater monitoring network currently expresses good quality water, with most bores meeting drinking water quality guidelines for both human and livestock consumption, excluding fluoride. The potential risk to groundwater from the mining operations at Agate Creek relate to the storage and interaction with waste rock, particularly within the residual voids. The findings of the waste rock assessment are presented in detail in Section 9.1.13. Overall, the waste rock associated with the project is relatively benign and considered of very low to low risk of environmental harm (C&R Consulting, 2022b).

Groundwater and pit water quality will be assessed throughout the life of the operations to quantify any potential emerging risk to achieving the PMLU. Water quality monitoring will consider stratification and any resulting impacts to water quality within the pits.

### 9.2.9 Rehabilitation and management strategies

The final voids for the pits will be left in safe condition with stock exclusion fences, and 2m high abandonment bunds constructed around the perimeter of each pit. Geotechnical assessments will determine if any additional works are required to achieve certification as safe and stable.

## 9.3 Rehabilitation Maintenance

Maintenance activities on rehabilitated areas post-closure will be guided by general site inspections and rehabilitation monitoring. Maintenance may include:

- Management of newly recruited vegetation (re-planting of failed vegetation recruitment) prior to its establishment within the ecosystem;
- Repairing eroded areas and damage drainage systems;
- Improved management of surface water runoff by modifying landforms or structures;
- Maintenance of water management structures;
- Removing drainage that is not needed for long-term stability; and
- Replacing and repairing fences and signage.

It is expected that maintenance will be more intensive in the first years following closure and will gradually decrease as PLMUs begin to establish.

## 9.4 Summary of Key Rehabilitation and Management Practices

Table 34 details the key rehabilitation activities for each RA.

**Table 34. Key Rehabilitation Activities to Drive Achieve Rehabilitation Milestones**

| Rehabilitation Area | Relevant Activities | Rehabilitation Activities | Rehabilitation Timing | Rehabilitation Milestones |
|---|---|---|---|---|
| RA1 | Open cut pits 1-4 | • Pits will be backfilled with waste rock and suitably compacted<br>• The surface will be shaped to ensure a safe, stable landform.<br>• Landform will be topsoiled and ripped to promote vegetation growth.<br>• Landforms will be seeded with species relevant to the regional ecosystem.<br>• Domain to be monitored for rehabilitation success. | • The timing of rehabilitation will depend on any probable or proved ore reserve remaining within the pit on closure.<br>• Approximately 2035 | RM3<br>RM9<br>RM11<br>RM13 |
| RA2 | Open cut pits 5-6 | • Pits are to be stabilised by securing the highwalls to ensure a safe, stable landform.<br>• Once deemed stable, a bund and fencing will be erected around the open cut to prevent ingress.<br>• Monitor water quality to assess whether the PMLU has been achieved. | • The timing of rehabilitation will depend on any probable or proved ore reserve remaining within the pit on closure.<br>• Approximately 2035 | RM4<br>RM15 |
| RA3 | Waste Rock Dumps<br>Topsoil dump | • Undertake assessment for contaminated land and remediate if required.<br>• Remove contaminated material and dispose of in WRD.<br>• Spread remaining NAF over the WRD areas.<br>• Shape landform to be free draining and of similar shape to the surrounding topography.<br>• Spread topsoil on landform to a minimum thickness of 15cm.<br>• Conduct analysis on spread topsoil to determine whether topsoil is suitable to achieve the PMLU, or whether ameliorants/ fertiliser is required.<br>• Where required, apply ameliorants/ fertiliser.<br>• Rip landform parallel to landform contours.<br>• Apply selected pasture seed mix to landform.<br>• Monitor to assess rehabilitation success and whether the | • Waste rock will be removed from dumps to backfill the pit. The timing of rehabilitation will depend on any probable or proved ore reserve remaining within the pit on closure.<br>• Topsoil stockpiles will be utilised in rehabilitation of other RAs. The footprint will be available all topsoil resources have been exhausted.<br>• Approximately 2035 | RM5<br>RM8<br>RM9<br>RM11<br>RM13 |

| Rehabilitation Area | Relevant Activities | Rehabilitation Activities | Rehabilitation Timing | Rehabilitation Milestones |
|---|---|---|---|---|
| | | PMLU has been achieved. | | |
| RA4 | ROM<br>ROM Stockpiles | • Undertake assessment for contaminated land and remediate if required.<br>• Remove contaminated material and dispose of offsite (if required).<br>• Shape landform as per design.<br>• Spread topsoil on landform to a minimum thickness of 15cm.<br>• Conduct analysis on spread topsoil to determine whether topsoil is suitable to achieve the PMLU, or whether ameliorants/ fertiliser is required.<br>• Where required, apply ameliorants/ fertiliser.<br>• Rip landform parallel to landform contours.<br>• Apply selected pasture seed mix to landform.<br>• Monitor to assess rehabilitation success and whether the PMLU has been achieved | • Area will be available for rehabilitation with the completion of mining in 2025<br>• Landform establishment by 2027<br>• Seeding to be completed by end 2032 | RM1<br>RM2<br>RM6<br>RM8<br>RM10<br>RM12<br>RM14 |
| | Access roads and tracks<br>Mine haul road<br>Laydown yards<br>Camps/administration | • Undertake assessment for contaminated land and remediate if required.<br>• Remove contaminated material and dispose of offsite (if required).<br>• Decommission any remnant infrastructure and remove/dispose of.<br>• Shape landform to be free draining and of similar shape to the surrounding topography.<br>• Spread topsoil on landform to a minimum thickness of 15cm.<br>• Conduct analysis on spread topsoil to determine whether topsoil is suitable to achieve the PMLU, or whether ameliorants/ fertiliser is required. | • Ore may be processed after mining has been completed. Area will be available for rehabilitation once processing has been complete.<br>• Landform establishment by 2027.<br>• Seeding to be completed by end 2032.<br>• Access tracks account for 0.2 Ha of RA3. Access tracks are required for the PMLU and therefore, not included in this PRCP schedule.<br>• 7.28 ha of tracks will be retained under a landholder agreement. Remaining tracks and haul roads will commence | RM1<br>RM2<br>RM6<br>RM8<br>RM10<br>RM12<br>RM14 |

| Rehabilitation Area | Relevant Activities | Rehabilitation Activities | Rehabilitation Timing | Rehabilitation Milestones |
|---|---|---|---|---|
| | | • Where required, apply ameliorants/ fertiliser.<br>• Rip landform parallel to landform contours.<br>• Apply selected pasture seed mix to landform.<br>• Monitor to assess rehabilitation success and whether the PMLU has been achieved. | rehabilitation in 2026. | |
| RA5 | Water storage dam<br>Sediment Ponds | • Decommission any remnant infrastructure from mining.<br>• Undertake assessment for contaminated land and remediate if required.<br>• Remove contaminated material and dispose of offsite (if required).<br>• Monitor water quality to assess whether the PMLU has been achieved. | • Required as a water supply for rehabilitation of other mining domains. | RM1<br>RM2<br>RM7<br>RM15 |
| RA6 | Exploration Drill Pads and Tracks | • Decommission drill holes (if required):<br>o Seal drill holes by an appropriately qualified person<br>o Cut collar below ground level<br>• Decommission drill pads, removing infrastructure and rubbish.<br>• Undertake assessment for contaminated land and remediate if required. Contaminated material to be disposed of offsite (if required).<br>• Shape landform to be free draining and of similar shape to the surrounding topography.<br>• Spread topsoil on landform to a minimum thickness of 15cm.<br>• Conduct analysis on spread topsoil to determine whether topsoil is suitable to achieve the PMLU, or whether ameliorants/ fertiliser is required.<br>• Where required, apply ameliorants/ fertiliser.<br>• Rip landform parallel to landform contours. | • Exploration pads and tracks available for remediation with the completion of exploration.<br>• Landform establishment to occur in 2026.<br>• Seeding to be completed by end 2026. | RM1<br>RM2<br>RM8<br>RM10<br>RM12<br>RM14 |

| Rehabilitation Area | Relevant Activities | Rehabilitation Activities | Rehabilitation Timing | Rehabilitation Milestones |
|---|---|---|---|---|
| | | • Apply selected pasture seed mix to landform.<br>• Monitor to assess rehabilitation success and whether the PMLU has been achieved. | | |

# 10. Risk Assessment

A closure and rehabilitation risk assessment has been prepared in accordance with Section 126C(1)(f) of the EP Act. The risk methodology utilised has been developed based on the *Australia and New Zealand Standard AS/NZS for Risk Management – Principles and Guidelines* (ISO 31000:2018).

The risk management process involves the systematic application of policies, procedures, and practices to the activities of communicating and consulting, establishing the context and assessing, treating, monitoring, reviewing, recording, and reporting risk.

Closure and rehabilitation risk assessments have the objective to identify and define specific risks from closure and rehabilitation and associated activities toward environmental, economic, and social values.

## 10.1 Risk Identification

The purpose of risk identification is to find, recognise and describe risks that might help or prevent an organisation achieving its objectives. Relevant, appropriate, and up-to-date information is important in identifying risks (Standards Australia, 2018).

The following factors have been considered by this risk assessment:

- Tangible and intangible sources of risk;
- Causes and events;
- Threats and opportunities;
- Vulnerabilities and capabilities;
- Changes in the external and internal context;
- Indicators or emerging risks;
- The nature and value of assets and resources;
- Consequences and their impacts on objectives;
- Limitations of knowledge and reliability of information;
- Time-related factors; and
- Biases, assumptions, and beliefs of those involved.

## 10.2 Risk Analysis and Evaluation

The purpose of risk analysis is to comprehend the nature of risk and its characteristics, including, where appropriate, the level of risk. Risk analysis can be undertaken with varying degrees of detail and complexity, depending on the purpose of the analysis, the availability and reliability of information

and the resources available. Risk analysis techniques can be qualitative, quantitative or a combination of these and should include:

- the likelihood of events and consequences
- the nature and magnitude of consequences
- complexity and connectivity
- time-related factors and volatility
- the effectiveness of existing controls
- sensitivity and confidence levels.

A likelihood of occurrence and severity of consequence rating has been assigned to each identified risk in accordance with the risk matrix detailed in Table 35. Control measures have been developed following the identification of risks to achieve a level of risk that is considered to be an acceptable level, as described in Table 36.

**Table 35. Risk Matrix**

| Likelihood of Occurrence | Severity of Consequence | | | | |
|---|---|---|---|---|---|
| | Catastrophic (5) | Major (4) | Moderate (3) | Minor (2) | Insignificant (1) |
| Almost certain (5) | 10 | 9 | 8 | 7 | 6 |
| Likely (4) | 9 | 8 | 7 | 6 | 5 |
| Possible (3) | 8 | 7 | 6 | 5 | 4 |
| Unlikely (2) | 7 | 6 | 5 | 4 | 3 |
| Rare (1) | 6 | 5 | 4 | 3 | 2 |

| Risk Score | Risk Rating | Actions Required |
|---|---|---|
| 9 – 10 | Extreme | Requires immediate action to reduce risk score. |
| 7 – 8 | High | Requires an action plan approved by senior management. |
| 5 – 6 | Moderate | Specific monitoring and procedures required. |
| 2 - 4 | Low | Management through routine procedures and protocols. |

**Table 36. Risk Evaluation**

| Rehabilitation Milestone | Hazard | Potential Impact | Risk Rating | | | Risk Controls | Justification of controls | Residual Risk Rating | | | Remedial Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | C | R | | | L | C | R | |
| RM1 Infrastructure decommissioning and removal | Infrastructure is not adequately identified during planning process | Failure to remove all infrastructure in accordance with schedule.<br>Achievement of RM1 is delayed. | 2 | 3 | 5 | A register of infrastructure is to be developed to track which structures exist in each rehabilitation area.<br>Demolition works to be scoped with area managers to identify all infrastructure. | The proposed actions will ensure the demolition works are correctly scoped and scheduled. | 1 | 3 | 4 | Contractors will return to site to remove all infrastructure. |
| RM2 Remediation of contaminated land | Previously unidentified contamination source discovered. | Financial cost of remediation<br>Achievement of RM2 is delayed. | 3 | 3 | 6 | Records are to be kept of all spills and other incidents occurring at the Project that might result in contamination.<br>Employees and contractors are to be made aware of their reporting obligations through a Site Induction.<br>Initial consultation | Disturbance is restricted to approved areas as defined on the EA.<br>Initial contaminant land assessments will identify areas for further investigation and remediation. | 2 | 3 | 5 | Ongoing rehabilitation monitoring will identify presence of previously unidentified contaminants.<br>Any contamination will be investigated and further contaminated |

| Rehabilitation Milestone | Hazard | Potential Impact | Risk Rating | | | Risk Controls | Justification of controls | Residual Risk Rating | | | Remedial Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | with an approved contaminant land assessor to identify contamination targets for remediation or removal. | | | | | land sampling/ removal will be conducted as required. |
| | Contaminated sediment is not removed to appropriate depth. | Contamination of land and water resources<br>Ongoing cost of remediation<br>Financial cost of remobilising earthworks crew | 3 | 3 | 6 | Conduct validation sampling to determine that contaminant removal has been successful. | To be suitable for a PMLU of low-intensity grazing, contaminated land must be removed from the Contaminated Land Register or the Environmental Management Register. These works must be approved by a suitably qualified person and an approved auditor (under the Environmental | 2 | 3 | 5 | Ongoing rehabilitation monitoring will identify presence of previously unidentified contaminants. Any contamination will be investigated and further contaminated land sampling/ removal will be conducted as required |

| Rehabilitation Milestone | Hazard | Potential Impact | Risk Rating | | | Risk Controls | Justification of controls | Residual Risk Rating | | | Remedial Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Protection Act 1999 Act). | | | | |
| RM3 Landform development and reshaping (RA1) | Final landform not adequately shaped per design. | Reduced safety or instability of landform.<br>Erosion leading to contamination of water ways.<br>Unsuccessful revegetation | 4 | 3 | 7 | Landform is assessed as geotechnically stable by a suitably qualified geotechnical engineer | Proposed landform is to be gently sloping, limiting potential for erosion | 2 | 3 | 5 | Landform will be reshaped until stability is achieved. |
| RM4 Landform development and reshaping (RA2) | Final landform not adequately shaped per design. | Reduced safety or instability of landform.<br>Erosion leading to contamination of water ways.<br>Unsuccessful revegetation | 4 | 3 | 7 | Landform is assessed as geotechnically stable by a suitably qualified geotechnical engineer | Proposed landform is to be gently sloping, limiting potential for erosion. Little earthworks will be required to achieve profile. | 2 | 3 | 5 | Landform will be reshaped until stability is achieved. |
| | Unstable landform | Uncontrolled movement of landform<br>Fauna injury/death | 3 | 4 | 7 | Assessment of void by suitably qualified person<br>Landform will be stabilised mechanical if required<br>Bunding, perimeter fencing and signage | Assessment will identify any high risk areas for treatment | 2 | 4 | 6 | Ongoing monitoring will guide corrective action as required |

| Rehabilitation Milestone | Hazard | Potential Impact | Risk Rating | | | Risk Controls | Justification of controls | Residual Risk Rating | | | Remedial Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wildlife accessing pit | Fauna injury/death<br>Erosion | 4 | 4 | 8 | Bunding, perimeter fencing and signage | Bunding and fencing will prevent wildlife access | 2 | 4 | 6 | Ongoing monitoring will guide corrective action as required |
| RM5 Landform development and reshaping (RA3) | Final landform not adequately shaped per design. | Reduced safety or instability of landform.<br>Erosion leading to contamination of water ways.<br>Unsuccessful revegetation | 4 | 3 | 7 | Landform is assessed as geotechnically stable by a suitably qualified geotechnical engineer | Proposed landform is to be gently sloping, limiting potential for erosion. Little earthworks will be required to achieve profile. | 2 | 3 | 5 | Landform will be reshaped until stability is achieved. |
| | Contaminated material not fully encapsulated in the WRD | Contamination of land and water resources | 3 | 4 | 7 | Contaminated land assessment will be undertaken prior to shaping. | Assessment will identify if any contaminated materials is exposed on the WRD. | 3 | 3 | 6 | Ongoing rehabilitation monitoring will identify presence of previously unidentified contaminants. Any contamination will be |

| Rehabilitation Milestone | Hazard | Potential Impact | Risk Rating | | | Risk Controls | Justification of controls | Residual Risk Rating | | | Remedial Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | investigated and further contaminated land sampling/ removal will be conducted as required. |
| RM6 Landform development and reshaping (RA4) | Final landform not adequately shaped per design. | Reduced safety or instability of landform.<br>Erosion leading to contamination of water ways.<br>Unsuccessful revegetation. | 4 | 3 | 7 | Landform is assessed as geotechnically stable by a suitably qualified geotechnical engineer | Proposed landform is to be gently sloping, limiting potential for erosion. Little earthworks will be required to achieve profile. | 2 | 3 | 5 | Landform will be reshaped until stability is achieved. |
| RM7 Landform development and reshaping (RA5) | Final landform not adequately shaped per design. | Reduced safety or instability of landform.<br>Erosion leading to contamination of water ways. | 4 | 3 | 7 | Landform is assessed as geotechnically stable by a suitably qualified geotechnical engineer | Landform will be assessed as stable prior to achievement of PMLU | 2 | 3 | 5 | Landform will be reshaped until stability is achieved. |
| RM8 Surface preparation | Insufficient topsoil | Erosion<br>Unsuccessfully revegetation<br>Cost of repeating | 4 | 3 | 7 | Topsoil will be selectively placed at high risk areas in 5m wide sections. | High risk areas will received more intense treatment. | 3 | 3 | 6 | Ongoing erosion and vegetation monitoring will |

| Rehabilitation Milestone | Hazard | Potential Impact | Risk Rating | | | Risk Controls | Justification of controls | Residual Risk Rating | | | Remedial Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | landform reshaping and surface preparation. | | | | Additional topsoil will obtained from an external source if required. | | | | | guide management interventions. Additional topsoil or ameliorants will be applied as required. |
| | Inappropriate topsoil management whilst stockpiled | Reduced viability of topsoil, limiting plant establishment at rehabilitated sites. Topsoil infested with weed propagules, which will invade rehabilitated sites. | 3 | 2 | 5 | Topsoil is managed as per existing site procedures. Topsoil is recorded in the Topsoils Register and is inspected regularly. | Site has established processes to minimise risk. | 2 | 2 | 4 | Topsoil will be inspected prior to application. Any contaminated topsoil will not be used for rehabilitation. |
| | Vehicles contaminated with weed seeds used for earthworks. | Weeds invading rehabilitated sites, inhibiting the establishment of desirable species and preventing achievement of RM11 and RM12. | 3 | 2 | 5 | Vehicles will be inspected prior to entering site. Vehicles will be cleaned in the site washdown bay if weeds or seeds are identified. | Site has established processes to minimise risk. | 2 | 2 | 4 | A weed treatment program will be implemented, if required. |
| | Heavy rainfall occurring | Loss of topsoil | 3 | 2 | 5 | Earthworks will be | The area has | 2 | 2 | 4 | Rehabilitation |

| Rehabilitation Milestone | Hazard | Potential Impact | Risk Rating | | | Risk Controls | Justification of controls | Residual Risk Rating | | | Remedial Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | prior to establishment of vegetative cover. | Siltation of downstream waterways.<br>Failure of vegetation to establish on eroded surfaces.<br>Cost of reapplying topsoil to eroded surfaces | | | | completed during the dry season.<br>Earthworks will be scheduled progressively so that areas are exposed for the least amount of time possible. | established wet/dry seasons and works can be scheduled. | | | | monitoring will guide corrective action (reseeding, etc) as required. |
| RM9 Revegetation (native ecosystem) | Natural revegetation unsuccessfully | Inability to meet RM11 and RM13 | 3 | 2 | 5 | Areas will be monitored annually, for 5 years, and seeded if natural vegetation is unsuccessful | Annual monitoring will allow early detection if seeded is required. | 2 | 2 | 4 | Rehabilitation monitoring will guide corrective action (reseeding, etc) as required. |
| RM10 Revegetation (grazing) | Natural revegetation unsuccessful | Inability to meet RM12 and RM14 | 3 | 2 | 5 | Areas will be monitored annually, for 5 years, and seeded if natural vegetation is unsuccessful | Annual monitoring will allow early detection if seeded is required. | 2 | 2 | 4 | Apply seed as required. |
| | Heavy rain immediately after seeding. | Loss of topsoil.<br>Siltation of downstream waterways.<br>Failure of vegetation to | 3 | 2 | 5 | Low slope gradient in landform design to limit capacity for sediment loss. | The area has established wet/dry seasons and works can | 2 | 2 | 4 | Rehabilitation monitoring will guide corrective |

| Rehabilitation Milestone | Hazard | Potential Impact | Risk Rating | | | Risk Controls | Justification of controls | Residual Risk Rating | | | Remedial Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | establish on eroded surfaces.<br>Cost of reapplying topsoil and seed to eroded surfaces. | | | | Surface preparation and sowing is not to take place if heavy rain (>40 mm) is forecast over any one day within the next fortnight. | be scheduled taking this into account. | | | | action (reseeding, etc) as required. |
| | Drought over the first months after planting. | Poor seedling survival and establishment.<br>Increased exposure of bare soil leading to erosion | 3 | 2 | 5 | Planting is to take place in the early wet season, when probability of further rain during seedling establishment is high. | The area has established wet/dry seasons and works can be scheduled taking this into account. | 2 | 2 | 4 | Rehabilitation monitoring will guide corrective action (reseeding, etc) as required. |
| | Vehicles and/or footwear contaminated with weed seeds | Weeds invading rehabilitated sites, inhibiting the establishment of desirable species and preventing achievement of RM9 and RM11. | 3 | 2 | 5 | Vehicles will be inspected prior to entering site.<br>Vehicles will be cleaned in the site washdown bay if weeds or seeds are identified. | The site has established controls. | 2 | 2 | 4 | A weed treatment program will be implemented, if required. |
| | Intruding livestock. | Grazing could lead to poor seedling establishment. | 2 | 2 | 4 | Areas will be fenced to allow vegetation to establish. | PMLU is for native habitat so cattle will be | 1 | 2 | 3 | Rehabilitation monitoring will guide |

| Rehabilitation Milestone | Hazard | Potential Impact | Risk Rating | | | Risk Controls | Justification of controls | Residual Risk Rating | | | Remedial Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | excluded. | | | | corrective action (reseeding, etc) as required. |
| RM11 Achievement of surface requirements (native ecosystem) | Weed species dominating native species | Weeds spreading to other rehabilitation areas.<br>Outcompeting native species<br>Cost of treatment<br>Delay in achieving RM | 3 | 2 | 5 | Annual monitoring to identify high risk areas.<br>Weed treatment completed early to minimise outbreak | The site has established controls. | 2 | 2 | 4 | A weed treatment program will be implemented, if required. |
| | Revegetation unsuccessful | Erosion<br>Potential weed recruitment<br>Delay in achieving RM<br>Cost of additional seeding | 3 | 3 | 6 | Annual monitoring to high risk areas.<br>Seeding to occur if revegetation is not successful | Annual monitoring will allow early detection if seeded is required. | 2 | 3 | 5 | Rehabilitation monitoring will guide corrective action (reseeding, etc) as required. |
| | Significant erosion | Loss of topsoil.<br>Siltation of downstream waterways.<br>Failure of vegetation to establish on eroded surfaces. | 3 | 2 | 5 | Low slope gradient in landform design to limit capacity for sediment loss.<br>Annual monitoring to identify high risk | Monitoring will allow early identification and intervention. | 2 | 2 | 4 | Rehabilitation monitoring will guide corrective action (topsoilling |

| Rehabilitation Milestone | Hazard | Potential Impact | Risk Rating | | | Risk Controls | Justification of controls | Residual Risk Rating | | | Remedial Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cost of reapplying topsoil and seed to eroded surfaces. | | | | areas | | | | | etc) as required. |
| RM12 Achievement of surface requirements (grazing) | Weed species dominating native species | Weeds spreading to other rehabilitation areas.<br>Outcompeting native species<br>Cost of treatment<br>Delay in achieving RM | 3 | 2 | 5 | Annual monitoring to identify high risk areas.<br>Weed treatment completed early to minimise outbreak | Monitoring will allow early identification and intervention | 2 | 2 | 4 | A weed treatment program will be implemented, if required. |
| | Revegetation unsuccessful | Erosion<br>Potential weed recruitment<br>Delay in achieving RM<br>Cost of additional seeding | 3 | 3 | 6 | Annual monitoring to high risk areas.<br>Seeding to occur if revegetation is not successful | Annual monitoring will allow early detection if seeded is required. | 2 | 3 | 5 | Rehabilitation monitoring will guide corrective action (reseeding, etc) as required. |
| | Significant erosion | Loss of topsoil.<br>Siltation of downstream waterways.<br>Failure of vegetation to establish on eroded surfaces.<br>Cost of reapplying topsoil and seed to | 3 | 2 | 5 | Low slope gradient in landform design to limit capacity for sediment loss.<br>Annual monitoring to identify high risk areas | Monitoring will allow early identification and intervention. | 2 | 2 | 4 | Rehabilitation monitoring will guide corrective action (topsoilling etc) as required. |

| Rehabilitation Milestone | Hazard | Potential Impact | Risk Rating | | | Risk Controls | Justification of controls | Residual Risk Rating | | | Remedial Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | eroded surfaces. | | | | | | | | | |
| | Intruding livestock. | Grazing could lead to poor seedling establishment. | 3 | 2 | 5 | Areas will be fenced until RM12 is achieved. | Fencing will limit cattle access. | 2 | 2 | 4 | Rehabilitation monitoring will guide corrective action (reseeding, etc) as required. |
| RM13 Achievement of post mining land use to a stable condition (native ecosystem) | Weed species dominating native species | Weeds spreading to other rehabilitation areas.<br>Outcompeting native species<br>Cost of treatment<br>Delay in achieving RM | 3 | 2 | 5 | Annual monitoring to identify high risk areas.<br>Weed treatment completed early to minimise outbreak | Monitoring will allow early identification and intervention | 2 | 2 | 4 | A weed treatment program will be implemented, if required. |
| | Revegetation unsuccessful | Erosion<br>Potential weed recruitment<br>Delay in achieving RM<br>Cost of additional seeding | 3 | 3 | 6 | Annual monitoring to high risk areas.<br>Seeding to occur if revegetation is not successful | Annual monitoring will allow early detection if seeded is required. | 2 | 3 | 5 | Rehabilitation monitoring will guide corrective action (reseeding, etc) as required. |
| | Significant erosion | Loss of topsoil.<br>Siltation of downstream | 3 | 2 | 5 | Low slope gradient in landform design to | Monitoring will allow early | 2 | 2 | 4 | Rehabilitation monitoring will |

| Rehabilitation Milestone | Hazard | Potential Impact | Risk Rating | | | Risk Controls | Justification of controls | Residual Risk Rating | | | Remedial Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | waterways.<br>Failure of vegetation to establish on eroded surfaces.<br>Cost of reapplying topsoil and seed to eroded surfaces. | | | | limit capacity for sediment loss.<br>Annual monitoring to identify high risk areas | identification and intervention. | | | | guide corrective action (topsoilling etc) as required. |
| RM14 Achievement of post mining land use to a stable condition (grazing) | Weed species dominating native species | Weeds spreading to other rehabilitation areas.<br>Outcompeting native species<br>Cost of treatment<br>Delay in achieving RM | 3 | 2 | 5 | Annual monitoring to identify high risk areas.<br>Weed treatment completed early to minimise outbreak | Monitoring will allow early identification and intervention | 2 | 2 | 4 | A weed treatment program will be implemented, if required. |
| | Revegetation unsuccessful | Erosion<br>Potential weed recruitment<br>Delay in achieving RM<br>Cost of additional seeding | 3 | 3 | 6 | Annual monitoring to high risk areas.<br>Seeding to occur if revegetation is not successful | Annual monitoring will allow early detection if seeded is required. | 2 | 3 | 5 | Rehabilitation monitoring will guide corrective action (reseeding, etc) as required. |
| | Significant erosion | Loss of topsoil.<br>Siltation of downstream waterways.<br>Failure of vegetation to | 3 | 2 | 5 | Low slope gradient in landform design to limit capacity for sediment loss. | Monitoring will allow early identification and intervention. | 2 | 2 | 4 | Rehabilitation monitoring will guide corrective |

| Rehabilitation Milestone | Hazard | Potential Impact | Risk Rating | | | Risk Controls | Justification of controls | Residual Risk Rating | | | Remedial Measures |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | establish on eroded surfaces.<br>Cost of reapplying topsoil and seed to eroded surfaces. | | | | Annual monitoring to identify high risk areas | | | | | action (topsoilling etc) as required. |
| | Landform doesn't support grazing | Delay in achieving PMLU. | 3 | 4 | 7 | Annual monitoring to determine trajectory of vegetation establishment.<br>Re-seeding as required. | PMLU is consistent with surrounding land use.<br>Monitoring will allow early identification and intervention. | 2 | 4 | 6 | Rehabilitation monitoring will guide corrective action (seeding, etc) as required |
| RM15 Achievement of post mining land use to a stable condition (water storage) | Water quality exceeds guideline values for stock watering | Costly water removal or treatment<br>Failure to meet PMLU | 3 | 3 | 6 | Ongoing monitoring during operations to maintain pit water quality. | Monitoring will identify emerging risks well before rehabilitation activities commence. | 2 | 3 | 5 | Treat water as required. |

# 11. Monitoring and Maintenance

## 11.1 Rehabilitation Milestone Monitoring

The achievement of early rehabilitation milestones (RM1 – RM8) will be demonstrated by the monitoring described in Table 16. A detailed monitoring program has been developed to assess achievement of RM9 – RM15. This program is described below.

## 11.2 Monitoring Program

A Monitoring and Maintenance Program has been developed for the Project in accordance with Section 3.8 of the PRC Plan Guideline. The objective of the monitoring program is to evaluate the progress of rehabilitation towards fulfilling the rehabilitation criteria as well as to implement adaptive management techniques and interventions as required. The program will:

- Compare monitoring results against rehabilitation milestone criteria
- Determine the trajectory of rehabilitation success
- Identify areas for improvement
- Compare rehabilitation areas to analogue sites
- Assess effectiveness of environmental controls
- Assess vegetation health
- Identify areas where seeding or the application of fertilizers/ameliorants may be required
- Assess existing and potential erosion
- Assess native fauna species diversity and the effectiveness of habitat creation for target fauna species.

The success of rehabilitated areas will be determined by continued progression, stability, and self-sustainability, with analogue sites providing a comparative basis. Rehabilitated areas are expected to reach the same landscape functionality as a given analogue sites.

### 11.2.1 Establishment of Reference sites

Analogue sites will be used to compare rehabilitation success with regard to groundcover, carrying capacity, weed proportion and species mix. Analogue sites will be established for each PMLU. Analogue sites will be recorded using GIS and signposted to prevent disturbance during operational activities.

Monitoring of analogue sites will be completed using the same monitoring methods employed at rehabilitation areas, as described below. Monitoring will be completed biannually, in the wet and dry seasons, for the first five years of sites being established. Following this, this monitoring program will be reviewed, and the frequency may be adjusted as required.

### 11.2.2 Monitoring Schedule

Initial monitoring will occur approximately 12 months after revegetation has commenced has been completed to observe the success, identify risks, and develop baseline data. Monitoring will be ongoing, and the timing of the programs will take into consideration potential seasonal and long-term weather influences.

The creeks and drainage lines at Agate Creek are ephemeral therefore inhibiting the ability to collect and assess surface water samples within fixed timings. Resultingly, surface water monitoring will be undertaken at nominated points when available and accessible.

### 11.2.3 Desktop Monitoring

Desktop monitoring will be completed prior to on-site monitoring work. Using LiDAR and aerial imagery, an understanding of the following can be gained:

- Assessing landform design through a Digital Elevation Slope Model;
- Potential erosion areas to be confirmed during field surveys;
- Representative locations to establish permanent monitoring plots in respect to the rehabilitation slope, PMLUs, and accessibility.

An erosion monitoring program will be developed, focusing on areas with high erosion potential, such as final landforms with steep slopes.

### 11.2.4 Landform and Erosion

Desktop monitoring will determine high risk areas to focus landform and erosion monitoring. Assessments completed for early milestones will also be considered when developing the land and erosion monitoring plan.

### 11.2.5 Soil

Soil monitoring will be conducted for all mining domains except for residual voids. A soil monitoring program will be developed for Agate Creek, and will aim to:

- Optimise rehabilitation processes;
- Accurately measure utilisation of stockpile storage and soil reuse; and
- Optimise stockpile management and reuse.

Samples will be acquired, and soil profiles logged by an appropriately qualified person, and analysed at an accredited laboratory. Analytes proposed to be tested are detailed in Table 37.

**Table 37. Analysis Parameters for the Soil Monitoring Program**

| Parameter | Purpose | | | Monitoring phase | |
|---|---|---|---|---|---|
| | | Topsoil | Subsoil | Initial | Major |

| | | | | | |
|---|---|---|---|---|---|
| pH | Identify variations that may inhibit plant growth and sustainability. | x | x | x | x |
| EC and Chloride | Identify areas that may inhibit germination and establishment. | x | x | x | x |
| Exchangeable cations | Links to soil stability, fertility, nutrient availability, and structure. | x | x | x | x |
| Organic carbon | Indicates soil nutrient stores and soil structure. Variations can indicate successfulness. | x | | x | x |
| Major elements including N, P, K, S, Ca, and Mg. | Indicator of nutrients and potential for runoff or acid Metalliferous drainage. | x | | x | x |
| Trace elements including Mn, Fe, Zn, and Cu | All are important to the vegetation success. | x | | x | x |
| Metals | Metals that have been identified as occurring at elevated levels during material characterisation should be tested for during monitoring. | x | x | x | x |
| Physical parameters | Soil texture and other characteristics will affect water entry and storage as well as impact on erosion, dispersion, and success. | x | x | x | |
| Field analysis | Gain an understanding of soil profile characteristics for interpretation purposes. | x | x | x | |

### 11.2.6 Vegetation

Vegetation monitoring methods will be based on the BioCondition Assessment Framework for Terrestrial Biodiversity in Queensland Assessment Manual (Queensland Herbarium, 2015).

Acceptance criteria are rehabilitation performance goals presented as criterion completion scores for relevant attributes of vegetation. They provide measures: to which rehabilitation progress can be compared to determine success of the rehabilitation; to identify the need for intervention and management actions; and by which rehabilitated land is deemed to be complete.

Preliminary completion criteria are presented in Table 38. Completion criteria will be finalised based on results from monitoring at reference sites over the course of operations.

**Table 38 Completion Criteria Summary**

| Criterion | Completion Score |
|---|---|
| T1 Height | 70% of reference site |

| | |
|---|---|
| Total Native Tree Species | 70% of reference site |
| Shrub Species Richness | 70% of reference site |
| Grass Species Richness | 70% of reference site |
| Forbes and Other Species Richness | 70% of reference site |
| Non-native Plant Cover (%) | <10% |
| Native Perennial Grass Cover (%) | 70% of reference site |
| Native Forbes and Other Species Cover (%) | 70% of reference site |
| Native Shrubs Cover (%) | 25% of reference site |
| Non-native Grass Cover (%) | <10% |
| Non-native Forbes and Other Species Cover (%) | <10% |
| Litter (%) | 80% of reference site |
| Canopy | 50% of reference site |
| Subcanopy | 25% of reference site |
| Total Canopy | 70% of reference site |
| Shrub | 70% of reference site |
| Stems/hectare (tree) | 70% of reference site |
| Stems/hectare (shrub | 70% of reference site |
| Stems/hectare (eucalypt) | <10% |

### 11.2.7 Surface Waters

Surface waters will continue to be monitored at locations nominated in the REMP. The ANZECC Livestock Guideline values will continue to be utilised to provide parameters and trigger limits for surface waters at Agate Creek as detailed in Table 39. Pit water quality will be monitored throughout rehabilitation.

**Table 39.Surface Water Trigger Limits**

| Parameter | Trigger Value (Low Risk) (mg/L) |
|---|---|
| Aluminium | 5 |
| Arsenic | 0.5 up to 5 |
| Boron | 5 |
| Cadmium | 0.01 |
| Chromium | 1 |

| | |
|---|---|
| Cobalt | 1 |
| Copper | 1 |
| Fluoride | 2 |
| Lead | 0.1 |
| Mercury | 0.002 |
| Molybdenum | 0.15 |
| Nickel | 1 |
| Selenium | 0.02 |
| Uranium | 0.2 |
| Zinc | 20 |
| Calcium | 1000 |
| Nitrate and Nitrite | 400 |
| Sulfate | 1000 |
| Total Dissolved Solids (TDS) | 5000 |

### 11.2.8 Groundwater

Groundwater will continue to be monitored on a quarterly basis. Water quality results will be compared to ANZECC/ARMCANZ Table for livestock drinking water.

## 11.3 Analysis, Recording, and Reporting

All actions will occur in accordance with relevant Queensland Guidelines including the Queensland Monitoring and Sampling Manual. This includes appropriately qualified personnel collecting and analysing the samples and data. The data will be analysed to identify trends, changes, anomalies, and to track progress. Throughout the process, the data and achievements will be assessed against the milestone criteria; remedial actions will occur where necessary.

The relevant data will be stored and processed within internal geospatial and document management systems.

## 11.4 Quality Assurance

All staff undertaking monitoring and reporting activities will be suitably qualified for that task. QA/QC methodologies will be followed and acted upon should breaches in QA/QC procedures occur.

Samples collected will be sent to NATA accredited laboratory ALS Environmental Townsville for analysis. For surface water and groundwater samples, at a minimum, for every 10 sites sampled, one field blank, travel blank, and duplicate sample will be taken.

Results from this monitoring program will provide information for future and post-mine closure monitoring requirements.

The monitoring and maintenance allows for a repetitive execution-verification-monitoring QA/QC approach to ensure rehabilitation areas progress and achieve the milestone criteria.

## 11.5 Review

This Plan will be reviewed by an SQP should an amendment to the PRCP be made or under timed renewal of the PRCP. In the context of monitoring, a review of the plan must consider:

- Environmental performance;
- Rehabilitation objectives and indictors;
- Environmental inspection outcomes;
- Changes in relevant legislation, policy and guidelines;
- Changes in the mine plan; and
- Rehabilitation completion criteria.

## 11.6 EA Relinquishment

Prior to certification of progressive rehabilitation for part of Agate Creek, or acceptance of EA surrender for part or the whole of the Agate Creek tenure, DES must be satisfied with the rehabilitation. The decision is based on either a final rehabilitation report (section 264 of the EP Act) for the whole tenure or a part being surrendered, or a progressive rehabilitation report for part of Agate Creek (section 318Z of the EP Act).

The Proponent is required to prepare either of the above, including a compliance statement, and submit to DES for assessment. Relevant rehabilitation requirements (section 318Z or section 268 of the Ep Act) will be considered by DES when deciding whether to certify progressive rehabilitation or to approve surrender application. A post-relinquishment plan will also need to be developed by the proponent to assist with ongoing land management beyond the surrender of the Agate Creek tenure

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# Appendix A: PRCP Schedule

| Post-mining land uses (PMLU) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Rehabilitation area** | RA1 | | | | | | | | | |
| **Relevant activities** | Open cut pits 1-4 | | | | | | | | | |
| **Total rehabilitation area size (ha)** | 3.83 | | | | | | | | | |
| **Commencement of first milestone: <insert milestone reference>** | 10/12/2035 | | | | | | | | | |
| **PMLU** | Native ecosystem | | | | | | | | | |
| **Date area is available** | 10/12/35 | 1/01/37 | 1/01/42 | 1/01/47 | | | | | | |
| **Cumulative area available (ha)** | | | | | | | | | | |
| **Milestone completed by** | 10/12/36 | 10/12/41 | 10/12/46 | 10/12/51 | | | | | | |
| **Milestone Reference** | **Cumulative area achieved (ha)** | | | | | | | | | |
| **RM3** | 3.83 | | | | | | | | | |
| **RM9** | | 3.83 | | | | | | | | |
| **RM11** | | | 3.83 | | | | | | | |
| **RM13** | | | | 3.83 | | | | | | |

| Post-mining land uses (PMLU) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Rehabilitation area** | RA2 | | | | | | | | | |
| **Relevant activities** | Open cut pits 5-6 | | | | | | | | | |
| **Total rehabilitation area size (ha)** | 5.1 | | | | | | | | | |
| **Commencement of first milestone: <insert milestone reference>** | 10/12/2035 | | | | | | | | | |
| **PMLU** | Water storage | | | | | | | | | |
| **Date area is available** | 10/12/35 | 1/01/37 | | | | | | | | |
| **Cumulative area available (ha)** | | | | | | | | | | |
| **Milestone completed by** | 10/12/36 | 10/12/41 | | | | | | | | |
| **Milestone Reference** | **Cumulative area achieved (ha)** | | | | | | | | | |
| **RM4** | 5.1 | | | | | | | | | |
| **RM15** | | 5.1 | | | | | | | | |

| Post-mining land uses (PMLU) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Rehabilitation area** | RA3 | | | | | | | | | |
| **Relevant activities** | Waste rock dumps | | | | | | | | | |
| **Total rehabilitation area size (ha)** | 25.88 | | | | | | | | | |
| **Commencement of first milestone: <insert milestone reference>** | 10/12/2035 | | | | | | | | | |
| **PMLU** | Native ecosystem | | | | | | | | | |
| **Date area is available** | 10/12/35 | 1/01/37 | 1/01/42 | 1/01/47 | | | | | | |
| **Cumulative area available (ha)** | | | | | | | | | | |
| **Milestone completed by** | 10/12/36 | 10/12/41 | 10/12/46 | 10/12/51 | | | | | | |
| **Milestone Reference** | **Cumulative area achieved (ha)** | | | | | | | | | |
| **RM5** | 25.88 | | | | | | | | | |
| **RM8** | 25.88 | | | | | | | | | |
| **RM9** | | 25.88 | | | | | | | | |
| **RM11** | | | 25.88 | | | | | | | |
| **RM13** | | | | 25.88 | | | | | | |

| Post-mining land uses (PMLU) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Rehabilitation area** | RA4 | | | | | | | | | |
| **Relevant activities** | Mine Infrastructure Area | | | | | | | | | |
| **Total rehabilitation area size (ha)** | 13.93 | | | | | | | | | |
| **Commencement of first milestone: <insert milestone reference>** | 10/12/2025 | | | | | | | | | |
| **PMLU** | Low intensity grazing | | | | | | | | | |
| **Date area is available** | 10/12/25 | 1/01/27 | 1/01/28 | 1/01/33 | 1/01/38 | | | | | |
| **Cumulative area available (ha)** | 13.93 | 13.93 | 13.93 | 13.93 | 13.93 | | | | | |
| **Milestone completed by** | 10/12/26 | 10/12/27 | 10/12/32 | 10/12/37 | 10/12/42 | | | | | |
| **Milestone Reference** | **Cumulative area achieved (ha)** | | | | | | | | | |
| **RM1** | 13.93 | | | | | | | | | |
| **RM2** | 13.93 | | | | | | | | | |
| **RM6** | | 13.93 | | | | | | | | |
| **RM8** | | 13.93 | | | | | | | | |
| **RM10** | | | 13.93 | | | | | | | |
| **RM12** | | | | 13.93 | | | | | | |
| **RM14** | | | | | 13.93 | | | | | |

| Post-mining land uses (PMLU) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Rehabilitation area** | RA5 | | | | | | | | | |
| **Relevant activities** | Water Storages | | | | | | | | | |
| **Total rehabilitation area size (ha)** | 6.49 | | | | | | | | | |
| **Commencement of first milestone: <insert milestone reference>** | 10/12/2025 | | | | | | | | | |
| **PMLU** | Low intensity grazing | | | | | | | | | |
| **Date area is available** | 10/12/25 | 1/01/27 | 1/01/32 | | | | | | | |
| **Cumulative area available (ha)** | 6.49 | 6.49 | 6.49 | | | | | | | |
| **Milestone completed by** | 10/12/26 | 10/12/31 | 10/12/36 | | | | | | | |
| **Milestone Reference** | **Cumulative area achieved (ha)** | | | | | | | | | |
| **RM1** | 6.49 | | | | | | | | | |
| **RM2** | 6.49 | | | | | | | | | |
| **RM7** | | 6.49 | | | | | | | | |
| **RM15** | | | 6.49 | | | | | | | |

| Post-mining land uses (PMLU) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Rehabilitation area** | RA6 | | | | | | | | | |
| **Relevant activities** | Exploration | | | | | | | | | |
| **Total rehabilitation area size (ha)** | 3.34 | | | | | | | | | |
| **Commencement of first milestone: <insert milestone reference>** | 10/12/2025 | | | | | | | | | |
| **PMLU** | Low intensity grazing | | | | | | | | | |
| **Date area is available** | 10/12/25 | 1/01/27 | 1/01/32 | 1/01/37 | | | | | | |
| **Cumulative area available (ha)** | 3.34 | 3.34 | 3.34 | 3.34 | | | | | | |
| **Milestone completed by** | 10/12/26 | 10/12/31 | 10/12/36 | 10/12/41 | | | | | | |
| **Milestone Reference** | **Cumulative area achieved (ha)** | | | | | | | | | |
| **RM1** | 3.34 | | | | | | | | | |
| **RM2** | 3.34 | | | | | | | | | |
| **RM8** | 3.34 | | | | | | | | | |
| **RM10** | | 3.34 | | | | | | | | |
| **RM12** | | | 3.34 | | | | | | | |
| **RM14** | | | | 3.34 | | | | | | |

# Appendix B: Waste Rock Characterisation (C&R Consulting, 2022)

C&R CONSULTING
Geochemical & Hydrobiological Solutions Pty Ltd
ABN 72 077 518 784

*Underground Coal Gasification / Coal Seam Gas Investigations*
*Mineralogical, Geological, Petrographic and Soils Services*
*Hydrogeomorphic and Palaeogeomorphic Evaluations*
*Terrestrial and Aquatic Fauna and Flora Surveys*
*Climate History and Extreme Events Analysis*
*Contaminated Site and Mine Water Analysis*
*Environmental Compliance and Monitoring*
*Estuarine and Marine Water Assessments*
*Registered Research and Development*
*Surface and Groundwater Hydrology*

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# AGATE CREEK GOLD MINE



## Waste Rock Characterisation

Report Prepared for:

WULGURU TECHNICAL SERVICES

Date:
August 2022

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Dr Chris Cuff
Director

18 August 2022
Date



Dr Cecily Rasmussen
Director

18 August 2022
Date

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7. The report reflects both the information provided to C&R Consulting in documents made available for review and the results of observations and consultations by C&R Consulting staff.

# SUMMARY OF RELEVANT INFORMATION

| | |
|---|---|
| Project Title | Agate Creek Gold Mine – Waste Rock Characterisation |
| Property Location | Agate Creek Gold Mine |
| Property Description | Open-cut gold mine |
| Project Purpose | Conduct a geochemical waste rock characterisation study to support the major environmental authority amendment for the Agate Creek Gold Mine |
| Project Number | 21108 |
| Client's Details | |
| Nominated Representative | Scott Hayes-Stanley |
| Title/Position | Director |
| Company | Wulguru Technical Services |
| Telephone | +61 437 799 193 |
| Email | scott@wulgurutechservices.com.au |
| Author's Details | |
| Primary Author | Alexander Barnes |
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| Experience | $20^{+}$ years of mining experience |
| Affiliations | Member of Australasian Institute of Mining and Metallurgy |

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# EXECUTIVE SUMMARY

C&R Consulting Pty Ltd (C&R) were commissioned by Wulguru Technical Services (WTS) to undertake a geochemical waste rock characterisation (WRC) study of the Agate Creek Gold Mine (Agate Creek). This study will form part of the major environmental authority (EA) amendment and progressive rehabilitation and closure plan that WTS are currently preparing on behalf of Agate Creek's current owners, Laneway Resources.

In accordance with the Queensland Department of Environment and Science (DES, 2021) *Guideline – Progressive rehabilitation and closure plans (PRC plans)*, this WRC study has been undertaken to:

*"Characterise mine wastes in a report that describes the likely physical behaviour and chemical reactivity of the waste materials under the conditions in which they would be stored. The report must address the constituent elements present, and their likely future speciation and mobility."*

To achieve this, 260 rock samples were collected from 27 drill holes across the six proposed open-cut pits. These samples were tested in a National Association of Testing Authorities accredited laboratory for a range of static and kinetic geochemical properties, including acid generation, salinity, major ions and metal/metalloid concentrations.

The undertaken geochemical testing identified that all of the waste rock samples have similar physical and geochemical characteristics. This is to be expected given that most waste rock areas are constructed of the same lithology (volcaniclastic sediment).

The static geochemical results indicate that all waste rock areas:

- Are overwhelmingly non-acid forming, with 90% of the waste rock considered NAF with the potential to buffer any acid that is produced;
- Display low salinity values (mean of 43.5 µS/cm);
- Have some degree of fluoride enrichment; and
- Are not particularly enriched with respect to any of the other elements analysed.

The kinetic geochemical results compared well with the static results, indicating a level chemical stability.

Overall, the waste rock associated with the project is relatively benign and considered of very low to low risk of environmental harm.

# 1. INTRODUCTION

## 1.1 BACKGROUND INFORMATION

C&R Consulting Pty Ltd (C&R) have been asked to undertake a geochemical waste rock characterisation (WRC) study of the Agate Creek Gold Mine (Agate Creek) stage 2 expansion, on behalf of Wulguru Technical Services (WTS). This study will form part of a major environmental authority (EA) amendment and progressive rehabilitation and closure plan (PRCP) that WTS are currently preparing on behalf of Agate Creek's current owners, Laneway Resources (Laneway).

Agate Creek is located in north Queensland, approximately 340 km (520 km by road) west of Townsville and 45 km (70 km by road) south of the township of Forsayth (Figure 1). Alluvial gold was reported at Agate Creek in the early 20th century, and was followed by various prospecting activities – including panning, shallow digs and regional exploration.

In February 2015, Laneway lodged a mining lease application for the Agate Creek prospect following a successful 5,000 tonne bulk trial pit. Mining lease (ML) 100030 was granted to Laneway on 7 February 2019, allowing Laneway to mine up to 250,000 tonnes of ore at Agate Creek under EA EPSL03068015 (dated 6 September 2021).

Laneway intends to progress Agate Creek into the stage 2 expansion phase, requiring approval to mine up to 250,000 tonnes of ore and a major EA amendment. In accordance with the Queensland Department of Environment and Science (DES, 2021) *Guideline – Progressive rehabilitation and closure plans (PRC plans)*, a WRC assessment should be undertaken to accompany the major EA amendment submission.

## 1.2 SCOPE OF WORK

The PRCP guideline (DES, 2021) outlines the WRC reporting requirement:

*"Characterise mine wastes in a report that describes the likely physical behaviour and chemical reactivity of the waste materials under the conditions in which they would be stored. The report must address the constituent elements present, and their likely future speciation and mobility."*

In order to characterise the mine wastes as per the PRCP guideline, this investigation employed the following scope of works:

- Review existing geological and geochemical data;
- Design a sampling programme to be undertaken as part of the Agate Creek open-cut exploration, reverse-circulation (RC) drilling programme;
- Collate, validate and statistically analyse geochemical test results from a National Association of Testing Authorities (NATA) accredited laboratory;
- Compile a WRC dataset to consider waste rock drainage characteristics and the potential environmental risks these may pose; and
- Conduct a WRC study to provide supporting evidence for the rehabilitation requirements to support the submission of the Agate Creek major EA amendment.

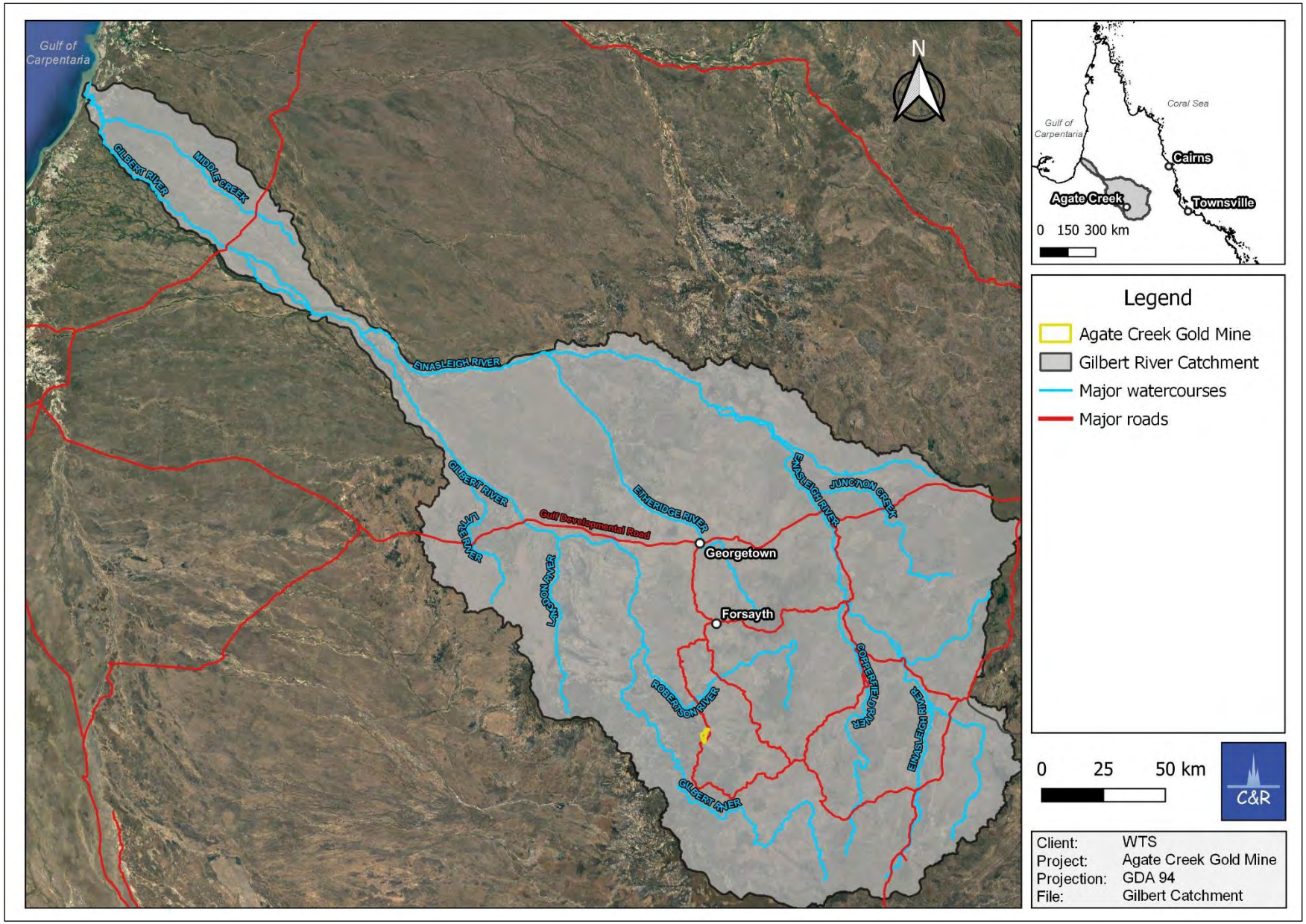



**Figure 1: Project site location.**

# 2. SITE DESCRIPTION

Agate Creek is an open-cut gold mining operation located within the Etheridge Shire in north Queensland, within the Gilbert River Basin that flows into the Gulf of Carpentaria (Figure 1). Trial mining commenced at Agate Creek in 2013, with a transition to full-scale production occurring in 2019. All mining activities undertaken at Agate Creek are permitted under the current EA EPSL03068015 (dated 6 September 2021).

## 2.1 CLIMATE

Agate Creek is located within the seasonally arid tropics, with the area dominated by intense rainfall events throughout the summer months. These rainfall events are often highly variable in their spatial and temporal distribution, with the majority of the rain falling in distinct, spatially separated cells across the landscape. Rainfall throughout the remainder of the year is generally limited to an occasional shower in June or July and evaporation tends to exceed rainfall for almost all days of the year, with the exception of periods with intense rainfall events. The Agate Creek operations are exposed to this seasonal rainfall, whereby it is expected that more than 90% of the rainfall will eventuate as either surface runoff or waste dump seepage.

## 2.2 GEOLOGY

The Agate Creek deposit is located in the central portion of the Proterozoic Etheridge Province. These Proterozoic Etheridge metamorphic rocks were extensively intruded by Silurian to Early Devonian granitoid batholiths, and dominantly felsic Carboniferous to Early Permian magmatic complexes (Morrison *et al.*, 2019). The mineralisation at Agate Creek is related to the emplacement of Permo-Carboniferous porphyritic rhyolite and andesite extrusives and intrusives, commonly referred to as the Agate Creek Volcanic Group.

Gold mineralisation at Agate Creek is hosted by a low sulphidation, epithermal system consisting of quartz-chalcedony veining, stockwork and breccia. Host rock lithology is predominantly porphyritic rhyolite or andesite that occupy shallow, south-east dipping thrust faults in Silurian granodiorite (Morrison *et al.*, 2019). This host rock is principally volcanic in origin. Therefore, for the purpose of this WRC study, the waste rock is inferred to be entirely composed of the same unit: felsic volcanics with silicified veins and/or breccia.

A series of complex hydrothermal alteration assemblages surround the Agate Creek ore body. These assemblages range from a distal, ubiquitous propylitic zone (chlorite +/- carbonate-epidote-pyrite-haematite) grading inwards to a more proximal, variably argillic to sericitic zone (clay +/- quartz-sericite-pyrite) and locally phyllic zone (silica +/- pyrite or iron oxide) (Morrison *et al.*, 2019). Most of the hydrothermal alteration in the Agate Creek expansion area is predominantly clay +/- silica, sericite and/or pyrite (now weathered to iron oxide). Therefore, alteration was not considered a significant factor in this WRC study.

## 2.3 PROPOSED OPEN-CUT PITS

### 2.3.1 STAGE 2 EXPANSION

The stage 2 expansion of the Agate Creek mine involves mining six different open-cut pits (Figure 2). The mine is currently working Pit 6 under the current EA that allows up to 200,000 tonnes of material to be extracted. However, further approval is required to mine Pit 6 deeper – exceeding the 200,000 tonnes limit – as well mining an additional five satellite pits. This proposed Agate Creek stage 2 expansion comprises 3,774,081 tonnes of waste rock material.

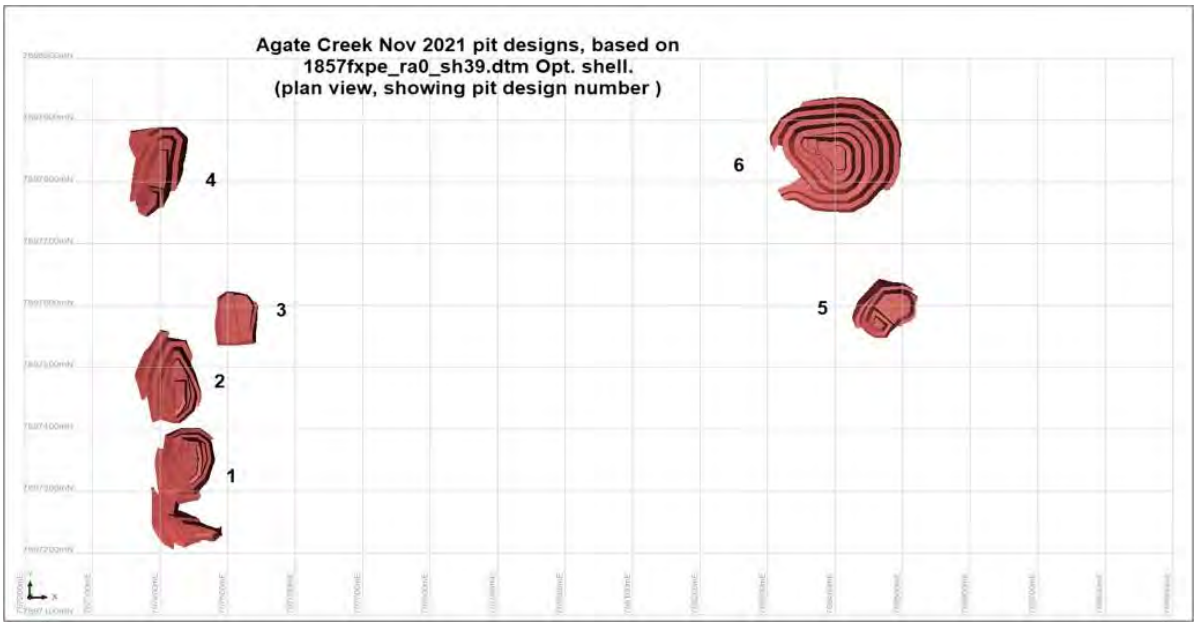



**Figure 2: Pit designs for the proposed Agate Creek stage 2 expansion. Figure sourced from WTS.**

## 2.4 WASTE CHARACTERISATION SAMPLING STRATEGY

The waste rock sampling programme for the six proposed open-cut pits was guided by the Australian technical guidelines for the geochemical assessment of mining wastes (Department of Mines and Energy [DME], 1995; Department of Environment and Heritage Protection [DEHP], 2013; Commonwealth of Australia [COA], 2016). The DME (1995) guideline recommends that the tonnage of mined material determine the sampling interval, whereas the more recent guidelines favour a risk-based approach.

The waste characterisation sampling strategy for the Agate Creek stage 2 expansion open-cut pits incorporated the collection of samples from regular intervals (every 3 m) in selected RC drill holes. These selected drillholes were chosen to represent a cross-section of the rock profile in each proposed open-cut pit (Figure 3 to Figure 8).

Figure 9 demonstrates that sampling was undertaken at regular intervals in the selected RC drill holes. The interval spacing was selected to cover all areas anticipated to have acid rock drainage (ARD) potential – including around the ore bodies, alteration zones, transitional material and fresh rock. This sampling methodology was adopted with the aim to provide a good statistical and spatial representation of the waste rock profile in each pit.

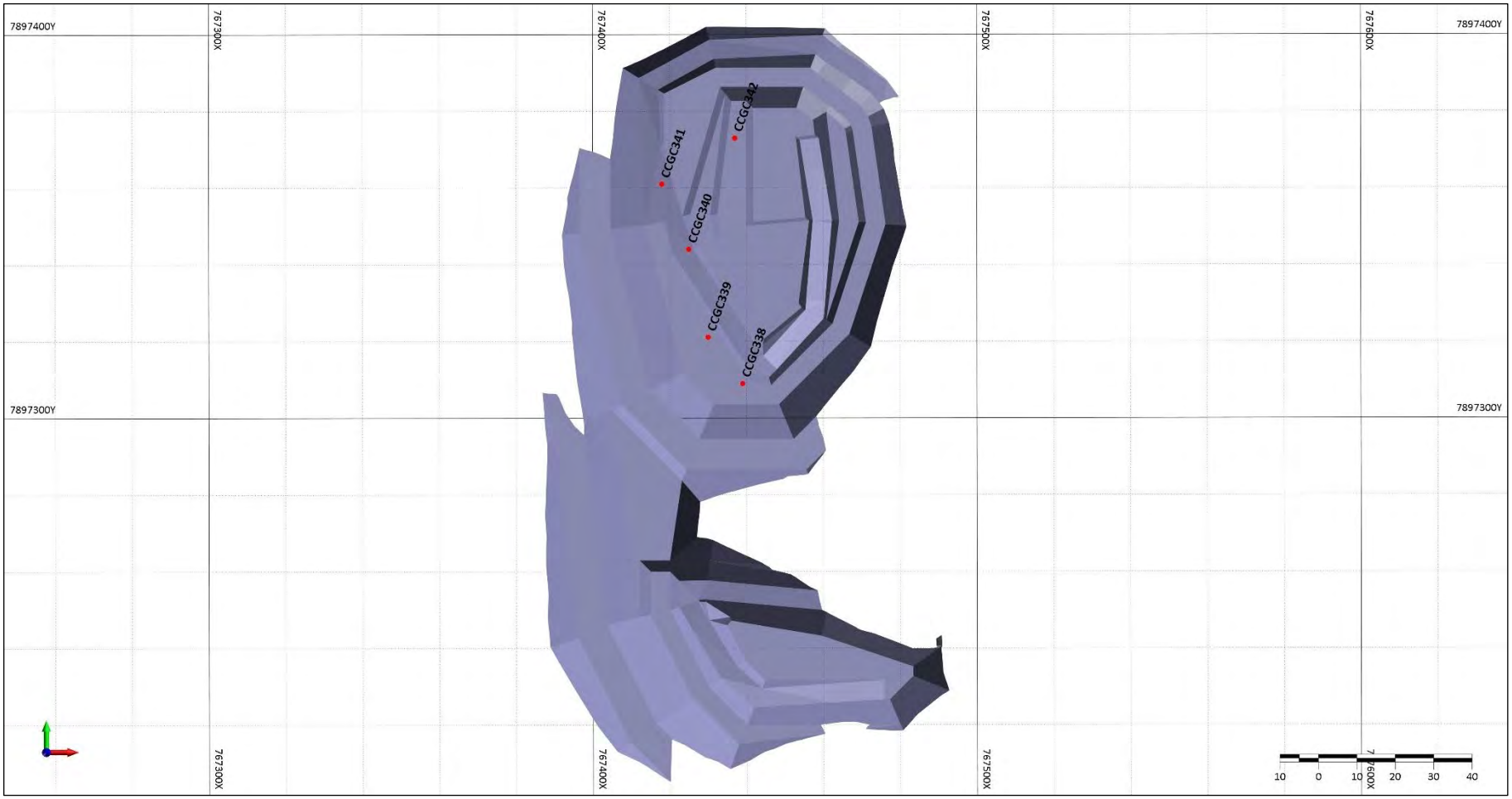



**Figure 3: Location of exploration drill holes sampled in Pit 1.**

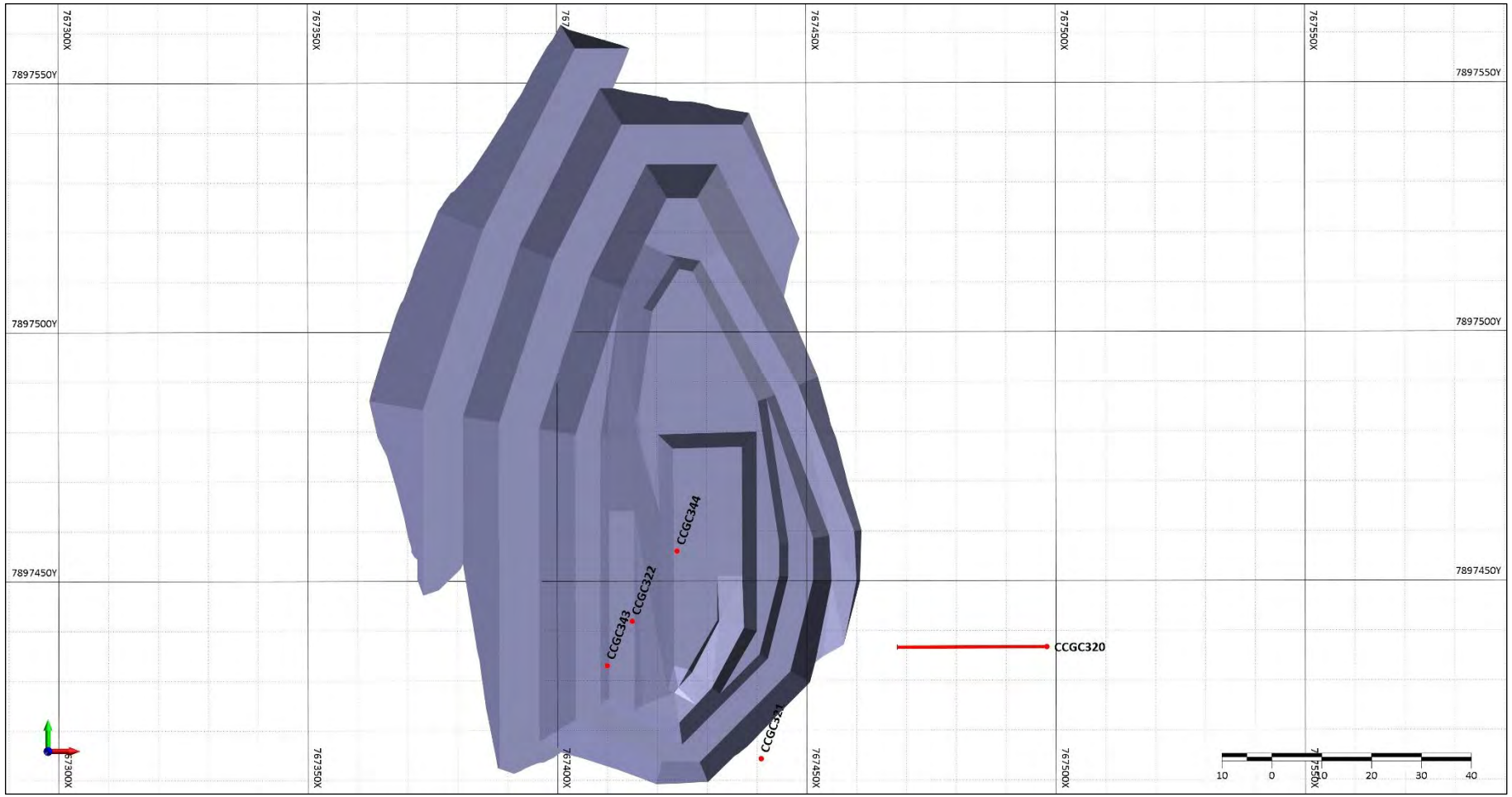



**Figure 4: Location of exploration drill holes sampled in Pit 2.**

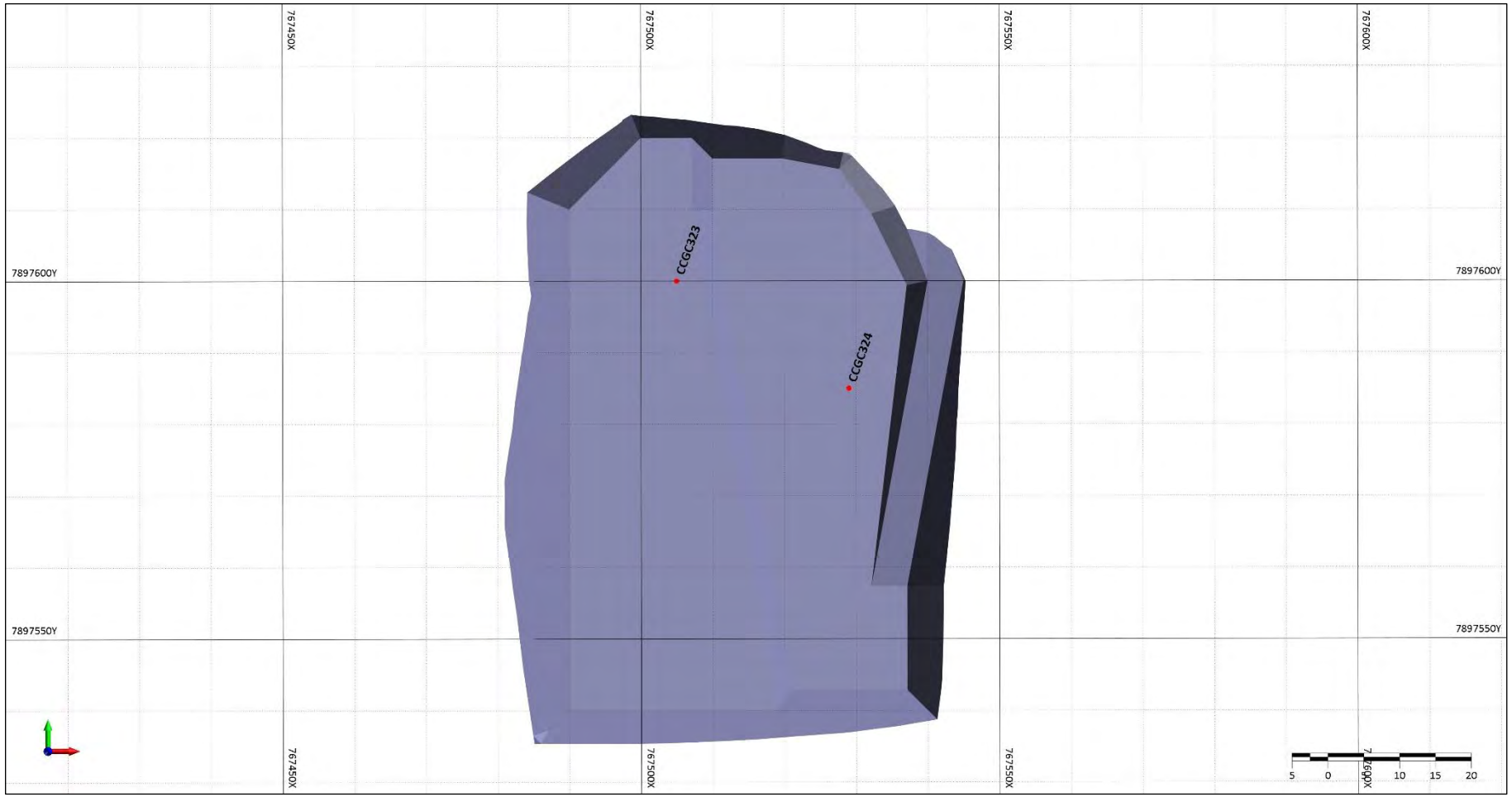



**Figure 5: Location of exploration drill holes sampled in Pit 3.**

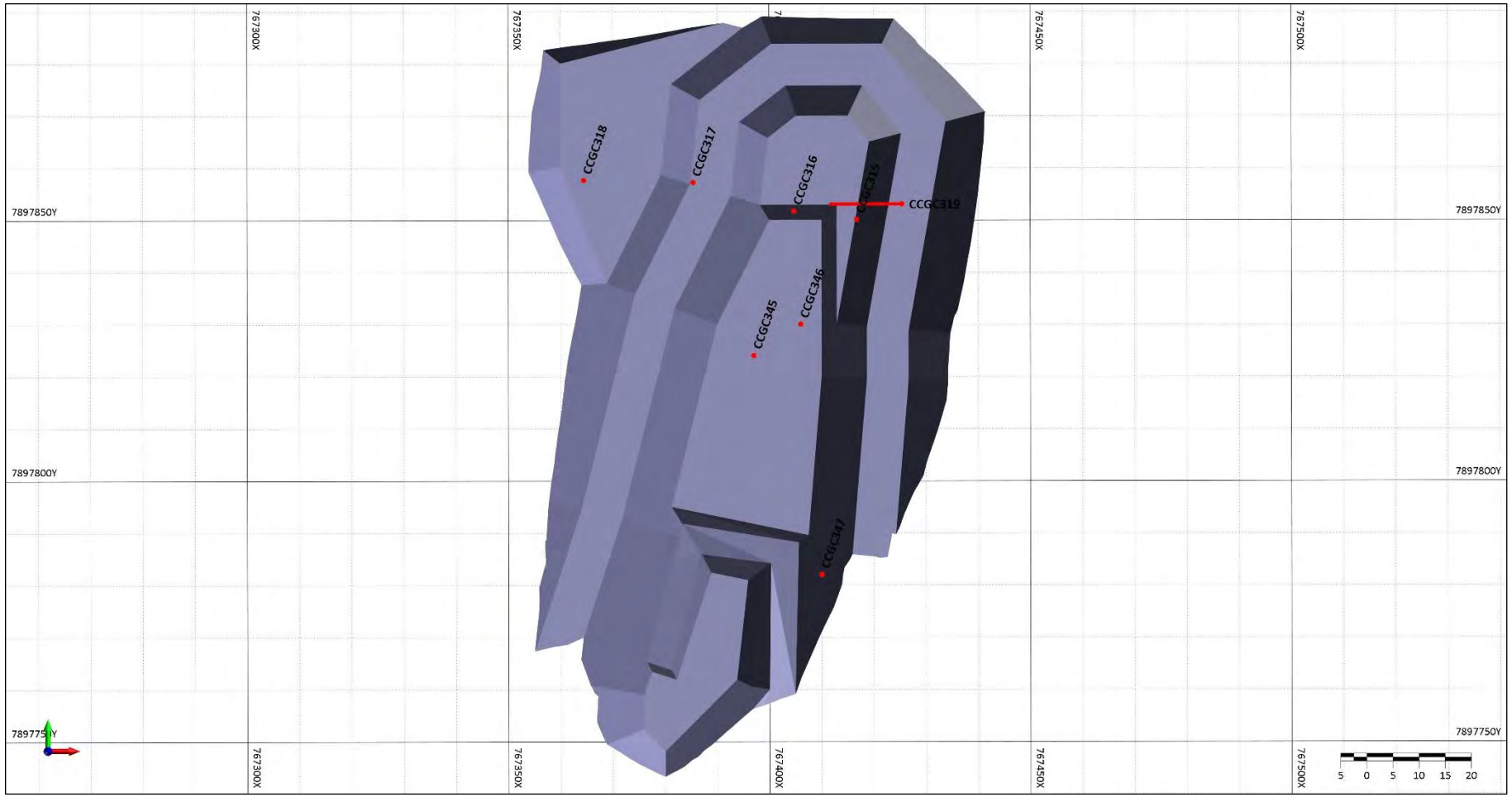



**Figure 6: Location of exploration drill holes sampled in Pit 4.**

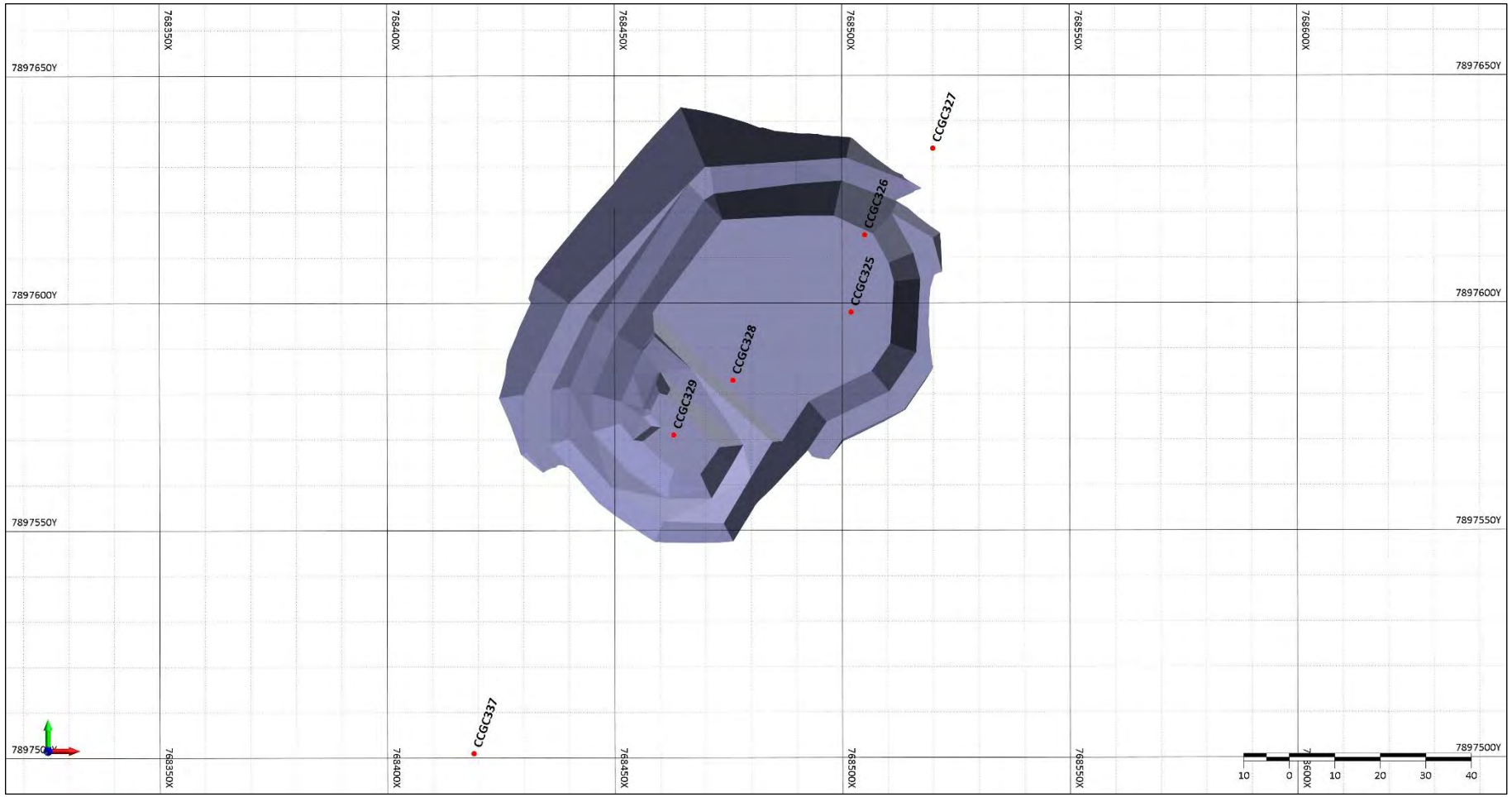



**Figure 7: Location of exploration drill holes sampled in Pit 5.**

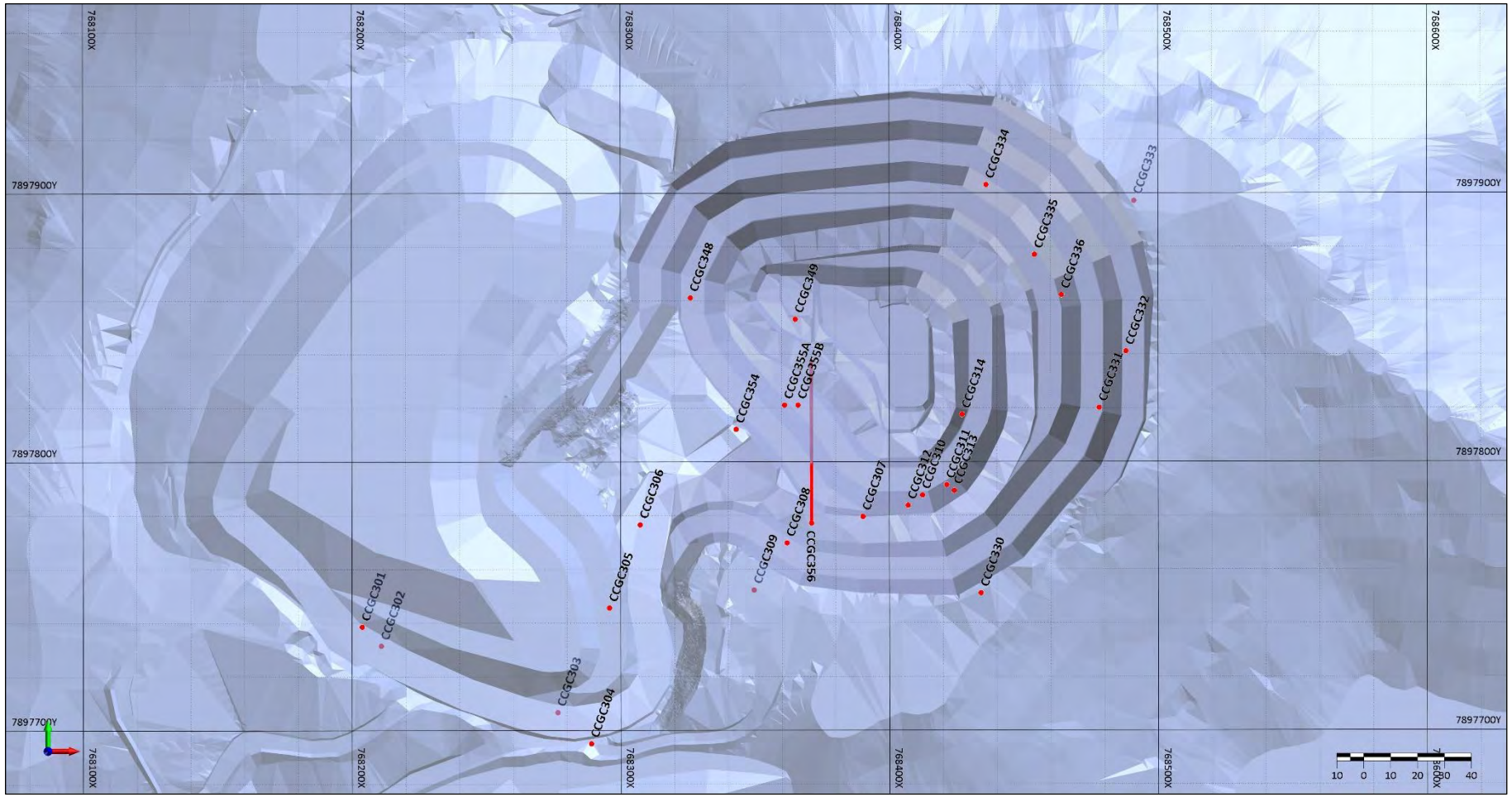



**Figure 8: Location of exploration drill holes sampled in Pit 6.**

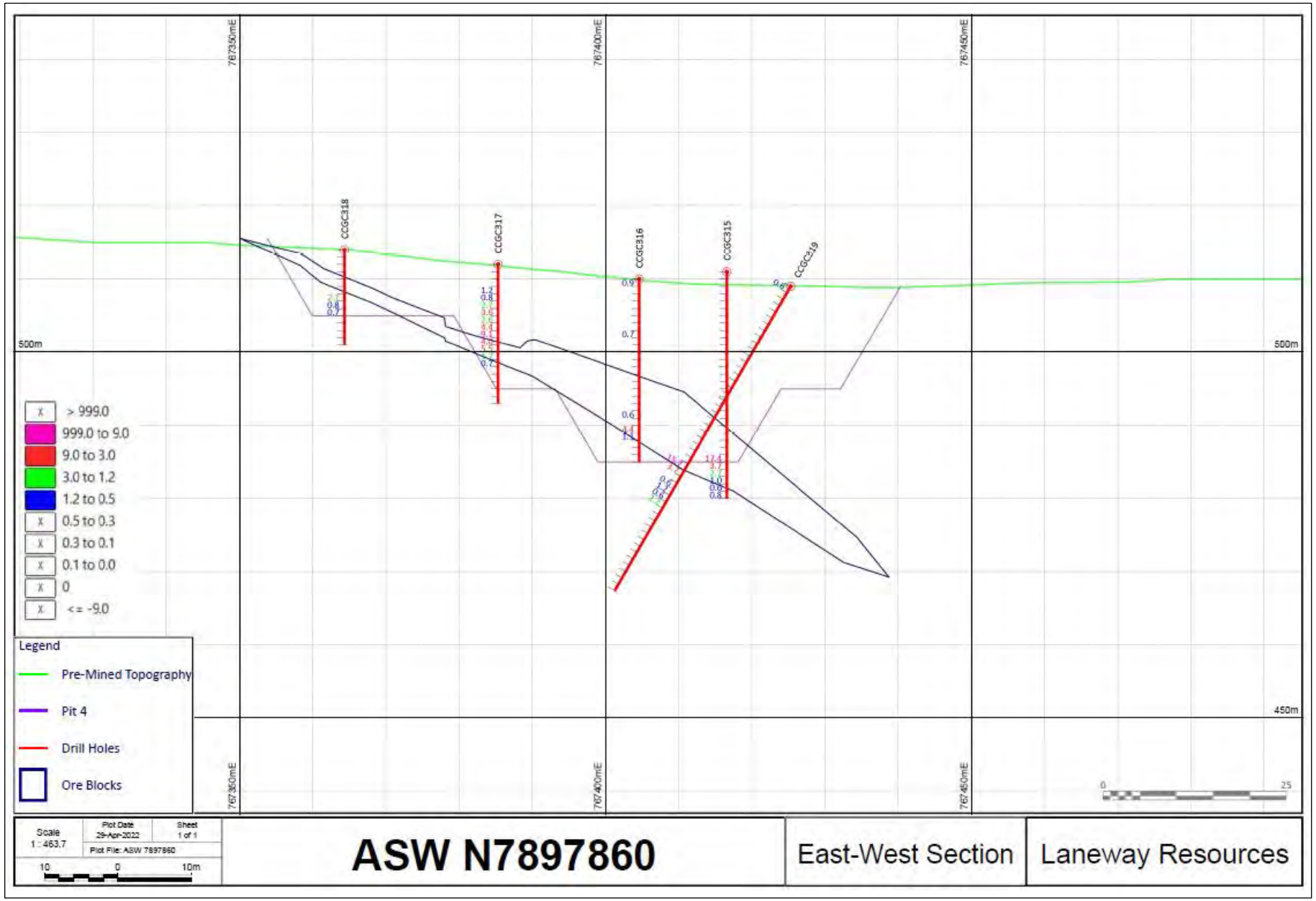



**Figure 9: Sample selection example.**

# 3. METHODS

## 3.1 SAMPLING PROGRAMME

A total of 260 rock samples were collected from 27 drill holes across the six proposed pits. The samples represent the rock type (felsic volcanics) and provide a reasonable distribution of alteration zones and weathering types (oxide, transitional and fresh). The 260 rock samples were taken at regular intervals (generally every 3 m) from select exploration holes (Table 1). Discussions with on-site geologists revealed that it was difficult to accurately determine where the targeted ore occurred within each exploration hole due to the varying ore grades – encountered throughout each hole – that have the potential to be utilised in the future. Therefore, all analysed samples were included in the assessment/investigation to provide a worst-case scenario (because it contains the highly mineralised ore body) characterisation of potential waste rock (Table 1).

Each sample consists of RC chip material collected by Laneway geological personnel at the exploration drilling rig, utilising a cyclone splitter attachment. Laneway provided bulk sample bags for each metre of each exploration hole to a NATA-accredited laboratory. The NATA-accredited laboratory then split the required samples for geochemical analysis. The minimum amount of sample collected (during the split) was 250 g for static tests, with more than 25 kg gathered for kinetic test work.

**Table 1: Summary of samples taken across the proposed pits.**

| Proposed pit | Waste tonnes | Number of holes | Hole ID | Number of samples | Number of samples/pit |
|---|---|---|---|---|---|
| Pit 1 | 750,195 | 4 | CCGC338 | 7 | 22 |
| | | | CCGC339 | 1 | |
| | | | CCGC340 | 7 | |
| | | | CCGC341 | 7 | |
| Pit 2 | 348,570 | 3 | CCGC321 | 9 | 22 |
| | | | CCGC343 | 7 | |
| | | | CCGC344 | 6 | |
| Pit 3 | 51,627 | 2 | CCGC323 | 5 | 14 |
| | | | CCGC324 | 9 | |
| Pit 4 | 229,591 | 5 | CCGC316 | 9 | 34 |
| | | | CCGC319 | 11 | |
| | | | CCGC345 | 7 | |
| | | | CCGC346 | 1 | |
| | | | CCGC347 | 6 | |
| Pit 5 | 157,318 | 2 | CCGC326 | 7 | 18 |
| | | | CCGC329 | 11 | |
| Pit 6 | 2,236,780 | 11 | CCGC302 | 3 | 150 |
| | | | CCGC303 | 9 | |

| Proposed pit | Waste tonnes | Number of holes | Hole ID | Number of samples | Number of samples/pit |
|---|---|---|---|---|---|
| | | | CCGC306 | 11 | |
| | | | CCGC308 | 11 | |
| | | | CCGC309 | 1 | |
| | | | CCGC311 | 21 | |
| | | | CCGC334 | 6 | |
| | | | CCGC336 | 1 | |
| | | | CCGC349 | 14 | |
| | | | CCGC354 | 25 | |
| | | | CCGC356 | 48 | |
| **Total** | **3,774,081** | **27** | **-** | **260** | **260** |

## 3.2 GEOCHEMICAL CHARACTERISATION

The geochemical test work was based on industry-recognised procedures for the geochemical characterisation and assessment of mine waste (AMIRA, 2002; The International Network for Acid Prevention [INAP], 2014; COA, 2016).

### 3.2.1 STATIC TESTS

Static geochemical tests provide information on the bulk geochemical characteristics of samples at a single point in time. They do not provide information on rates of chemical processes – or the release rates due to weathering processes.

All 260 samples dispatched to the ALS laboratory underwent static geochemical testing to evaluate the risk associated with the potential oxidation of sulphides, acid generation, and the presence of metals/metalloids and salts.

Each sample underwent static geochemical testing for:

- pH;
- Electrical conductivity (EC);
- Total sulphur;
- Acid neutralising capacity (ANC);
- Net acid generation (NAG);
- Net acid production potential (NAPP);
- Major dissolved anions for Cl, F and $SO_4$; and
- Total metals/metalloids for Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se, V and Zn.

Furthermore, four selected kinetic leach column samples (refer to Section 3.2.2) underwent additional static geochemical testing for:

- Moisture content;
- Major dissolved cations for Ca, Mg, Na and K; and
- Total metals/metalloids for Mo, Sb, Te, Th, Tl and U.

All static geochemical results are provided in Appendix A.

### 3.2.2 KINETIC LEACH COLUMN TESTS

Kinetic leach column (KLC) tests accelerate the weathering of samples and provide information on the magnitude and/or effects of dynamic processes that result from weathering. Unlike static tests, KLC tests measure the varying geochemical characteristics of sample effluent over a prolonged period of time.

Four samples were dispatched to a NATA-accredited laboratory for KLC tests: one from Pit 1, one from Pit 4 and two from Pit 6. These large KLC samples (>25 kg) represent a considerable proportion of the waste rock profile of each pit (Table 2).

**Table 2: Summary of the KLC samples taken across the proposed pits.**

| Proposed Pit | Borehole | Composite samples | Interval |
|---|---|---|---|
| Pit 1 | CCGC339 | V34619 – V34636 | 0 – 21.6 metres |
| Pit 4 | CCGC346 | V34745 – V34762 | 0 – 21.6 metres |
| Pit 6 | CCGC309 | V32228 – V32258 | 0 – 31.0 metres |
| | CCGC336 | V34048 – V34117 | 0 – 70.0 metres |

Individual leach columns were set up for each of the four samples, with a leachate-analysis cycle undertaken on a fortnightly basis.

Each kinetic leachate column underwent kinetic geochemical testing for:

- pH;
- EC;
- Total dissolved solids (calculated);
- Hardness;
- Acidity;
- Alkalinity;
- Major cations for Ca, Mg, Na and K;
- Major anions for Cl, F and $SO_4$; and
- Dissolved metals/metalloids for Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mo, Mn, Ni, Pb, Sb, Se, Te, Th, U, V and Zn.

All kinetic geochemical results are provided in Appendix B.

# 4. GEOCHEMICAL RESULTS

## 4.1 ACID BASE ACCOUNT

### 4.1.1 pH VALUE

The pH value of the 260 waste rock samples ranged from slightly acidic (4.5) to slightly basic (8.8), with a neutral median pH value of 6.7. The standard deviation (SD) of the dataset is 1.0. In general, most waste rock samples are in the neutral range (Figure 10). However, slightly acidic samples are also prevalent, indicative of the waste rock lithology (largely felsic volcanics).

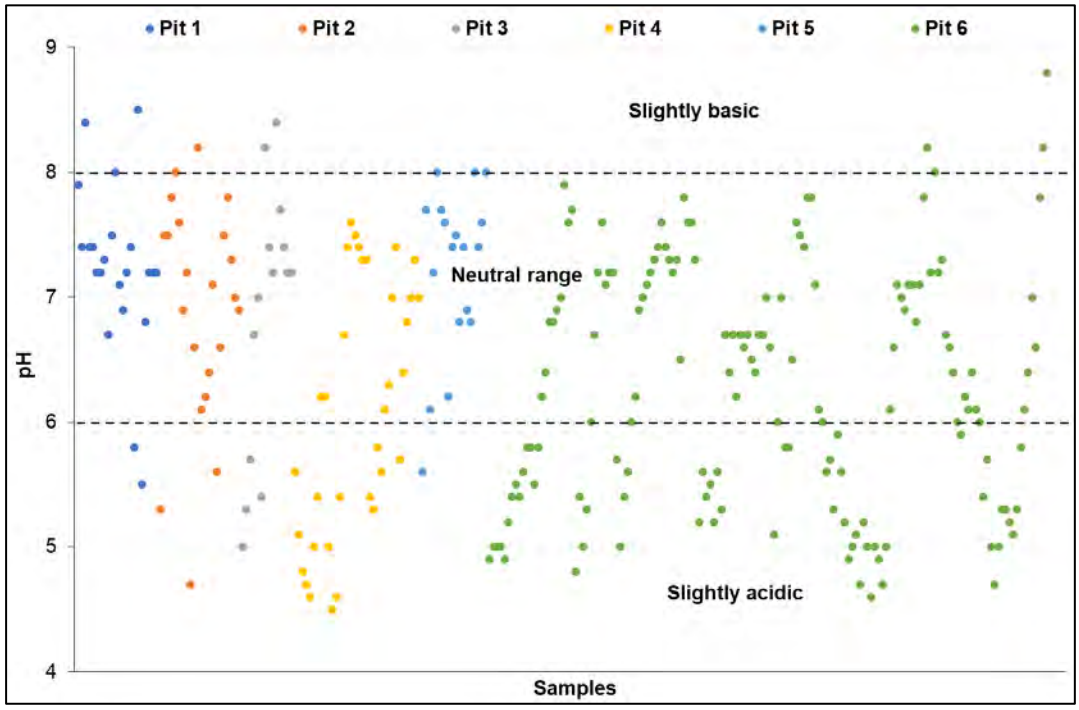



**Figure 10: pH values for Agate Creek waste rock samples.**

Because of the method of testwork (i.e. fluid extract from crushed samples, with a very high surface area to solution ratio), it is expected that both the low and high pH results in the waste rock are a worst-case scenario. Therefore, it is envisaged that the pH of runoff from the proposed open-cut pits waste rock will not be as low or high as that reflected in the waste rock sample test results. Also, in order for significant runoff to occur at Agate Creek, the rainfall dilution factor would be expected to be greater than the 1:5 (sample:water) ratio used in the extract solutions for analysis. This, in turn, would counteract the resulting acidity or alkalinity.

### 4.1.2 ELECTRICAL CONDUCTIVITY (EC)

The EC of the 260 Agate Creek waste rock samples ranges from 7 µS/cm to 1,680 µS/cm and has a very low median value of 43.5 µS/cm. Most Agate Creek waste rock samples have low EC values (<300 µS/cm). Apart from an outlier in Pit 2 (1,680 µS/cm), EC values in all waste rock samples are below 500 µS/cm (Figure 11).

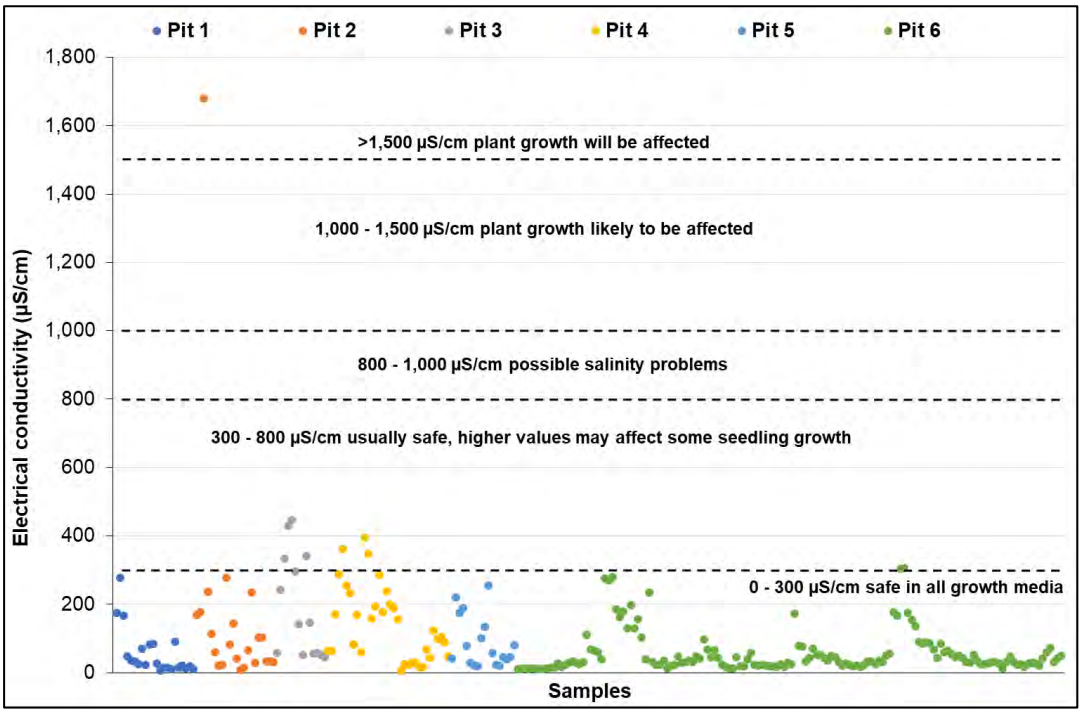



**Figure 11: Electrical conductivity for Agate Creek waste rock samples.**

### 4.1.3 TOTAL SULPHUR

The total sulphur (measured by LECO method) of the 260 Agate Creek waste rock samples ranged from <0.01% (i.e. below the limit of reporting [BLOR]) to 3.05%. The median is extremely low, with most samples BLOR. Most of the Agate Creek waste rock is therefore barren (<0.1%) with respect to total sulphur (Figure 12). Except for one value each in Pit 2 (3.05%) and Pit 6 (1.01%), all values above the barren level (i.e. >0.1%) are still classified as very low (<0.55%).

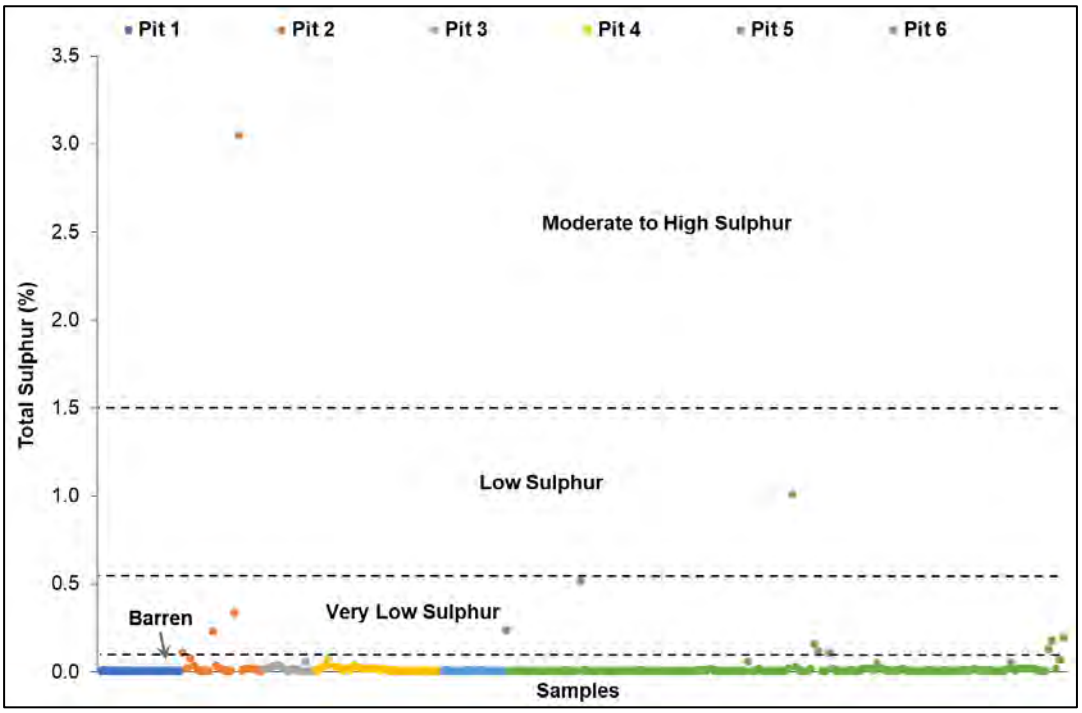



**Figure 12: Total sulphur concentration for Agate Creek waste rock samples.**

### 4.1.4 MAXIMUM POTENTIAL ACIDITY

Maximum potential acidity (MPA) is the maximum amount of acid that can be produced by the oxidation of sulphur-bearing minerals in the waste rock material. MPA is calculated from the total sulphur content. The MPA – that could be generated by the 260 Agate Creek waste rock samples – ranges from 0.15 to 93.3 kg $H_2SO_4$/t and has a low median value of 0.15 kg $H_2SO_4$/t.

### 4.1.5 ACID NEUTRALISING CAPACITY (ANC)

ANC is related to the amount of acid neutraliser (usually carbonate minerals) in the waste rock sample. ANC is determined experimentally by reacting a standardised acid mixture with a known amount of waste rock sample – and is reported as kg $H_2SO_4$/t eq. (equivalent). The ANC of the 260 Agate Creek waste rock samples ranges from 0.25 to 28.0 kg $H_2SO_4$/t eq., with a low median of 3.0 kg $H_2SO_4$/t eq.

### 4.1.6 ANC:MPA RATIO

The ANC:MPA ratio can assist in classifying the potential for waste rock samples to generate acid.

Generally speaking – and depending on the mineralogy – a sample with an ANC:MPA ratio below 1 is likely to be acid forming because it contains more acid-generating than acid-neutralising minerals. Samples with an ANC:MPA ratio of ≥1 but ≤2 have a degree of uncertainty and represent a potential risk, whereas samples with an ANC:MPA ratio of >2 are generally low risk. However, there are exceptions because samples with an MPA of <3.1 kg $H_2SO_4$/t are considered to contain insufficient acid-forming potential (i.e. they are barren). Conversely, samples with an MPA of >3.1 but <10 kg $H_2SO_4$/t would, at worst, be classified as low capacity, potentially acid-forming (PAF) material (Figure 13).

The 260 Agate Creek waste rock samples have an ANC:MPA ratio ranging from 0.08 to 183.01, with a median value of 11.93. According to these ANC:MPA ratios, with respect to acid-generation:

- 204 samples are considered to be of negligible to low risk;
- 41 samples are deemed to be a potential risk; and
- 15 samples are regarded as an increased risk.

This is because the low and negligible risk samples contain more acid-neutralising than acid-generating minerals, whereas the potential and increased risk samples contain more acid-generating than acid-neutralising minerals.

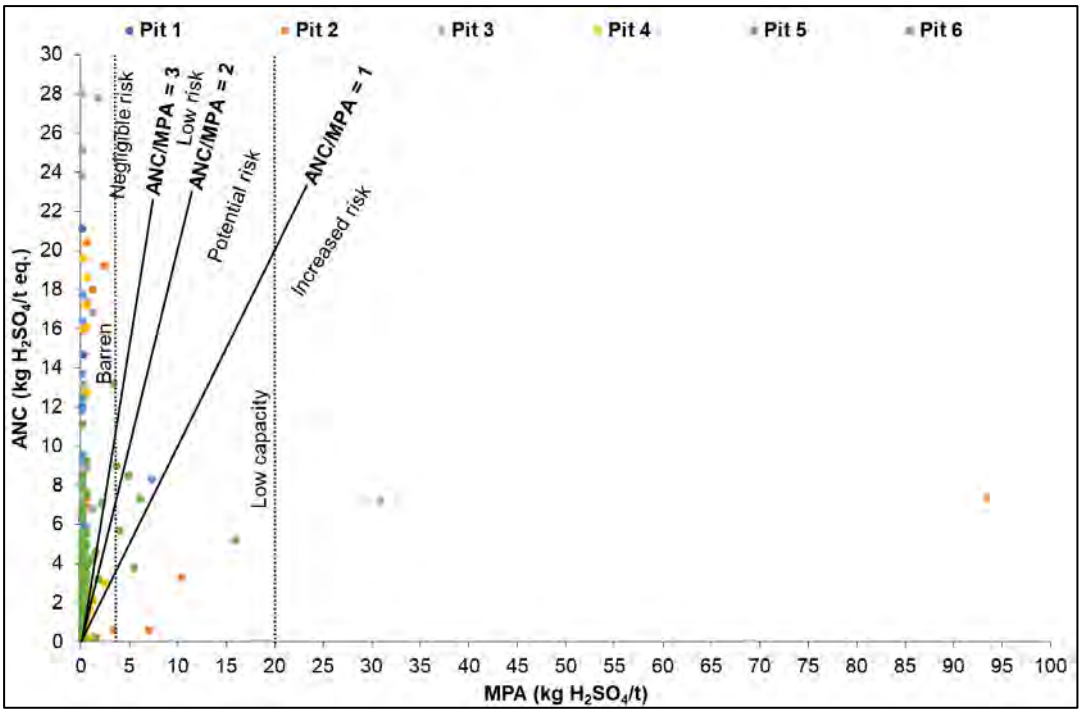



**Figure 13: MPA versus ANC for Agate Creek waste rock samples.**

### 4.1.7 NET ACID PRODUCTION POTENTIAL (NAPP)

NAPP is a theoretical calculation of the net acid producing (or consuming) value of a rock sample.

Generally speaking, samples with a negative NAPP value are non-acid forming (NAF), and those with a positive NAPP value are PAF. Miller (1997) provides further categorisation of waste rock material based on the magnitude of the NAPP value (Table 3).

**Table 3: NAPP classification categories.**

| ARD Classification | NAPP Value (kg $H_2SO_4$/t) |
|---|---|
| Potentially acid forming (PAF) | > 10 |
| Uncertain | 0 to 10 |
| Non-acid forming (NAF) | -50 to 0 |
| Acid consuming material | < -50 |

Of the 260 waste rock samples, 45 have positive NAPP values. However, most of these positive samples are in the uncertain range, with only three samples having values greater than 10. These are associated with either Pit 2 or Pit 6.

## 4.2 NET ACID GENERATION (NAG) TEST

The NAG test is used to directly measure the net amount of acid produced by a waste rock sample.

Generally speaking, samples with a $NAG_{(pH)}$ (oxidised pH) below 4.5 may be acid generating and samples with a $NAG_{(pH)}$ equal or greater than 4.5 (≥4.5) are unlikely to be acid producing. However, the NAG test does not estimate acid neutralisation potential. Therefore, AMIRA (2002) recommends the combined use of the NAPP values and the NAG results for a more detailed classification of acid generation.

Figure 14 demonstrates that most Agate Creek waste rock samples have a $NAG_{(pH)}$ of at least 4.5 and a NAPP value below 0. Therefore, they are not acid generating. In contrast, five samples has a negative NAPP value and $NAG_{(pH)}$ below 4.5. In addition, several samples have NAPP values slightly above 0 that coincide with $NAG_{(pH)}$ in excess of 4.5. Both groups are classified as uncertain PAF. Six samples are certainly PAF, having a $NAG_{(pH)}$ less than 4.5 and a positive NAPP value (Figure 14).

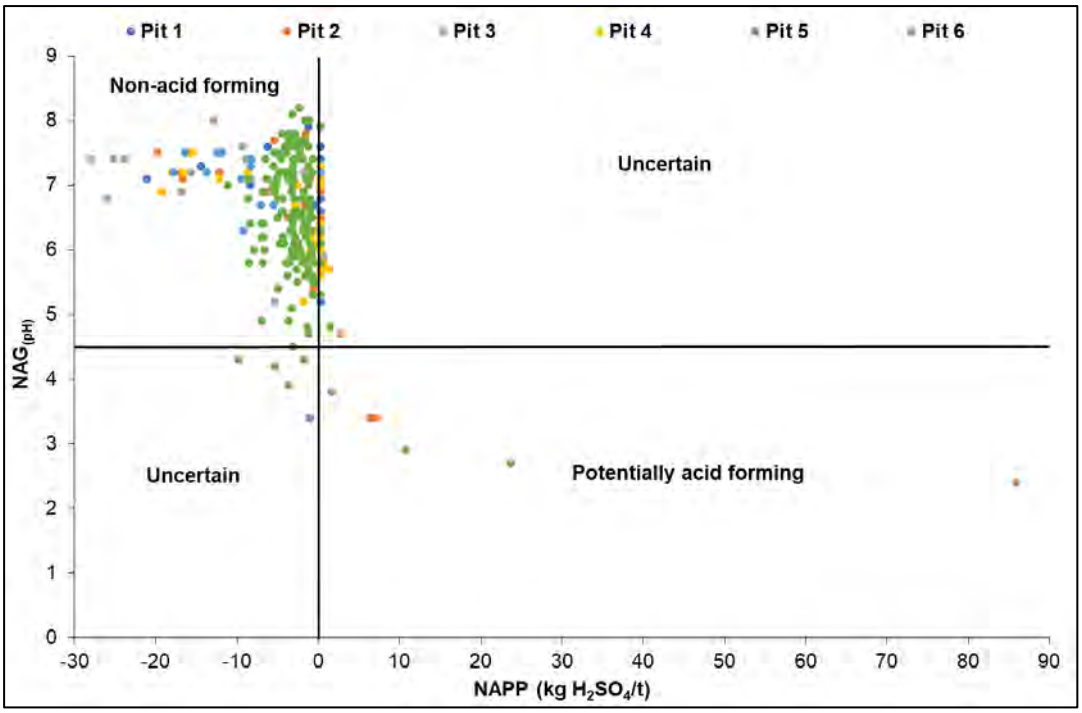



**Figure 14: $NAG_{(pH)}$ versus NAPP for Agate Creek waste rock samples.**

A summary of the $NAG_{(pH)}$ versus total sulphur geochemical classification criteria for the waste rock samples is presented in Table 4.

**Table 4: Geochemical classification criteria for Agate Creek waste rock samples.**

| Geochemical Classification | Total Sulphur (%) | $NAG_{(pH)}$ | Pit 1 | Pit 2 | Pit 3 | Pit 4 | Pit 5 | Pit 6 |
|---|---|---|---|---|---|---|---|---|
| NAF (barren) | ≤0.1 | - | 22 | 18 | 14 | 34 | 17 | 142 |
| NAF (very low sulphur) | >0.1 to ≤0.55 | ≥ 4.5 | 0 | 1 | 0 | 0 | 0 | 1 |
| NAF (low sulphur) | 0.55 to 1.5 | ≥ 4.5 | 0 | 0 | 0 | 0 | 0 | 0 |
| PAF (very low sulphur) | 0.1 to ≤0.55 | < 4.5 | 0 | 2 | 0 | 0 | 1 | 6 |
| PAF (low sulphur) | 0.55 to 1.5 | < 4.5 | 0 | 0 | 0 | 0 | 0 | 1 |
| PAF (moderate to high sulphur) | >1.5 | < 4.5 | 0 | 1 | 0 | 0 | 0 | 0 |
| Percentage of NAF samples | | | 100% | 86.4% | 100% | 100% | 94.4% | 95.3% |
| Percentage of very low sulphur PAF samples | | | 0% | 9.1% | 0% | 0% | 6% | 4.0% |
| Percentage of low sulphur PAF samples | | | 0% | 0% | 0% | 0% | 0% | 0.7% |
| Percentage of moderate to high sulphur PAF samples – actionable levels | | | 0% | 4.5% | 0% | 0% | 0% | 0% |

Applying the $NAG_{(pH)}$ and total sulphur geochemical classification criteria (Table 4), it can be shown that most waste characterisation samples are NAF (Figure 15).

Of the 260 Agate Creek waste rock samples, there are only 11 samples that could be categorised as PAF when the $NAG_{(pH)}$ and total sulphur values are considered:

- Three samples in Pit 2;
- One sample in Pit 5; and
- Seven samples in Pit 6.

These samples make up less than 14% of the total sample size for their respective areas – and their sulphur values are still very low to low except for one sample in Pit 2. It is therefore expected that only one of these eleven samples presents an acid drainage issue because:

- The amount of produced acid would be negligible; and
- Any acid produced by the samples will be buffered by the surrounding NAF rock that makes up more than 90% of the waste rock.

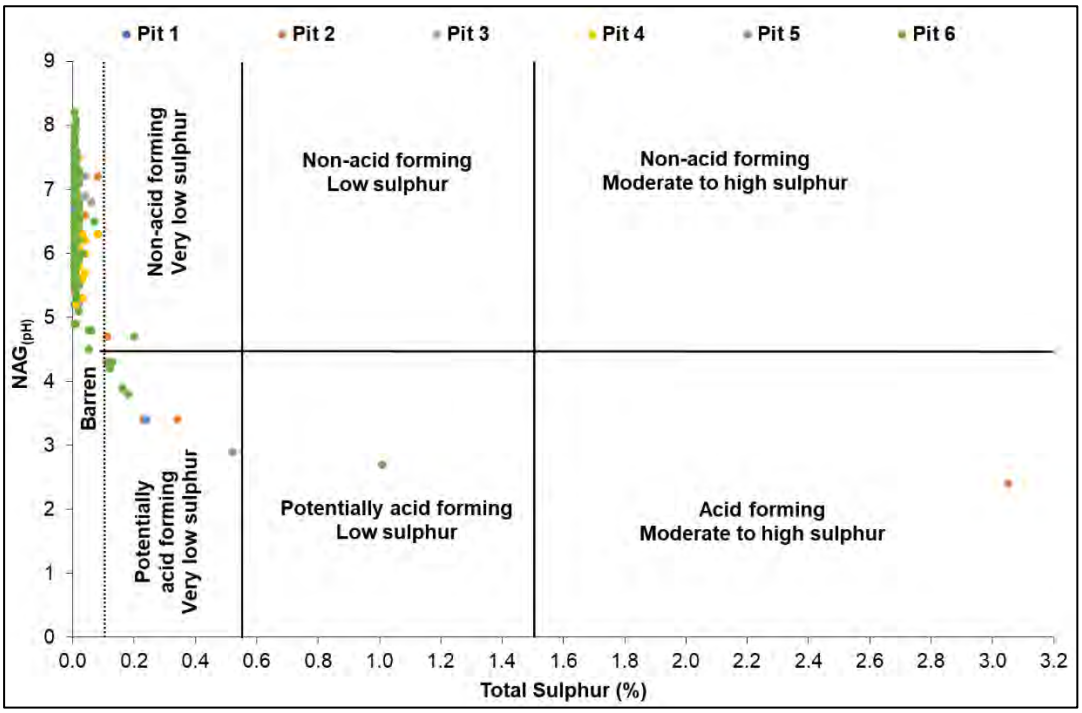



**Figure 15: $NAG_{(pH)}$ versus sulphur for Agate Creek waste rock samples.**

## 4.3 METAL/METALLOID ANALYSES

Static multi-element scans were undertaken on the 260 Agate Creek waste rock samples. This test work was carried out to assess natural background elemental levels, and to identify if any elements (particularly metals and metalloids) are present in the waste rock at concentrations that may be of environmental concern with respect to revegetation and water quality.

### 4.3.1 GEOCHEMICAL ABUNDANCE INDEX

The total metal and metalloid concentrations in the waste rock can be compared to the average crustal abundance of unmineralised soils (INAP, 2014). In this process, the geochemical abundance index (GAI) is used to report on the extent of elemental enrichment, by relating the actual concentration in a sample with the average crustal abundance on a $log_2$ scale (Table 5).

**Table 5: Geochemical abundance index classification categories.**

| GAI | Enrichment Factor | Classification |
|---|---|---|
| <1 | Less than 3-fold enrichment | Not enriched |
| 1 | 3- to 6-fold enrichment | Not enriched |
| 2 | 6- to 12-fold enrichment | Slightly enriched |
| 3 | 12- to 24-fold enrichment | Significantly enriched |
| 4 | 24- to 48-fold enrichment | Significantly enriched |
| 5 | 48- to 96-fold enrichment | Highly enriched |
| 6 | Greater than 96-fold enrichment | Highly enriched |

As a general guide, samples with a GAI of 3 or greater indicate enrichment that may warrant further investigation. However, elements identified as enriched may not necessarily be a reason for concern regarding revegetation and/or water quality because:

- The average crustal abundance varies between different literature sources;
- Some elements are more environmentally important than others (i.e. As, Al, Cr, Cd, Cu, Pb, Se and Zn are more important than Ca, Fe, Mg and Na);
- If a sample is shown to be enriched in a particular element, there is no direct correlation that the sample will leach the element at elevated concentrations; and
- The nature of an ore deposit means that the background levels for some elements are expected to be elevated.

Similarly, because an element is not enriched does not mean that it will never be a concern because – under certain conditions (e.g. low pH) – the solubility of some common, environmentally important elements (such as Al, Cu, Cd, Fe and Zn) will increase significantly.

Summaries of the multi-element scans and GAIs for the Agate Creek waste rock samples are presented in Table 6. Boron was intentionally left out of these tables because all of the test results (n = 260) were BLOR (<50 mg/kg). Similarly, all tellurium values were BLOR (<0.5 mg/kg), although the number of measurements (four) is limited. The limit of reporting is well above the normal crustal abundance of tellurium, which is approximately a hundred times lower.

Any laboratory analyses that were reported as BLOR were not included in the GAI-related statistical analysis. The BLOR data were purposely omitted to minimise bias in the GAI calculation and resulting statistics.

**Table 6: Summary of multi-element analyses, results and geochemical abundance indices for Agate Creek waste rock samples.**

| Element | Unit | Limit of Reporting | ACA* | n | n# | Concentration Statistics | | | NEPM Guideline HIL~ 'Recreational C' | GAI Statistics | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min. | Median | Max. | | Min. GAI | Median GAI | Max. GAI | Number of GAIs ≥3 |
| Aluminium | mg/kg | 50 | 82,000 | 260 | 260 | 380 | 1,300 | 41,000 | - | 0 | 0 | 0 | 0 |
| Antimony | mg/kg | 0.1 | 0.2 | 4 | 4 | 0.2 | 0.4 | 1.8 | - | 0 | 0 | 2 | 0 |
| Arsenic | mg/kg | 5 | 1.5 | 260 | 154 | BLOR^ | 6.5 | 206 | 300 | 1 | 2 | 6 | 42 |
| Barium | mg/kg | 10 | 500 | 260 | 206 | BLOR | 20 | 530 | - | 0 | 0 | 0 | 0 |
| Beryllium | mg/kg | 1 | 2.6 | 260 | 33 | BLOR | BLOR | 6 | 90 | 0 | 0 | 0 | 0 |
| Cadmium | mg/kg | 1 | 0.11 | 260 | 6 | BLOR | BLOR | 2 | 90 | 2 | 2.5 | 3 | 3 |
| Chromium | mg/kg | 2 | 100 | 260 | 245 | BLOR | 8 | 90 | 300 | 0 | 0 | 0 | 0 |
| Cobalt | mg/kg | 2 | 20 | 260 | 196 | BLOR | 5 | 190 | 300 | 0 | 0 | 2 | 0 |
| Copper | mg/kg | 5 | 50 | 260 | 206 | BLOR | 11 | 364 | 17,000 | 0 | 0 | 2 | 0 |
| Iron | mg/kg | 50 | 41,000 | 260 | 260 | 380 | 15,650 | 107,000 | - | 0 | 0 | 0 | 0 |
| Lead | mg/kg | 5 | 14 | 260 | 195 | BLOR | 9 | 111 | 600 | 0 | 0 | 2 | 0 |
| Manganese | mg/kg | 5 | 950 | 260 | 243 | BLOR | 192.5 | 4,260 | 19,000 | 0 | 0 | 1 | 0 |
| Mercury | mg/kg | 0.1 | 0.05 | 260 | 2 | BLOR | BLOR | 0.3 | 80 | 2 | 2 | 2 | 0 |
| Molybdenum | mg/kg | 0.1 | 1.5 | 4 | 4 | 0.2 | 1.85 | 3.7 | - | 0 | 0 | 0 | 0 |
| Nickel | mg/kg | 2 | 80 | 260 | 232 | BLOR | 8 | 291 | 1,200 | 0 | 0 | 1 | 0 |
| Selenium | mg/kg | 5 | 0.05 | 260 | 1 | BLOR | 2.5 | 8 | 700 | 6 | 6 | 6 | 1 |
| Thallium | mg/kg | 0.1 | 0.6 | 4 | 1 | BLOR | BLOR | 0.1 | - | 0 | 0 | 0 | 0 |
| Thorium | mg/kg | 0.1 | 12 | 4 | 4 | 0.6 | 0.85 | 1.7 | - | 0 | 0 | 0 | 0 |
| Uranium | mg/kg | 0.1 | 2.4 | 4 | 4 | 0.3 | 0.45 | 0.6 | - | 0 | 0 | 0 | 0 |
| Vanadium | mg/kg | 5 | 160 | 260 | 191 | BLOR | 9 | 406 | - | 0 | 0 | 0 | 0 |
| Zinc | mg/kg | 5 | 75 | 260 | 238 | BLOR | 35 | 395 | 30,000 | 0 | 0 | 1 | 0 |

* Average crustal abundance (Bowen, 1979).

# Number of reported measurements that were not below the limit of reporting.

~ *National Environment Protection (Assessment of Site Contamination) Measure 1999 – Health-based investigation levels* (NEPC, 2013).

^ Below limit of reporting.

Red shaded cells are above the NEPM HIL Guidelines for 'Recreational C' areas.

Orange shaded cells indicate significant enrichment (i.e. ≥ 12 – 24 fold enrichment with respect to the average crustal abundance).

Based on the GAI assessment of the Agate Creek waste rock samples, approximately 27% of the waste rock samples are significantly enriched with respect to arsenic (Table 6). Most (n = 30) of the enriched arsenic samples (n = 42) have a GAI of 3, with a further nine samples attributed a GAI of 4. Two arsenic samples are associated with a GAI of 5, whereas only one sample reaches a GAI of 6.

The sole sample with selenium above the limit of reporting suggests that the waste rock is significantly enriched with respect to that trace element. However, a GAI of 5 would be obtained even if half of the LOR value (2.5 mg/kg) were to be applied to the GAI assessment. Thus, because of analytical limitations in measurement precision, any sample that included selenium testing would automatically be associated with a high GAI.

Of the six cadmium samples at or above the LOR, only three results reached a GAI of 3.

### 4.3.2 CONTAMINANT LIMITS

The metals/metalloid concentrations of the 260 Agate Creek waste rock samples have been compared against the National Environment Protection Measure (NEPM) health-based investigation level (HIL) guidelines for 'Recreational C' – public open space scenario (National Environment Protection Council [NEPC], 2013). Table 6 demonstrates that all analysed metals/metalloids would meet the 'Recreational C' limits.

## 4.4 STATIC WATER QUALITY ANALYSES

Static water quality multi-element scans were undertaken on water extracts from the 260 Agate Creek waste rock samples. This testwork was carried out in order to assess water quality characteristics (particularly salinity and soluble anion levels) that could potentially be sourced from the waste rock in leachate.

Before data analysis was undertaken, results below the laboratory limit of reporting (LOR) were entered into the database as half the LOR value, in line with the *Australian and New Zealand guidelines for fresh and marine water quality* (ANZECC and ARMCANZ, 2000). Also based on the dilution ratio (1:5) and EC values of the water extracts, all values reported as mg/kg are assumed to be the equivalent in mg/L.

There are no specific regulatory criteria for salinity or anion concentrations from waste rock material on mine sites in Queensland. Furthermore, the current EA for Agate Creek does not specify contaminant release limits for salinity or soluble anions. Consequently, the results for the waste rock water extracts have been compared with the ANZECC and ARMCANZ (2000) guidelines for livestock drinking water.

Note: It is inappropriate to use the ANZECC and ARMCANZ (2000) freshwater ecosystems guidelines to compare the anion and EC levels of the water extracts with environmental trigger levels. This is because the freshwater ecosystems guidelines do not contain anion trigger values. Further, the guidelines only apply tropical criteria for salinity triggers in the Agate Creek area – and do not consider the local geological and climatic conditions (i.e. Agate Creek is in a volcanic province that receives relatively low and highly seasonal rainfall).

### 4.4.1 SALINITY

The EC of the water extracts from the 260 Agate Creek waste rock samples ranges from 7 µS/cm to 1,680 µS/cm and has a very low median value of 43.5 µS/cm. These EC values generally represent fresh water and are well below the ANZECC and ARMCANZ (2000) livestock drinking water trigger limit of 5,970 µS/cm (Figure 16). Further, the Queensland Government document *Science Notes – Land series – L137* (provided in Appendix C), states that 1,500 to 2,000 µS/cm soil (using a 1 in 5 static test method) is considered slightly saline.

The study only recorded one sample in this range with all other static samples recording values well below 500 µS/cm (Figure 16). This suggests that salinity is not an issue associated with the Agate Creek Mine waste rock.

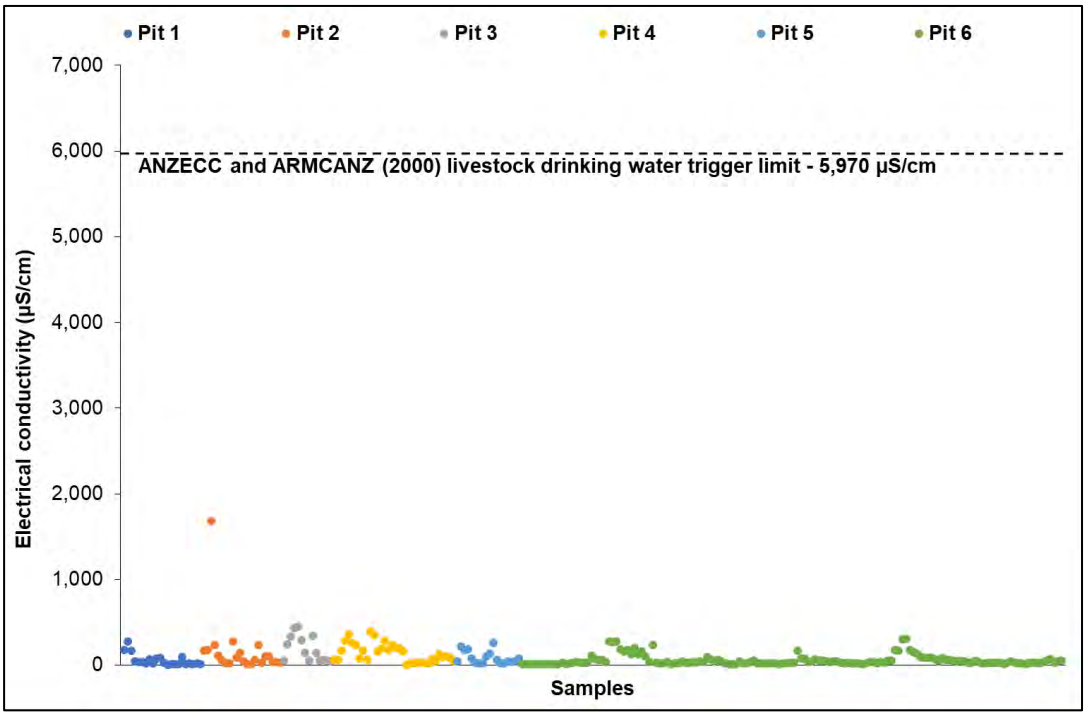



**Figure 16: Electrical conductivity for water extracts from Agate Creek waste rock samples.**

It should be noted that the ECs of the water extracts are higher than that expected of the surface runoff and seepage from the proposed waste rock material. This is because dissolution rates will be lower in the waste rock dumps than observed in the static laboratory samples. The KLC tests demonstrate this, with lower electrical conductivity values recorded compared to the static results (refer to Section 4.5.2).

### 4.4.2 FLUORIDE

The fluoride values of the water extracts from the 260 Agate Creek waste rock samples ranges from BLOR (<1 mg/kg) to 63 mg/kg and has a median value of 4 mg/kg. In the 260 water extracts, fluoride exceeded the low-risk trigger level for livestock drinking water (2 mg/L; ANZECC & AMRCANZ, 2000) on multiple occasions (Figure 17). While this guideline value is not directly comparable to the results (as the guideline is for surface waters [mg/L] and not sediment extracts [mg/kg]), exceedances may be of a concern as elevated fluoride is prevalent in most of the waste rock (Table 7). However, these fluoride levels are not unusual for the Agate Creek area. As a volcanic province, much of the rock, surface water and groundwater are enriched with respect to fluoride. Therefore, the risk of fluoride – sourced from the Agate Creek waste rock – further enriching fluoride levels in the receiving environment is low.

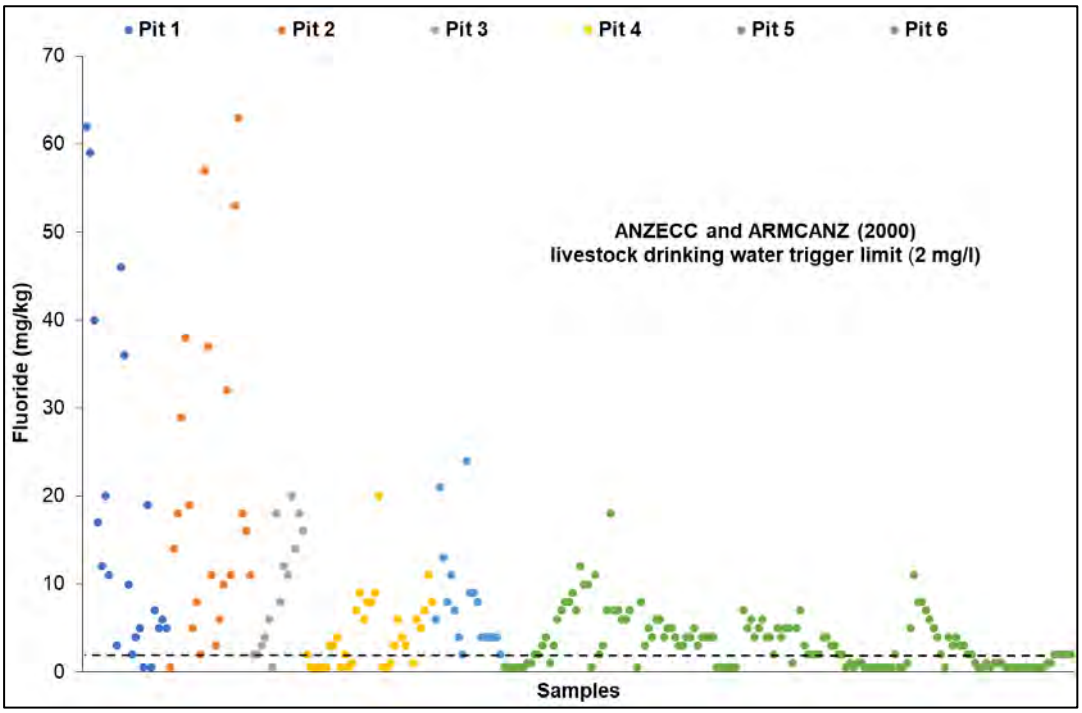



**Figure 17: Fluoride values for water extracts from Agate Creek waste rock samples.**

**Table 7: Fluoride statistics for waste rock sample water extracts.**

| Fluoride Statistic | Unit | Pit 1 | Pit 2 | Pit 3 | Pit 4 | Pit 5 | Pit 6 |
|---|---|---|---|---|---|---|---|
| Minimum | mg/L | 0.5 | 0.5 | 0.5 | 0.5 | 2 | 0.5 |
| Median | mg/L | 10 | 15 | 9.5 | 3 | 6.5 | 3 |
| Maximum | mg/L | 62 | 63 | 20 | 20 | 24 | 18 |
| SD | mg/L | 19 | 18 | 7 | 4 | 6 | 3 |
| cv | % | 1.1 | 0.9 | 0.7 | 1.0 | 0.8 | 1.0 |
| n | - | 21 | 22 | 14 | 33 | 18 | 148 |
| Percentage of samples exceeding 2 mg/L | | 85.7% | 90.9% | 78.6% | 57.6% | 88.9% | 49.3% |

^ BLOR – Below the limit of reporting.

### 4.4.3 SULPHATE

The dissolved sulphate levels of the water extracts from the 260 Agate Creek waste rock samples range from 5 mg/kg to 1,780 mg/kg and have a low median value of 20 mg/kg. Except for one value (a sample in Pit 2), all results were below the ANZECC and ARMCANZ (2000) beef cattle livestock drinking water trigger limit of 1,000 mg/L (if applied as 1,000 mg/kg; Figure 18). However, the guideline is only used to provide an indication of elevated levels and an exceedance displayed in Figure 18 does not necessarily imply the sample is toxic to cattle. This is because the guideline is developed for surface waters [mg/L] and not sediment extracts [mg/kg]. Instead, these results suggest that sulphate levels within waste rock are not of concern to the environmental values associated with the site.

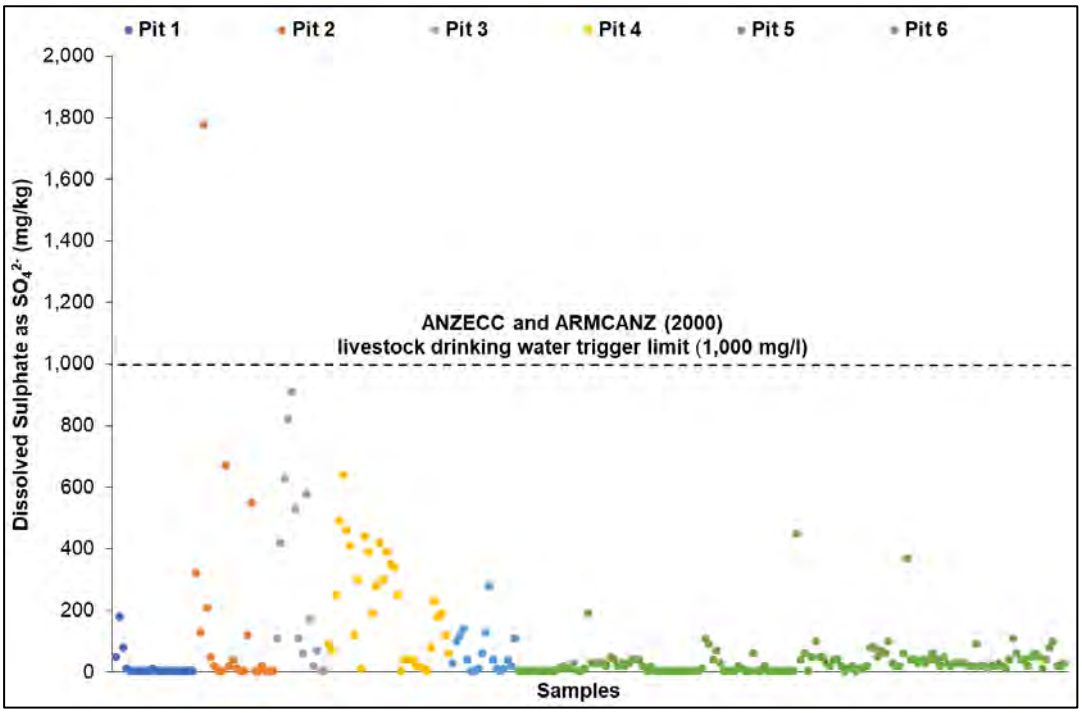



**Figure 18: Sulphate values for water extracts from Agate Creek waste rock samples.**

## 4.5 KINETIC LEACH COLUMN WATER QUALITY ANALYSES

In order to understand the potential for the Agate Creek waste rock to leach environmental contaminants into the surrounding environment, KLC tests were undertaken on four composite samples (refer to Section 3.2.2). Unlike static tests, KLC tests measure the varying geochemical characteristics of sample effluent over a prolonged period, consequently providing a better indication of chemical reactivity of waste materials under potential storage conditions.

The results of the waste rock KCL tests have to be considered against the mineralogy, and thus the chemical composition of the host rock and its associated complex hydrothermal alteration assemblages. The waste rock will be dominated by the host rock assemblage of rhyolite and andesite. Mineralogically, the composition of the rhyolite is dominated by alkali feldspars > plagioclase feldspars and quartz with minor biotite, muscovite, pyroxenes, amphiboles, oxides, and glass. Comparably, the mineralogical composition of andesites is dominated by plagioclase feldspars and amphiboles, with minor amounts of quartz, pyroxene, biotite and muscovite.

The composition of the primary mineralogy will be supplemented by material from the complex alteration assemblages (refer Section 2.2). The majority of the rocks will, to some degree, have been subjected to recent weathering cycles which will have changed the primary and alteration mineralogy to a series of minerals of very fine to colloidal particle size, including clay minerals (illite, smectites, kaolinite and mixed layer variants), and hydrated oxyhydroxides of Al, Fe and Mn (e.g. gibbsite, goethite and “birnessite”).

It is the reaction of the above mineral phases that determine the composition of the leach fluid.

Before data analysis was undertaken of the leach data, results below the laboratory LOR were entered into the database as half the LOR value, in line with the *Australian and New Zealand guidelines for fresh and marine water quality* (ANZG, 2018).

There are no specific regulatory criteria for contaminant releases from waste rock material on mine sites in Queensland. Furthermore, the current EA for Agate Creek does not specify contaminant release limits. Consequently, the results for the KLC tests are compared with the ANZG (2018) guidelines for freshwater ecosystems (95% species protection level) and livestock drinking water (Table 8).

**Table 8: Summary of kinetic leach multi-element analyses and results.**

| Quality Characteristic | Limit of Reporting | Livestock Guideline[1] | Freshwater Ecosystems Guideline[2] | Bore ID | Leach 0 | Leach 1 | | Leach 2 | | Leach 3 | | Leach 4 | | Leach 5 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | V | V | C | V | C | V | C | V | C | V | C |
| pH[3] | 0.01 | 5 – 9 | NA[4] | CCGC339 | 6.49 | 6.50 | - | 6.24 | - | 6.48 | - | 6.15 | - | 6.30 | - |
| | | | | CCGC346 | 5.82 | 6.30 | - | 5.88 | - | 5.98 | - | 5.59 | - | 5.45 | - |
| | | | | CCGC309 | 6.38 | 5.51 | - | 6.53 | - | 6.87 | - | 5.48 | - | 6.00 | - |
| | | | | CCGC336 | 5.84 | 5.88 | - | 5.57 | - | 5.66 | - | 5.40 | - | 5.55 | - |
| EC[3] (µS/cm) | 1 | 5,970[5] | NA[4] | CCGC339 | 553 | 68 | - | 49 | - | 44 | - | 41 | - | 36 | - |
| | | | | CCGC346 | 231 | 223 | - | 43 | - | 38 | - | 36 | - | 36 | - |
| | | | | CCGC309 | 20 | 14 | - | 15 | - | 14 | - | 10 | - | 17 | - |
| | | | | CCGC336 | 38 | 13 | - | 21 | - | 21 | - | 25 | - | 18 | - |
| Sulphate (mg/L) | 1 | 1,000 | NA | CCGC339 | 3 | BLOR | 3.5 | BLOR | 4 | BLOR | 4.5 | BLOR | 5 | BLOR | 5.5 |
| | | | | CCGC346 | 49 | 63 | 112 | 12 | 124 | 11 | 135 | 10 | 145 | 10 | 155 |
| | | | | CCGC309 | BLOR | BLOR | 1 | BLOR | 1.5 | BLOR | 2.0 | BLOR | 2.5 | BLOR | 3 |
| | | | | CCGC336 | 1 | BLOR | 1.5 | BLOR | 2 | BLOR | 2.5 | BLOR | 3 | 1 | 4 |
| Fluoride (mg/L) | 0.1 | 2 | NA | CCGC339 | 6.6 | 4.0 | 10.6 | 2.4 | 13.0 | 2.1 | 15.1 | 2.0 | 17.1 | 2.1 | 19.2 |
| | | | | CCGC346 | 0.6 | 0.8 | 1.4 | 0.5 | 1.9 | 0.4 | 2.3 | 0.5 | 2.8 | 0.5 | 3.3 |
| | | | | CCGC309 | 0.4 | BLOR | 0.45 | BLOR | 0.5 | BLOR | 0.55 | BLOR | 0.6 | BLOR | 0.65 |
| | | | | CCGC336 | 0.2 | BLOR | 0.25 | BLOR | 0.3 | BLOR | 0.35 | 0.1 | 0.45 | 0.1 | 0.55 |
| Aluminium (mg/L) | 0.01 | 5 | 0.055 | CCGC339 | BLOR | 0.07 | 0.075 | 0.16 | 0.235 | 0.02 | 0.255 | 0.01 | 0.265 | 0.02 | 0.285 |
| | | | | CCGC346 | BLOR | 0.01 | 0.015 | 0.04 | 0.055 | 0.02 | 0.075 | BLOR | 0.08 | 0.01 | 0.09 |
| | | | | CCGC309 | 0.06 | 0.01 | 0.07 | 0.01 | 0.08 | 0.01 | 0.09 | BLOR | 0.095 | BLOR | 0.10 |
| | | | | CCGC336 | 0.03 | BLOR | 0.035 | BLOR | 0.04 | BLOR | 0.045 | BLOR | 0.05 | BLOR | 0.055 |
| Arsenic (mg/L) | 0.001 | 0.5 | 0.013 | CCGC339 | BLOR | 0.001 | 0.0015 | BLOR | 0.002 | 0.002 | 0.004 | BLOR | 0.0045 | BLOR | 0.005 |
| | | | | CCGC346 | BLOR | BLOR | 0.001 | BLOR | 0.0015 | BLOR | 0.002 | BLOR | 0.0025 | BLOR | 0.003 |
| | | | | CCGC309 | BLOR | BLOR | 0.001 | BLOR | 0.0015 | BLOR | 0.002 | BLOR | 0.0025 | BLOR | 0.003 |
| | | | | CCGC336 | BLOR | BLOR | 0.001 | BLOR | 0.0015 | BLOR | 0.002 | BLOR | 0.0025 | BLOR | 0.003 |
| Boron (mg/L) | 0.05 | 5 | 0.37 | CCGC339 | 0.19 | 0.13 | 0.32 | 0.07 | 0.39 | 0.08 | 0.47 | 0.12 | 0.59 | 0.11 | 0.70 |
| | | | | CCGC346 | 0.17 | 1.15 | 1.32 | 0.18 | 1.5 | 0.19 | 1.69 | 0.25 | 1.94 | 0.30 | 2.24 |
| | | | | CCGC309 | BLOR | BLOR | 0.05 | BLOR | 0.075 | BLOR | 0.1 | 0.07 | 0.17 | BLOR | 0.195 |

| Quality Characteristic | Limit of Reporting | Livestock Guideline[1] | Freshwater Ecosystems Guideline[2] | Bore ID | Leach 0 | Leach 1 | | Leach 2 | | Leach 3 | | Leach 4 | | Leach 5 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | V | V | C | V | C | V | C | V | C | V | C |
| | | | | CCGC336 | 0.13 | 0.26 | 0.39 | 0.42 | 0.81 | 0.69 | 1.5 | 0.96 | 2.46 | 0.80 | 3.26 |
| Cadmium (mg/L) | 0.0001 | 0.01 | 0.0002 | CCGC339 | BLOR | BLOR | 0.0001 | BLOR | 0.00015 | BLOR | 0.0002 | BLOR | 0.00025 | BLOR | 0.0003 |
| | | | | CCGC346 | BLOR | BLOR | 0.0001 | BLOR | 0.00015 | BLOR | 0.0002 | BLOR | 0.00025 | BLOR | 0.0003 |
| | | | | CCGC309 | BLOR | BLOR | 0.0001 | BLOR | 0.00015 | BLOR | 0.0002 | BLOR | 0.00025 | BLOR | 0.0003 |
| | | | | CCGC336 | BLOR | BLOR | 0.0001 | BLOR | 0.00015 | BLOR | 0.0002 | BLOR | 0.00025 | BLOR | 0.0003 |
| Copper (mg/L) | 0.001 | 1.0[6] | 0.0014 | CCGC339 | BLOR | BLOR | 0.001 | 0.001 | 0.002 | BLOR | 0.0025 | BLOR | 0.003 | BLOR | 0.0035 |
| | | | | CCGC346 | BLOR | 0.002 | 0.0025 | BLOR | 0.003 | BLOR | 0.0035 | BLOR | 0.004 | BLOR | 0.0045 |
| | | | | CCGC309 | BLOR | BLOR | 0.001 | 0.001 | 0.002 | BLOR | 0.0025 | BLOR | 0.003 | BLOR | 0.0035 |
| | | | | CCGC336 | 0.002 | BLOR | 0.0025 | BLOR | 0.003 | BLOR | 0.0035 | BLOR | 0.004 | BLOR | 0.0045 |
| Lead (mg/L) | 0.001 | 0.1 | 0.0034 | CCGC339 | BLOR | BLOR | 0.001 | BLOR | 0.0015 | BLOR | 0.002 | BLOR | 0.0025 | BLOR | 0.003 |
| | | | | CCGC346 | BLOR | BLOR | 0.001 | BLOR | 0.0015 | BLOR | 0.002 | BLOR | 0.0025 | BLOR | 0.003 |
| | | | | CCGC309 | BLOR | BLOR | 0.001 | BLOR | 0.0015 | BLOR | 0.002 | BLOR | 0.0025 | BLOR | 0.003 |
| | | | | CCGC336 | BLOR | BLOR | 0.001 | BLOR | 0.0015 | BLOR | 0.002 | BLOR | 0.0025 | BLOR | 0.003 |
| Manganese (mg/L) | 0.001 | NA | 1.900 | CCGC339 | 0.031 | 0.004 | 0.035 | 0.003 | 0.038 | 0.003 | 0.041 | 0.002 | 0.043 | 0.002 | 0.045 |
| | | | | CCGC346 | 0.018 | 0.035 | 0.053 | 0.003 | 0.056 | 0.004 | 0.06 | 0.003 | 0.063 | 0.004 | 0.067 |
| | | | | CCGC309 | BLOR | BLOR | 0.001 | 0.006 | 0.007 | 0.009 | 0.016 | 0.004 | 0.02 | 0.016 | 0.036 |
| | | | | CCGC336 | 0.015 | 0.006 | 0.021 | 0.017 | 0.038 | 0.015 | 0.053 | 0.013 | 0.066 | 0.007 | 0.073 |
| Mercury (mg/L) | 0.0001 | 0.002 | 0.0006 | CCGC339 | BLOR | BLOR | 0.0001 | BLOR | 0.00015 | BLOR | 0.0002 | BLOR | 0.00025 | BLOR | 0.0003 |
| | | | | CCGC346 | BLOR | BLOR | 0.0001 | BLOR | 0.00015 | BLOR | 0.0002 | BLOR | 0.00025 | BLOR | 0.0003 |
| | | | | CCGC309 | BLOR | BLOR | 0.0001 | BLOR | 0.00015 | BLOR | 0.0002 | BLOR | 0.00025 | BLOR | 0.0003 |
| | | | | CCGC336 | BLOR | BLOR | 0.0001 | BLOR | 0.00015 | BLOR | 0.0002 | BLOR | 0.00025 | BLOR | 0.0003 |
| Nickel (mg/L) | 0.001 | 1.0 | 0.011 | CCGC339 | BLOR | BLOR | 0.001 | BLOR | 0.0015 | 0.001 | 0.0025 | BLOR | 0.003 | BLOR | 0.0035 |
| | | | | CCGC346 | BLOR | 0.003 | 0.0035 | BLOR | 0.004 | BLOR | 0.0045 | BLOR | 0.005 | BLOR | 0.0055 |
| | | | | CCGC309 | BLOR | BLOR | 0.001 | BLOR | 0.0015 | BLOR | 0.002 | BLOR | 0.0025 | BLOR | 0.003 |
| | | | | CCGC336 | BLOR | BLOR | 0.001 | BLOR | 0.0015 | 0.001 | 0.0025 | BLOR | 0.003 | BLOR | 0.0035 |
| Zinc (mg/L) | 0.005 | 20 | 0.008 | CCGC339 | BLOR | BLOR | 0.005 | BLOR | 0.0075 | 0.024 | 0.0315 | BLOR | 0.034 | BLOR | 0.0365 |
| | | | | CCGC346 | BLOR | 0.131 | 0.1335 | BLOR | 0.136 | BLOR | 0.1385 | BLOR | 0.141 | BLOR | 0.1435 |
| | | | | CCGC309 | BLOR | BLOR | 0.005 | BLOR | 0.0075 | BLOR | 0.010 | BLOR | 0.0125 | BLOR | 0.015 |

| Quality Characteristic | Limit of Reporting | Livestock Guideline[1] | Freshwater Ecosystems Guideline[2] | Bore ID | Leach 0 | Leach 1 | | Leach 2 | | Leach 3 | | Leach 4 | | Leach 5 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | V | V | C | V | C | V | C | V | C | V | C |
| | | | | CCGC336 | BLOR | 0.007 | 0.0095 | 0.011 | 0.0205 | 0.010 | 0.0305 | 0.006 | 0.033 | 0.007 | 0.040 |
| Acidity[3] as $CaCO_3$ (mg/L) | 1 | NA | NA | CCGC339 | 3 | 2 | - | BLOR | - | 3 | - | 1 | - | 3 | - |
| | | | | CCGC346 | 2 | 3 | - | BLOR | - | 3 | - | 1 | - | 3 | - |
| | | | | CCGC309 | 2 | 1 | - | BLOR | - | 2 | - | 2 | - | 3 | - |
| | | | | CCGC336 | 2 | 1 | - | BLOR | - | 3 | - | 2 | - | 3 | - |

[1] Australian guidelines for livestock drinking water - trigger values (low risk) (ANZG, 2018). Note: Metal guideline values are based on the total fraction, whereas results are provided as dissolved. Care must be taken when undertaking comparisons.

[2] Australian guidelines for aquatic freshwater ecosystems - 95% species protection level (ANZG, 2018). Note: Metal guideline values are based on the dissolved fraction.

[3] Cumulative results are not provided for pH, EC or acidity as these values are deemed inappropriate for assessing these quality characteristics.

[4] pH and EC guidelines for freshwater ecosystems for tropical regions are not representative of the climatic and/or geological conditions at Agate Creek.

[5] EC has been calculated from the tolerances of livestock (beef cattle) to total dissolved solids in livestock drinking water using a 1.4925 multiplier (ANZG, 2018).

[6] Cattle trigger value (low risk) for copper is cited.

Indicates an exceedance of the relevant livestock drinking water guideline value.

Indicates an exceedance of the relevant freshwater ecosystems guideline value.

V – Raw value.

C – Running cumulative total.

NA – Not available.

BLOR – Below the limit of reporting.

### 4.5.1 pH VALUE

The KLC results show that pH remains relatively stable over the course of the tests (Table 8 and Figure 19). Three of the samples show a marginal decreasing trend while CCGC309 recorded a drop in pH after the first leach before increasing over leaches 2 and 3 (Table 8 and Figure 19). While a marginal decrease over time is noted at most sites, no samples show a significant increase in acidity over time (Table 8; Figure 19 and Figure 20).

It should be noted that both pH and acidity are inherent properties of the mineralogical composition. Significant changes would only be expected if there were large changes in the overall mineralogy (e.g. total dissolution of phases) during the leaching process.

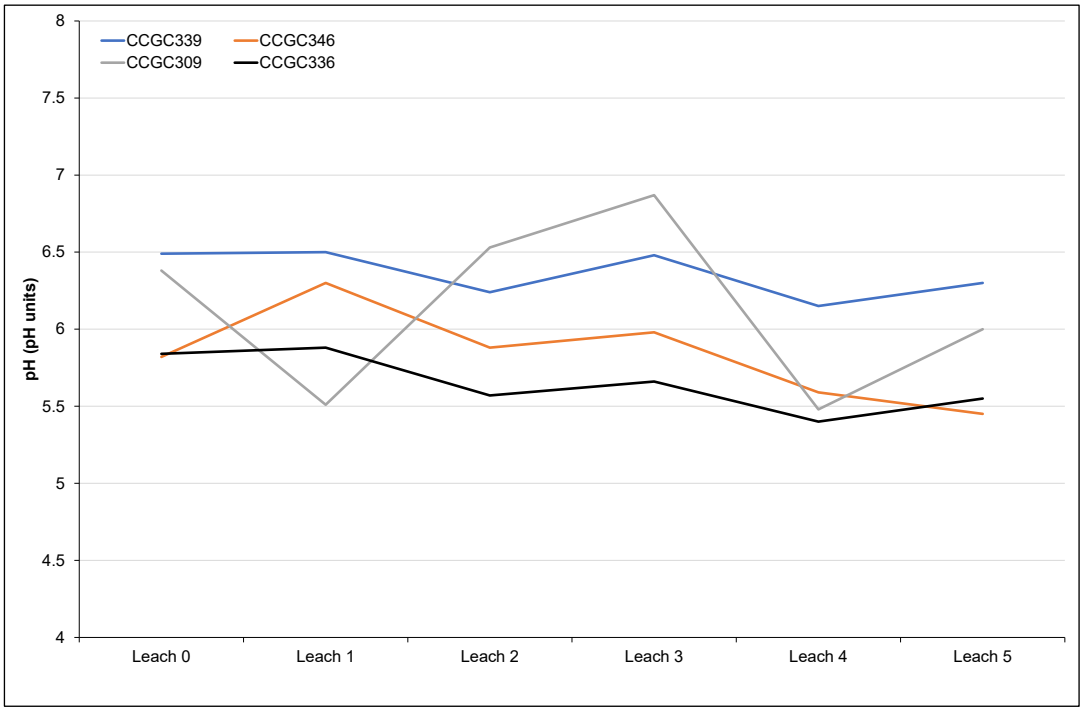



**Figure 19: Trend in pH of each KLC tested sample over time.**

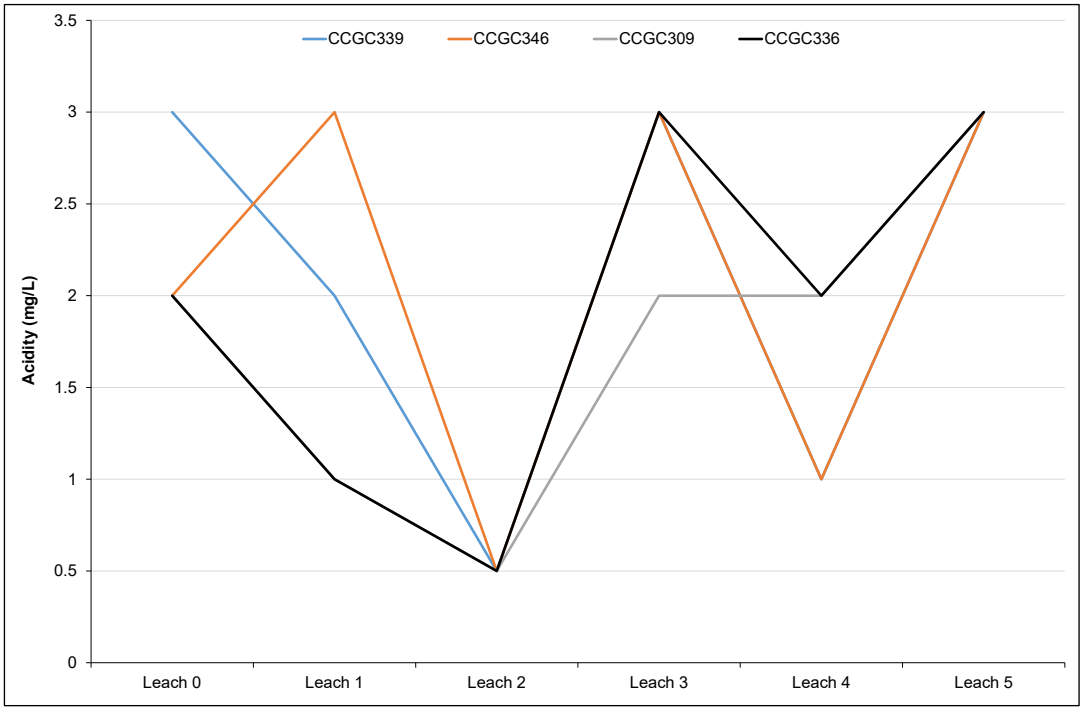



**Figure 20: Trends in acidity observed in each KLC tested sample over time.**

### 4.5.2 ELECTRICAL CONDUCTIVITY

Electrical conductivity is a property that will not accumulate over time with each value representing an individual snapshot in time. Thus, between successive leaches, conductivity in all samples generally falls, ranging from 553 to 20 µS/cm in leach 0 to 41, to 10 µS/cm in leach 4 (Table 8 and Figure 21). This is consistent with the general dilution of the leachate over time. These results indicate that each sample would still be considered freshwater under both the US Geological Survey guidelines (i.e. <1,560 µS/cm; refer to https://www.usgs.gov/special-topics/water-science-school/science/saline-water-and-salinity) and the Queensland Government (i.e. <1,500 µS/cm; refer to the Science Note provided in Appendix C). Therefore, salinity is not an issue associated with the Agate Creek Mine waste rock.

While electrical conductivity is not accumulative, the end products, upon evaporation (i.e. salts), are accumulative. This is true of any water evaporating in the bed sands of a stream where halite saturation (i.e. EC > 300,000 µS/cm) are achieved in the dry season.

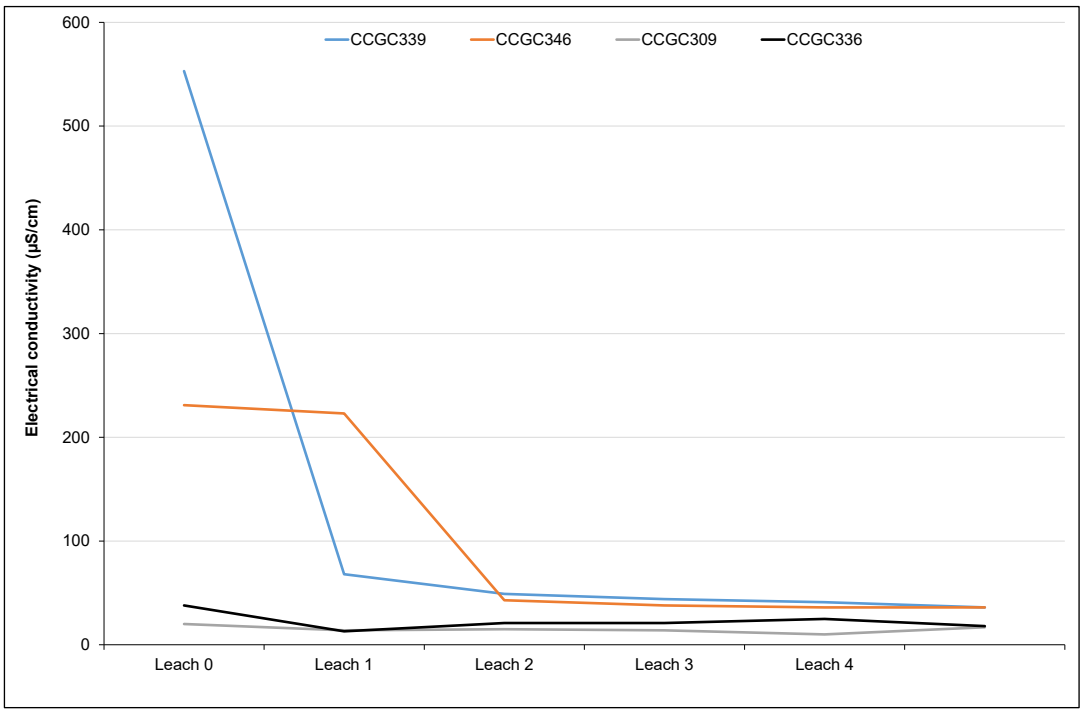



**Figure 21: Trends in electrical conductivity observed in each KLC tested sample over time.**

### 4.5.3 METALS / METALLOIDS

Most metal concentrations were found to be either compliant with relevant guideline values, or only exceeded these values in the cumulative results at the end of testing (Table 8). For instance, cadmium was recorded below the LOR in every sample tested. However, the cumulative results were found to exceed the 95% species protection level for aquatic ecosystems after leach 4 (Table 8). This is a result of the conservative method used to calculate the cumulative value in the event of below the LOR values (i.e. adopt a value equal to 50% of the limit of reporting), combined with the number of leaches performed, and the relatively low guideline value. Therefore, although the cumulative value for cadmium appears to have exceeded the aquatic ecosystem guideline value in leach 4, it is suggested that cadmium levels within Agate Creek Mine's waste rock are not of environmental concern.

With respect to metals and metalloids, cumulative values may be of use in assessing the total load that may build up by evaporation in any downstream sediments and may be available for later mobilisation in flow events.

Only four metals or metalloids were regularly recorded above their respective aquatic ecosystem guideline values (Table 8):

- Dissolved aluminium;
- Dissolved boron;
- Dissolved copper; and
- Dissolved zinc.

Values for aluminium (refer Figure 22 and Table 8) were opportunistic up to Leach 3 after which a consistent overall drop for all samples was observed. Erratic behaviour in Leaches 0 to 2 was shown by all samples, except for CCGC336. Non-compliance values (above 0.055 mg/L) were shown by CCGC309 in Leach 0 and CCGC339 in Leaches 1 and 2, with the value in Leach 2 exceeding 0.150 mg/L (Figure 22 and Table 8). After Leach 2, levels

in all samples decrease systematically. Accumulated values in all samples (except for CCGC336) exceed the 0.055 mg/L threshold (Figure 22 and Table 8).

As indicated above, individual levels are largely opportunistic, representing mineral availability to reaction at any particular time. Further, much of the "dissolved" aluminium will be in colloidal form.

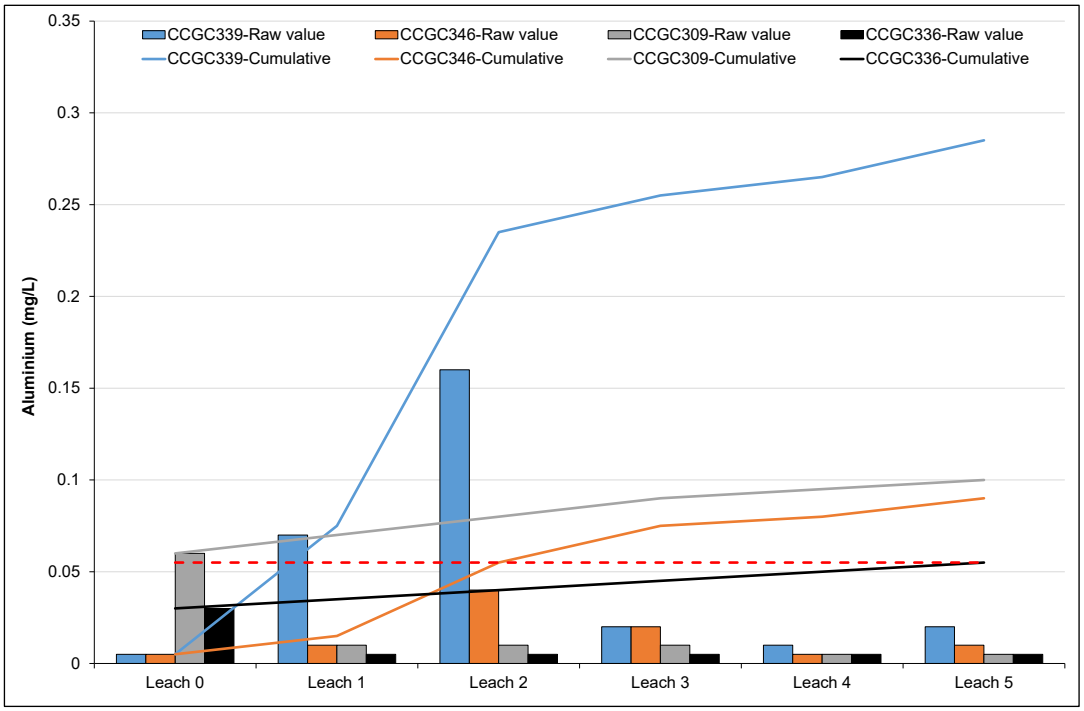



**Figure 22: Cumulative trends and individual leach values of dissolved aluminium observed in each KLC tested sample over time compared against the ANZG (2018) 95% species protection level for freshwater systems (red dashed line).**

Dissolved Boron levels reacted as expected in all samples (i.e. initially elevated and then relatively compliant levels in later leaches), except CCGC336 (Figure 23). CCGC336 (located in Pit 6) increased in dissolved boron concentrations with each subsequent leach, displaying an almost exponential cumulative rise in values up to leach 4. However, the results of leach 5 show the values of dissolved boron began to decrease (Figure 23). The relatively higher boron values from CCGC336 may be a response of the clay minerals present, in the sample, to the slight decrease in pH (increase in acidity) shown by the same sample over the 5 leaches.

Dissolved copper marginally exceeded the guideline value on two occasions in two separate samples (Figure 24). Both CCGC346 (from Pit 4) and CCGC336 (from Pit 6) recorded one result each above the guideline value with all other results from these two samples recorded below the LOR (Figure 24). Figure 24 shows the levels of copper within the waste rock quickly leach from the system at marginal levels prior to reducing to compliant concentrations. While the accumulation of copper within aquatic environments can be of environmental concern, it is predicted that the relatively low levels of copper leaching from the Agate Creek Mine waste rock are of negligible concern to its downstream receiving environment.

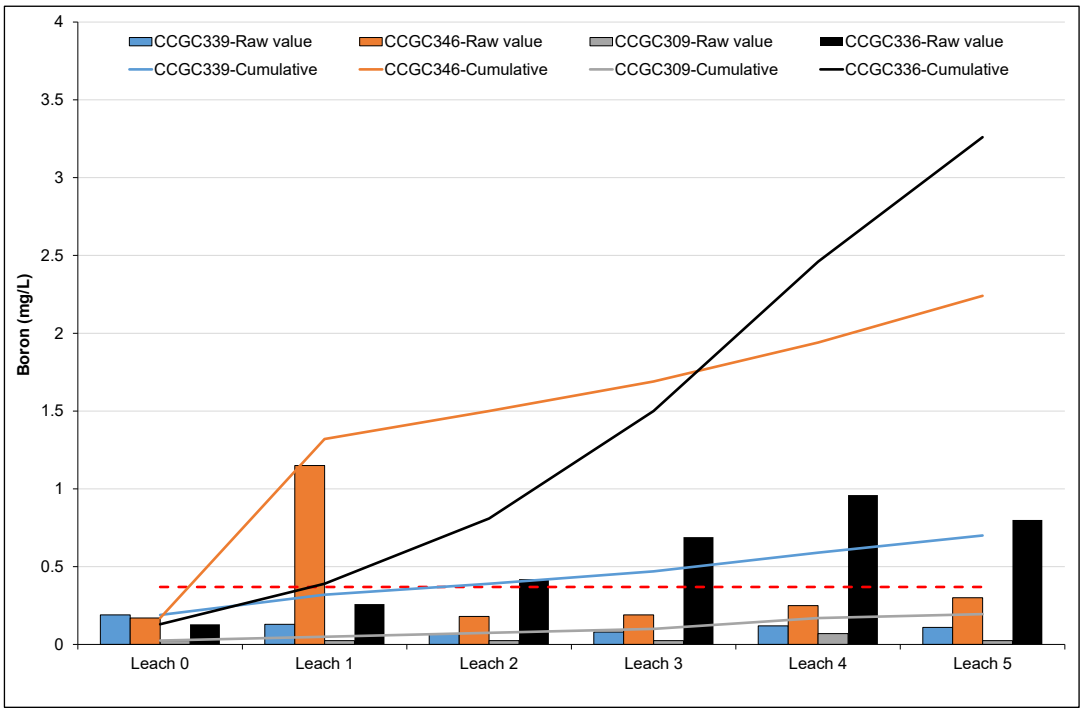



**Figure 23: Cumulative trends and individual leach values of dissolved boron observed in each KLC tested sample over time compared against the ANZG (2018) 95% species protection level for freshwater systems (red dashed line).**

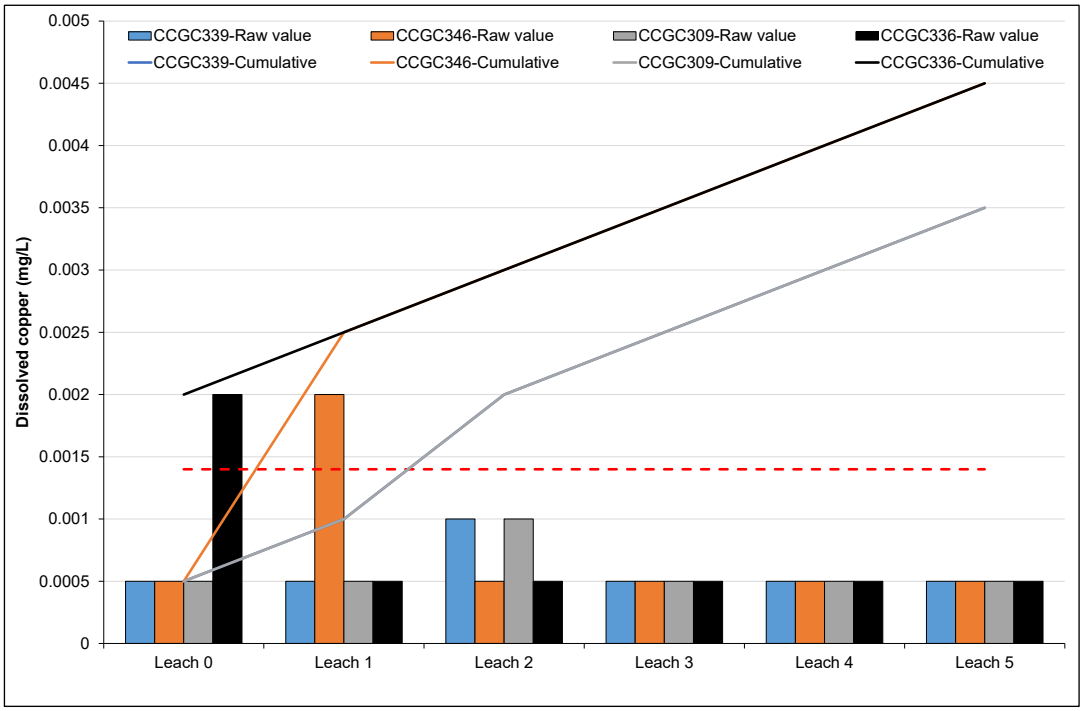



**Figure 24: Cumulative trends and individual leach values of dissolved copper observed in each KLC tested sample over time compared against the ANZG (2018) 95% species protection level for freshwater systems (red dashed line).**

During leach 1, CCGC346 (Pit 4) recorded one large spike of dissolved zinc (well above the aquatic ecosystem guideline level), but recorded levels below the LOR on every other occasion (Figure 25). CCGC309 (in Pit 6) is the only sample to record all values below the LOR, with no other site following any particular trend in results (Table 8 and Figure 25). In the absence of appreciable sulphate (i.e. evidence of sulphide oxidation) the behaviour of both copper and zinc are problematical. The most likely source of these metals into solution in the geological context (i.e. waste rock) is desorption from negatively charged manganese oxy-hydroxide colloids, and or, possibly negatively charged aluminium oxy-hydroxide colloids. Attempts to investigate these possibilities using correlation analyses have not been entirely successful. Possibly, by including adsorption on to smectite as an additional parameter may lead to success. Modelling at this level is beyond the scope of this current study.

Overall, it is considered likely that the probable sources of both copper and zinc are desorption from oxy-hydroxides and clays. This desorption would be opportunistic in the leaching solution as mineral species, and consequent value, may be elevated, but would be expected to show an overall decrease between successive leaches. This trend is generally consistent with the data up to Leach 5.

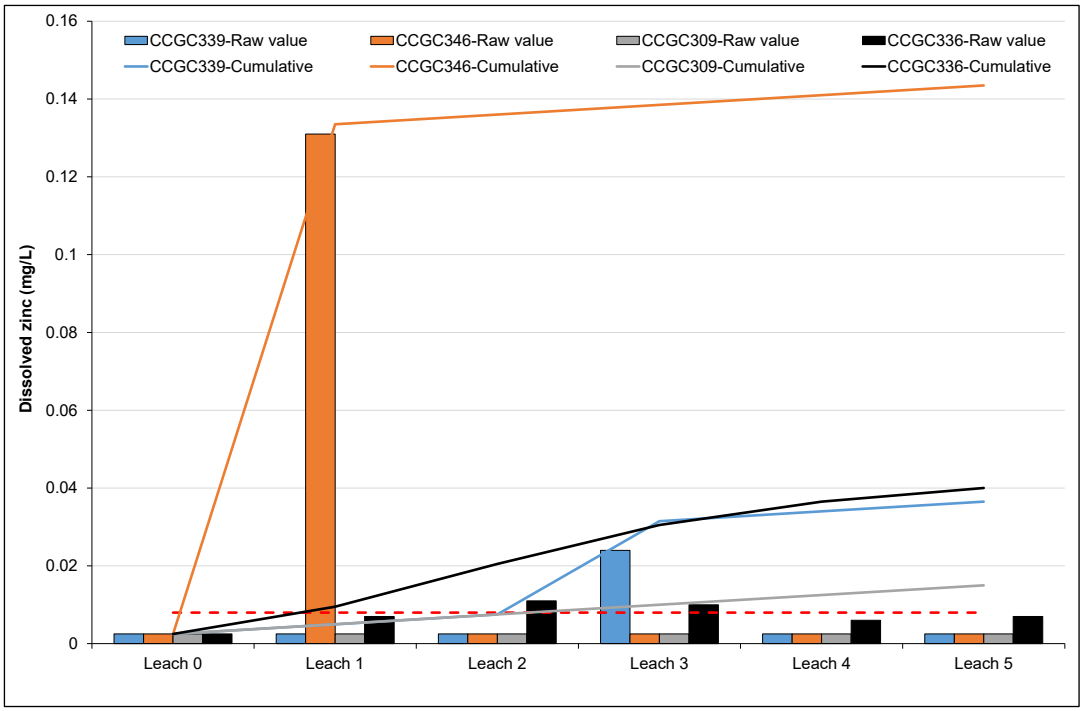



**Figure 25: Cumulative trends and individual leach values of dissolved zinc observed in each KLC tested sample over time compared against the ANZG (2018) 95% species protection level for freshwater systems (red dashed line).**

### 4.5.4 FLUORIDE

The KLC test results demonstrate that there is an expected overall accumulation of fluoride with successive leaching in sample CCGC339 (Table 8 and Figure 26). In all other samples (and particularly levels of fluoride), particulates are approximately constant with successive leaches.

For CCGC309, levels of fluoride fell from 6.6 mg/L in Leach 0, to 4 mg/L in Leach 1, to 2.0 mg/L in Leach 4 (Table 8 and Figure 26). The compliance level is 2.0 mg/L. The initial high level is probably due to the presence of the alteration mineral fluorite (CaF2) and its dissolution. Successive leaches reduce the influence of this mineral by dissolution.

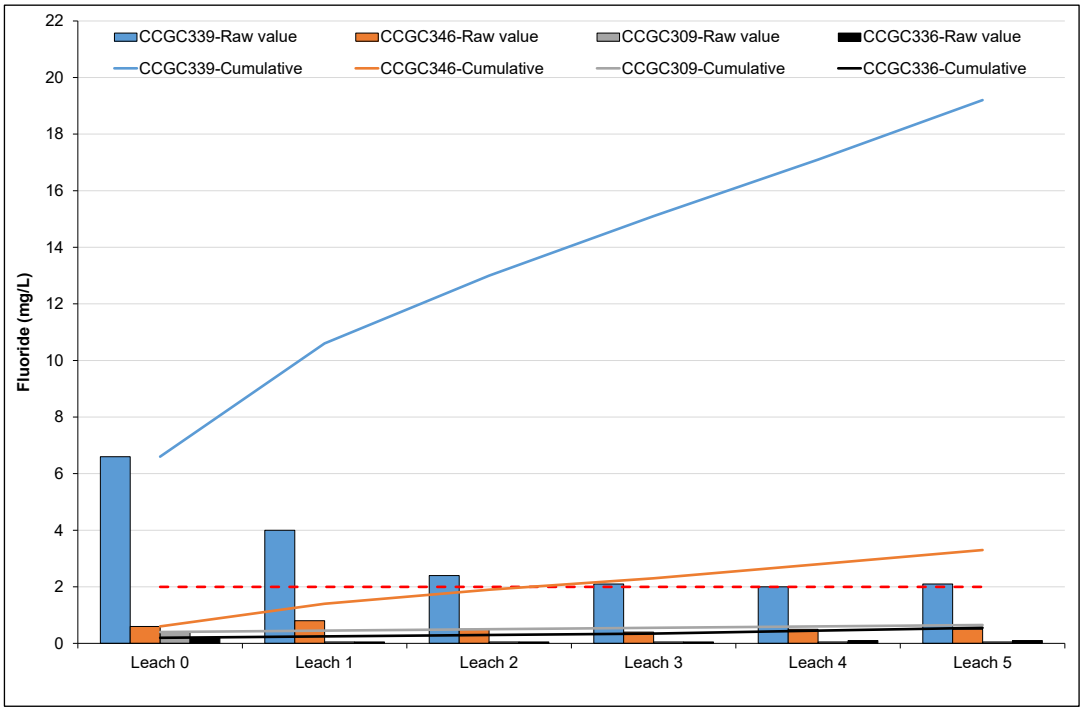



**Figure 26: Cumulative trends and individual leach values of fluoride observed in each KLC tested sample over time compared against the ANZG (2018) livestock drinking water value (red dashed line).**

# 5. CONCLUSION AND RECOMMENDATIONS

## 5.1 ACID MINE DRAINAGE

Static testing of 260 samples from Pits 1 to 6 from Agate Creek Mine were analysed for a broad range of analytes in manners consistent with the relevant protocols. Of the 260 samples analysed only 11 samples could be categorised as PAF. These samples are all found in Pits 2, 5 and 6 with 7 of the 11 being found in Pit 6. All of these, except for one sample in Pit 2, still only have very low to low sulphur values. Therefore, only one sample presents any possibility of acid mine drainage. Thus, it is expected that:

- The amount of any acid potentially produced will be small, and
- Any acid produced by the waste rock will be buffered by the surrounding NAF rock which makes up >90% of the waste rock.

Therefore, it is considered that the acid mine drainage risk posed by the waste rock associated with the project is very low.

## 5.2 SALINITY

The EC of water from the Agate Creek waste rock samples ranged from 7 to 1680 µS/cm with a very low median value of 43.5 µS/cm. These values are all within (or similar to in the case of the maximum value) appropriate guideline values for freshwater systems. Therefore, it is considered that salinity is not an issued in the management of the Agate Creek waste rock piles.

## 5.3 ELEMENTS

A broad range of analytes were assessed in both the static leach tests and KLC tests, with the following results of note:

- Fluoride: Levels were above the target level of 2 mg/L in many of the 260 waste rock samples analysed using static tests. The range in values overall was >0.5 mg/L to 63 mg/L. These exceedances may be of concern as fluorine is present in most of the waste rock, principally in the alteration zone minerals (fluorite) and in the micas. However, these fluoride values are not universal for the Agate Creek area which is a volcanic province where fluorine enrichment is not unexpected. The possibility of a high ambient level implies that the overall risk associated with fluoride is low.

  In the kinetic leach results, fluoride trended down to the compliance level of 2 mg/L by the 4$^{th}$ leach, supporting the overall proposition that the overall environmental risk from fluoride is low.
- Sulphate: The dissolved sulphate levels in the static test results from the Agate Creek waste rock samples range from 5 mg/L to 1760 mg/L with a low median value of 20 mg/L. Only one sample from Pit 2 is above the ANZECC and ARMCANZ (2000) Livestock Drinking Water Guideline of 1000 mg/L.

  Sulphate values in the KLC tests were all within compliance levels. Based on these results the environmental risk from sulphate is considered low.
- Metals and Metalloids: In KLC tests, levels above compliance values were detected for aluminium, boron, copper and zinc. These exceedances were relatively low and were probably associated with adsorbed species on colloids being included in the “dissolved” analyses. As such, these exceedances are considered to display a very low to low environmental risk associated with the Agate Creek waste rock piles.

## 5.4 RECOMMENDATIONS

The overall risk associated with the Agate Creek waste rock material is most likely very low to possibly low. In the light of this level of risk, capping is not recommended or appropriate. Any waste rock piles developed by the mining activities should be covered with layers of sub-soil and top-soil and revegetated with a range of native plant and grass species appropriate to the soils and climate of the area.

Additionally, it is recommended that the site determine site-specific water quality objectives for the receiving environment of Agate Creek and the groundwaters of relevance to the site, with particular focus on fluoride, sulphate, aluminium, boron, copper and zinc. This will allow for appropriate monitoring of potential impacts from operations/activities associated with the proposed project.

# 6. REFERENCES

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# Appendix A – Static Results

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2203022** | Page | : 1 of 26 |
| Client | : **C & R CONSULTING PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : ALEXANDER BARNES | Contact | : Princess Marcelo |
| Address | : 188 ROSS RIVER ROAD<br>AITKENVALE QUEENSLAND 4812 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : ---- | Telephone | : +61-7-3243 7222 |
| Project | : Agate Creek Geochemistry | Date Samples Received | : 01-Feb-2022 09:00 |
| Order number | : ---- | Date Analysis Commenced | : 10-Feb-2022 |
| C-O-C number | : ---- | Issue Date | : 08-Mar-2022 16:57 |
| Sampler | : PETER NEVILLE | | |
| Site | : ---- | | |
| Quote number | : TV/178/21 | | |
| No. of samples received | : 56 | | |
| No. of samples analysed | : 56 | | |

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Kim McCabe | Senior Inorganic Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

## General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EG005T (Total Metals by ICP-AES): V33205 (EB2203022-039) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V32485 (EB2203022-010) shows poor matrix spike recovery due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V32512 (EB2203022-019) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V32482 | V32485 | V32488 | V32491 | V32494 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203022-009 | EB2203022-010 | EB2203022-011 | EB2203022-012 | EB2203022-013 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.0 | 5.4 | 5.6 | 6.0 | 6.2 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | <0.5 | -0.5 | -7.0 | -6.8 | -1.1 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 40 | 234 | 32 | 23 | 22 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 5.3 | 5.5 | 4.9 | 5.8 | 5.9 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 1.9 | 3.8 | 13.6 | 3.5 | 3.4 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | <0.5 | 0.5 | 7.0 | 6.8 | 1.1 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | <0.1 | <0.1 | 0.7 | 0.7 | 0.1 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 1 | 1 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | 1.7 | <1.0 | 1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | 20 | <10 | <10 | <10 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 20 | 330 | 40 | 100 | 110 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 2420 | 1950 | 1470 | 1740 | 1680 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 11 | 33 | 6 | 26 | 9 |
| Barium | 7440-39-3 | 10 | mg/kg | 20 | 240 | 40 | 40 | 70 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 8 | 6 | 16 | 9 | 8 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 2 | <2 | <2 | 5 | 5 |
| Copper | 7440-50-8 | 5 | mg/kg | 7 | 7 | 9 | 17 | 14 |
| Iron | 7439-89-6 | 50 | mg/kg | 17800 | 5860 | 6030 | 12000 | 15700 |
| Lead | 7439-92-1 | 5 | mg/kg | 7 | 13 | 10 | 10 | 14 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V32482 | V32485 | V32488 | V32491 | V32494 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203022-009 | EB2203022-010 | EB2203022-011 | EB2203022-012 | EB2203022-013 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **33** | <5 | **5** | **481** | **120** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **4** | **5** | **9** | **5** | **6** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **17** | **13** | **9** | **21** | **16** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **32** | **24** | **6** | **21** | **34** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | <1 | **8** | **3** | **5** | **4** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V32497 | V32500 | V32503 | V32506 | V32509 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203022-014 | EB2203022-015 | EB2203022-016 | EB2203022-017 | EB2203022-018 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.9 | 7.0 | 7.1 | 7.2 | 7.3 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -0.6 | -0.8 | -0.8 | -0.9 | -1.2 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 36 | 13 | 20 | 22 | 47 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 5.8 | 6.0 | 5.9 | 6.3 | 7.0 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 3.6 | 2.5 | 3.2 | 1.1 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 0.6 | 0.8 | 0.8 | 0.9 | 1.2 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | <0.1 | <0.1 | <0.1 | <0.1 | 0.1 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | 1.1 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 20 | 10 | <10 | 10 | 30 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1700 | 1860 | 1420 | 2150 | 1390 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 8 | 17 | <5 | <5 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 70 | 80 | 30 | 20 | 20 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 12 | 11 | 9 | 12 | 14 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 6 | 14 | 3 | 30 | 4 |
| Copper | 7440-50-8 | 5 | mg/kg | 10 | 23 | 14 | 19 | 9 |
| Iron | 7439-89-6 | 50 | mg/kg | 22400 | 18100 | 6650 | 32200 | 9560 |
| Lead | 7439-92-1 | 5 | mg/kg | 17 | 16 | 14 | 13 | 10 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V32497 | V32500 | V32503 | V32506 | V32509 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203022-014 | EB2203022-015 | EB2203022-016 | EB2203022-017 | EB2203022-018 |
| | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | **62** | **312** | **84** | **376** | **191** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | **11** | **14** | **8** | **25** | **10** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | **11** | **9** | <5 | **8** | **5** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | **36** | **38** | **37** | **120** | **38** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | **6** | **6** | **4** | **5** | **5** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V32512 | V32515 | V32518 | V32521 | V32524 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203022-019 | EB2203022-020 | EB2203022-021 | EB2203022-022 | EB2203022-023 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.4 | 7.6 | 7.4 | 7.3 | 7.2 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | <0.5 | -0.8 | -6.7 | -6.7 | -1.1 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 28 | 30 | 35 | 30 | 47 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.9 | 6.5 | 6.4 | 6.9 | 8.0 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | 1.6 | 1.2 | 0.2 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | <0.5 | 0.8 | 6.7 | 6.7 | 1.1 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | <0.1 | <0.1 | 0.7 | 0.7 | 0.1 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 1 | 1 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | 1.0 | 1.0 | 1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | 20 | 20 | 20 | 40 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1920 | 1240 | 1370 | 1450 | 1450 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 70 | 20 | 40 | 10 | 100 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 11 | 14 | 12 | 18 | 8 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 10 | 4 | 3 | 2 | <2 |
| Copper | 7440-50-8 | 5 | mg/kg | 9 | 11 | <5 | 9 | 12 |
| Iron | 7439-89-6 | 50 | mg/kg | 27100 | 10900 | 9370 | 7860 | 8500 |
| Lead | 7439-92-1 | 5 | mg/kg | 6 | 8 | 20 | 11 | 10 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V32512 | V32515 | V32518 | V32521 | V32524 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203022-019 | EB2203022-020 | EB2203022-021 | EB2203022-022 | EB2203022-023 |
| | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | **456** | **161** | **104** | **219** | **128** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | **19** | **13** | **10** | **10** | **10** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | **6** | <5 | <5 | <5 | <5 |
| **Zinc** | 7440-66-6 | 5 | mg/kg | **72** | **38** | **34** | **35** | **39** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | **4** | **3** | **3** | **4** | **4** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V32527 | V32530 | V32533 | V32536 | V32539 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203022-024 | EB2203022-025 | EB2203022-026 | EB2203022-027 | EB2203022-028 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.3 | 6.5 | 7.8 | 7.6 | 7.6 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -1.6 | -1.0 | -1.2 | -0.7 | -0.8 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 41 | 96 | 69 | 46 | 65 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 8.0 | 6.8 | 7.6 | 7.4 | 7.2 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | 1.0 | <0.1 | <0.1 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 1.6 | 1.3 | 1.5 | 1.0 | 1.4 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.2 | 0.1 | 0.2 | 0.1 | 0.1 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 10 | 110 | 90 | 40 | 70 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | 0.01 | 0.01 | 0.01 | 0.02 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 20 | 120 | 10 | 10 | 20 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1240 | 1780 | 1190 | 3330 | 3170 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | 21 | 5 | <5 | 7 |
| Barium | 7440-39-3 | 10 | mg/kg | 130 | 290 | 50 | 50 | 80 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 9 | 8 | 10 | 14 | 13 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 6 | 45 | 18 | 7 | 7 |
| Copper | 7440-50-8 | 5 | mg/kg | 15 | 22 | 6 | 12 | 8 |
| Iron | 7439-89-6 | 50 | mg/kg | 8470 | 16400 | 9940 | 25600 | 26200 |
| Lead | 7439-92-1 | 5 | mg/kg | 11 | 18 | 19 | 9 | 17 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V32527 | V32530 | V32533 | V32536 | V32539 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203022-024 | EB2203022-025 | EB2203022-026 | EB2203022-027 | EB2203022-028 |
| | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | **325** | **52** | **562** | **515** | **738** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | **10** | **43** | **18** | **14** | **12** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | <5 | **5** | **6** | **14** | **11** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | **42** | **185** | **83** | **94** | **63** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | **0.3** | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | **5** | **3** | **4** | **4** | **4** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V32542 | V33151 | V33154 | V33157 | V33189 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203022-029 | EB2203022-030 | EB2203022-031 | EB2203022-032 | EB2203022-033 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.3 | 6.9 | 7.2 | 4.7 | 5.0 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -3.0 | -0.6 | <0.5 | 6.4 | 0.6 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 44 | 21 | 23 | 278 | 57 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.2 | 5.4 | 6.9 | 3.4 | 5.9 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | 2.4 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | 2.8 | 1.0 | 5.2 | 1.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 3.3 | 0.6 | <0.5 | 0.6 | <0.5 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.3 | <0.1 | <0.1 | <0.1 | <0.1 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | 1.5 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 30 | <10 | <10 | 670 | 110 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.01 | <0.01 | <0.01 | 0.23 | 0.02 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 10 | <10 | <10 | 100 | 30 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 5820 | 750 | 610 | 8800 | 2410 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | 19 | 6 | 37 | 18 |
| Barium | 7440-39-3 | 10 | mg/kg | 40 | <10 | <10 | <10 | 10 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | 1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 13 | 13 | 5 | 33 | 12 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 7 | 2 | <2 | 48 | 20 |
| Copper | 7440-50-8 | 5 | mg/kg | 10 | 25 | 25 | 155 | 48 |
| Iron | 7439-89-6 | 50 | mg/kg | 48100 | 6850 | 1010 | 46100 | 28500 |
| Lead | 7439-92-1 | 5 | mg/kg | 10 | <5 | <5 | <5 | 9 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V32542 | V33151 | V33154 | V33157 | V33189 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203022-029 | EB2203022-030 | EB2203022-031 | EB2203022-032 | EB2203022-033 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **903** | **36** | **6** | **589** | **187** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **18** | **10** | **3** | **118** | **6** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **10** | **10** | **8** | **64** | **57** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **120** | **15** | <5 | **215** | **16** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **4** | **5** | **8** | **2** | **2** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V33192 | V33195 | V33198 | V33201 | V33202 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203022-034 | EB2203022-035 | EB2203022-036 | EB2203022-037 | EB2203022-038 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.3 | 5.7 | 6.7 | 7.0 | 5.4 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -5.3 | -1.8 | -5.6 | -15.6 | -8.3 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 242 | 334 | 429 | 446 | 296 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 5.2 | 7.2 | 6.9 | 7.2 | 7.1 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 5.3 | <0.1 | 0.2 | <0.1 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 5.9 | 2.7 | 6.8 | 16.8 | 8.9 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.6 | 0.3 | 0.7 | 1.7 | 0.9 |
| Fizz Rating | ---- | 0 | Fizz Unit | 1 | 0 | 0 | 1 | 1 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | 1.0 | 1.7 | 2.9 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 420 | 630 | 820 | 910 | 530 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.02 | 0.03 | 0.04 | 0.04 | 0.02 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 90 | 130 | 180 | 160 | 120 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1190 | 1460 | 6370 | 14500 | 3050 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | <5 | <5 | 13 | 18 |
| Barium | 7440-39-3 | 10 | mg/kg | 60 | 20 | 20 | <10 | 20 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | 1 | <1 | 1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 6 | 7 | 16 | 32 | 20 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 4 | 37 | 39 | 53 | 31 |
| Copper | 7440-50-8 | 5 | mg/kg | 38 | 68 | 142 | 125 | 44 |
| Iron | 7439-89-6 | 50 | mg/kg | 14400 | 38500 | 40900 | 71800 | 40900 |
| Lead | 7439-92-1 | 5 | mg/kg | <5 | <5 | <5 | <5 | 10 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V33192 | V33195 | V33198 | V33201 | V33202 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203022-034 | EB2203022-035 | EB2203022-036 | EB2203022-037 | EB2203022-038 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **29** | **1580** | **1070** | **4260** | **453** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **4** | **17** | **47** | **62** | **14** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **28** | **32** | **66** | **126** | **70** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **15** | **68** | **68** | **108** | **33** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **2** | **3** | **4** | **6** | <1 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V33205 | V33208 | V33211 | V33214 | V33217 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203022-039 | EB2203022-040 | EB2203022-041 | EB2203022-042 | EB2203022-043 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 8.2 | 7.4 | 7.2 | 8.4 | 7.7 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -12.9 | -8.9 | -16.8 | -9.3 | -23.8 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 143 | 52 | 342 | 147 | 55 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 8.0 | 7.4 | 6.9 | 7.6 | 7.4 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | 0.2 | <0.1 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 13.2 | 9.2 | 17.4 | 9.6 | 23.8 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 1.3 | 0.9 | 1.8 | 1.0 | 2.4 |
| Fizz Rating | ---- | 0 | Fizz Unit | 1 | 1 | 1 | 1 | 1 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | 2.0 | <1.0 | 2.0 | <1.0 | 2.6 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 110 | 60 | 580 | 170 | 20 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.01 | 0.01 | 0.02 | 0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 90 | 20 | 140 | 60 | 20 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 2780 | 1140 | 27000 | 2470 | 22300 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | <5 | 9 | 11 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 80 | 20 | <10 | <10 | 20 |
| Beryllium | 7440-41-7 | 1 | mg/kg | 2 | <1 | <1 | <1 | 2 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 12 | 28 | 31 | 13 | 26 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 23 | 49 | 58 | 9 | 53 |
| Copper | 7440-50-8 | 5 | mg/kg | 73 | 56 | 60 | 9 | 80 |
| Iron | 7439-89-6 | 50 | mg/kg | 49000 | 9310 | 56000 | 6440 | 55400 |
| Lead | 7439-92-1 | 5 | mg/kg | <5 | <5 | <5 | 21 | 9 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V33205 | V33208 | V33211 | V33214 | V33217 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203022-039 | EB2203022-040 | EB2203022-041 | EB2203022-042 | EB2203022-043 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **2090** | **852** | **973** | **212** | **1560** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **12** | **31** | **162** | **20** | **135** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **50** | **14** | **111** | **9** | **106** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **59** | **24** | **114** | **17** | **121** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **18** | **8** | **12** | **11** | **20** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V33220 | V33223 | V33226 | V33246 | V33249 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203022-044 | EB2203022-045 | EB2203022-046 | EB2203022-047 | EB2203022-048 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.4 | 7.2 | 7.2 | 5.6 | 7.7 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -26.0 | -25.1 | -28.0 | -9.2 | -4.5 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 58 | 51 | 46 | 42 | 221 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.8 | 7.4 | 7.4 | 6.3 | 7.5 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 0.8 | <0.1 | <0.1 | 0.9 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 27.8 | 25.1 | 28.0 | 9.2 | 4.8 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 2.8 | 2.6 | 2.8 | 0.9 | 0.5 |
| Fizz Rating | ---- | 0 | Fizz Unit | 1 | 1 | 1 | 1 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | 2.1 | 5.4 | 5.0 | 1.7 | 1.4 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 70 | <10 | <10 | 30 | 100 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.06 | <0.01 | <0.01 | <0.01 | 0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 10 | 20 | 20 | 30 | 200 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 21800 | 27200 | 25400 | 5320 | 2570 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | <5 | <5 | 6 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 10 | 60 | 30 | 80 | 510 |
| Beryllium | 7440-41-7 | 1 | mg/kg | 1 | 2 | 2 | <1 | 1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 26 | 27 | 30 | 9 | 8 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 40 | 62 | 50 | 3 | 6 |
| Copper | 7440-50-8 | 5 | mg/kg | 51 | 109 | 120 | 5 | 6 |
| Iron | 7439-89-6 | 50 | mg/kg | 46500 | 57400 | 51100 | 14600 | 8610 |
| Lead | 7439-92-1 | 5 | mg/kg | <5 | <5 | <5 | 7 | 7 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V33220 | V33223 | V33226 | V33246 | V33249 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203022-044 | EB2203022-045 | EB2203022-046 | EB2203022-047 | EB2203022-048 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **2040** | **3200** | **1400** | **28** | **416** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **102** | **136** | **132** | **4** | **9** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **86** | **137** | **130** | **17** | **6** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **57** | **78** | **75** | **19** | **38** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **14** | **18** | **16** | **6** | **21** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V33252 | V33255 | V33258 | V33261 | V33264 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203022-049 | EB2203022-050 | EB2203022-051 | EB2203022-052 | EB2203022-053 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.1 | 7.2 | 8.0 | 7.7 | 7.6 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -2.6 | -2.9 | -12.4 | -8.2 | -17.8 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 175 | 189 | 78 | 28 | 21 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.0 | 6.2 | 7.5 | 7.4 | 7.2 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 3.0 | 1.4 | <0.1 | <0.1 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 2.6 | 2.9 | 12.4 | 8.2 | 17.8 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.3 | 0.3 | 1.2 | 0.8 | 1.8 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 1 | 0 | 1 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | 1.1 | <1.0 | 1.1 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 120 | 140 | 40 | <10 | <10 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 140 | 150 | 60 | 20 | 10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1290 | 760 | 3840 | 6740 | 7000 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 7 | 5 | <5 | <5 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 190 | 30 | 90 | 60 | 40 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 7 | 17 | 11 | 21 | 21 |
| Cobalt | 7440-48-4 | 2 | mg/kg | <2 | <2 | 7 | 12 | 11 |
| Copper | 7440-50-8 | 5 | mg/kg | 8 | 8 | 19 | 12 | 8 |
| Iron | 7439-89-6 | 50 | mg/kg | 4170 | 2930 | 16700 | 19000 | 18200 |
| Lead | 7439-92-1 | 5 | mg/kg | 7 | 6 | 11 | 8 | 6 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V33252 | V33255 | V33258 | V33261 | V33264 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203022-049 | EB2203022-050 | EB2203022-051 | EB2203022-052 | EB2203022-053 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **16** | **13** | **199** | **359** | **407** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **6** | **12** | **17** | **18** | **18** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | <5 | <5 | **9** | **19** | **19** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **15** | **12** | **72** | **64** | **59** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **13** | **8** | **11** | **7** | **4** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V33327 | V33330 | V33333 | V33336 | V33339 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203022-054 | EB2203022-055 | EB2203022-056 | EB2203022-057 | EB2203022-058 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.2 | 7.4 | 7.5 | 6.8 | 7.4 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -5.5 | -16.4 | -9.5 | -5.2 | -3.0 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 19 | 100 | 133 | 256 | 58 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.7 | 7.5 | 7.1 | 7.1 | 7.8 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 0.8 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 5.8 | 16.4 | 9.5 | 5.5 | 3.0 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.6 | 1.7 | 1.0 | 0.6 | 0.3 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 1 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | 1.0 | <1.0 | 1.1 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 10 | 60 | 130 | 280 | 40 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.01 | <0.01 | <0.01 | 0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 10 | 60 | 100 | 170 | 40 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 6940 | 6440 | 7330 | 6200 | 1580 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 6 | 7 | 6 | <5 | 8 |
| Barium | 7440-39-3 | 10 | mg/kg | 90 | 90 | 40 | 160 | 90 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 13 | 10 | 20 | 10 | 11 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 10 | 10 | 12 | 14 | 5 |
| Copper | 7440-50-8 | 5 | mg/kg | <5 | 6 | 10 | 14 | 10 |
| Iron | 7439-89-6 | 50 | mg/kg | 20200 | 16000 | 22300 | 18800 | 5040 |
| Lead | 7439-92-1 | 5 | mg/kg | 10 | 11 | 10 | 7 | 12 |

## Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

| Compound | CAS Number | LOR | Unit | Sample ID | V33327 | V33330 | V33333 | V33336 | V33339 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| | | | | | EB2203022-054 | EB2203022-055 | EB2203022-056 | EB2203022-057 | EB2203022-058 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **158** | **857** | **287** | **111** | **219** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **13** | **12** | **19** | **23** | **10** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **24** | **15** | **28** | **16** | **7** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **48** | **36** | **64** | **129** | **38** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **2** | **24** | **9** | **9** | **8** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V33342 | V33345 | V33348 | V33351 | V33354 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203022-059 | EB2203022-060 | EB2203022-061 | EB2203022-062 | EB2203022-063 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.9 | 6.8 | 8.0 | 7.4 | 7.6 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | <0.5 | -11.8 | -8.3 | -13.7 | -7.1 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 22 | 20 | 46 | 40 | 45 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.2 | 7.5 | 7.3 | 7.2 | 6.7 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | 0.9 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | <0.5 | 11.8 | 8.3 | 13.7 | 7.1 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | <0.1 | 1.2 | 0.8 | 1.4 | 0.7 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 1 | 0 | 1 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 10 | <10 | 10 | 40 | 20 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | 10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 2360 | 2530 | 8260 | 5420 | 9800 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 10 | <5 | <5 | <5 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 80 | 60 | 60 | 20 | 50 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | 1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 7 | 6 | 11 | 10 | 14 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 6 | 7 | 22 | 6 | 8 |
| Copper | 7440-50-8 | 5 | mg/kg | 11 | 9 | 14 | 12 | 17 |
| Iron | 7439-89-6 | 50 | mg/kg | 7770 | 7810 | 27400 | 18500 | 26500 |
| Lead | 7439-92-1 | 5 | mg/kg | 8 | 9 | 10 | 10 | 13 |

## Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

| Compound | CAS Number | LOR | Unit | Sample ID | V33342 | V33345 | V33348 | V33351 | V33354 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| | | | | | EB2203022-059 | EB2203022-060 | EB2203022-061 | EB2203022-062 | EB2203022-063 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **180** | **138** | **278** | **240** | **63** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **11** | **8** | **45** | **10** | **12** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **6** | **7** | **14** | **12** | **15** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **52** | **39** | **122** | **51** | **73** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **4** | **4** | **4** | **4** | **4** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V33357 | ---- | ---- | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | ---- | ---- | ---- | ---- |
| Compound | CAS Number | LOR | Unit | EB2203022-064 | -------- | -------- | -------- | -------- |
| | | | | Result | ---- | ---- | ---- | ---- |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| **pH Value** | ---- | 0.1 | pH Unit | **8.0** | ---- | ---- | ---- | ---- |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| **Net Acid Production Potential** | ---- | 0.5 | kg H2SO4/t | **-1.0** | ---- | ---- | ---- | ---- |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| **Electrical Conductivity @ 25°C** | ---- | 1 | µS/cm | **80** | ---- | ---- | ---- | ---- |
| **EA011: Net Acid Generation** | | | | | | | | |
| **pH (OX)** | ---- | 0.1 | pH Unit | **3.4** | ---- | ---- | ---- | ---- |
| **NAG (pH 4.5)** | ---- | 0.1 | kg H2SO4/t | **4.0** | ---- | ---- | ---- | ---- |
| **NAG (pH 7.0)** | ---- | 0.1 | kg H2SO4/t | **6.3** | ---- | ---- | ---- | ---- |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| **ANC as H2SO4** | ---- | 0.5 | kg H2SO4 equiv./t | **8.3** | ---- | ---- | ---- | ---- |
| **ANC as CaCO3** | ---- | 0.1 | % CaCO3 | **0.8** | ---- | ---- | ---- | ---- |
| **Fizz Rating** | ---- | 0 | Fizz Unit | **0** | ---- | ---- | ---- | ---- |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| **Moisture Content** | ---- | 1.0 | % | <1.0 | ---- | ---- | ---- | ---- |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| **Sulfate as SO4 2-** | 14808-79-8 | 10 | mg/kg | **110** | ---- | ---- | ---- | ---- |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| **Sulfur - Total as S (LECO)** | ---- | 0.01 | % | **0.24** | ---- | ---- | ---- | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| **Chloride** | 16887-00-6 | 10 | mg/kg | <10 | ---- | ---- | ---- | ---- |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| **Aluminium** | 7429-90-5 | 50 | mg/kg | **8370** | ---- | ---- | ---- | ---- |
| **Arsenic** | 7440-38-2 | 5 | mg/kg | **7** | ---- | ---- | ---- | ---- |
| **Barium** | 7440-39-3 | 10 | mg/kg | **160** | ---- | ---- | ---- | ---- |
| **Beryllium** | 7440-41-7 | 1 | mg/kg | <1 | ---- | ---- | ---- | ---- |
| **Boron** | 7440-42-8 | 50 | mg/kg | <50 | ---- | ---- | ---- | ---- |
| **Cadmium** | 7440-43-9 | 1 | mg/kg | <1 | ---- | ---- | ---- | ---- |
| **Chromium** | 7440-47-3 | 2 | mg/kg | **20** | ---- | ---- | ---- | ---- |
| **Cobalt** | 7440-48-4 | 2 | mg/kg | **13** | ---- | ---- | ---- | ---- |
| **Copper** | 7440-50-8 | 5 | mg/kg | **9** | ---- | ---- | ---- | ---- |
| **Iron** | 7439-89-6 | 50 | mg/kg | **29600** | ---- | ---- | ---- | ---- |
| **Lead** | 7439-92-1 | 5 | mg/kg | **11** | ---- | ---- | ---- | ---- |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V33357 | ---- | ---- | ---- | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | ---- | ---- | ---- | ---- |
| Compound | CAS Number | LOR | Unit | | EB2203022-064 | -------- | -------- | -------- | -------- |
| | | | | | Result | ---- | ---- | ---- | ---- |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **401** | ---- | ---- | ---- | ---- |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **17** | ---- | ---- | ---- | ---- |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | ---- | ---- | ---- | ---- |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **25** | ---- | ---- | ---- | ---- |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **55** | ---- | ---- | ---- | ---- |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | ---- | ---- | ---- | ---- |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **2** | ---- | ---- | ---- | ---- |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2203026** | Page | : 1 of 4 |
| **Amendment** | : **1** | | |
| Client | : **C & R CONSULTING PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : ALEXANDER BARNES | Contact | : Princess Marcelo |
| Address | : 188 ROSS RIVER ROAD<br>AITKENVALE QUEENSLAND 4812 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : ---- | Telephone | : +61-7-3243 7222 |
| Project | : Agate Creek Geochemistry | Date Samples Received | : 01-Feb-2022 09:00 |
| Order number | : ---- | Date Analysis Commenced | : 15-Feb-2022 |
| C-O-C number | : ---- | Issue Date | : 10-Mar-2022 15:27 |
| Sampler | : PETER NEVILLE | | |
| Site | : ---- | | |
| Quote number | : TV/178/21 | | |
| No. of samples received | : 1 | | |
| No. of samples analysed | : 1 | | |

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Ben Felgendrejeris | Senior Acid Sulfate Soil Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

## General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Amendment (10/3/22): This report has been amended and re-released to allow the reporting of additional analytical data, specifically Thorium that was missed at the log-in stage.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34048 to V34117 Composite | ---- | ---- | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | ---- | ---- | ---- | ---- |
| Compound | CAS Number | LOR | Unit | EB2203026-001 | -------- | -------- | -------- | -------- |
| | | | | Result | ---- | ---- | ---- | ---- |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| **pH Value** | ---- | 0.1 | pH Unit | **5.3** | ---- | ---- | ---- | ---- |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| **Net Acid Production Potential** | ---- | 0.5 | kg H2SO4/t | **-3.3** | ---- | ---- | ---- | ---- |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| **Electrical Conductivity @ 25°C** | ---- | 1 | µS/cm | **19** | ---- | ---- | ---- | ---- |
| **EA011: Net Acid Generation** | | | | | | | | |
| **pH (OX)** | ---- | 0.1 | pH Unit | **7.1** | ---- | ---- | ---- | ---- |
| **NAG (pH 4.5)** | ---- | 0.1 | kg H2SO4/t | <0.1 | ---- | ---- | ---- | ---- |
| **NAG (pH 7.0)** | ---- | 0.1 | kg H2SO4/t | <0.1 | ---- | ---- | ---- | ---- |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| **ANC as H2SO4** | ---- | 0.5 | kg H2SO4 equiv./t | **3.3** | ---- | ---- | ---- | ---- |
| **ANC as CaCO3** | ---- | 0.1 | % CaCO3 | **0.3** | ---- | ---- | ---- | ---- |
| **Fizz Rating** | ---- | 0 | Fizz Unit | **0** | ---- | ---- | ---- | ---- |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| **Moisture Content** | ---- | 1.0 | % | <1.0 | ---- | ---- | ---- | ---- |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| **Sulfate as SO4 2-** | 14808-79-8 | 10 | mg/kg | <10 | ---- | ---- | ---- | ---- |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| **Sulfur - Total as S (LECO)** | ---- | 0.01 | % | <0.01 | ---- | ---- | ---- | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| **Chloride** | 16887-00-6 | 10 | mg/kg | **20** | ---- | ---- | ---- | ---- |
| **ED093S: Soluble Major Cations** | | | | | | | | |
| **Calcium** | 7440-70-2 | 10 | mg/kg | <10 | ---- | ---- | ---- | ---- |
| **Magnesium** | 7439-95-4 | 10 | mg/kg | <10 | ---- | ---- | ---- | ---- |
| **Sodium** | 7440-23-5 | 10 | mg/kg | <10 | ---- | ---- | ---- | ---- |
| **Potassium** | 7440-09-7 | 10 | mg/kg | **20** | ---- | ---- | ---- | ---- |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| **Aluminium** | 7429-90-5 | 50 | mg/kg | **710** | ---- | ---- | ---- | ---- |
| **Arsenic** | 7440-38-2 | 5 | mg/kg | <5 | ---- | ---- | ---- | ---- |
| **Barium** | 7440-39-3 | 10 | mg/kg | <10 | ---- | ---- | ---- | ---- |
| **Beryllium** | 7440-41-7 | 1 | mg/kg | <1 | ---- | ---- | ---- | ---- |
| **Boron** | 7440-42-8 | 50 | mg/kg | <50 | ---- | ---- | ---- | ---- |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V34048 to V34117 Composite | ---- | ---- | ---- | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | ---- | ---- | ---- | ---- |
| Compound | CAS Number | LOR | Unit | | EB2203026-001 | -------- | -------- | -------- | -------- |
| | | | | | Result | ---- | ---- | ---- | ---- |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Cadmium** | 7440-43-9 | 1 | mg/kg | | <1 | ---- | ---- | ---- | ---- |
| **Chromium** | 7440-47-3 | 2 | mg/kg | | **5** | ---- | ---- | ---- | ---- |
| **Cobalt** | 7440-48-4 | 2 | mg/kg | | <2 | ---- | ---- | ---- | ---- |
| **Copper** | 7440-50-8 | 5 | mg/kg | | <5 | ---- | ---- | ---- | ---- |
| **Iron** | 7439-89-6 | 50 | mg/kg | | **5180** | ---- | ---- | ---- | ---- |
| **Lead** | 7439-92-1 | 5 | mg/kg | | <5 | ---- | ---- | ---- | ---- |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **78** | ---- | ---- | ---- | ---- |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | <2 | ---- | ---- | ---- | ---- |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | ---- | ---- | ---- | ---- |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **6** | ---- | ---- | ---- | ---- |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **14** | ---- | ---- | ---- | ---- |
| **EG020T: Total Metals by ICP-MS** | | | | | | | | | |
| **Thorium** | 7440-29-1 | 0.1 | mg/kg | | **0.8** | ---- | ---- | ---- | ---- |
| **Molybdenum** | 7439-98-7 | 0.1 | mg/kg | | **2.4** | ---- | ---- | ---- | ---- |
| **Antimony** | 7440-36-0 | 0.1 | mg/kg | | **0.5** | ---- | ---- | ---- | ---- |
| **Uranium** | 7440-61-1 | 0.1 | mg/kg | | **0.4** | ---- | ---- | ---- | ---- |
| **Tellurium** | 22541-49-7 | 0.5 | mg/kg | | <0.5 | ---- | ---- | ---- | ---- |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | ---- | ---- | ---- | ---- |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2203029** | Page | : 1 of 32 |
| Client | : **C & R CONSULTING PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : ALEXANDER BARNES | Contact | : Princess Marcelo |
| Address | : 188 ROSS RIVER ROAD<br>AITKENVALE QUEENSLAND 4812 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : ---- | Telephone | : +61-7-3243 7222 |
| Project | : Agate Creek Geochemistry | Date Samples Received | : 01-Feb-2022 09:00 |
| Order number | : ---- | Date Analysis Commenced | : 10-Feb-2022 |
| C-O-C number | : ---- | Issue Date | : 10-Mar-2022 15:31 |
| Sampler | : PETER NEVILLE | | |
| Site | : ---- | | |
| Quote number | : TV/178/21 | | |
| No. of samples received | : 73 | | |
| No. of samples analysed | : 73 | | |

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Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

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| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Ben Felgendrejeris | Senior Acid Sulfate Soil Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Ben Felgendrejeris | Senior Acid Sulfate Soil Chemist | Brisbane Inorganics, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

## General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **SPLIT WORK ORDER: It should be noted that ALS has split this work order over the following work orders (EB2203032, EB2203029) due to the size of the sample numbers. For any further information regarding this processing of samples please contact ALS client services division on ALSEnviro.Brisbane@alsglobal.com**
- EG005T (Total Metals by ICP-AES): V33031 (EB2203029-046) shows poor matrix spike recovery due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V31908 (EB2203029-005) and V320030 (EB2203029-015) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V31900 | V31903 | V31905 | V31906 | V31908 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-001 | EB2203029-002 | EB2203029-003 | EB2203029-004 | EB2203029-005 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 4.9 | 5.0 | 5.0 | 5.0 | 4.9 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -0.7 | -1.1 | -0.7 | -2.0 | -1.6 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 10 | 10 | 13 | 10 | 13 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 5.6 | 5.6 | 5.5 | 5.8 | 5.8 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 4.4 | 6.1 | 4.2 | 3.3 | 4.4 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 0.7 | 1.1 | 0.7 | 2.0 | 1.6 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | <0.1 | 0.1 | <0.1 | 0.2 | 0.2 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1000 | 980 | 1300 | 740 | 920 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | 6 | 13 | <5 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 10 | 10 | 10 | <10 | <10 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 5 | 2 | 3 | <2 | <2 |
| Cobalt | 7440-48-4 | 2 | mg/kg | <2 | <2 | <2 | <2 | <2 |
| Copper | 7440-50-8 | 5 | mg/kg | <5 | <5 | 8 | <5 | <5 |
| Iron | 7439-89-6 | 50 | mg/kg | 2240 | 4760 | 10700 | 2000 | 810 |
| Lead | 7439-92-1 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V31900 | V31903 | V31905 | V31906 | V31908 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203029-001 | EB2203029-002 | EB2203029-003 | EB2203029-004 | EB2203029-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | <5 | <5 | **6** | **5** | <5 |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **3** | <2 | <2 | <2 | <2 |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **10** | **6** | **6** | <5 | <5 |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | <5 | <5 | **8** | <5 | <5 |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | <1 | <1 | <1 | <1 | <1 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V31910 | V31912 | V31914 | V31916 | V31918 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-006 | EB2203029-007 | EB2203029-008 | EB2203029-009 | EB2203029-010 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.2 | 5.4 | 5.5 | 5.4 | 5.6 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | <0.5 | -1.6 | -1.9 | -2.4 | -2.5 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 10 | 10 | 11 | 13 | 15 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 5.8 | 5.6 | 5.9 | 6.6 | 6.1 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 3.6 | 4.2 | 2.7 | 0.8 | 2.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | <0.5 | 1.6 | 1.9 | 2.4 | 2.5 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | <0.1 | 0.2 | 0.2 | 0.2 | 0.2 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | 1.0 | 1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | 10 | 10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1000 | 790 | 1080 | 1010 | 760 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | <5 | 5 | 8 | 9 |
| Barium | 7440-39-3 | 10 | mg/kg | 10 | 20 | 40 | 60 | 10 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | <2 | 2 | 3 | 2 | <2 |
| Cobalt | 7440-48-4 | 2 | mg/kg | <2 | <2 | <2 | <2 | <2 |
| Copper | 7440-50-8 | 5 | mg/kg | <5 | <5 | 6 | 7 | 13 |
| Iron | 7439-89-6 | 50 | mg/kg | 380 | 4920 | 5820 | 5600 | 3400 |
| Lead | 7439-92-1 | 5 | mg/kg | <5 | <5 | 7 | 10 | 6 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V31910 | V31912 | V31914 | V31916 | V31918 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-006 | EB2203029-007 | EB2203029-008 | EB2203029-009 | EB2203029-010 |
| | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | <5 | <5 | **20** | **93** | **39** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | <2 | <2 | **2** | **3** | **2** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | <5 | **6** | **7** | **8** | <5 |
| **Zinc** | 7440-66-6 | 5 | mg/kg | <5 | <5 | **10** | **11** | **14** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | <1 | **1** | **1** | **2** | **2** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V31920 | V31922 | V31997 | V32000 | V32003 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-011 | EB2203029-012 | EB2203029-013 | EB2203029-014 | EB2203029-015 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.8 | 5.8 | 5.5 | 5.8 | 6.2 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | <0.5 | -3.0 | -1.0 | -1.7 | -2.9 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 15 | 26 | 16 | 23 | 29 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.1 | 7.1 | 6.1 | 6.4 | 7.6 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 3.4 | <0.1 | 1.5 | 1.3 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | <0.5 | 3.0 | 1.0 | 1.7 | 2.9 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | <0.1 | 0.3 | <0.1 | 0.2 | 0.3 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | 1.2 | 1.4 | <1.0 | <1.0 | 1.1 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | 10 | 20 | 10 | 10 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | 230 | <10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 980 | 990 | 410 | 620 | 990 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 14 | 11 | 19 | <5 | 11 |
| Barium | 7440-39-3 | 10 | mg/kg | 40 | 10 | 40 | 20 | 80 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 2 | <2 | 5 | 8 | 5 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 3 | 6 | <2 | <2 | 8 |
| Copper | 7440-50-8 | 5 | mg/kg | 11 | 9 | 12 | <5 | 9 |
| Iron | 7439-89-6 | 50 | mg/kg | 9380 | 14700 | 4630 | 2510 | 13800 |
| Lead | 7439-92-1 | 5 | mg/kg | 8 | 5 | <5 | <5 | 7 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V31920 | V31922 | V31997 | V32000 | V32003 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203029-011 | EB2203029-012 | EB2203029-013 | EB2203029-014 | EB2203029-015 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **188** | **66** | **23** | **22** | **307** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **4** | **5** | **4** | **4** | **8** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **5** | **6** | **8** | <5 | <5 |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **18** | **25** | **10** | <5 | **29** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **3** | **4** | **1** | **3** | **6** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V32006 | V32009 | V32012 | V32015 | V32018 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-016 | EB2203029-017 | EB2203029-018 | EB2203029-019 | EB2203029-020 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.4 | 6.8 | 6.8 | 6.9 | 7.0 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -1.5 | -3.4 | -3.7 | -2.0 | 10.7 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 33 | 29 | 25 | 30 | 112 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.2 | 6.5 | 7.8 | 6.5 | 2.9 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | 9.9 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 3.3 | 1.6 | <0.1 | 1.2 | 12.2 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 1.8 | 3.4 | 3.7 | 2.0 | 5.2 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.2 | 0.4 | 0.4 | 0.2 | 0.5 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | 1.3 | 1.1 | 1.1 | 1.4 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 30 | <10 | <10 | 10 | 190 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.01 | <0.01 | <0.01 | <0.01 | 0.52 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1200 | 900 | 1320 | 1020 | 4250 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 14 | 7 | 27 | 15 | 59 |
| Barium | 7440-39-3 | 10 | mg/kg | 210 | 40 | 70 | 20 | 10 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 4 | 5 | 6 | 4 | 7 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 3 | <2 | 7 | 4 | 15 |
| Copper | 7440-50-8 | 5 | mg/kg | 7 | <5 | 12 | 6 | 12 |
| Iron | 7439-89-6 | 50 | mg/kg | 4940 | 7590 | 17700 | 11700 | 22900 |
| Lead | 7439-92-1 | 5 | mg/kg | 9 | 8 | 14 | 6 | 8 |

## Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

| Compound | CAS Number | LOR | Unit | Sample ID | V32006 | V32009 | V32012 | V32015 | V32018 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| | | | | | EB2203029-016 | EB2203029-017 | EB2203029-018 | EB2203029-019 | EB2203029-020 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **54** | **77** | **462** | **103** | **506** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **7** | **6** | **7** | **8** | **29** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | <5 | <5 | **5** | <5 | **11** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **34** | **22** | **26** | **27** | **126** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **7** | **8** | **8** | **9** | **7** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V32021 | V32024 | V32027 | V32137 | V32140 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-021 | EB2203029-022 | EB2203029-023 | EB2203029-024 | EB2203029-025 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.9 | 7.6 | 7.7 | 4.8 | 5.4 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -3.1 | -5.5 | -2.2 | -1.7 | -2.7 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 67 | 63 | 59 | 39 | 276 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.4 | 7.3 | 6.0 | 5.8 | 5.7 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | 1.2 | 1.3 | 1.2 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 3.4 | 5.5 | 2.2 | 1.7 | 2.7 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.3 | 0.6 | 0.2 | 0.2 | 0.3 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 1 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | 1.6 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 30 | 30 | 30 | 30 | 20 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | <10 | 20 | 310 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1560 | 1000 | 1060 | 2360 | 1800 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | <5 | 9 | 10 | 11 |
| Barium | 7440-39-3 | 10 | mg/kg | 40 | 20 | 40 | 30 | 120 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 4 | 3 | 2 | 6 | 11 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 7 | 6 | 4 | <2 | 3 |
| Copper | 7440-50-8 | 5 | mg/kg | 6 | <5 | 12 | <5 | 9 |
| Iron | 7439-89-6 | 50 | mg/kg | 22000 | 26400 | 18100 | 13200 | 11000 |
| Lead | 7439-92-1 | 5 | mg/kg | 8 | 5 | 8 | <5 | 5 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V32021 | V32024 | V32027 | V32137 | V32140 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203029-021 | EB2203029-022 | EB2203029-023 | EB2203029-024 | EB2203029-025 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **365** | **428** | **382** | **19** | **25** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **11** | **6** | **7** | **3** | **8** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **7** | **7** | **6** | **17** | **12** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **78** | **61** | **46** | **14** | **21** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **12** | **10** | **10** | <1 | **11** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V32143 | V32146 | V32149 | V32152 | V32155 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-026 | EB2203029-027 | EB2203029-028 | EB2203029-029 | EB2203029-030 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.0 | 5.3 | 6.0 | 6.7 | 7.2 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -2.2 | -2.3 | -2.9 | -3.4 | -3.6 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 270 | 279 | 186 | 162 | 180 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 5.9 | 6.0 | 6.8 | 6.3 | 7.7 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 2.0 | 1.9 | 0.9 | 2.3 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 2.2 | 2.3 | 2.9 | 3.4 | 3.6 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.2 | 0.2 | 0.3 | 0.4 | 0.4 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | 1.6 | 1.5 | <1.0 | 1.1 | 1.1 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 50 | 40 | 20 | 30 | 20 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 370 | 350 | 210 | 140 | 200 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1830 | 1410 | 1220 | 1460 | 1200 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 29 | 14 | 8 | 12 | 7 |
| Barium | 7440-39-3 | 10 | mg/kg | 70 | 30 | 20 | 130 | 20 |
| Beryllium | 7440-41-7 | 1 | mg/kg | 1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 9 | 21 | 17 | 17 | 19 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 4 | 3 | 4 | 8 | 4 |
| Copper | 7440-50-8 | 5 | mg/kg | 9 | 8 | 8 | 11 | 8 |
| Iron | 7439-89-6 | 50 | mg/kg | 20500 | 5580 | 6080 | 10200 | 8550 |
| Lead | 7439-92-1 | 5 | mg/kg | 8 | 6 | 10 | 13 | 12 |

## Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

| Compound | CAS Number | LOR | Unit | Sample ID | V32143 | V32146 | V32149 | V32152 | V32155 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| | | | | | EB2203029-026 | EB2203029-027 | EB2203029-028 | EB2203029-029 | EB2203029-030 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **14** | **9** | **85** | **63** | **162** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **11** | **14** | **12** | **21** | **15** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **9** | **10** | **7** | **7** | **6** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **35** | **21** | **16** | **64** | **17** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **2** | **3** | **7** | **18** | **7** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V32158 | V32161 | V32164 | V32167 | V32967 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-031 | EB2203029-032 | EB2203029-033 | EB2203029-034 | EB2203029-035 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.6 | 7.1 | 7.2 | 7.2 | 5.6 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -2.8 | -3.9 | -2.9 | -4.5 | -2.6 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 130 | 198 | 129 | 157 | 64 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.8 | 7.5 | 7.7 | 7.8 | 7.0 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 2.8 | 3.9 | 2.9 | 4.5 | 2.9 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.3 | 0.4 | 0.3 | 0.4 | 0.3 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | 1.4 | 1.3 | <1.0 | 1.1 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 30 | 40 | 40 | 40 | 90 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 110 | 210 | 110 | 160 | 20 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1110 | 1230 | 1300 | 3060 | 3170 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | 6 |
| Barium | 7440-39-3 | 10 | mg/kg | 20 | 20 | 100 | 20 | 30 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 15 | 14 | 11 | 12 | 20 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 4 | 5 | 10 | 18 | 29 |
| Copper | 7440-50-8 | 5 | mg/kg | 7 | 7 | 12 | 12 | 70 |
| Iron | 7439-89-6 | 50 | mg/kg | 17400 | 45200 | 33500 | 47900 | 31900 |
| Lead | 7439-92-1 | 5 | mg/kg | 13 | 15 | 15 | 11 | 28 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V32158 | V32161 | V32164 | V32167 | V32967 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203029-031 | EB2203029-032 | EB2203029-033 | EB2203029-034 | EB2203029-035 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **217** | **814** | **1100** | **451** | **405** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **13** | **11** | **11** | **24** | **17** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **6** | **9** | **11** | **8** | **53** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **28** | **46** | **40** | **140** | **47** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **7** | **6** | **6** | **7** | **2** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V32970 | V32973 | V32976 | V32979 | V32982 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-036 | EB2203029-037 | EB2203029-038 | EB2203029-039 | EB2203029-040 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.1 | 4.8 | 4.7 | 4.6 | 5.0 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -0.2 | -1.0 | -0.6 | -0.9 | -1.4 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 64 | 170 | 287 | 362 | 256 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.1 | 6.0 | 6.3 | 6.2 | 6.3 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 5.3 | 3.2 | 2.4 | 1.0 | 1.0 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 0.8 | 2.2 | 3.0 | 2.1 | 2.3 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | <0.1 | 0.2 | 0.3 | 0.2 | 0.2 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | 1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 70 | 250 | 490 | 640 | 460 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.02 | 0.04 | 0.08 | 0.04 | 0.03 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 40 | 60 | 60 | 70 | 40 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1070 | 1000 | 1210 | 1510 | 1130 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | 13 |
| Barium | 7440-39-3 | 10 | mg/kg | 30 | <10 | <10 | <10 | 10 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | 1 | 1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 10 | 10 | 9 | 13 | 10 |
| Cobalt | 7440-48-4 | 2 | mg/kg | <2 | <2 | <2 | 4 | <2 |
| Copper | 7440-50-8 | 5 | mg/kg | 8 | 11 | 19 | 66 | 62 |
| Iron | 7439-89-6 | 50 | mg/kg | 29100 | 15700 | 16600 | 44500 | 31100 |
| Lead | 7439-92-1 | 5 | mg/kg | <5 | <5 | <5 | 34 | 24 |

## Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

| Compound | CAS Number | LOR | Unit | Sample ID | V32970 | V32973 | V32976 | V32979 | V32982 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| | | | | | EB2203029-036 | EB2203029-037 | EB2203029-038 | EB2203029-039 | EB2203029-040 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | <5 | <5 | <5 | **27** | **6** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **3** | **5** | **3** | **6** | **4** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **11** | **13** | **21** | **83** | **34** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | <5 | **7** | **5** | **24** | **12** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | <1 | <1 | <1 | <1 | <1 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V32985 | V32988 | V32991 | V33025 | V33028 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-041 | EB2203029-042 | EB2203029-043 | EB2203029-044 | EB2203029-045 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.4 | 6.2 | 6.2 | 5.0 | 4.5 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -1.7 | -0.7 | -0.4 | -1.8 | 1.2 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 233 | 82 | 168 | 60 | 394 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 5.6 | 6.1 | 5.8 | 5.2 | 5.7 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 4.4 | 3.3 | 5.7 | 2.6 | 1.4 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 2.6 | 1.0 | 1.0 | 2.1 | <0.5 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.3 | 0.1 | <0.1 | 0.2 | <0.1 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | 1.6 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 410 | 120 | 300 | 10 | 440 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.03 | 0.01 | 0.02 | 0.01 | 0.04 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 30 | 20 | 20 | 60 | 230 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1380 | 880 | 840 | 1400 | 1470 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 22 | 18 | 26 | <5 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 10 | <10 | <10 | 10 | 30 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 14 | 12 | 9 | 7 | 9 |
| Cobalt | 7440-48-4 | 2 | mg/kg | <2 | <2 | 2 | 2 | 8 |
| Copper | 7440-50-8 | 5 | mg/kg | 38 | 29 | 123 | 13 | 23 |
| Iron | 7439-89-6 | 50 | mg/kg | 31500 | 31600 | 23500 | 15600 | 33100 |
| Lead | 7439-92-1 | 5 | mg/kg | 14 | 10 | 31 | <5 | <5 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V32985 | V32988 | V32991 | V33025 | V33028 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203029-041 | EB2203029-042 | EB2203029-043 | EB2203029-044 | EB2203029-045 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **12** | **25** | **77** | **25** | **230** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **6** | **6** | **7** | **2** | **7** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **104** | **10** | **10** | **15** | **32** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **16** | **10** | **24** | **7** | **27** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **3** | **3** | **4** | <1 | **2** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V33031 | V33034 | V33037 | V33040 | V33043 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-046 | EB2203029-047 | EB2203029-048 | EB2203029-049 | EB2203029-050 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 4.6 | 5.4 | 6.7 | 7.4 | 7.6 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -0.7 | 0.6 | -12.2 | -16.6 | -8.6 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 347 | 158 | 194 | 286 | 177 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 5.3 | 5.8 | 7.1 | 7.2 | 7.2 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 2.2 | 4.2 | <0.1 | <0.1 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 1.6 | <0.5 | 12.8 | 17.2 | 9.2 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.2 | <0.1 | 1.3 | 1.8 | 0.9 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 1 | 1 | 1 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | 2.0 | <1.0 | 1.4 | 2.7 | 2.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 390 | 190 | 280 | 420 | 300 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 200 | 90 | 70 | 90 | 40 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 2180 | 3170 | 11600 | 41000 | 32400 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 60 | <10 | 10 | 10 | <10 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | 1 | 2 | 2 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 16 | 13 | 17 | 71 | 90 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 10 | 17 | 67 | 182 | 85 |
| Copper | 7440-50-8 | 5 | mg/kg | 35 | 26 | 27 | 74 | 75 |
| Iron | 7439-89-6 | 50 | mg/kg | 28900 | 27700 | 36700 | 94500 | 68200 |
| Lead | 7439-92-1 | 5 | mg/kg | 7 | <5 | <5 | 15 | 8 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V33031 | V33034 | V33037 | V33040 | V33043 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203029-046 | EB2203029-047 | EB2203029-048 | EB2203029-049 | EB2203029-050 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **186** | **97** | **218** | **871** | **741** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **8** | **25** | **55** | **101** | **68** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **32** | **17** | **29** | **176** | **151** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **37** | **63** | **129** | **216** | **165** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | <1 | **1** | **7** | **9** | **6** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V33046 | V33049 | V33052 | V33055 | V33133 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-051 | EB2203029-052 | EB2203029-053 | EB2203029-054 | EB2203029-055 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.5 | 7.4 | 7.3 | 7.3 | 5.3 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -18.0 | -15.7 | -15.5 | -19.3 | 2.8 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 238 | 200 | 190 | 157 | 169 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.2 | 7.5 | 7.5 | 6.9 | 4.7 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | 0.2 | 2.2 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 18.6 | 16.0 | 16.1 | 19.6 | 0.6 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 1.9 | 1.6 | 1.6 | 2.0 | <0.1 |
| Fizz Rating | ---- | 0 | Fizz Unit | 1 | 1 | 1 | 1 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | 2.3 | 1.8 | 2.2 | 3.0 | 1.6 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 390 | 350 | 340 | 250 | 320 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.02 | 0.01 | 0.02 | 0.01 | 0.11 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 40 | 30 | 20 | 20 | 30 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 34900 | 28700 | 29500 | 38000 | 5080 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | 60 |
| Barium | 7440-39-3 | 10 | mg/kg | <10 | 10 | 20 | 10 | 40 |
| Beryllium | 7440-41-7 | 1 | mg/kg | 2 | 2 | 2 | 2 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | 2 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 27 | 38 | 28 | 60 | 26 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 107 | 118 | 100 | 82 | 33 |
| Copper | 7440-50-8 | 5 | mg/kg | 96 | 100 | 99 | 134 | 71 |
| Iron | 7439-89-6 | 50 | mg/kg | 95800 | 91500 | 94100 | 107000 | 44400 |
| Lead | 7439-92-1 | 5 | mg/kg | 11 | 12 | 26 | 94 | 16 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V33046 | V33049 | V33052 | V33055 | V33133 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-051 | EB2203029-052 | EB2203029-053 | EB2203029-054 | EB2203029-055 |
| | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | **785** | **1490** | **1150** | **1170** | **632** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | **75** | **92** | **70** | **102** | **31** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | **198** | **165** | **181** | **240** | **91** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | **187** | **234** | **317** | **395** | **55** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | **8** | **8** | **9** | **20** | <1 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V33136 | V33139 | V33142 | V33145 | V33148 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-056 | EB2203029-057 | EB2203029-058 | EB2203029-059 | EB2203029-060 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.5 | 7.5 | 7.8 | 8.0 | 7.6 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -19.8 | -16.8 | -16.8 | -12.2 | -5.4 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 177 | 1680 | 236 | 114 | 59 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.5 | 7.2 | 7.2 | 7.2 | 7.7 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 20.4 | 19.2 | 18.0 | 12.5 | 5.4 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 2.1 | 2.0 | 1.8 | 1.3 | 0.5 |
| Fizz Rating | ---- | 0 | Fizz Unit | 1 | 1 | 1 | 1 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | 8.4 | 6.6 | 3.2 | 2.5 | 1.5 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 130 | 1780 | 210 | 50 | 20 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.02 | 0.08 | 0.04 | 0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 120 | 750 | 120 | 30 | 10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 24200 | 25300 | 24800 | 18700 | 2320 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 7 | 8 | 50 | 8 | 44 |
| Barium | 7440-39-3 | 10 | mg/kg | 290 | 280 | 270 | 270 | 90 |
| Beryllium | 7440-41-7 | 1 | mg/kg | 3 | 6 | 6 | 6 | 3 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 37 | 33 | 28 | 23 | 11 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 63 | 89 | 91 | 190 | 24 |
| Copper | 7440-50-8 | 5 | mg/kg | 99 | 129 | 74 | 89 | 246 |
| Iron | 7439-89-6 | 50 | mg/kg | 60700 | 72400 | 65400 | 69500 | 50600 |
| Lead | 7439-92-1 | 5 | mg/kg | 6 | 5 | 7 | <5 | <5 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V33136 | V33139 | V33142 | V33145 | V33148 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203029-056 | EB2203029-057 | EB2203029-058 | EB2203029-059 | EB2203029-060 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **2710** | **2360** | **2830** | **3300** | **638** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **145** | **164** | **169** | **291** | **25** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **148** | **139** | **118** | **78** | **50** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **80** | **138** | **158** | **369** | **100** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **14** | **18** | **29** | **38** | **19** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V33833 | V33836 | V33839 | V33842 | V33845 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-062 | EB2203029-063 | EB2203029-064 | EB2203029-065 | EB2203029-066 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.2 | 5.6 | 5.4 | 5.5 | 5.2 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -2.7 | -2.8 | -3.1 | <0.5 | -1.9 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 23 | 16 | 12 | 12 | 45 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.1 | 6.5 | 6.4 | 6.3 | 6.3 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 1.7 | 1.1 | 1.0 | 1.2 | 2.7 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 2.7 | 2.8 | 3.1 | <0.5 | 1.9 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.3 | 0.3 | 0.3 | <0.1 | 0.2 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | <10 | <10 | <10 | 20 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 30 | 20 | 10 | <10 | 40 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 950 | 860 | 380 | 1270 | 810 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | 8 | <5 | <5 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 4 | 10 | 10 | 5 | 10 |
| Cobalt | 7440-48-4 | 2 | mg/kg | <2 | <2 | <2 | <2 | <2 |
| Copper | 7440-50-8 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| Iron | 7439-89-6 | 50 | mg/kg | 800 | 2130 | 1660 | 1150 | 1710 |
| Lead | 7439-92-1 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V33833 | V33836 | V33839 | V33842 | V33845 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-062 | EB2203029-063 | EB2203029-064 | EB2203029-065 | EB2203029-066 |
| | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | <5 | **6** | **5** | <5 | **5** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | <2 | <2 | <2 | <2 | <2 |
| **Selenium** | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| **Zinc** | 7440-66-6 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V33848 | V34601 | V34604 | V34607 | V34610 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203029-067 | EB2203029-068 | EB2203029-069 | EB2203029-070 | EB2203029-071 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.6 | 7.9 | 7.4 | 8.4 | 7.4 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -2.4 | -12.0 | -14.4 | -6.2 | -4.4 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 18 | 174 | 278 | 166 | 48 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.1 | 7.5 | 7.3 | 7.6 | 7.2 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 1.2 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 2.4 | 12.0 | 14.7 | 6.2 | 4.4 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.2 | 1.2 | 1.5 | 0.6 | 0.4 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 1 | 1 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | 3.0 | 3.7 | 1.8 | 1.3 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 10 | 50 | 180 | 80 | 10 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | 0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 20 | 130 | 210 | 160 | 20 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1060 | 19400 | 26300 | 2560 | 1480 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | 31 | 16 | <5 | 9 |
| Barium | 7440-39-3 | 10 | mg/kg | <10 | 70 | 20 | 150 | 40 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | 1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 7 | 41 | 50 | 16 | 17 |
| Cobalt | 7440-48-4 | 2 | mg/kg | <2 | 88 | 73 | 32 | 15 |
| Copper | 7440-50-8 | 5 | mg/kg | <5 | 108 | 84 | 140 | 102 |
| Iron | 7439-89-6 | 50 | mg/kg | 1370 | 53500 | 68500 | 29900 | 30700 |
| Lead | 7439-92-1 | 5 | mg/kg | <5 | 11 | 9 | 6 | 7 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V33848 | V34601 | V34604 | V34607 | V34610 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203029-067 | EB2203029-068 | EB2203029-069 | EB2203029-070 | EB2203029-071 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | <5 | **2010** | **1250** | **2130** | **873** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | <2 | **184** | **189** | **47** | **23** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **6** | **129** | **170** | **62** | **74** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | <5 | **90** | **165** | **119** | **54** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | <1 | **62** | **59** | **40** | **17** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34613 | V34616 | V34618 | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | ---- | ---- |
| Compound | CAS Number | LOR | Unit | EB2203029-072 | EB2203029-073 | EB2203029-074 | -------- | -------- |
| | | | | Result | Result | Result | ---- | ---- |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | **7.4** | **7.2** | **7.2** | ---- | ---- |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | **-0.5** | **-4.5** | **-3.9** | ---- | ---- |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | **36** | **34** | **24** | ---- | ---- |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | **6.7** | **6.6** | **7.6** | ---- | ---- |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | ---- | ---- |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | **1.3** | **1.0** | <0.1 | ---- | ---- |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | **0.5** | **4.5** | **3.9** | ---- | ---- |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | <0.1 | **0.4** | **0.4** | ---- | ---- |
| Fizz Rating | ---- | 0 | Fizz Unit | **0** | **0** | **0** | ---- | ---- |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | <10 | <10 | ---- | ---- |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | ---- | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | **10** | **10** | <10 | ---- | ---- |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | **870** | **2370** | **920** | ---- | ---- |
| Arsenic | 7440-38-2 | 5 | mg/kg | **12** | **9** | **7** | ---- | ---- |
| Barium | 7440-39-3 | 10 | mg/kg | **10** | **10** | **150** | ---- | ---- |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | ---- | ---- |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | ---- | ---- |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | ---- | ---- |
| Chromium | 7440-47-3 | 2 | mg/kg | **6** | **8** | **15** | ---- | ---- |
| Cobalt | 7440-48-4 | 2 | mg/kg | **3** | **7** | **54** | ---- | ---- |
| Copper | 7440-50-8 | 5 | mg/kg | **29** | **23** | **68** | ---- | ---- |
| Iron | 7439-89-6 | 50 | mg/kg | **2260** | **9050** | **4520** | ---- | ---- |
| Lead | 7439-92-1 | 5 | mg/kg | **8** | <5 | <5 | ---- | ---- |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V34613 | V34616 | V34618 | ---- | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | ---- | ---- |
| Compound | CAS Number | LOR | Unit | | EB2203029-072 | EB2203029-073 | EB2203029-074 | -------- | -------- |
| | | | | | Result | Result | Result | ---- | ---- |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **39** | **182** | **1170** | ---- | ---- |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **4** | **17** | **27** | ---- | ---- |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | ---- | ---- |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **24** | **23** | **13** | ---- | ---- |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **5** | **19** | **14** | ---- | ---- |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | ---- | ---- |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **12** | **20** | **11** | ---- | ---- |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2203032** | Page | : 1 of 18 |
| Client | : **C & R CONSULTING PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : ALEXANDER BARNES | Contact | : Princess Marcelo |
| Address | : 188 ROSS RIVER ROAD<br>AITKENVALE QUEENSLAND 4812 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : ---- | Telephone | : +61-7-3243 7222 |
| Project | : Agate Creek Geochemistry | Date Samples Received | : 01-Feb-2022 09:00 |
| Order number | : ---- | Date Analysis Commenced | : 10-Feb-2022 |
| C-O-C number | : ---- | Issue Date | : 08-Mar-2022 16:47 |
| Sampler | : PETER NEVILLE | | |
| Site | : ---- | | |
| Quote number | : TV/178/21 | | |
| No. of samples received | : 40 | | |
| No. of samples analysed | : 40 | | |

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Kim McCabe | Senior Inorganic Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

## General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **SPLIT WORK ORDER: It should be noted that ALS has split this work order over the following work orders (EB2203032, EB2203029) due to the size of the sample numbers. For any further information regarding this processing of samples please contact ALS client services division on ALSEnviro.Brisbane@alsglobal.com**
- EG005T (Total Metals by ICP-AES): V34637 (EB2203032-001) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V34640 (EB2203032-002) shows poor matrix spike recovery due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V34708 (EB2203032-021) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V34712 (EB2203032-023) shows poor matrix spike recovery due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V34664 (EB2203032-011) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34637 | V34640 | V34643 | V34646 | V34649 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203032-001 | EB2203032-002 | EB2203032-003 | EB2203032-004 | EB2203032-005 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.7 | 7.5 | 8.0 | 7.1 | 6.9 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -2.8 | -21.1 | <0.5 | <0.5 | <0.5 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 23 | 82 | 85 | 27 | 7 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.8 | 7.1 | 7.6 | 6.5 | 6.1 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 0.7 | <0.1 | <0.1 | 1.3 | 3.7 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 2.8 | 21.1 | <0.5 | <0.5 | <0.5 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.3 | 2.2 | <0.1 | <0.1 | <0.1 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 1 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | 3.5 | 3.4 | 1.5 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | <10 | 10 | <10 | <10 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 10 | 30 | 40 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 18200 | 22600 | 1900 | 1200 | 410 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 16 | 24 | <5 | 23 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 200 | 70 | 60 | 20 | 20 |
| Beryllium | 7440-41-7 | 1 | mg/kg | 2 | 1 | 1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 48 | 46 | 16 | 6 | <2 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 44 | 44 | 17 | 3 | 3 |
| Copper | 7440-50-8 | 5 | mg/kg | 100 | 80 | 90 | 49 | 8 |
| Iron | 7439-89-6 | 50 | mg/kg | 49000 | 51800 | 40600 | 13600 | 1490 |
| Lead | 7439-92-1 | 5 | mg/kg | 9 | 10 | 11 | <5 | <5 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V34637 | V34640 | V34643 | V34646 | V34649 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203032-001 | EB2203032-002 | EB2203032-003 | EB2203032-004 | EB2203032-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **951** | **499** | **853** | **105** | **228** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **90** | **116** | **24** | **5** | **4** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **147** | **125** | **52** | **22** | <5 |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **96** | **111** | **92** | **14** | **7** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **3** | **46** | **36** | **10** | **2** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34652 | V34654 | V34655 | V34658 | V34661 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203032-006 | EB2203032-007 | EB2203032-008 | EB2203032-009 | EB2203032-010 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.2 | 7.4 | 5.8 | 8.5 | 5.5 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | <0.5 | <0.5 | <0.5 | -1.2 | <0.5 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 14 | 14 | 10 | 91 | 14 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.4 | 7.0 | 6.8 | 7.9 | 5.2 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | 0.6 | <0.1 | 4.0 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | <0.5 | <0.5 | <0.5 | 1.2 | <0.5 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | <0.1 | <0.1 | <0.1 | 0.1 | <0.1 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | 2.3 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | 10 | 70 | 20 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 600 | 840 | 4050 | 4460 | 870 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 13 | 10 | 17 | 41 | 11 |
| Barium | 7440-39-3 | 10 | mg/kg | 20 | 10 | 70 | 70 | <10 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | 1 | 1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | <2 | <2 | 37 | 10 | 3 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 6 | 4 | 41 | 28 | <2 |
| Copper | 7440-50-8 | 5 | mg/kg | 10 | 18 | 50 | 145 | 14 |
| Iron | 7439-89-6 | 50 | mg/kg | 2160 | 1800 | 47600 | 13800 | 3340 |
| Lead | 7439-92-1 | 5 | mg/kg | 6 | 33 | 6 | 5 | <5 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34652 | V34654 | V34655 | V34658 | V34661 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203032-006 | EB2203032-007 | EB2203032-008 | EB2203032-009 | EB2203032-010 |
| | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | **266** | **202** | **1680** | **435** | **22** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | **8** | **6** | **46** | **56** | **4** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | <5 | <5 | **85** | **46** | **14** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | **12** | **12** | **21** | **75** | **5** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | **4** | **5** | <1 | **19** | <1 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34664 | V34667 | V34670 | V34672 | V34691 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203032-011 | EB2203032-012 | EB2203032-013 | EB2203032-014 | EB2203032-015 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.8 | 7.2 | 7.2 | 7.2 | 6.6 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | <0.5 | <0.5 | <0.5 | <0.5 | -3.0 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 21 | 13 | 19 | 11 | 83 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.3 | 7.1 | 6.0 | 6.6 | 6.6 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | 3.0 | 0.8 | 0.8 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | <0.5 | <0.5 | <0.5 | <0.5 | 4.2 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | <0.1 | <0.1 | <0.1 | <0.1 | 0.4 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | 2.5 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | <10 | <10 | <10 | 20 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | <0.01 | 0.04 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1100 | 550 | 680 | 620 | 15100 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 11 | 13 | 8 | 5 | 23 |
| Barium | 7440-39-3 | 10 | mg/kg | 30 | 20 | <10 | <10 | 360 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | 3 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 4 | <2 | <2 | <2 | 64 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 6 | 7 | <2 | 4 | 174 |
| Copper | 7440-50-8 | 5 | mg/kg | 27 | 14 | 6 | <5 | 220 |
| Iron | 7439-89-6 | 50 | mg/kg | 2610 | 1590 | 940 | 1830 | 48400 |
| Lead | 7439-92-1 | 5 | mg/kg | 9 | 15 | 10 | 8 | 6 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V34664 | V34667 | V34670 | V34672 | V34691 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203032-011 | EB2203032-012 | EB2203032-013 | EB2203032-014 | EB2203032-015 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **226** | **194** | **23** | **78** | **1820** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **5** | **4** | **3** | **5** | **176** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **16** | <5 | <5 | <5 | **170** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **12** | **9** | **10** | **16** | **228** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **7** | **5** | **6** | **5** | **57** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34694 | V34697 | V34700 | V34703 | V34706 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203032-016 | EB2203032-017 | EB2203032-018 | EB2203032-019 | EB2203032-020 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 8.2 | 6.1 | 6.2 | 6.4 | 7.1 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -1.0 | <0.5 | -1.5 | <0.5 | 7.1 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 144 | 42 | 9 | 15 | 65 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.1 | 6.4 | 7.8 | 6.4 | 3.4 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | 3.6 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | 0.6 | <0.1 | 0.8 | 7.3 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 1.6 | <0.5 | 1.5 | <0.5 | 3.3 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.2 | <0.1 | 0.1 | <0.1 | 0.3 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | 1.4 | 1.6 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 40 | 10 | <10 | <10 | 120 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.02 | 0.01 | <0.01 | <0.01 | 0.34 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 110 | 30 | <10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 2890 | 3800 | 670 | 740 | 34300 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 121 | 78 | 8 | <5 | 33 |
| Barium | 7440-39-3 | 10 | mg/kg | 30 | 30 | 60 | <10 | <10 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | 1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 18 | 29 | <2 | 4 | 26 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 10 | 10 | 16 | 3 | 63 |
| Copper | 7440-50-8 | 5 | mg/kg | 77 | 240 | 41 | 7 | 364 |
| Iron | 7439-89-6 | 50 | mg/kg | 20800 | 25800 | 2390 | 1060 | 78800 |
| Lead | 7439-92-1 | 5 | mg/kg | <5 | 5 | <5 | 8 | 17 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V34694 | V34697 | V34700 | V34703 | V34706 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203032-016 | EB2203032-017 | EB2203032-018 | EB2203032-019 | EB2203032-020 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **51** | **38** | **625** | **62** | **912** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **19** | **23** | **9** | <2 | **77** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **48** | **83** | **6** | **12** | **406** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **44** | **51** | **11** | <5 | **268** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **37** | **11** | **3** | **6** | **10** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34708 | V34712 | V34715 | V34718 | V34721 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203032-021 | EB2203032-023 | EB2203032-024 | EB2203032-025 | EB2203032-026 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.6 | 6.6 | 7.5 | 7.8 | 7.3 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | 85.9 | -1.6 | -6.8 | -16.7 | -6.3 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 235 | 29 | 103 | 102 | 34 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 2.4 | 6.7 | 6.9 | 7.1 | 6.9 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | 57.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 71.6 | 0.6 | 0.3 | <0.1 | 0.2 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 7.4 | 1.9 | 7.4 | 17.3 | 6.9 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.8 | 0.2 | 0.8 | 1.8 | 0.7 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 1 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | 2.6 | 2.1 | 2.2 | 1.2 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 550 | <10 | <10 | 20 | <10 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 3.05 | 0.01 | 0.02 | 0.02 | 0.02 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | 40 | 20 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 29800 | 8620 | 16300 | 23400 | 16600 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 206 | 32 | 31 | 56 | 28 |
| Barium | 7440-39-3 | 10 | mg/kg | <10 | 120 | 70 | 30 | 30 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | 1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 23 | 45 | 26 | 25 | 21 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 44 | 51 | 29 | 41 | 38 |
| Copper | 7440-50-8 | 5 | mg/kg | 239 | 150 | 174 | 184 | 152 |
| Iron | 7439-89-6 | 50 | mg/kg | 74600 | 45700 | 49600 | 55300 | 43600 |
| Lead | 7439-92-1 | 5 | mg/kg | 9 | <5 | <5 | <5 | <5 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V34708 | V34712 | V34715 | V34718 | V34721 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203032-021 | EB2203032-023 | EB2203032-024 | EB2203032-025 | EB2203032-026 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **604** | **1150** | **504** | **667** | **680** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **60** | **69** | **53** | **56** | **55** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **364** | **131** | **158** | **172** | **114** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **116** | **74** | **123** | **95** | **106** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **32** | **11** | **53** | **63** | **18** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34724 | V34726 | V34727 | V34730 | V34733 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203032-027 | EB2203032-028 | EB2203032-029 | EB2203032-030 | EB2203032-031 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.0 | 6.9 | 5.4 | 5.3 | 5.8 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -3.7 | <0.5 | <0.5 | <0.5 | <0.5 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 34 | 31 | 7 | 24 | 22 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.5 | 6.5 | 5.6 | 5.7 | 6.0 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 0.8 | 0.8 | 4.7 | 3.2 | 2.8 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 4.0 | <0.5 | <0.5 | <0.5 | <0.5 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.4 | <0.1 | <0.1 | <0.1 | <0.1 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | 1.6 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | <10 | <10 | 40 | 40 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.01 | <0.01 | <0.01 | 0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | 10 | <10 | 10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 12600 | 4100 | 1270 | 750 | 630 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 18 | 30 | 7 | 6 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 20 | 20 | 10 | 20 | <10 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 32 | 33 | 5 | 2 | 2 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 40 | 8 | <2 | 2 | 4 |
| Copper | 7440-50-8 | 5 | mg/kg | 252 | 92 | 21 | 16 | 12 |
| Iron | 7439-89-6 | 50 | mg/kg | 39600 | 15000 | 13200 | 9380 | 8510 |
| Lead | 7439-92-1 | 5 | mg/kg | 9 | 10 | <5 | <5 | <5 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34724 | V34726 | V34727 | V34730 | V34733 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203032-027 | EB2203032-028 | EB2203032-029 | EB2203032-030 | EB2203032-031 |
| | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | **272** | **142** | <5 | **17** | **56** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | **74** | **31** | <2 | **3** | **4** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | **102** | **44** | **12** | **6** | <5 |
| **Zinc** | 7440-66-6 | 5 | mg/kg | **171** | **39** | <5 | **7** | **11** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | **16** | **11** | <1 | <1 | **1** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34736 | V34739 | V34742 | V34744 | V34766 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203032-032 | EB2203032-033 | EB2203032-034 | EB2203032-035 | EB2203032-037 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.6 | 6.1 | 6.3 | 7.0 | 5.7 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 29 | 28 | 17 | 17 | 43 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.4 | 6.2 | 7.1 | 6.3 | 6.0 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 1.0 | 1.3 | <0.1 | 1.2 | 1.6 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 40 | 20 | 20 | 10 | 80 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | <10 | <10 | 10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 960 | 800 | 710 | 400 | 440 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | 10 | 14 | <5 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 10 | <10 | <10 | <10 | 20 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 7 | 10 | 8 | 5 | <2 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 5 | <2 | 11 | <2 | <2 |
| Copper | 7440-50-8 | 5 | mg/kg | 64 | 20 | 36 | 11 | 24 |
| Iron | 7439-89-6 | 50 | mg/kg | 22000 | 6220 | 22100 | 8350 | 4100 |
| Lead | 7439-92-1 | 5 | mg/kg | <5 | <5 | 10 | 5 | <5 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V34736 | V34739 | V34742 | V34744 | V34766 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203032-032 | EB2203032-033 | EB2203032-034 | EB2203032-035 | EB2203032-037 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **124** | **46** | **221** | **43** | <5 |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **7** | **2** | **8** | **3** | **2** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **43** | **44** | **37** | **11** | <5 |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **21** | **5** | **9** | <5 | **5** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **3** | **6** | **4** | **3** | **1** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34769 | V34772 | V34775 | V34778 | V34780 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2203032-038 | EB2203032-039 | EB2203032-040 | EB2203032-041 | EB2203032-042 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.4 | 6.8 | 7.0 | 7.3 | 7.0 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 124 | 98 | 105 | 89 | 47 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.3 | 7.3 | 7.0 | 7.0 | 7.3 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 230 | 180 | 190 | 120 | 60 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 20 | 20 | 20 | 120 | 10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1110 | 680 | 1800 | 760 | 1080 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | <10 | 10 | 30 | <10 | <10 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 3 | 3 | 4 | 5 | 7 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 3 | 6 | 181 | 6 | 10 |
| Copper | 7440-50-8 | 5 | mg/kg | 65 | 67 | 150 | 61 | 73 |
| Iron | 7439-89-6 | 50 | mg/kg | 33700 | 18700 | 30000 | 24900 | 33400 |
| Lead | 7439-92-1 | 5 | mg/kg | 35 | 15 | 13 | 19 | 29 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V34769 | V34772 | V34775 | V34778 | V34780 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2203032-038 | EB2203032-039 | EB2203032-040 | EB2203032-041 | EB2203032-042 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **150** | **258** | **2020** | **255** | **443** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **5** | **4** | **98** | **6** | **9** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **15** | **14** | **9** | **25** | **40** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **15** | **18** | **69** | **31** | **44** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **6** | **5** | **7** | **11** | **8** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2203035** | Page | : 1 of 4 |
| **Amendment** | : **1** | | |
| Client | : **C & R CONSULTING PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : ALEXANDER BARNES | Contact | : Princess Marcelo |
| Address | : 188 ROSS RIVER ROAD<br>AITKENVALE QUEENSLAND 4812 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : ---- | Telephone | : +61-7-3243 7222 |
| Project | : Agate Creek Geochemistry | Date Samples Received | : 01-Feb-2022 09:00 |
| Order number | : ---- | Date Analysis Commenced | : 15-Feb-2022 |
| C-O-C number | : ---- | Issue Date | : 10-Mar-2022 15:31 |
| Sampler | : PETER NEVILLE | | |
| Site | : ---- | | |
| Quote number | : TV/178/21 | | |
| No. of samples received | : 3 | | |
| No. of samples analysed | : 3 | | |

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Ben Felgendrejeris | Senior Acid Sulfate Soil Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

## General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Amendment (10/3/22): This report has been amended and re-released to allow the reporting of additional analytical data, specifically Thorium that was missed at the log-in stage.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V32228 - V32258 Composite | V34619 - V34636 Composite | V34745 - V34762 Composite | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | ---- | ---- |
| Compound | CAS Number | LOR | Unit | EB2203035-001 | EB2203035-002 | EB2203035-003 | -------- | -------- |
| | | | | Result | Result | Result | ---- | ---- |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | **5.7** | **7.3** | **7.4** | ---- | ---- |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | **-2.8** | **-8.4** | **-2.8** | ---- | ---- |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | **102** | **70** | **67** | ---- | ---- |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | **6.6** | **7.0** | **6.7** | ---- | ---- |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | ---- | ---- |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | **1.2** | <0.1 | **0.9** | ---- | ---- |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | **2.8** | **8.4** | **2.8** | ---- | ---- |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | **0.3** | **0.8** | **0.3** | ---- | ---- |
| Fizz Rating | ---- | 0 | Fizz Unit | **0** | **0** | **0** | ---- | ---- |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | **1.4** | <1.0 | ---- | ---- |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | **20** | <10 | <10 | ---- | ---- |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | ---- | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | **110** | **60** | **60** | ---- | ---- |
| **ED093S: Soluble Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 10 | mg/kg | <10 | <10 | <10 | ---- | ---- |
| Magnesium | 7439-95-4 | 10 | mg/kg | <10 | <10 | <10 | ---- | ---- |
| Sodium | 7440-23-5 | 10 | mg/kg | **100** | **70** | **70** | ---- | ---- |
| Potassium | 7440-09-7 | 10 | mg/kg | <10 | <10 | <10 | ---- | ---- |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | **1100** | **7440** | **850** | ---- | ---- |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | **15** | <5 | ---- | ---- |
| Barium | 7440-39-3 | 10 | mg/kg | **50** | **60** | <10 | ---- | ---- |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | ---- | ---- |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | ---- | ---- |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V32228 - V32258 Composite | V34619 - V34636 Composite | V34745 - V34762 Composite | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | 01-Feb-2022 00:00 | ---- | ---- |
| Compound | CAS Number | LOR | Unit | EB2203035-001 | EB2203035-002 | EB2203035-003 | -------- | -------- |
| | | | | Result | Result | Result | ---- | ---- |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | |
| **Cadmium** | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | ---- | ---- |
| **Chromium** | 7440-47-3 | 2 | mg/kg | **25** | **15** | **4** | ---- | ---- |
| **Cobalt** | 7440-48-4 | 2 | mg/kg | **2** | **64** | **5** | ---- | ---- |
| **Copper** | 7440-50-8 | 5 | mg/kg | **5** | **76** | **20** | ---- | ---- |
| **Iron** | 7439-89-6 | 50 | mg/kg | **6770** | **23600** | **19300** | ---- | ---- |
| **Lead** | 7439-92-1 | 5 | mg/kg | **7** | **5** | <5 | ---- | ---- |
| **Manganese** | 7439-96-5 | 5 | mg/kg | **142** | **664** | **129** | ---- | ---- |
| **Nickel** | 7440-02-0 | 2 | mg/kg | **16** | **80** | **6** | ---- | ---- |
| **Selenium** | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | ---- | ---- |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | **7** | **47** | **16** | ---- | ---- |
| **Zinc** | 7440-66-6 | 5 | mg/kg | **10** | **70** | **14** | ---- | ---- |
| **EG020T: Total Metals by ICP-MS** | | | | | | | | |
| **Thorium** | 7440-29-1 | 0.1 | mg/kg | **0.6** | **0.9** | **1.7** | ---- | ---- |
| **Molybdenum** | 7439-98-7 | 0.1 | mg/kg | **3.7** | **1.3** | **0.2** | ---- | ---- |
| **Antimony** | 7440-36-0 | 0.1 | mg/kg | **0.3** | **0.2** | **1.8** | ---- | ---- |
| **Uranium** | 7440-61-1 | 0.1 | mg/kg | **0.3** | **0.6** | **0.5** | ---- | ---- |
| **Tellurium** | 22541-49-7 | 0.5 | mg/kg | <0.5 | <0.5 | <0.5 | ---- | ---- |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | ---- | ---- |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2203945** | Page | : 1 of 8 |
| Client | : **C & R CONSULTING PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : ALEXANDER BARNES | Contact | : Princess Marcelo |
| Address | : 188 ROSS RIVER ROAD<br>AITKENVALE QUEENSLAND 4812 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : ---- | Telephone | : +61-7-3243 7222 |
| Project | : Agate Creek Geochemistry | Date Samples Received | : 15-Feb-2022 08:45 |
| Order number | : ---- | Date Analysis Commenced | : 16-Feb-2022 |
| C-O-C number | : ---- | Issue Date | : 22-Feb-2022 15:39 |
| Sampler | : PETER NEVILLE (ALS Geochemistry) | | |
| Site | : ---- | | |
| Quote number | : TV/178/21 | | |
| No. of samples received | : 14 | | |
| No. of samples analysed | : 14 | | |

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Ben Felgendrejeris | Senior Acid Sulfate Soil Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

## General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EG035T (Total Mercury) Sample V34448(EB2203945-014) shows poor matrix spike recovery due to sample heterogeneity. Confirmed by re-extraction and re-analysis.
- EG005T (Total Metals by ICP-AES): EB2203885-003 shows poor matrix spike recovery due to sample heterogeneity. This has been confirmed by visual inspection.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | Sample ID | V34409 | V34412 | V34415 | V34418 | V34421 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | [10-Feb-2022] | [10-Feb-2022] | [10-Feb-2022] | [10-Feb-2022] | [10-Feb-2022] |
| Compound | CAS Number | LOR | Unit | EB2203945-001 | EB2203945-002 | EB2203945-003 | EB2203945-004 | EB2203945-005 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.7 | 6.4 | 6.7 | 6.2 | 6.7 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -4.7 | -1.4 | -6.7 | -6.6 | -7.0 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 40 | 57 | 23 | 20 | 22 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.1 | 4.8 | 6.2 | 6.0 | 6.2 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 3.5 | 2.4 | 2.2 | 2.2 | 1.0 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 4.7 | 3.2 | 6.7 | 6.6 | 7.6 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.5 | 0.3 | 0.7 | 0.7 | 0.8 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 1 | 1 | 1 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | 60 | <10 | <10 | 20 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | 0.06 | <0.01 | <0.01 | 0.02 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | 10 | <10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 5290 | 4470 | 3070 | 3060 | 1260 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 6 | 14 | 8 | <5 | 13 |
| Barium | 7440-39-3 | 10 | mg/kg | 20 | 40 | 20 | 60 | 40 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 4 | 6 | 8 | 7 | 14 |
| Cobalt | 7440-48-4 | 2 | mg/kg | <2 | 7 | 2 | <2 | <2 |
| Copper | 7440-50-8 | 5 | mg/kg | 9 | 9 | <5 | <5 | <5 |
| Iron | 7439-89-6 | 50 | mg/kg | 16700 | 20700 | 12900 | 6060 | 13900 |
| Lead | 7439-92-1 | 5 | mg/kg | 6 | 9 | <5 | 7 | 6 |
| Manganese | 7439-96-5 | 5 | mg/kg | 46 | 234 | 125 | 78 | 108 |
| Nickel | 7440-02-0 | 2 | mg/kg | 4 | 6 | 2 | 2 | 2 |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | Sample ID | V34409 | V34412 | V34415 | V34418 | V34421 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | [10-Feb-2022] | [10-Feb-2022] | [10-Feb-2022] | [10-Feb-2022] | [10-Feb-2022] |
| Compound | CAS Number | LOR | Unit | EB2203945-001 | EB2203945-002 | EB2203945-003 | EB2203945-004 | EB2203945-005 |
| | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | |
| **Selenium** | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | **8** | **11** | **8** | **7** | <5 |
| **Zinc** | 7440-66-6 | 5 | mg/kg | **28** | **46** | **14** | **12** | <5 |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | **7** | **5** | **6** | **4** | **5** |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | Sample ID | V34424 | V34427 | V34430 | V34433 | V34436 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | [10-Feb-2022] | [10-Feb-2022] | [10-Feb-2022] | [10-Feb-2022] | [10-Feb-2022] |
| Compound | CAS Number | LOR | Unit | EB2203945-006 | EB2203945-007 | EB2203945-008 | EB2203945-009 | EB2203945-010 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.6 | 6.7 | 6.5 | 6.4 | 6.7 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -8.5 | -7.9 | -4.2 | -2.9 | -3.2 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 20 | 18 | 19 | 16 | 24 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 5.8 | 6.0 | 6.1 | 6.1 | 6.3 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 2.8 | 2.3 | 5.3 | 2.9 | 2.6 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 8.5 | 7.9 | 4.2 | 2.9 | 3.2 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.9 | 0.8 | 0.4 | 0.3 | 0.3 |
| Fizz Rating | ---- | 0 | Fizz Unit | 1 | 1 | 0 | 0 | 0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 2230 | 2160 | 4070 | 3900 | 4680 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | 11 | <5 | <5 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 10 | 10 | <10 | 20 | 20 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 11 | 8 | 3 | 5 | 4 |
| Cobalt | 7440-48-4 | 2 | mg/kg | <2 | <2 | <2 | <2 | <2 |
| Copper | 7440-50-8 | 5 | mg/kg | <5 | <5 | <5 | <5 | 5 |
| Iron | 7439-89-6 | 50 | mg/kg | 6460 | 8850 | 2760 | 4740 | 3170 |
| Lead | 7439-92-1 | 5 | mg/kg | <5 | <5 | 10 | 8 | 6 |
| Manganese | 7439-96-5 | 5 | mg/kg | 66 | 67 | 28 | 49 | 32 |
| Nickel | 7440-02-0 | 2 | mg/kg | <2 | <2 | <2 | <2 | <2 |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | Sample ID | V34424 | V34427 | V34430 | V34433 | V34436 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | [10-Feb-2022] | [10-Feb-2022] | [10-Feb-2022] | [10-Feb-2022] | [10-Feb-2022] |
| Compound | CAS Number | LOR | Unit | EB2203945-006 | EB2203945-007 | EB2203945-008 | EB2203945-009 | EB2203945-010 |
| | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | |
| **Selenium** | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | **5** | <5 | <5 | <5 | <5 |
| **Zinc** | 7440-66-6 | 5 | mg/kg | **6** | **6** | **9** | **7** | **8** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | **6** | **4** | **4** | **2** | **5** |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | Sample ID | V34439 | V34442 | V34445 | V34448 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | [10-Feb-2022] | [10-Feb-2022] | [10-Feb-2022] | [10-Feb-2022] | ---- |
| Compound | CAS Number | LOR | Unit | EB2203945-011 | EB2203945-012 | EB2203945-013 | EB2203945-014 | -------- |
| | | | | Result | Result | Result | Result | ---- |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.7 | 7.0 | 6.6 | 5.1 | ---- |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -7.0 | -8.4 | -2.9 | 23.7 | ---- |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 17 | 28 | 25 | 172 | ---- |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.4 | 6.4 | 5.9 | 2.7 | ---- |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | 19.9 | ---- |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 1.2 | 1.9 | 3.0 | 25.6 | ---- |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 7.0 | 8.4 | 3.5 | 7.2 | ---- |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.7 | 0.8 | 0.4 | 0.7 | ---- |
| Fizz Rating | ---- | 0 | Fizz Unit | 1 | 1 | 0 | 1 | ---- |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | <10 | <10 | 450 | ---- |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | 0.02 | 1.01 | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | <10 | <10 | ---- |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 3500 | 4730 | 4810 | 1820 | ---- |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | 6 | 8 | 66 | ---- |
| Barium | 7440-39-3 | 10 | mg/kg | 20 | 30 | 10 | 40 | ---- |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | ---- |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | ---- |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | ---- |
| Chromium | 7440-47-3 | 2 | mg/kg | 6 | 8 | 5 | 10 | ---- |
| Cobalt | 7440-48-4 | 2 | mg/kg | <2 | <2 | <2 | <2 | ---- |
| Copper | 7440-50-8 | 5 | mg/kg | <5 | 5 | 9 | 27 | ---- |
| Iron | 7439-89-6 | 50 | mg/kg | 5010 | 4700 | 4140 | 23000 | ---- |
| Lead | 7439-92-1 | 5 | mg/kg | 5 | 7 | 7 | 7 | ---- |
| Manganese | 7439-96-5 | 5 | mg/kg | 53 | 39 | 25 | 75 | ---- |
| Nickel | 7440-02-0 | 2 | mg/kg | <2 | <2 | <2 | 3 | ---- |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | Sample ID | V34439 | V34442 | V34445 | V34448 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | [10-Feb-2022] | [10-Feb-2022] | [10-Feb-2022] | [10-Feb-2022] | ---- |
| Compound | CAS Number | LOR | Unit | EB2203945-011 | EB2203945-012 | EB2203945-013 | EB2203945-014 | -------- |
| | | | | Result | Result | Result | Result | ---- |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | |
| **Selenium** | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | **8** | **----** |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | <5 | <5 | **6** | **7** | **----** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | <5 | **7** | <5 | <5 | **----** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | **0.3** | **----** |
| **EK040S: Fluoride Soluble** | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | **4** | **5** | **5** | **1** | **----** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2213934** | Page | : 1 of 32 |
| Client | : **C & R CONSULTING PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MR MATT KNOTT | Contact | : Princess Marcelo |
| Address | : 188 ROSS RIVER ROAD<br>AITKENVALE QUEENSLAND 4812 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 47253751 | Telephone | : +61-7-3243 7222 |
| Project | : Agate Creek Geochemistry | Date Samples Received | : 16-May-2022 09:00 |
| Order number | : ---- | Date Analysis Commenced | : 19-May-2022 |
| C-O-C number | : ---- | Issue Date | : 30-May-2022 15:12 |
| Sampler | : Peter Neville (ALS Geochemistry) | | |
| Site | : ---- | | |
| Quote number | : TV/178/21 | | |
| No. of samples received | : 73 | | |
| No. of samples analysed | : 73 | | |

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Kim McCabe | Senior Inorganic Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

## General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EG005T (Total Metals by ICP-AES): V34909 (EB2213934-001) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V34912 (EB2213934-002) shows poor matrix spike recovery due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V34939 (EB2213934-011) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V34969 (EB2213934-021) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V35047 (EB2213934-041) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V35050 (EB2213934-042) shows poor matrix spike recovery due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V35077 (EB2213934-051) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V35107 (EB2213934-061) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34909 | V34912 | V34915 | V34918 | V34921 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-001 | EB2213934-002 | EB2213934-003 | EB2213934-004 | EB2213934-005 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.0 | 7.0 | 5.8 | 5.8 | 6.5 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -3.3 | -4.8 | -4.3 | -3.5 | -4.4 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 79 | 77 | 34 | 43 | 70 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.0 | 7.2 | 6.6 | 5.8 | 6.8 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 2.1 | <0.1 | 0.8 | 2.6 | 0.7 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 4.2 | 4.8 | 4.3 | 3.5 | 5.0 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.4 | 0.5 | 0.4 | 0.4 | 0.5 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 40 | 60 | <10 | 50 | 100 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.03 | <0.01 | <0.01 | <0.01 | 0.02 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 90 | 60 | 30 | 10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 750 | 700 | 880 | 810 | 810 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 5 | 5 | 6 | <5 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 40 | 30 | 40 | 20 | 160 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | <2 | 3 | 4 | <2 | 2 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 3 | <2 | <2 | 2 | 11 |
| Copper | 7440-50-8 | 5 | mg/kg | <5 | 5 | 6 | 5 | <5 |
| Iron | 7439-89-6 | 50 | mg/kg | 2530 | 20000 | 6370 | 8030 | 33900 |
| Lead | 7439-92-1 | 5 | mg/kg | 10 | <5 | 7 | 10 | 11 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V34909 | V34912 | V34915 | V34918 | V34921 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2213934-001 | EB2213934-002 | EB2213934-003 | EB2213934-004 | EB2213934-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **29** | **110** | **184** | **82** | **1340** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **4** | **2** | <2 | **3** | **4** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | <5 | <5 | **8** | <5 | **5** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **20** | **15** | **11** | **20** | **135** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **5** | **7** | **3** | **2** | **2** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34924 | V34927 | V34930 | V34933 | V34936 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-006 | EB2213934-007 | EB2213934-008 | EB2213934-009 | EB2213934-010 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.6 | 7.5 | 7.4 | 7.8 | 7.8 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -3.6 | -5.3 | -8.6 | -11.1 | -9.8 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 52 | 51 | 43 | 36 | 49 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 3.9 | 4.2 | 7.1 | 7.0 | 4.3 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | 0.7 | 0.4 | <0.1 | <0.1 | 0.4 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 2.3 | 2.2 | <0.1 | <0.1 | 1.6 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 8.5 | 9.0 | 8.6 | 11.1 | 13.2 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.9 | 0.9 | 0.9 | 1.1 | 1.3 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 1 | 1 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 50 | 50 | 30 | 20 | 40 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.16 | 0.12 | <0.01 | <0.01 | 0.11 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 8670 | 4620 | 3090 | 7960 | 8590 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 14 | <5 | <5 | 7 | 15 |
| Barium | 7440-39-3 | 10 | mg/kg | 40 | <10 | 20 | 20 | <10 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 13 | 7 | 7 | 11 | 14 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 21 | 11 | 11 | 28 | 16 |
| Copper | 7440-50-8 | 5 | mg/kg | <5 | <5 | <5 | <5 | 39 |
| Iron | 7439-89-6 | 50 | mg/kg | 28600 | 14100 | 19400 | 25400 | 25000 |
| Lead | 7439-92-1 | 5 | mg/kg | 20 | 12 | <5 | 6 | 18 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34924 | V34927 | V34930 | V34933 | V34936 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-006 | EB2213934-007 | EB2213934-008 | EB2213934-009 | EB2213934-010 |
| | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | **327** | **161** | **419** | **216** | **232** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | **35** | **16** | **23** | **56** | **19** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | **22** | **11** | **8** | **15** | **22** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | **308** | **104** | **129** | **297** | **148** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | **2** | **2** | **4** | **4** | **3** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34939 | V34942 | V34945 | V34948 | V34951 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-011 | EB2213934-012 | EB2213934-013 | EB2213934-014 | EB2213934-015 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.1 | 6.1 | 6.0 | 5.6 | 5.7 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -8.6 | -6.5 | -6.3 | -6.4 | -5.3 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 45 | 30 | 20 | 26 | 22 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.8 | 7.4 | 7.1 | 7.1 | 6.9 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 0.6 | <0.1 | <0.1 | <0.1 | 0.2 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 9.2 | 6.5 | 6.3 | 6.4 | 5.3 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.9 | 0.7 | 0.6 | 0.6 | 0.5 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 40 | 20 | <10 | 10 | 20 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.02 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 4000 | 800 | 680 | 590 | 650 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | 8 | 13 | 14 | 31 |
| Barium | 7440-39-3 | 10 | mg/kg | 20 | 10 | 20 | <10 | 40 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 6 | 4 | 4 | 3 | 3 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 13 | 5 | 6 | 5 | 6 |
| Copper | 7440-50-8 | 5 | mg/kg | <5 | 14 | 13 | 16 | 7 |
| Iron | 7439-89-6 | 50 | mg/kg | 29600 | 35000 | 31800 | 18000 | 22700 |
| Lead | 7439-92-1 | 5 | mg/kg | 111 | 15 | 14 | 13 | 17 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V34939 | V34942 | V34945 | V34948 | V34951 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2213934-011 | EB2213934-012 | EB2213934-013 | EB2213934-014 | EB2213934-015 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **407** | **859** | **904** | **644** | **396** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **33** | **4** | **6** | **6** | **16** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **9** | **10** | **11** | **5** | **5** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **231** | **62** | **58** | **44** | **84** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **3** | **2** | **2** | <1 | **1** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34954 | V34957 | V34960 | V34963 | V34966 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-016 | EB2213934-017 | EB2213934-018 | EB2213934-019 | EB2213934-020 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.3 | 5.9 | 5.6 | 5.2 | 4.9 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -5.1 | -5.6 | -5.2 | -5.0 | -2.6 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 18 | 20 | 16 | 22 | 33 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.1 | 7.0 | 7.0 | 6.8 | 5.5 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | 0.3 | 2.5 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 5.4 | 5.6 | 5.2 | 5.6 | 3.2 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.6 | 0.6 | 0.5 | 0.6 | 0.3 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | 10 | 10 | 20 | 80 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.01 | <0.01 | <0.01 | 0.02 | 0.02 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 560 | 1040 | 820 | 1230 | 520 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 16 | 11 | 30 | 26 | 6 |
| Barium | 7440-39-3 | 10 | mg/kg | 10 | 60 | 40 | 480 | <10 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | 2 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 4 | 4 | 5 | 8 | 3 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 6 | 5 | 4 | 11 | 6 |
| Copper | 7440-50-8 | 5 | mg/kg | 10 | 18 | 15 | 19 | 6 |
| Iron | 7439-89-6 | 50 | mg/kg | 28400 | 24300 | 20300 | 29900 | 750 |
| Lead | 7439-92-1 | 5 | mg/kg | 17 | 13 | 10 | 20 | 15 |

## Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

| Compound | CAS Number | LOR | Unit | Sample ID | V34954 | V34957 | V34960 | V34963 | V34966 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| | | | | | EB2213934-016 | EB2213934-017 | EB2213934-018 | EB2213934-019 | EB2213934-020 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **572** | **473** | **471** | **918** | **14** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **7** | **8** | **14** | **12** | **3** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **8** | **7** | **7** | **10** | <5 |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **62** | **54** | **69** | **90** | **45** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | <1 | **1** | **1** | <1 | <1 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V34969 | V34972 | V34975 | V34978 | V34981 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-021 | EB2213934-022 | EB2213934-023 | EB2213934-024 | EB2213934-025 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.0 | 5.1 | 4.7 | 5.2 | 5.0 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -3.3 | -4.9 | -3.1 | -4.3 | -4.4 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 33 | 24 | 36 | 30 | 50 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 5.1 | 5.4 | 4.5 | 6.2 | 6.2 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 3.6 | 4.2 | 2.6 | 1.2 | 0.6 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 3.9 | 5.2 | 4.6 | 4.9 | 4.7 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 80 | 50 | 70 | 60 | 100 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.02 | 0.01 | 0.05 | 0.02 | 0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 820 | 590 | 560 | 470 | 620 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 8 | 6 | 15 | <5 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 3 | 3 | 3 | 5 | 4 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 4 | 4 | <2 | <2 | <2 |
| Copper | 7440-50-8 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| Iron | 7439-89-6 | 50 | mg/kg | 1300 | 870 | 1490 | 1240 | 870 |
| Lead | 7439-92-1 | 5 | mg/kg | 12 | 25 | 33 | 29 | 33 |

## Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

| Compound | CAS Number | LOR | Unit | Sample ID | V34969 | V34972 | V34975 | V34978 | V34981 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| | | | | | EB2213934-021 | EB2213934-022 | EB2213934-023 | EB2213934-024 | EB2213934-025 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **14** | **14** | **21** | **17** | **14** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **3** | **2** | <2 | **2** | <2 |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **23** | **20** | **9** | **11** | **26** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | <1 | <1 | <1 | <1 | <1 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V35002 | V35005 | V35008 | V35011 | V35014 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-026 | EB2213934-027 | EB2213934-028 | EB2213934-029 | EB2213934-030 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 4.6 | 5.0 | 4.9 | 4.7 | 5.0 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -3.6 | -3.8 | -4.0 | -3.8 | -3.3 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 56 | 176 | 166 | 305 | 307 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 4.9 | 7.2 | 5.8 | 5.6 | 5.9 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 2.4 | <0.1 | 1.7 | 4.4 | 1.3 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 3.9 | 3.8 | 4.3 | 4.1 | 3.9 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 30 | 20 | 20 | 60 | 370 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.01 | <0.01 | 0.01 | 0.01 | 0.02 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 20 | 250 | 240 | 440 | 210 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 2430 | 580 | 780 | 1540 | 1060 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 13 | <5 | 8 | 23 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 50 | 30 | <10 | 10 | 110 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 8 | 5 | 4 | 6 | 3 |
| Cobalt | 7440-48-4 | 2 | mg/kg | <2 | <2 | <2 | 7 | <2 |
| Copper | 7440-50-8 | 5 | mg/kg | 9 | <5 | <5 | 12 | <5 |
| Iron | 7439-89-6 | 50 | mg/kg | 16600 | 6110 | 9360 | 12800 | 610 |
| Lead | 7439-92-1 | 5 | mg/kg | 7 | <5 | <5 | <5 | 8 |

## Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

| Compound | CAS Number | LOR | Unit | Sample ID | V35002 | V35005 | V35008 | V35011 | V35014 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| | | | | | EB2213934-026 | EB2213934-027 | EB2213934-028 | EB2213934-029 | EB2213934-030 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **39** | <5 | <5 | **15** | <5 |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **4** | **3** | <2 | **9** | <2 |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **18** | <5 | **8** | **14** | <5 |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **20** | **6** | **9** | **41** | **6** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | <1 | **2** | <1 | <1 | **1** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V35017 | V35020 | V35023 | V35026 | V35029 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-031 | EB2213934-032 | EB2213934-033 | EB2213934-034 | EB2213934-035 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.1 | 6.6 | 7.1 | 7.0 | 6.9 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -2.4 | -1.2 | -2.3 | -2.9 | -3.0 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 174 | 155 | 135 | 91 | 85 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.7 | 5.7 | 8.2 | 7.4 | 7.4 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | 5.4 | <0.1 | <0.1 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 2.4 | 1.2 | 2.3 | 2.9 | 3.0 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.2 | 0.1 | 0.2 | 0.3 | 0.3 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | 3.3 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 40 | 40 | 30 | 40 | 30 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 200 | 140 | 140 | 80 | 100 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1100 | 780 | 1060 | 990 | 4000 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 16 | <5 | 14 | 5 | 10 |
| Barium | 7440-39-3 | 10 | mg/kg | 200 | 40 | 530 | 180 | 80 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 4 | 3 | 4 | 4 | 12 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 12 | <2 | 62 | 112 | 55 |
| Copper | 7440-50-8 | 5 | mg/kg | 10 | <5 | 26 | 15 | 16 |
| Iron | 7439-89-6 | 50 | mg/kg | 1350 | 420 | 1300 | 6980 | 25200 |
| Lead | 7439-92-1 | 5 | mg/kg | 24 | 14 | 22 | 8 | 11 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V35017 | V35020 | V35023 | V35026 | V35029 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2213934-031 | EB2213934-032 | EB2213934-033 | EB2213934-034 | EB2213934-035 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **612** | **34** | **1840** | **613** | **250** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **4** | **3** | **13** | **16** | **64** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **6** | <5 | **10** | <5 | **13** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **9** | **18** | **35** | **57** | **289** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **5** | **11** | **8** | **8** | **7** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V35032 | V35035 | V35038 | V35041 | V35044 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-036 | EB2213934-037 | EB2213934-038 | EB2213934-039 | EB2213934-040 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.1 | 7.1 | 6.8 | 7.1 | 7.8 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -2.8 | -3.2 | -2.0 | -1.8 | -4.6 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 89 | 87 | 69 | 43 | 84 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.2 | 8.1 | 6.6 | 6.9 | 7.2 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 1.5 | <0.1 | 0.7 | 0.8 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 2.8 | 3.5 | 2.0 | 1.8 | 4.6 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.3 | 0.4 | 0.2 | 0.2 | 0.5 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 40 | 60 | 40 | 20 | 50 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 90 | 60 | 60 | 40 | 40 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 690 | 620 | 580 | 720 | 640 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | 27 | <5 | <5 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 40 | 320 | 40 | 20 | 240 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 5 | 9 | 3 | 6 | 4 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 3 | 6 | 4 | 3 | 8 |
| Copper | 7440-50-8 | 5 | mg/kg | 7 | 6 | 6 | 7 | 12 |
| Iron | 7439-89-6 | 50 | mg/kg | 4630 | 3530 | 4300 | 5710 | 26900 |
| Lead | 7439-92-1 | 5 | mg/kg | 7 | 23 | 8 | 10 | 14 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V35032 | V35035 | V35038 | V35041 | V35044 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-036 | EB2213934-037 | EB2213934-038 | EB2213934-039 | EB2213934-040 |
| | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | **53** | **798** | **104** | **132** | **947** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | **6** | **6** | **3** | **6** | **3** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | **10** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | **23** | **12** | **16** | **17** | **43** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | **6** | **5** | **4** | **2** | <1 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V35047 | V35050 | V35053 | V35056 | V35059 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-041 | EB2213934-042 | EB2213934-043 | EB2213934-044 | EB2213934-045 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 8.2 | 7.2 | 8.0 | 7.2 | 7.3 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -2.7 | -3.2 | -4.1 | -1.6 | -2.2 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 59 | 63 | 53 | 46 | 50 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.6 | 7.0 | 7.6 | 7.7 | 7.5 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 3.0 | 3.2 | 4.1 | 1.6 | 2.2 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.3 | 0.3 | 0.4 | 0.2 | 0.2 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | 1.1 | <1.0 | 1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 30 | 20 | 30 | 30 | 30 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 30 | 20 | 10 | 20 | 20 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 560 | 800 | 1040 | 700 | 830 |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | 19 | 26 | 8 | 10 |
| Barium | 7440-39-3 | 10 | mg/kg | 20 | 60 | 80 | 20 | 20 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | 2 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 3 | 6 | 6 | 3 | 5 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 7 | 12 | 6 | 2 | 4 |
| Copper | 7440-50-8 | 5 | mg/kg | 9 | 13 | 14 | 10 | 9 |
| Iron | 7439-89-6 | 50 | mg/kg | 14200 | 44400 | 16600 | 10300 | 18100 |
| Lead | 7439-92-1 | 5 | mg/kg | 18 | 10 | 11 | 11 | 10 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V35047 | V35050 | V35053 | V35056 | V35059 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-041 | EB2213934-042 | EB2213934-043 | EB2213934-044 | EB2213934-045 |
| | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | **1090** | **1270** | **432** | **186** | **318** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | **3** | **12** | **14** | **5** | **8** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | <5 | **16** | **5** | **6** | **7** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | **39** | **96** | **44** | **25** | **40** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | **4** | **3** | **4** | **3** | **3** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V35062 | V35065 | V35068 | V35071 | V35074 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-046 | EB2213934-047 | EB2213934-048 | EB2213934-049 | EB2213934-050 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.7 | 6.6 | 6.4 | 6.0 | 5.9 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -1.9 | -2.2 | -2.4 | -1.2 | -1.9 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 43 | 30 | 28 | 51 | 35 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.4 | 7.6 | 7.4 | 7.3 | 7.4 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 2.2 | 2.5 | 2.7 | 1.8 | 2.2 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.2 | 0.2 | 0.3 | 0.2 | 0.2 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 30 | 20 | 20 | 90 | 20 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 10 | <10 | <10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 620 | 800 | 670 | 860 | 1450 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 53 | 12 | <5 | 9 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | 40 | 90 | 50 | 20 | 20 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 2 | 5 | 4 | 4 | 7 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 4 | 7 | <2 | 3 | 3 |
| Copper | 7440-50-8 | 5 | mg/kg | 10 | 5 | 10 | 8 | <5 |
| Iron | 7439-89-6 | 50 | mg/kg | 15900 | 23200 | 11100 | 17400 | 9900 |
| Lead | 7439-92-1 | 5 | mg/kg | 13 | 13 | 10 | 17 | 6 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V35062 | V35065 | V35068 | V35071 | V35074 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2213934-046 | EB2213934-047 | EB2213934-048 | EB2213934-049 | EB2213934-050 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **308** | **678** | **289** | **410** | **176** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **24** | **6** | **4** | **8** | **9** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **5** | **7** | <5 | **6** | **6** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **40** | **67** | **36** | **33** | **40** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **2** | **2** | **1** | <1 | <1 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V35077 | V35080 | V35083 | V35086 | V35089 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-051 | EB2213934-052 | EB2213934-053 | EB2213934-054 | EB2213934-055 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.2 | 6.1 | 6.4 | 6.1 | 6.0 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -4.6 | -3.0 | -3.2 | -5.1 | -5.4 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 24 | 24 | 26 | 30 | 32 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.4 | 7.6 | 7.6 | 7.5 | 7.5 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 4.9 | 3.0 | 3.5 | 5.1 | 5.4 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.5 | 0.3 | 0.4 | 0.5 | 0.5 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 20 | 10 | 20 | 20 | 30 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.01 | <0.01 | 0.01 | <0.01 | <0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 810 | 950 | 710 | 1910 | 4740 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 7 | 14 | 12 | 17 | 23 |
| Barium | 7440-39-3 | 10 | mg/kg | 10 | 10 | 40 | 30 | 40 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 6 | 6 | 5 | 8 | 9 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 4 | 4 | 3 | 6 | 12 |
| Copper | 7440-50-8 | 5 | mg/kg | 8 | 15 | 13 | 13 | 15 |
| Iron | 7439-89-6 | 50 | mg/kg | 20000 | 17000 | 15400 | 30200 | 34200 |
| Lead | 7439-92-1 | 5 | mg/kg | 13 | 14 | 8 | 8 | 15 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V35077 | V35080 | V35083 | V35086 | V35089 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2213934-051 | EB2213934-052 | EB2213934-053 | EB2213934-054 | EB2213934-055 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **490** | **421** | **316** | **455** | **452** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **6** | **9** | **7** | **14** | **41** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **7** | **8** | <5 | **9** | **9** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **38** | **35** | **29** | **74** | **244** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **1** | <1 | **1** | **1** | **1** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V35092 | V35095 | V35098 | V35101 | V35104 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-056 | EB2213934-057 | EB2213934-058 | EB2213934-059 | EB2213934-060 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.4 | 5.7 | 5.0 | 4.7 | 5.0 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -3.3 | -3.1 | -0.9 | 1.5 | -0.7 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 26 | 13 | 32 | 47 | 32 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.9 | 7.3 | 6.5 | 4.8 | 5.3 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 0.3 | <0.1 | 0.7 | 1.5 | 5.4 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 3.3 | 3.1 | 1.5 | <0.5 | 1.0 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.3 | 0.3 | 0.2 | <0.1 | <0.1 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 20 | 10 | 40 | 110 | 60 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | <0.01 | <0.01 | 0.02 | 0.05 | 0.01 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1220 | 990 | 760 | 790 | 770 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 5 | <5 | 8 | 17 | 8 |
| Barium | 7440-39-3 | 10 | mg/kg | 10 | 30 | <10 | <10 | <10 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 5 | 4 | 5 | 6 | 7 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 3 | 6 | 7 | 4 | 4 |
| Copper | 7440-50-8 | 5 | mg/kg | 11 | 11 | <5 | <5 | <5 |
| Iron | 7439-89-6 | 50 | mg/kg | 12200 | 26700 | 1660 | 1650 | 1430 |
| Lead | 7439-92-1 | 5 | mg/kg | 12 | 12 | 30 | 21 | 17 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V35092 | V35095 | V35098 | V35101 | V35104 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2213934-056 | EB2213934-057 | EB2213934-058 | EB2213934-059 | EB2213934-060 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **212** | **686** | **23** | **14** | **19** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **6** | **6** | **6** | **7** | **8** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | **6** | **8** | <5 | <5 | <5 |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **50** | **105** | **22** | **28** | **32** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | <1 | <1 | <1 | <1 | <1 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V35107 | V35110 | V35113 | V35116 | V35119 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-061 | EB2213934-062 | EB2213934-063 | EB2213934-064 | EB2213934-065 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.3 | 5.3 | 5.2 | 5.1 | 5.3 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -1.0 | -1.5 | -1.4 | -1.0 | -1.2 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 22 | 24 | 16 | 27 | 29 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.6 | 7.1 | 6.4 | 6.7 | 7.1 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 1.4 | <0.1 | 1.2 | 1.1 | <0.1 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 1.6 | 2.1 | 2.0 | 1.6 | 1.8 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 40 | 40 | 20 | 50 | 60 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 880 | 750 | 800 | 420 | 770 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 6 | <5 | <5 | <5 | <5 |
| Barium | 7440-39-3 | 10 | mg/kg | <10 | <10 | 10 | <10 | 20 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 6 | 5 | 7 | 3 | 6 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 2 | 3 | 2 | <2 | 2 |
| Copper | 7440-50-8 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| Iron | 7439-89-6 | 50 | mg/kg | 1530 | 3840 | 2900 | 1270 | 8520 |
| Lead | 7439-92-1 | 5 | mg/kg | 17 | 18 | 19 | 9 | 22 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Sample ID | V35107 | V35110 | V35113 | V35116 | V35119 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2213934-061 | EB2213934-062 | EB2213934-063 | EB2213934-064 | EB2213934-065 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **8** | **66** | **34** | **21** | **174** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **4** | **3** | **4** | **2** | **3** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **18** | **31** | **34** | **13** | **43** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | <1 | <1 | <1 | <1 | <1 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V35122 | V35125 | V35128 | V35131 | V35134 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| Compound | CAS Number | LOR | Unit | EB2213934-066 | EB2213934-067 | EB2213934-068 | EB2213934-069 | EB2213934-070 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.8 | 6.1 | 6.4 | 7.0 | 6.6 |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -2.0 | -4.1 | -4.4 | -1.7 | 1.7 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 27 | 21 | 41 | 59 | 73 |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 6.8 | 7.2 | 7.2 | 4.3 | 3.8 |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | 0.4 | 0.9 |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | 0.4 | <0.1 | <0.1 | 1.9 | 3.2 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 2.3 | 4.1 | 4.4 | 5.7 | 3.8 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.2 | 0.4 | 0.4 | 0.6 | 0.4 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | 0 | 0 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | <1.0 | 1.9 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 50 | 10 | 40 | 80 | 100 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.01 | <0.01 | <0.01 | 0.13 | 0.18 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | <10 | <10 | <10 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 740 | 800 | 1150 | 3500 | 4380 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 6 | 10 | 8 | 11 | 16 |
| Barium | 7440-39-3 | 10 | mg/kg | 20 | 90 | 50 | 40 | 30 |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | 2 | 1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 9 | 8 | 6 | 10 | 9 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 2 | 3 | <2 | 14 | 21 |
| Copper | 7440-50-8 | 5 | mg/kg | <5 | 10 | 10 | 9 | 30 |
| Iron | 7439-89-6 | 50 | mg/kg | 2150 | 15200 | 7950 | 19200 | 29400 |
| Lead | 7439-92-1 | 5 | mg/kg | 20 | 8 | 5 | 30 | 47 |

## Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

| Compound | CAS Number | LOR | Unit | Sample ID | V35122 | V35125 | V35128 | V35131 | V35134 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 |
| | | | | | EB2213934-066 | EB2213934-067 | EB2213934-068 | EB2213934-069 | EB2213934-070 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **46** | **606** | **182** | **392** | **874** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **4** | **6** | **6** | **17** | **19** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | | <5 | <5 | <5 | **8** | **12** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **33** | **71** | **38** | **232** | **125** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | <1 | **1** | **1** | **2** | **2** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V35137 | V35140 | V35143 | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | ---- | ---- |
| Compound | CAS Number | LOR | Unit | EB2213934-071 | EB2213934-072 | EB2213934-073 | -------- | -------- |
| | | | | Result | Result | Result | ---- | ---- |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.8 | 8.2 | 8.8 | ---- | ---- |
| **EA009: Net Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -3.7 | -5.0 | -1.2 | ---- | ---- |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 32 | 42 | 50 | ---- | ---- |
| **EA011: Net Acid Generation** | | | | | | | | |
| pH (OX) | ---- | 0.1 | pH Unit | 7.1 | 6.5 | 4.7 | ---- | ---- |
| NAG (pH 4.5) | ---- | 0.1 | kg H2SO4/t | <0.1 | <0.1 | <0.1 | ---- | ---- |
| NAG (pH 7.0) | ---- | 0.1 | kg H2SO4/t | <0.1 | 0.6 | 1.2 | ---- | ---- |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 4.3 | 7.1 | 7.3 | ---- | ---- |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.4 | 0.7 | 0.7 | ---- | ---- |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 0 | ---- | ---- |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 20 | 20 | 30 | ---- | ---- |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.02 | 0.07 | 0.20 | ---- | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | <10 | <10 | <10 | ---- | ---- |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 2380 | 5780 | 7350 | ---- | ---- |
| Arsenic | 7440-38-2 | 5 | mg/kg | 8 | <5 | 5 | ---- | ---- |
| Barium | 7440-39-3 | 10 | mg/kg | 40 | 20 | 30 | ---- | ---- |
| Beryllium | 7440-41-7 | 1 | mg/kg | <1 | <1 | <1 | ---- | ---- |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | ---- | ---- |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | ---- | ---- |
| Chromium | 7440-47-3 | 2 | mg/kg | 7 | 10 | 15 | ---- | ---- |
| Cobalt | 7440-48-4 | 2 | mg/kg | 7 | 6 | 8 | ---- | ---- |
| Copper | 7440-50-8 | 5 | mg/kg | 9 | 16 | 15 | ---- | ---- |
| Iron | 7439-89-6 | 50 | mg/kg | 10400 | 15600 | 28000 | ---- | ---- |
| Lead | 7439-92-1 | 5 | mg/kg | 9 | 11 | 20 | ---- | ---- |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | V35137 | V35140 | V35143 | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | ---- | ---- |
| Compound | CAS Number | LOR | Unit | EB2213934-071 | EB2213934-072 | EB2213934-073 | -------- | -------- |
| | | | | Result | Result | Result | ---- | ---- |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | |
| **Manganese** | 7439-96-5 | 5 | mg/kg | **228** | **602** | **1680** | **----** | **----** |
| **Nickel** | 7440-02-0 | 2 | mg/kg | **10** | **7** | **13** | **----** | **----** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | **----** | **----** |
| **Vanadium** | 7440-62-2 | 5 | mg/kg | <5 | **12** | **14** | **----** | **----** |
| **Zinc** | 7440-66-6 | 5 | mg/kg | **73** | **39** | **53** | **----** | **----** |
| **EG035T: Total Recoverable Mercury by FIMS** | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.1 | mg/kg | <0.1 | <0.1 | <0.1 | **----** | **----** |
| **EK040S: Fluoride Soluble** | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | **2** | **2** | **2** | **----** | **----** |

# Appendix B – Kinetic Results

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2212859** | Page | : 1 of 5 |
| Client | : **C & R CONSULTING PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : DR CHRIS CUFF | Contact | : Princess Marcelo |
| Address | : 188 ROSS RIVER ROAD<br>AITKENVALE QUEENSLAND 4812 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 47253751 | Telephone | : +61-7-3243 7222 |
| Project | : Agate Creek KLC - Leach 0 | Date Samples Received | : 10-May-2022 11:47 |
| Order number | : ---- | Date Analysis Commenced | : 11-May-2022 |
| C-O-C number | : ---- | Issue Date | : 18-May-2022 09:29 |
| Sampler | : ---- | | |
| Site | : ---- | | |
| Quote number | : TV/110/21 v2 | | |
| No. of samples received | : 4 | | |
| No. of samples analysed | : 4 | | |

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Kim McCabe | Senior Inorganic Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

## General Comments

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Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

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Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EG020F-Dissolved Metals by ICP-MS: Sample EB2212787-001 shows poor matrix spike recovery due to sample matrix interference. Confirmed by re-extraction and re-analysis.
- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

Sub-Matrix: **LEACHATE** (Matrix: **WATER**)

| | | | | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | ---- |
| Compound | CAS Number | LOR | Unit | | EB2212859-001 | EB2212859-002 | EB2212859-003 | EB2212859-004 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **EA005P: pH by PC Titrator** | | | | | | | | | |
| **pH Value** | ---- | 0.01 | pH Unit | | **6.38** | **6.49** | **5.82** | **5.84** | **----** |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | | |
| **Electrical Conductivity @ 25°C** | ---- | 1 | µS/cm | | **20** | **553** | **231** | **38** | **----** |
| **EA016: Calculated TDS (from Electrical Conductivity)** | | | | | | | | | |
| **Total Dissolved Solids (Calc.)** | ---- | 1 | mg/L | | **13** | **359** | **150** | **25** | **----** |
| **EA065: Total Hardness as CaCO3** | | | | | | | | | |
| **Total Hardness as CaCO3** | ---- | 1 | mg/L | | <1 | **89** | **8** | <1 | **----** |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | | |
| **Hydroxide Alkalinity as CaCO3** | DMO-210-001 | 1 | mg/L | | <1 | <1 | <1 | <1 | **----** |
| **Carbonate Alkalinity as CaCO3** | 3812-32-6 | 1 | mg/L | | <1 | <1 | <1 | <1 | **----** |
| **Bicarbonate Alkalinity as CaCO3** | 71-52-3 | 1 | mg/L | | **2** | **10** | **5** | **2** | **----** |
| **Total Alkalinity as CaCO3** | ---- | 1 | mg/L | | **2** | **10** | **5** | **2** | **----** |
| **ED038: Acidity** | | | | | | | | | |
| **Acidity as CaCO3** | ---- | 1 | mg/L | | **2** | **3** | **2** | **2** | **----** |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | | |
| **Sulfate as SO4 - Turbidimetric** | 14808-79-8 | 1 | mg/L | | <1 | **3** | **49** | **1** | **----** |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | | |
| **Chloride** | 16887-00-6 | 1 | mg/L | | **4** | **136** | **21** | **7** | **----** |
| **ED093F: Dissolved Major Cations** | | | | | | | | | |
| **Calcium** | 7440-70-2 | 1 | mg/L | | <1 | **1** | <1 | <1 | **----** |
| **Magnesium** | 7439-95-4 | 1 | mg/L | | <1 | **21** | **2** | <1 | **----** |
| **Sodium** | 7440-23-5 | 1 | mg/L | | **4** | **69** | **36** | **4** | **----** |
| **Potassium** | 7440-09-7 | 1 | mg/L | | <1 | **2** | **5** | **4** | **----** |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | | |
| **Aluminium** | 7429-90-5 | 0.01 | mg/L | | **0.06** | <0.01 | <0.01 | **0.03** | **----** |
| **Antimony** | 7440-36-0 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Arsenic** | 7440-38-2 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | <0.05 | **0.19** | **0.17** | **0.13** | **----** |
| **Barium** | 7440-39-3 | 0.001 | mg/L | | <0.001 | **0.306** | **0.013** | **0.034** | **----** |
| **Beryllium** | 7440-41-7 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Cadmium** | 7440-43-9 | 0.0001 | mg/L | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | **----** |
| **Cobalt** | 7440-48-4 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Chromium** | 7440-47-3 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |

## Analytical Results

Sub-Matrix: **LEACHATE** (Matrix: **WATER**)

| | | | | Sample ID | **Column 1 V32228 to V32258** | **Column 2 V34619 to V34636** | **Column 3 V34745 to V34762** | **Column 4 V34048 to V34117** | **----** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | | **EB2212859-001** | **EB2212859-002** | **EB2212859-003** | **EB2212859-004** | **--------** |
| | | | | | Result | Result | Result | Result | ---- |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Copper** | 7440-50-8 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | **0.002** | **----** |
| **Manganese** | 7439-96-5 | 0.001 | mg/L | | <0.001 | **0.031** | **0.018** | **0.015** | **----** |
| **Nickel** | 7440-02-0 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Lead** | 7439-92-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Selenium** | 7782-49-2 | 0.01 | mg/L | | <0.01 | <0.01 | <0.01 | <0.01 | **----** |
| **Vanadium** | 7440-62-2 | 0.01 | mg/L | | <0.01 | <0.01 | <0.01 | <0.01 | **----** |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | <0.005 | <0.005 | <0.005 | <0.005 | **----** |
| **Molybdenum** | 7439-98-7 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Tellurium** | 22541-49-7 | 0.005 | mg/L | | <0.005 | <0.005 | <0.005 | <0.005 | **----** |
| **Thorium** | 7440-29-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Uranium** | 7440-61-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | **----** |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | **----** |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.4** | **6.6** | **0.6** | **0.2** | **----** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | 10-May-2022 00:00 | ---- |
| Compound | CAS Number | LOR | Unit | EB2212859-001 | EB2212859-002 | EB2212859-003 | EB2212859-004 | -------- |
| | | | | Result | Result | Result | Result | ---- |
| **EA047 Free Draining Leach Column** | | | | | | | | |
| ø **Initial weight of sample** | ---- | 0.001 | g | **2000** | **2000** | **2000** | **2000** | **----** |
| ø **Leachate added** | ---- | 0.01 | mL | **900** | **900** | **900** | **900** | **----** |
| ø **Leachate collected** | ---- | 0.01 | mL | **370** | **460** | **460** | **480** | **----** |
| ø **Initial pH** | ---- | 0.01 | pH Unit | **7.14** | **7.13** | **4.98** | **5.82** | **----** |
| ø **Initial Electrical Conductivity** | ---- | 1 | µS/cm | **20** | **546** | **231** | **36** | **----** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2214607** | Page | : 1 of 5 |
| Client | : **C & R CONSULTING PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : DR CHRIS CUFF | Contact | : Princess Marcelo |
| Address | : 188 ROSS RIVER ROAD<br>AITKENVALE QUEENSLAND 4812 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 47253751 | Telephone | : +61-7-3243 7222 |
| Project | : Agate Creek KLC - Leach 1 | Date Samples Received | : 25-May-2022 11:06 |
| Order number | : ---- | Date Analysis Commenced | : 25-May-2022 |
| C-O-C number | : ---- | Issue Date | : 06-Jun-2022 12:00 |
| Sampler | : ---- | | |
| Site | : ---- | | |
| Quote number | : TV/110/21 v2 | | |
| No. of samples received | : 4 | | |
| No. of samples analysed | : 4 | | |

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

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| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Kim McCabe | Senior Inorganic Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

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^ = This result is computed from individual analyte detections at or above the level of reporting
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- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

Sub-Matrix: **LEACHATE** (Matrix: **WATER**)

| | | | | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 25-May-2022 00:00 | 25-May-2022 00:00 | 25-May-2022 00:00 | 25-May-2022 00:00 | ---- |
| Compound | CAS Number | LOR | Unit | | EB2214607-001 | EB2214607-002 | EB2214607-003 | EB2214607-004 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **EA005P: pH by PC Titrator** | | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | | 5.51 | 6.50 | 6.30 | 5.88 | ---- |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | | 14 | 68 | 223 | 13 | ---- |
| **EA016: Calculated TDS (from Electrical Conductivity)** | | | | | | | | | |
| Total Dissolved Solids (Calc.) | ---- | 1 | mg/L | | 9 | 44 | 145 | 8 | ---- |
| **EA065: Total Hardness as CaCO3** | | | | | | | | | |
| Total Hardness as CaCO3 | ---- | 1 | mg/L | | <1 | 4 | 12 | <1 | ---- |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | | <1 | <1 | <1 | <1 | ---- |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | | <1 | <1 | <1 | <1 | ---- |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | | 1 | 4 | 3 | <1 | ---- |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | | 1 | 4 | 3 | <1 | ---- |
| **ED038: Acidity** | | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | | 1 | 2 | 3 | 1 | ---- |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | | <1 | <1 | 63 | <1 | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | | 4 | 11 | 15 | 3 | ---- |
| **ED093F: Dissolved Major Cations** | | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | | <1 | <1 | <1 | <1 | ---- |
| Magnesium | 7439-95-4 | 1 | mg/L | | <1 | 1 | 3 | <1 | ---- |
| Sodium | 7440-23-5 | 1 | mg/L | | 2 | 12 | 34 | 1 | ---- |
| Potassium | 7440-09-7 | 1 | mg/L | | <1 | <1 | 5 | 2 | ---- |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | | 0.01 | 0.07 | 0.01 | <0.01 | ---- |
| Antimony | 7440-36-0 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Arsenic | 7440-38-2 | 0.001 | mg/L | | <0.001 | 0.001 | <0.001 | <0.001 | ---- |
| Boron | 7440-42-8 | 0.05 | mg/L | | <0.05 | 0.13 | 1.15 | 0.26 | ---- |
| Barium | 7440-39-3 | 0.001 | mg/L | | <0.001 | 0.001 | 0.037 | 0.004 | ---- |
| Beryllium | 7440-41-7 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | ---- |
| Cobalt | 7440-48-4 | 0.001 | mg/L | | <0.001 | <0.001 | 0.002 | <0.001 | ---- |
| Chromium | 7440-47-3 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |

## Analytical Results

Sub-Matrix: **LEACHATE** (Matrix: **WATER**)

| Compound | CAS Number | LOR | Unit | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 25-May-2022 00:00 | 25-May-2022 00:00 | 25-May-2022 00:00 | 25-May-2022 00:00 | ---- |
| | | | | | EB2214607-001 | EB2214607-002 | EB2214607-003 | EB2214607-004 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Copper** | 7440-50-8 | 0.001 | mg/L | | <0.001 | <0.001 | **0.002** | <0.001 | **----** |
| **Manganese** | 7439-96-5 | 0.001 | mg/L | | <0.001 | **0.004** | **0.035** | **0.006** | **----** |
| **Nickel** | 7440-02-0 | 0.001 | mg/L | | <0.001 | <0.001 | **0.003** | <0.001 | **----** |
| **Lead** | 7439-92-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Selenium** | 7782-49-2 | 0.01 | mg/L | | <0.01 | <0.01 | <0.01 | <0.01 | **----** |
| **Vanadium** | 7440-62-2 | 0.01 | mg/L | | <0.01 | <0.01 | <0.01 | <0.01 | **----** |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | <0.005 | <0.005 | **0.131** | **0.007** | **----** |
| **Molybdenum** | 7439-98-7 | 0.001 | mg/L | | <0.001 | **0.001** | <0.001 | <0.001 | **----** |
| **Tellurium** | 22541-49-7 | 0.005 | mg/L | | <0.005 | <0.005 | <0.005 | <0.005 | **----** |
| **Thorium** | 7440-29-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Uranium** | 7440-61-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | **----** |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | **----** |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | <0.1 | **4.0** | **0.8** | <0.1 | **----** |

## Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

| Compound | CAS Number | LOR | Unit | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 25-May-2022 00:00 | 25-May-2022 00:00 | 25-May-2022 00:00 | 25-May-2022 00:00 | ---- |
| | | | | | EB2214607-001 | EB2214607-002 | EB2214607-003 | EB2214607-004 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **EA047 Free Draining Leach Column** | | | | | | | | | |
| ø **Leachate added** | ---- | 0.01 | mL | | **800** | **800** | **800** | **800** | **----** |
| ø **Leachate collected** | ---- | 0.01 | mL | | **760** | **740** | **750** | **760** | **----** |
| ø **Initial pH** | ---- | 0.01 | pH Unit | | **5.93** | **6.76** | **6.41** | **5.51** | **----** |
| ø **Initial Electrical Conductivity** | ---- | 1 | µS/cm | | **14** | **66** | **219** | **12** | **----** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2216196** | Page | : 1 of 5 |
| Client | : **C & R CONSULTING PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : DR CHRIS CUFF | Contact | : Princess Marcelo |
| Address | : 188 ROSS RIVER ROAD<br>AITKENVALE QUEENSLAND 4812 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 47253751 | Telephone | : +61-7-3243 7222 |
| Project | : Agate Creek KLC - Leach 2 | Date Samples Received | : 08-Jun-2022 10:00 |
| Order number | : ---- | Date Analysis Commenced | : 08-Jun-2022 |
| C-O-C number | : ---- | Issue Date | : 16-Jun-2022 09:43 |
| Sampler | : ---- | | |
| Site | : ---- | | |
| Quote number | : TV/110/21 v2 | | |
| No. of samples received | : 4 | | |
| No. of samples analysed | : 4 | | |

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

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- Analytical Results

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This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Kim McCabe | Senior Inorganic Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

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^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

| Sub-Matrix: LEACHATE (Matrix: WATER) | | | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 08-Jun-2022 00:00 | 08-Jun-2022 00:00 | 08-Jun-2022 00:00 | 08-Jun-2022 00:00 | ---- |
| Compound | CAS Number | LOR | Unit | EB2216196-001 | EB2216196-002 | EB2216196-003 | EB2216196-004 | -------- |
| | | | | Result | Result | Result | Result | ---- |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | 6.53 | 6.24 | 5.88 | 5.57 | ---- |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 15 | 49 | 43 | 21 | ---- |
| **EA016: Calculated TDS (from Electrical Conductivity)** | | | | | | | | |
| Total Dissolved Solids (Calc.) | ---- | 1 | mg/L | 10 | 32 | 28 | 14 | ---- |
| **EA065: Total Hardness as CaCO3** | | | | | | | | |
| Total Hardness as CaCO3 | ---- | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | 3 | 3 | 1 | <1 | ---- |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | 3 | 3 | 1 | <1 | ---- |
| **ED038: Acidity** | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | <1 | <1 | 12 | <1 | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | 4 | 9 | 2 | 5 | ---- |
| **ED093F: Dissolved Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Magnesium | 7439-95-4 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Sodium | 7440-23-5 | 1 | mg/L | 2 | 8 | 7 | 2 | ---- |
| Potassium | 7440-09-7 | 1 | mg/L | <1 | <1 | 1 | 2 | ---- |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | 0.01 | 0.16 | 0.04 | <0.01 | ---- |
| Antimony | 7440-36-0 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Arsenic | 7440-38-2 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Boron | 7440-42-8 | 0.05 | mg/L | <0.05 | 0.07 | 0.18 | 0.42 | ---- |
| Barium | 7440-39-3 | 0.001 | mg/L | 0.002 | 0.001 | 0.003 | 0.005 | ---- |
| Beryllium | 7440-41-7 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | ---- |
| Cobalt | 7440-48-4 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Chromium | 7440-47-3 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |

## Analytical Results

Sub-Matrix: **LEACHATE** (Matrix: **WATER**)

| Compound | CAS Number | LOR | Unit | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 08-Jun-2022 00:00 | 08-Jun-2022 00:00 | 08-Jun-2022 00:00 | 08-Jun-2022 00:00 | ---- |
| | | | | | EB2216196-001 | EB2216196-002 | EB2216196-003 | EB2216196-004 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Copper** | 7440-50-8 | 0.001 | mg/L | | **0.001** | **0.001** | <0.001 | <0.001 | **----** |
| **Manganese** | 7439-96-5 | 0.001 | mg/L | | **0.006** | **0.003** | **0.003** | **0.017** | **----** |
| **Nickel** | 7440-02-0 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Lead** | 7439-92-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Selenium** | 7782-49-2 | 0.01 | mg/L | | <0.01 | <0.01 | <0.01 | <0.01 | **----** |
| **Vanadium** | 7440-62-2 | 0.01 | mg/L | | <0.01 | <0.01 | <0.01 | <0.01 | **----** |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | <0.005 | <0.005 | <0.005 | **0.011** | **----** |
| **Molybdenum** | 7439-98-7 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Tellurium** | 22541-49-7 | 0.005 | mg/L | | <0.005 | <0.005 | <0.005 | <0.005 | **----** |
| **Thorium** | 7440-29-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Uranium** | 7440-61-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | **----** |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | <0.05 | **0.06** | <0.05 | <0.05 | **----** |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | **----** |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | <0.1 | **2.4** | **0.5** | <0.1 | **----** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 08-Jun-2022 00:00 | 08-Jun-2022 00:00 | 08-Jun-2022 00:00 | 08-Jun-2022 00:00 | ---- |
| Compound | CAS Number | LOR | Unit | EB2216196-001 | EB2216196-002 | EB2216196-003 | EB2216196-004 | -------- |
| | | | | Result | Result | Result | Result | ---- |
| **EA047 Free Draining Leach Column** | | | | | | | | |
| ø **Leachate added** | ---- | 0.01 | mL | **800** | **800** | **800** | **800** | **----** |
| ø **Leachate collected** | ---- | 0.01 | mL | **720** | **600** | **650** | **670** | **----** |
| ø **Initial pH** | ---- | 0.01 | pH Unit | **4.61** | **6.22** | **5.66** | **5.06** | **----** |
| ø **Initial Electrical Conductivity** | ---- | 1 | µS/cm | **19** | **48** | **41** | **20** | **----** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2218098** | Page | : 1 of 5 |
| Client | : **C & R CONSULTING PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : DR CHRIS CUFF | Contact | : Princess Marcelo |
| Address | : 188 ROSS RIVER ROAD<br>AITKENVALE QUEENSLAND 4812 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 47253751 | Telephone | : +61-7-3243 7222 |
| Project | : Agate Creek KLC - Leach 3 | Date Samples Received | : 23-Jun-2022 12:34 |
| Order number | : ---- | Date Analysis Commenced | : 23-Jun-2022 |
| C-O-C number | : ---- | Issue Date | : 30-Jun-2022 16:47 |
| Sampler | : ---- | | |
| Site | : ---- | | |
| Quote number | : TV/110/21 v2 | | |
| No. of samples received | : 4 | | |
| No. of samples analysed | : 4 | | |

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Kim McCabe | Senior Inorganic Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |
| Mark Hallas | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

## General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

| Sub-Matrix: LEACHATE (Matrix: WATER) | | | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 23-Jun-2022 00:00 | 23-Jun-2022 00:00 | 23-Jun-2022 00:00 | 23-Jun-2022 00:00 | ---- |
| Compound | CAS Number | LOR | Unit | EB2218098-001 | EB2218098-002 | EB2218098-003 | EB2218098-004 | -------- |
| | | | | Result | Result | Result | Result | ---- |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | **6.87** | **6.48** | **5.98** | **5.66** | ---- |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | **14** | **44** | **38** | **21** | ---- |
| **EA016: Calculated TDS (from Electrical Conductivity)** | | | | | | | | |
| Total Dissolved Solids (Calc.) | ---- | 1 | mg/L | **9** | **29** | **25** | **14** | ---- |
| **EA065: Total Hardness as CaCO3** | | | | | | | | |
| Total Hardness as CaCO3 | ---- | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | **3** | **5** | **5** | **4** | ---- |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | **3** | **5** | **5** | **4** | ---- |
| **ED038: Acidity** | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | **2** | **3** | **3** | **3** | ---- |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | <1 | <1 | **11** | <1 | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | **4** | **8** | **1** | **5** | ---- |
| **ED093F: Dissolved Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Magnesium | 7439-95-4 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Sodium | 7440-23-5 | 1 | mg/L | **2** | **8** | **6** | **2** | ---- |
| Potassium | 7440-09-7 | 1 | mg/L | <1 | <1 | **1** | **2** | ---- |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | **0.01** | **0.02** | **0.02** | <0.01 | ---- |
| Antimony | 7440-36-0 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Arsenic | 7440-38-2 | 0.001 | mg/L | <0.001 | **0.002** | <0.001 | <0.001 | ---- |
| Boron | 7440-42-8 | 0.05 | mg/L | <0.05 | **0.08** | **0.19** | **0.69** | ---- |
| Barium | 7440-39-3 | 0.001 | mg/L | **0.002** | <0.001 | **0.002** | **0.004** | ---- |
| Beryllium | 7440-41-7 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | ---- |
| Cobalt | 7440-48-4 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Chromium | 7440-47-3 | 0.001 | mg/L | <0.001 | **0.002** | <0.001 | <0.001 | ---- |

## Analytical Results

Sub-Matrix: **LEACHATE** (Matrix: **WATER**)

| Compound | CAS Number | LOR | Unit | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 23-Jun-2022 00:00 | 23-Jun-2022 00:00 | 23-Jun-2022 00:00 | 23-Jun-2022 00:00 | ---- |
| | | | | | EB2218098-001 | EB2218098-002 | EB2218098-003 | EB2218098-004 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Copper** | 7440-50-8 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| **Manganese** | 7439-96-5 | 0.001 | mg/L | | **0.009** | **0.003** | **0.004** | **0.015** | ---- |
| **Nickel** | 7440-02-0 | 0.001 | mg/L | | <0.001 | **0.001** | <0.001 | **0.001** | ---- |
| **Lead** | 7439-92-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| **Selenium** | 7782-49-2 | 0.01 | mg/L | | <0.01 | <0.01 | <0.01 | <0.01 | ---- |
| **Vanadium** | 7440-62-2 | 0.01 | mg/L | | <0.01 | <0.01 | <0.01 | <0.01 | ---- |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | <0.005 | **0.024** | <0.005 | **0.010** | ---- |
| **Molybdenum** | 7439-98-7 | 0.001 | mg/L | | <0.001 | **0.001** | <0.001 | <0.001 | ---- |
| **Tellurium** | 22541-49-7 | 0.005 | mg/L | | <0.005 | <0.005 | <0.005 | <0.005 | ---- |
| **Thorium** | 7440-29-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| **Uranium** | 7440-61-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | ---- |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | <0.1 | **2.1** | **0.4** | <0.1 | ---- |

## Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

| | | | | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 23-Jun-2022 00:00 | 23-Jun-2022 00:00 | 23-Jun-2022 00:00 | 23-Jun-2022 00:00 | ---- |
| Compound | CAS Number | LOR | Unit | | EB2218098-001 | EB2218098-002 | EB2218098-003 | EB2218098-004 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **EA047 Free Draining Leach Column** | | | | | | | | | |
| ø **Leachate added** | ---- | 0.01 | mL | | **800** | **800** | **800** | **800** | **----** |
| ø **Leachate collected** | ---- | 0.01 | mL | | **700** | **610** | **630** | **660** | **----** |
| ø **Initial pH** | ---- | 0.01 | pH Unit | | **5.49** | **6.21** | **5.50** | **5.13** | **----** |
| ø **Initial Electrical Conductivity** | ---- | 1 | µS/cm | | **14** | **44** | **38** | **20** | **----** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2219694** | Page | : 1 of 5 |
| Client | : **C & R CONSULTING PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : DR CHRIS CUFF | Contact | : Princess Marcelo |
| Address | : 188 ROSS RIVER ROAD<br>AITKENVALE QUEENSLAND 4812 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 47253751 | Telephone | : +61-7-3243 7222 |
| Project | : Agate Creek KLC - Leach 4 | Date Samples Received | : 07-Jul-2022 10:46 |
| Order number | : ---- | Date Analysis Commenced | : 07-Jul-2022 |
| C-O-C number | : ---- | Issue Date | : 15-Jul-2022 08:59 |
| Sampler | : ---- | | |
| Site | : ---- | | |
| Quote number | : TV/110/21 v2 | | |
| No. of samples received | : 4 | | |
| No. of samples analysed | : 4 | | |

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Kim McCabe | Senior Inorganic Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

## General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

| Sub-Matrix: LEACHATE (Matrix: WATER) | | | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 07-Jul-2022 00:00 | 07-Jul-2022 00:00 | 07-Jul-2022 00:00 | 07-Jul-2022 00:00 | ---- |
| Compound | CAS Number | LOR | Unit | EB2219694-001 | EB2219694-002 | EB2219694-003 | EB2219694-004 | -------- |
| | | | | Result | Result | Result | Result | ---- |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | 5.48 | 6.15 | 5.59 | 5.40 | ---- |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 10 | 41 | 36 | 25 | ---- |
| **EA016: Calculated TDS (from Electrical Conductivity)** | | | | | | | | |
| Total Dissolved Solids (Calc.) | ---- | 1 | mg/L | 6 | 27 | 23 | 16 | ---- |
| **EA065: Total Hardness as CaCO3** | | | | | | | | |
| Total Hardness as CaCO3 | ---- | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | <1 | 1 | <1 | <1 | ---- |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | <1 | 1 | <1 | <1 | ---- |
| **ED038: Acidity** | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | 2 | 1 | 1 | 2 | ---- |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | <1 | <1 | 10 | <1 | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | 4 | 7 | <1 | 5 | ---- |
| **ED093F: Dissolved Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Magnesium | 7439-95-4 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Sodium | 7440-23-5 | 1 | mg/L | 2 | 7 | 6 | 3 | ---- |
| Potassium | 7440-09-7 | 1 | mg/L | <1 | <1 | 1 | 3 | ---- |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | <0.01 | 0.01 | <0.01 | <0.01 | ---- |
| Antimony | 7440-36-0 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Arsenic | 7440-38-2 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Boron | 7440-42-8 | 0.05 | mg/L | 0.07 | 0.12 | 0.25 | 0.96 | ---- |
| Barium | 7440-39-3 | 0.001 | mg/L | 0.001 | <0.001 | 0.002 | 0.008 | ---- |
| Beryllium | 7440-41-7 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | ---- |
| Cobalt | 7440-48-4 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Chromium | 7440-47-3 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |

## Analytical Results

Sub-Matrix: **LEACHATE** (Matrix: **WATER**)

| Compound | CAS Number | LOR | Unit | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 07-Jul-2022 00:00 | 07-Jul-2022 00:00 | 07-Jul-2022 00:00 | 07-Jul-2022 00:00 | ---- |
| | | | | | EB2219694-001 | EB2219694-002 | EB2219694-003 | EB2219694-004 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Copper** | 7440-50-8 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| **Manganese** | 7439-96-5 | 0.001 | mg/L | | **0.004** | **0.002** | **0.003** | **0.013** | ---- |
| **Nickel** | 7440-02-0 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| **Lead** | 7439-92-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| **Selenium** | 7782-49-2 | 0.01 | mg/L | | <0.01 | <0.01 | <0.01 | <0.01 | ---- |
| **Vanadium** | 7440-62-2 | 0.01 | mg/L | | <0.01 | <0.01 | <0.01 | <0.01 | ---- |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | <0.005 | <0.005 | <0.005 | **0.006** | ---- |
| **Molybdenum** | 7439-98-7 | 0.001 | mg/L | | <0.001 | **0.001** | <0.001 | <0.001 | ---- |
| **Tellurium** | 22541-49-7 | 0.005 | mg/L | | <0.005 | <0.005 | <0.005 | <0.005 | ---- |
| **Thorium** | 7440-29-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| **Uranium** | 7440-61-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | ---- |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | <0.1 | **2.0** | **0.5** | **0.1** | ---- |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 07-Jul-2022 00:00 | 07-Jul-2022 00:00 | 07-Jul-2022 00:00 | 07-Jul-2022 00:00 | ---- |
| Compound | CAS Number | LOR | Unit | EB2219694-001 | EB2219694-002 | EB2219694-003 | EB2219694-004 | -------- |
| | | | | Result | Result | Result | Result | ---- |
| **EA047 Free Draining Leach Column** | | | | | | | | |
| ø **Leachate added** | ---- | 0.01 | mL | **800** | **800** | **800** | **800** | **----** |
| ø **Leachate collected** | ---- | 0.01 | mL | **710** | **590** | **610** | **620** | **----** |
| ø **Initial pH** | ---- | 0.01 | pH Unit | **5.59** | **6.56** | **5.91** | **5.57** | **----** |
| ø **Initial Electrical Conductivity** | ---- | 1 | µS/cm | **9** | **38** | **32** | **23** | **----** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2221216** | Page | : 1 of 5 |
| **Amendment** | : **1** | | |
| Client | : **C & R CONSULTING PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : DR CHRIS CUFF | Contact | : Princess Marcelo |
| Address | : 188 ROSS RIVER ROAD<br>AITKENVALE QUEENSLAND 4812 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 47253751 | Telephone | : +61-7-3243 7222 |
| Project | : Agate Creek KLC - Leach 5 | Date Samples Received | : 21-Jul-2022 09:41 |
| Order number | : ---- | Date Analysis Commenced | : 21-Jul-2022 |
| C-O-C number | : ---- | Issue Date | : 29-Jul-2022 16:11 |
| Sampler | : ---- | | |
| Site | : ---- | | |
| Quote number | : TV/110/21 v2 | | |
| No. of samples received | : 4 | | |
| No. of samples analysed | : 4 | | |

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Kim McCabe | Senior Inorganic Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

## General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Amendment (29/7/22): This report has been amended as a result of changes to the contacts for the distribution of the report. All analysis results are as per the previous report.
- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

| Sub-Matrix: LEACHATE (Matrix: WATER) | | | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 21-Jul-2022 00:00 | 21-Jul-2022 00:00 | 21-Jul-2022 00:00 | 21-Jul-2022 00:00 | ---- |
| Compound | CAS Number | LOR | Unit | EB2221216-001 | EB2221216-002 | EB2221216-003 | EB2221216-004 | -------- |
| | | | | Result | Result | Result | Result | ---- |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | 6.00 | 6.30 | 5.45 | 5.55 | ---- |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 17 | 36 | 36 | 18 | ---- |
| **EA016: Calculated TDS (from Electrical Conductivity)** | | | | | | | | |
| Total Dissolved Solids (Calc.) | ---- | 1 | mg/L | 11 | 23 | 23 | 12 | ---- |
| **EA065: Total Hardness as CaCO3** | | | | | | | | |
| Total Hardness as CaCO3 | ---- | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | 1 | 2 | <1 | <1 | ---- |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | 1 | 2 | <1 | <1 | ---- |
| **ED038: Acidity** | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | 3 | 3 | 3 | 3 | ---- |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | <1 | <1 | 10 | 1 | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | 4 | 6 | <1 | 4 | ---- |
| **ED093F: Dissolved Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Magnesium | 7439-95-4 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Sodium | 7440-23-5 | 1 | mg/L | 4 | 6 | 5 | 3 | ---- |
| Potassium | 7440-09-7 | 1 | mg/L | <1 | <1 | 1 | 2 | ---- |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | <0.01 | 0.02 | 0.01 | <0.01 | ---- |
| Antimony | 7440-36-0 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Arsenic | 7440-38-2 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Boron | 7440-42-8 | 0.05 | mg/L | <0.05 | 0.11 | 0.30 | 0.80 | ---- |
| Barium | 7440-39-3 | 0.001 | mg/L | 0.005 | <0.001 | 0.002 | 0.005 | ---- |
| Beryllium | 7440-41-7 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | ---- |
| Cobalt | 7440-48-4 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Chromium | 7440-47-3 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |

## Analytical Results

Sub-Matrix: **LEACHATE** (Matrix: **WATER**)

| Compound | CAS Number | LOR | Unit | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sampling date / time | 21-Jul-2022 00:00 | 21-Jul-2022 00:00 | 21-Jul-2022 00:00 | 21-Jul-2022 00:00 | ---- |
| | | | | | EB2221216-001 | EB2221216-002 | EB2221216-003 | EB2221216-004 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Copper** | 7440-50-8 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| **Manganese** | 7439-96-5 | 0.001 | mg/L | | **0.016** | **0.002** | **0.004** | **0.007** | ---- |
| **Nickel** | 7440-02-0 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| **Lead** | 7439-92-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| **Selenium** | 7782-49-2 | 0.01 | mg/L | | <0.01 | <0.01 | <0.01 | <0.01 | ---- |
| **Vanadium** | 7440-62-2 | 0.01 | mg/L | | <0.01 | <0.01 | <0.01 | <0.01 | ---- |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | <0.005 | <0.005 | <0.005 | **0.007** | ---- |
| **Molybdenum** | 7439-98-7 | 0.001 | mg/L | | <0.001 | **0.001** | <0.001 | <0.001 | ---- |
| **Tellurium** | 22541-49-7 | 0.005 | mg/L | | <0.005 | <0.005 | <0.005 | <0.005 | ---- |
| **Thorium** | 7440-29-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| **Uranium** | 7440-61-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | ---- |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | <0.1 | **2.1** | **0.5** | **0.1** | ---- |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Sample ID | Column 1 V32228 to V32258 | Column 2 V34619 to V34636 | Column 3 V34745 to V34762 | Column 4 V34048 to V34117 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 21-Jul-2022 00:00 | 21-Jul-2022 00:00 | 21-Jul-2022 00:00 | 21-Jul-2022 00:00 | ---- |
| Compound | CAS Number | LOR | Unit | EB2221216-001 | EB2221216-002 | EB2221216-003 | EB2221216-004 | -------- |
| | | | | Result | Result | Result | Result | ---- |
| **EA047 Free Draining Leach Column** | | | | | | | | |
| ø **Leachate added** | ---- | 0.01 | mL | **800** | **800** | **800** | **800** | **----** |
| ø **Leachate collected** | ---- | 0.01 | mL | **710** | **590** | **590** | **650** | **----** |
| ø **Initial pH** | ---- | 0.01 | pH Unit | **5.61** | **6.31** | **5.73** | **5.42** | **----** |
| ø **Initial Electrical Conductivity** | ---- | 1 | µS/cm | **19** | **35** | **34** | **18** | **----** |

# Appendix C – Queensland Government Science Notes

# Measuring salinity

Salinity is the accumulation of salt in soil and water. High salt levels can adversely affect plant growth, soil structure, water quality and infrastructure.

High salt levels occur naturally in many parts of the Australian landscape but in many cases have been exacerbated where human activities accelerate the mobilisation and accumulation of salt.

## Methods for measuring salinity

It is important to identify saline areas so they can be appropriately managed. There are a range of methods for measuring salinity. Two common ways are by using an electrical conductivity (EC) meter or by measuring how much salt is in a solution of soil or water.

An EC meter measures how much electricity moves through a solution—the saltier the solution, the more electricity moves through it and the higher the conductivity reading. EC can be easily measured in the field or in a laboratory. A wide range of EC meters are available, ranging in price and size.

Electrical conductivity can be expressed in different units—for soil, EC is measured in dS/m (deci-Siemens/metre), while water is measured in µS/cm (micro-Siemens/centimetre). It is important to always calibrate the EC meter before use.

Another way to detect salinity is by measuring how much salt is in a solution—this measurement is called total dissolved solids (TDS) or total dissolved ions (TDI). It is measured in units of mg/l (milligrams/litre) or ppm (parts per million). Higher readings mean more salt is present in the solution.

### Measuring salinity in water

Salinity in surface water and groundwater can be easily measured in the field by collecting a water sample, inserting an EC probe into the sample and reading the value shown on the meter.

Alternatively, a water sample can be collected and forwarded to a laboratory for testing of salinity and chemical composition. The container should be entirely filled with the water sample to exclude air. Samples for laboratory analysis should be forwarded as quickly as possible. Delays and high temperatures will change the composition of salts in the sample, affecting the results. Typical salinity values for water are given in Table 3.

### Measuring salinity in soil

EC is usually measured in the field using a 1:5 soil:water suspension (EC1:5), or in a laboratory using a soil saturation extract EC (ECse) or a 1:5 solution.

To measure EC1:5 in the field, put approximately 10 millilitres of distilled water, rainwater or tank water into a jar, container or tube. Add small soil particles until the contents of the container increase by 5 millilitres to bring the volume to 15 millilitres. Add additional water to bring the total volume to 30 millilitres. Shake intermittently for five minutes and allow it to settle for five minutes. Dip an EC probe into the solution and take a reading. Remember to wash the EC probe after using it.

The interpretation of EC values to determine soil salinity levels depends on the texture of the soil. Salts are readily dissolved out of sandy soils whereas salts are more tightly held by clay soils. This means that the same amount of salt will have a greater impact on sandy soils then it will on clay soils. As a guide, sandy or loamy

soils are moderately saline if EC1:5 is above 0.3 deci- Siemens/metre, and clay soils are moderately saline if EC1:5 is above 0.6 deci- Siemens/metre.

As the EC1:5 is measured on a diluted sample, a more realistic measurement of the actual salt levels that a plant will encounter can be measured on a saturated extract (ECse). This can be done by some laboratories. As a guide, soils are generally considered saline if their ECse is greater than 2– 4 deci- Siemens/metre.

Salinity tolerance ratings for soils are usually based on ECse values, rather than EC1:5. To convert EC1:5 to ECse, identify the texture of the soil, and use the guide in Table 1

**Table. 1. Conversion of EC1:5 to ECse for a range of soil textures**

| Soil type | Multiply EC1:5 by |
|---|---|
| Sand | 23 |
| Sandy loam | 14 |
| Loam | 10 |
| Clay loam | 9 |
| Light clay | 7.5 |
| Heavy clay | 6 |

For example, sand with an EC1:5 of 0.3 dS/m is equivalent to an ECse of 6.9 dS/m, while a heavy clay with an EC1:5 of 0.3 dS/m is equivalent to an ECse of 1.8 dS/m. Soil salinity classes are shown in Table 2.

**Table 2. Approximate soil salinity classes**

| Salinity rating | $EC_{se}$ (dS/m) | |
|---|---|---|
| Slightly saline | 1.5—2 | Salinity effects usually minimal |
| Moderately saline | 2—6 | Yield of salt sensitive plants restricted |
| Highly saline | 6—15 | Only salt tolerant plants yield satisfactorily |
| Extremely saline | >15 | Few salt tolerant plants yield satisfactorily |

## Salinity tolerance of crops

As a general guide, salt tolerant crops include barley, canola, cotton, beetroot, soybean, wheat, olives and sorghum. Moderately salt tolerant crops include lucerne, tomato, cabbage, potato and carrots. Low salt tolerant crops include maize, sugar cane, celery, lettuce and pumpkin.

Table 3. Guide to typical salinity limits for waters. It is important to also check other water quality parameters (e.g. chemical composition, sodium adsorption ration, metals etc) before use.

| | | Electrical conductivity (EC) | | TDS |
|---|---|---|---|---|
| | | (µS/cm) | (dS/m) | (mg/l or ppm) |
| Distilled water | | 1 | 0.001 | 0.67 |
| Rainfall | | 30 | 0. 03 | 20 |
| Sewage effluent | | 840 | 0.84 | 565 |
| Freshwater | | 0-1500 | 0-1.5 | 0-1000 |
| Great Artesian Basin Water | | 700-1000 | 0.7-1.0 | 470-670 |
| Brackish water | | 1500-15000 | 1.5-15 | 1000-10050 |
| Upper limit recommended for drinking | | 1600 | 1.6 | 1070 |
| Tolerances of livestock to salinity in drinking water (at these values, animals may have an initial reluctance to drink, but stock should adapt without loss of production) | Beef cattle | 5970-7460 | 5.9-7.5 | 4000-5000 |
| | Dairy cattle | 3730-5970 | 3.7-5.9 | 2500-4000 |
| | Sheep | 7460-14925 | 7.5-14.9 | 5000-10000 |
| | Horses | 5970-8955 | 5.9-8.9 | 4000-6000 |
| | Pigs | 5970-8955 | 5.9-8.9 | 4000-6000 |
| | Poultry | 2985-4475 | 2.9-4.4 | 2000-3000 |
| General limits for irrigation | Salt sensitive crops | 650 | 0.65 | 435 |
| | Moderately salt sensitive crops | 1300 | 1.3 | 870 |
| | Salt tolerant crops | 5200 | 5.2 | 3485 |
| | Generally too saline for crops | 8100 | 8.1 | 5430 |
| Salt water swimming pool | | 5970-8955 | 5.9-8.9 | 4000-6000 |
| Seawater | | 55000 | 55 | 36850 |
| Dead sea | | 110000 | 110 | 73700 |

*Note: To convert from µS/cm to dS/m, divide by 1000. To approximately convert from µS/cm to mg/l, multiply by 0.67.*

## References


- ANZECC (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. ANZECC and ARMCANZ.
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- Foth HD (1990). Fundamentals of Soil Science, 8th Edition. John Wiley & Sons, New York, USA.
- Price G (ed) (2006). Australian Soil Fertility Manual, 3rd Edition. CSIRO Publishing and Fertilizer Industry Federation of Australia, Collingwood.
- Salcon (1997). Salinity Management Handbook. Department of Natural Resources, Indooroopilly.


# Further information

This and other science notes are available from the Queensland Government website www.qld.gov.au – search ‘science notes’. For further information about this science notes series phone **13 QGOV** (13 74 68) – ask for science notes – Land series L137.

For further information about salinity visit < http://www.qld.gov.au/environment/land/soil/salinity/> or email soils@qld.gov.au.

# Appendix C: Terrestrial Flora and Fauna Baseline (SLR, 2021)

# AGATE CREEK

## Terrestrial Flora and Fauna Baseline Assessment

**Prepared for:**

Laneway Resources
Level 21, Matisse Tower
110 Mary Street
Brisbane QLD 4000



SLR Ref: 623.20155.00000-R01
Version No: -v1.0
March 2021

# PREPARED BY

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# BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Laneway Resources (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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# 1 Introduction

## 1.1 Project background

Laneway Resources Ltd hold the Agate Creek mining lease (ML) 100030, which encompasses ~691ha and is located ~45km to the south west of Forsayth. Environmentally relevant activities within this ML are regulated under environmental authority (EA) EPSL03068015, which contains standard conditions outlined within the Code of Environmental Compliance for Mining Lease Projects Version 1.1 (EHP, 2013) made under the Environmental Protection Regulation 2008 (EP Regulation).

Laneway Resources Ltd commissioned SLR Consulting Pty Ltd (SLR) to undertake baseline flora and fauna assessments within the ML to support site-specific EA application processes. These baseline assessments were undertaken during the early dry season, from 25 to 29 May 2020, and during the early wet season from 30 November to the 4 December 2020

## 1.2 Study area description

The study area for the field surveys included all areas within ML 100030 (Appendix A), which occurs on the boundary of the Gulf Plains and Einasleigh Uplands bioregions and to the north east of the Rungulla National Park (NP) and Rungulla Resource Reserve (RR). The western portion of the study area is bordered by the Gregory Range, which includes steep sandstone scarps and formations. The central western portion of the study area is characterised by steeply undulating hills, which form sheltered gullies in some areas. However, most of the study area is dominated by gently undulating open woodland on seasonal floodplains. Agate Creek is a fourth order ephemeral watercourse that dissects the central northern portion of the study area flowing from the south east to north west. Several other smaller ephemeral watercourses also occur throughout the study area.

Existing mining infrastructure and disturbance was present at the time of the baseline assessments, which included a central haul road, run of mine, mining camp and workshop facilities, open-cut pit, and waste rock dump.

## 1.3 Purpose and objectives

The objective of this report is to describe current biodiversity values and relevant Matters of State and National Environmental Significance (MSES & MNES), in accordance with current State and Commonwealth legislation, that occur within the study area.

The above was achieved through a desktop and field assessments examining:

- The occurrence of MSES and MNES in accordance with current State and Commonwealth legislation;
- The terrestrial flora and fauna biodiversity values within the study area; and
- The presence and status of species and communities identified to occur within the study area based on ground-truthing field assessments.

This is the first known terrestrial flora and fauna assessment conducted specifically to inform environmental approvals for development of the study area.

## 1.4 Regulatory framework

### 1.4.1 Commonwealth legislation

#### Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Australian Government Department of Agriculture, Water and the Environment (DAWE). The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as MNES. The MNES listed in the EPBC Act that are relevant to this report are:

- Nationally threatened species and ecological communities
- Migratory species.

Database searches and field assessments should be conducted as part of any flora and fauna impact assessment. The results of these assessments can be used to determine the presence or likelihood of the presence of any MNES within the study area. If any species or communities listed under the EPBC Act are present or likely to be present, an assessment of significance is required. If the proposed action may have a significant impact on a MNES, it must be referred to DAWE for assessment. If DAWE determines that the proposed action is likely to have significant impacts despite any suggested mitigation strategies, the project will be considered as a controlled action and will require formal assessment and approval. If the proposed action is not likely to be significant, approval is not required if the action is taken in accordance with the referral. Consequently, the action can proceed, subject to any state or local government requirements.

### 1.4.2 State legislation

#### Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) is intended "to protect Queensland's environment while allowing for development that improves total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development)". The EP Act regulates environmentally relevant activities (ERAs). The Queensland Department of Environment and Science (DES) assesses applications to undertake ERAs, and issues Environmental Authorities (EAs) that identify environmental conditions to be met to ensure the prevention or minimisation of environmental harm caused by the authorised ERAs. An assessment of environmental impacts on identified environmental values is required as part of the EA application.

Environmentally Sensitive Areas (ESAs) are defined under Schedule 12 of the Environmental Protection Regulation 2008 (EP Regulation). ERAs and/or exploration and/or mining activities within and adjacent to ESAs are regulated by DES in accordance with the following documents:

- *Eligibility criteria and standard conditions for exploration and mineral development projects – Version 2*; and
- *Eligibility criteria and standard conditions for mining lease activities – Version 2*.

#### Vegetation Management Act 1999

The *Vegetation Management Act 1999* (VM Act) is administered by the Queensland Department of Natural Resources, Mines and Energy (DNRME) and protects Queensland's biodiversity by conserving native vegetation and addressing land degradation issues.

Queensland's vegetation management framework regulates the clearing of certain native vegetation. The VM Act incorporates the RE classification scheme to regulate the clearing of native vegetation. REs are remnant vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. Remnant vegetation is defined under the VM Act as vegetation where the dominant canopy layer has greater than 70% of the height and greater than 50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.

The Queensland Herbarium has mapped the remnant extent of REs for much of the state using a combination of satellite imagery, aerial photography and on-ground studies (ground-truthing). RE maps published by DNRME describe the extent and conservation status of remnant vegetation as REs. REs are classified in the following vegetation management class and biodiversity status categories:

- Remnant Vegetation—Category B
  - Endangered—less than 10% remains
  - Of Concern—10-30% remains
  - No Concern at Present—>30% remains, >10,000ha remains
- Regrowth
  - High Value Regrowth—Category C
  - Reef Regrowth Watercourse Veg—Category R
- Non-remnant—Category X.

The classification of REs is relevant to identifying vegetation communities of conservation significance in a regional context, including those classified as ESAs, and potential environmental offset requirements under the Queensland environmental offsets framework.

In association with the VM Act, essential habitat mapping is available for protected flora and fauna, encompassing areas that the chief executive reasonably believes are areas of essential habitat. Essential habitat is mapped over areas of remnant vegetation, usually within 2.5km of a reported location of a threatened species, that are likely to contain either three or more essential habitat factors for the relevant species, or presence of the relevant species at any stage of its life cycle (DNRME, 2018b). Essential habitat factors for protected flora and fauna incorporate components of a species habitat and can be characterised by a landform, pollinator, regional ecosystem, soil type and water body that is necessary or desirable for the species at any stage of its life cycle.

## Nature Conservation Act 1992

The *Nature Conservation Act 1992* (NC Act) is administered by DES and provides the framework for the declaration and management of protected areas, and protection of wildlife listed under the Nature Conservation (Wildlife) Regulation 2006 (NC Regulation).

### Protected areas

Protected areas are declared under the NC Act for the conservation of Queensland's natural and cultural resources. Classes of protected areas under the NC Act include national parks, regional parks, resource reserves and nature refuges. An environmental offset may be required for actions resulting in significant residual impacts within a protected area.

Under the Queensland environmental offsets framework, an impact on a protected area is significant if a prescribed activity results, or is likely to result, in one or more of the following:

- Authorised clearing or inundation of all or part of the protected area for the construction of private or publicly owned infrastructure on the area
- The exclusion of, or reduction in, the public use or enjoyment of all or part of the protected area
- A reduction in the natural or cultural values of all or part of the protected area.

### Protected wildlife

The purpose of the NC Regulation is to prescribe wildlife as one of the following classes of wildlife:

- Extinct in the wild
- Endangered
- Vulnerable
- Near threatened
- Least concern.

Threatened wildlife under the NC Act is wildlife that is prescribed under the Act as extinct in the wild, endangered or vulnerable. All native flora and fauna species are protected under the Act, and 'permits to take' protected wildlife are required from DES.

DES provides the Wildlife Online database, which can be searched to generate a list of all species recorded within a specified area. This tool is useful for determining the presence or likelihood of occurrence of threatened species in an area.

A Protected Plants Flora Survey Trigger Map is also available, which shows high risk areas for protected plants (those considered as endangered, vulnerable and near threatened (EVNT) species) and is used to help determine flora survey and clearing permit requirements for a specified area. If the study area is located within a high-risk area, a comprehensive flora survey is required to be undertaken before any clearing of protected plants can occur. This survey will need to comply with Queensland's *Flora Survey Guidelines – Protected Plants* v2.01 (DES, 2020a).

If threatened plants are found to occur within the high-risk area during the field survey and these are likely to be cleared or impacted by the proposed project, an application for a clearing permit from DES will be required. This application will need to be accompanied by the flora survey results and potential impact management options for the protected plants that include appropriate avoidance, mitigation or offsetting measures.

In addition, if threatened plants are found outside a high-risk area during the field survey, and these plants are likely to be cleared or impacted by the proposed project, a clearing permit will also be required. Where a flora survey identifies that there are no protected plants present or impacts can be avoided, clearing will be exempt from requiring a permit under the NC Act.

## Biosecurity Act 2014

The *Biosecurity Act 2014* commenced on 1 July 2016 with the aim to ensure a consistent, modern, risk-based and less prescriptive approach to biosecurity in Queensland. The *Biosecurity Act 2014* replaced the many separate pieces of legislation that were previously used to manage biosecurity. Under this Act, the Biosecurity Regulation 2016 sets out how the Act is implemented and applied.

Under the *Biosecurity Act 2014*, there are three types of invasive plant species:

- Prohibited invasive plants
- Restricted Invasive plants
- Invasive plants.

Prohibited invasive plants are not considered to be present in Queensland and would seriously threaten Queensland's primary industries, natural environment, livestock, human health and people's livelihoods. If a prohibited invasive plant is found in Queensland, it must be reported to Biosecurity Queensland within 24 hours of the sighting.

Restricted invasive plants also seriously threaten Queensland's primary industries, natural environment, livestock, human health and people's livelihoods, but are already established in Queensland. Under the *Biosecurity Act 2014*, restricted invasive plants may fall into one or more categories, with different restrictions relevant to each category.

Restricted invasive plant categories and restrictions:

- Category 2: the invasive plant must be reported within 24 hours Biosecurity Queensland
- Category 3: the invasive plant must not be distributed or released into the environment
- Category 4: the invasive plant must not be moved
- Category 5: the invasive plant must not be kept.

Invasive plants include species that are not listed as prohibited or restricted invasive plants, but the species has, or is likely to have, an adverse impact on a biosecurity consideration because of the introduction, spread or increase in population size of the species in an area. Everyone is required under their 'general biosecurity obligation' (GBO) to take all reasonable and practical steps to minimise the risks associated with invasive plants under their control. Under the Act, local governments are required to have a Biosecurity Plan for managing biosecurity matters within its local government area and may also declare additional pest species using a local law under the *Local Government Act 2009*. Local governments and Biosecurity Queensland provide weed control support services but may also enforce landowner responsibilities if necessary.

Invasive animals are classified in a similar manner to plants and include prohibited and restricted classifications. Landholder responsibilities and restrictions pertaining to these classifications are specific for each category and an invasive animal may be listed under multiple categories. Category actions that must, or must not, be carried out are defined under the *Biosecurity Act 2014*, however, additional obligations may be specified in the relevant local government Biosecurity Plan.

## Queensland environmental offsets framework

The Queensland environmental offsets framework includes an Act, a regulation and a single policy, which replaces the five previous single-issue policies.

The Environmental Offsets Regulation 2014 (EO Regulation) provides details of the prescribed activities regulated under legislation and the prescribed environmental matters (MSES) to which the framework applies. Examples of MSES include:

- Wetlands and watercourses
- Endangered and of concern REs
- Connectivity areas
- Protected wildlife habitat.

For any new development, all impacts to MSES must be avoided or minimised where possible. Where there is a *significant residual impact* to MSES, an environmental offset may be required in accordance with the Queensland Environmental Offsets Policy.

# 2 Flora and Fauna Assessment Methodology

## 2.1 Overall assessment methodology

SLR employed a joint approach of desktop analysis and field surveys in this study. The study team implemented best practice recommendations from sources such as:

- *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre *et al*., 2018)
- *Methodology for survey and mapping of REs and Vegetation Communities in Queensland* (Neldner *et al*., 2020)
- *Flora Survey Guidelines—protected plants* (DES, 2020a.

The methodology encompassed two phases – scoping and field surveys. The scoping phase encompassed:

- Project planning and definition of objectives
- Assignment of qualified ecologists
- Detailed desktop studies
- Review of previous studies
- Collation of existing records
- Literature review of species and potential threats and impacts.

The field surveys phase encompassed:

- Systematic, targeted and incidental flora surveys
- Vegetation community mapping and assessments
- Systematic, targeted and incidental fauna surveys.

SLR is a registered scientific user with ethics approval to conduct fauna studies from the Department of Agriculture and Fisheries Animal Ethics Committee. The survey work involved in this report was conducted under Scientific Purposes Permit number WA0009163.

## 2.2 Desktop analysis

### 2.2.1 Database searches

The DAWE Protected Matters Search Tool (PMST) and the Queensland Government Wildlife Online (WO) database were utilised to determine species, communities and areas of conservation significance with potential relevance to the study area. Both searches included a 20km buffer around a central co-ordinate within the study area (-18.9972° S, 143.5455° E), which includes the entire study area and a large buffer incorporating similar habitat in the surrounding landscape.

The results of database searches and their relevance to the study area are discussed in the Results section of this report. SLR has developed an approach for ranking threatened species and communities recorded from the desktop searches in terms of their likelihood of occurring within the study area. The approach is based on the presence of local records and the habitat requirements for each species, which are recommended criteria for desktop impact assessment in State published survey guideline documents, such as Eyre *et al.* (2018).

Details of the criteria used to assess the likelihood of occurrence for threatened and near threatened species are provided in **Table 1**. The potential impacts to threatened species that may occur within the study area are discussed in the Impacts Assessment and Management section of this report.

It is possible that some locally occurring near threatened or threatened species may not be recorded in the State and Commonwealth databases. The field survey component of this assessment is therefore an important aspect of the assessment process, to determine the presence of any threatened species that have not been previously recorded in the local area.

**Table 1 Key assessment criteria for likelihood of occurrence of threatened and near threatened species**

| Likelihood of occurring | Key criteria | Definition |
|---|---|---|
| Present | Present during survey or historical records in the study area | Species was recorded during field surveys or a historical record of the species was located in the study area |
| High | Known records (<20km) or within species known range<br>AND<br>Suitable habitat of high quality is present | Historical records of the species occur within a 20km radius of the study area or the study area is within the species known range<br>Suitable habitat of high quality exists with the study area |
| Moderate | Known records (<20km) or within species known range<br>AND<br>Suitable habitat is present, but degraded | Historical records of the species occur within a 20km radius of the study area or the study area is within the species known range<br>Suitable habitat is present but is significantly degraded or fragmented |
| Low | No records (<20km) and not within species known range<br>OR<br>Habitat present is unsuitable, absent, or highly degraded | No historical records of this species occur within a 20km radius of the study area and/or the study area is not within the known range for this species<br>OR<br>The habitat within the study area is not suitable and/or is in extremely poor condition, or is absent for the species |

### 2.2.2 Mapping

The following mapping resources were reviewed as part of the desktop analysis:

- Queensland Globe interactive mapping (QLD Globe, 2020):
  - Surface geology maps
  - Regulated vegetation maps (including DNRME, 2020)
  - Protected plants flora survey trigger map
  - Essential habitat map
- Referable wetlands (DES, 2020c)
- ESAs Map (DES, 2020d)

- Atlas of Living Australia (ALA) species occurrence maps (ALA, 2020)

## 2.3 Nomenclature and taxonomy

Apart from technical descriptions and tables, all flora and fauna species are referred to by their common names throughout this report, with their scientific names given in brackets after the first reference. Scientific names for flora species within this report follow the *Census of the Queensland Flora* (Brown & Bostock, 2019). Where no common name is provided in reference texts, a search was conducted for other accepted common names and, if none were found, only the scientific name was used. An asterisk is used to denote species that are not native to Australia. The taxonomic sequence of birds within Appendix G, is structured in accordance with Gill and Donsker (2015).

The use of scientific and common names for fauna species is in accordance with the following:

- Birds: Australian Bird Guide (ABG): Menkhorst *et al.* (2017)
- Amphibians: Vanderduys (2012)
- Reptiles: Wilson & Swan (2017) for all reptiles except the Silver-eyed Velvet Gecko (*Oedura argentea*) and Gilbert Ground Gecko (*Lucasium iris*) where names are used in accordance with Hoskin *et al.* (2018) and Vanderduys *et al.* (2020), respectively.
- Mammals (except bats): Van Dyck *et al.* (2013)
- Bats: Reardon *et al*. (2015).

## 2.4 Flora Survey Methodology

### 2.4.1 Overall methodology

Techniques described in the Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland (Neldner *et al*., 2020) were used to collect sufficient data during the field vegetation assessments to verify the RE codes of the State mapped remnant vegetation in the study area. The key features recorded in the field relevant to this report are:

- Vegetation structure including height of each stratum and cover density
- Key species within each stratum
- Geology, landform and other landzone characteristics.

The species composition and structure for each community were compared to the technical descriptions provided in the Regional Ecosystem Description Database (REDD) (Queensland Herbarium, 2019). The landzone characteristics of each site were compared to the descriptions provided in Wilson and Taylor (2012). This information provided the basis for determining the appropriate RE code for each community. The information in these documents was also used in conjunction with site observations to determine appropriate values for the factors relating to remnant status.

Vegetation surveys were conducted during the early dry season, from 25 to 29 May 2020, and during the early wet season from 30 November to 4 December 2020. The purpose of the survey was to:

- Determine the appropriate RE code, extent and remnant status of vegetation communities throughout the study area

- Perform targeted searches for threatened flora species identified during desktop analyses
- Compile a flora species inventory for the study area.

### 2.4.2 Vegetation assessment sites

#### Site selection

Ground-truthing of the remnant vegetation mapping involved assessments of the floristic structure and composition at various locations within the study area. Assessment sites were selected where they would provide representative data for the vegetation community that was the subject of the assessment.

The location of the assessment sites and the survey techniques employed were selected to achieve the following:

- Accurately determine of the extent of each vegetation type
- Resolve heterogeneous polygons
- Determine the remnant status of vegetation
- Provide data on the vegetation community condition
- Target threatened flora species identified during desktop assessments and their habitat
- Compile a species inventory for the entire study area.

#### Survey techniques

39 quaternary and eight secondary vegetation assessments, in accordance with Neldner *et al.* (2020), were conducted over the survey period. Vegetation assessment sites were distributed over the study area to incorporate variations in community composition or structure and to assess the accuracy of State mapped vegetation community polygons (Appendix A).

Quaternary assessment sites were sampled to validate the vegetation community mapping and to capture any variability in the structure and composition of the community. Data collected at quaternary sites included species composition and structural information for the canopy layer. In general, focus was given to the dominant species, crown cover and median height of the ecologically dominant layer, which is used to define each community and determine the appropriate RE code and remnant status.

Secondary assessments included a 50m x 10m vegetation transect within each of the RE assessment sites within the study area. Within these transects, a combination of quantitative and qualitative techniques was employed. A summary of vegetation survey techniques and measures is presented in **Table 2**. Quantitative measurements such as canopy height and cover were used to describe the structural form of each community and determine the remnant status of the vegetation. Species composition and structure were used to determine the relevant RE code for each community and remnant status.

**Table 2 Attributes measured at secondary assessment sites**

| Survey area | Attributes measured |
|---|---|
| Survey plot (50 x 10m) | Key species of each stratum<br>Median height of each stratum<br>Complete species list<br>Land zone characteristics<br>Central coordinate<br>Basal area of woody stems |
| Along 50m transect | Percentage cover of each stratum<br>Stem density measures of abundance |
| Greater area encompassing the present vegetation community | A list of species present<br>Additional relevant notes, including those pertaining to environmental condition and landzone that communities occur on. |

### 2.4.3 Vegetation mapping

Mapping of vegetation communities was performed using a combination of vegetation traverses and aerial imagery. Using the information gained at each of the vegetation assessment sites, and observations made when traversing the study area, the boundaries of vegetation communities were recorded using handheld GPS devices.

## 2.5 Fauna Survey Methodology

### 2.5.1 Survey timing and environmental conditions

The fauna survey generally incorporated survey timing and effort recommendations outlined in the '*Terrestrial Vertebrate Survey Guidelines for Queensland*' (Eyre *et al*., 2018). Surveys were conducted between 25 and 29 May 2020 and 30 November to 4 December 2020, which are in the 'early dry season' (May – July) and 'early wet season' (November – January) survey periods as recommended in Eyre et al. (2018) for the Einasleigh Uplands and Gulf Plains bioregions.

Weather data relevant to the fauna survey periods was obtained from the Bureau of Meteorology (BoM) Georgetown Airport weather station (Station number 30124) for temperature data and the Robin Hood Station weather station (Station number 30107) for local rainfall. Daily minimum and maximum temperature and rainfall (BoM, 2020) data for these periods are provided in **Table 3**. Conditions were cool during the early dry season survey and conditions were considered unfavourable for the detection of reptile species during most parts of the day. However, conditions were contrastingly hot during the early wet season survey, which resulted in traps having to be closed during the day. Overall, between the two surveys, conditions were considered to be favourable for the detection of most faunal groups.

The local area was dry during both surveys, however rainfall in the days prior to the early dry season survey (32mm; BoM, 2020) resulted in some surface water pools and vegetation being more readily identifiable. Approximately 42mm of rain fell within the local area in the month prior to the early wet season survey, however conditions were distinctly drier compared to the early dry season survey (BoM, 2020).

**Table 3 Temperature and rainfall conditions during the early dry and late wet season surveys**

| Date | Temperature | | Rainfall (mm) |
|---|---|---|---|
| | Minimum | Maximum | |
| **Early Dry Season Survey** | | | |
| 25/05/2020 | 6.5 | 23.8 | 0 |
| 26/05/2020 | 7.9 | 25.9 | 0 |
| 27/05/2020 | 9.1 | 27.7 | 0 |
| 28/05/2020 | 10.6 | 29 | 0 |
| 29/05/2020 | 14.1 | 29.3 | 0 |
| **Early Wet Season Survey** | | | |
| 30/09/2020 | 23.8 | 38.6 | 0 |
| 01/12/2020 | 26.1 | 39.6 | 0 |
| 02/12/2020 | 23.9 | 39.6 | 0 |
| 03/12/2020 | 25.3 | 38.8 | 0 |
| 04/12/2020 | 23.1 | 38.1 | 0 |

### 2.5.2 Systematic survey sites

During the survey period six systematic survey sites were established and an array of fauna trapping and survey techniques were employed at each site. The systematic survey sites were positioned to provide an appropriate spatial distribution within the study area while encompassing different habitat types. A description of the habitat present at each systematic survey site is provided in **Table 4**. In addition to the systematic survey sites, several other areas of interest were identified and used as additional locations for bat detectors. The location of each survey site is depicted in the fauna survey map in Appendix A.

**Table 4 Systematic fauna survey sites and corresponding habitat**

| Site number and location | Habitat description | Representative photograph |
|---|---|---|
| Site 1:<br>Located in the central portion of the study area to the south west of the existing ROM pad. | Situated within RE 9.5.10a on mostly flat terrain at the base of hills. Gilbert river box (*Eucalyptus microneura*) open woodland on light red-brown clay loam with sub-surface cobbles and boulders. |  |

| Site number and location | Habitat description | Representative photograph |
|---|---|---|
| Site 2:<br>Located to the west of the existing Agate Creek pit and WRD. | Situated within RE 2.10.5a on hill crest with weathered sandstone remnants. Habitat dominated by Lancewood (*Acacia shirleyi*) woodland with Narrow-leaved ironbark (*Eucalyptus crebra*) dominant to the south on steep hill slopes. |  |
| Site 3:<br>Located to the east of the existing Agate Creek pit and WRD. | Situated within RE 9.3.13 in River red gum (*Eucalyptus camaldulensis*) and Melaleuca dominated riparian vegetation fringing a fourth order ephemeral watercourse |  |
| Site 4:<br>Located within the north eastern portion of the study area. | Situated on the boundary of REs 9.11.16 and 9.12.11. Open woodland habitat dominated by Narrow-leaved Ironbark on steep to moderately steep hilly terrain with an abundance of cobbles, boulders, and igneous and metamorphic outcropping. |  |

| Site number and location | Habitat description | Representative photograph |
|---|---|---|
| Site 5:<br>Located to the south east of the existing Agate Creek pit and WRD. | Situated within RE 2.10.5a adjacent to sandstone outcropping and plateaus. Habitats dominated by Lancewood woodland with Paperbark gum (*Eucalyptus chartaboma)* dominated plateaus to the immediate west. |  |
| Site 6:<br>Located to the west of the existing Agate Creek pit and WRD. | Situated in RE 9.12.11 at the base of a gully within steep, hilly terrain. Habitats dominated by Narrow-leafed Ironbark with a narrow drainage line dominated by Black tea-tree (*Melaleuca bracteata*) at the base of the gully. |  |

### 2.5.3 Survey techniques

The survey techniques employed at the systematic survey sites and additional areas of interest are detailed in **Table 5.**

**Table 5 Fauna survey methods employed throughout the study area**

| Survey method | Description |
|---|---|
| Elliott traps | 20 type-A Elliott style traps were placed on the ground approximately 5–10m apart in a straight line for four nights at each systematic survey site. All traps were baited with a mixture of rolled oats, peanut butter and honey. |

| Survey method | Description |
|---|---|
| Pitfall and funnel traps | Drift fence lines incorporating pitfall and funnel traps were established for four nights at sites 1-3 and sites 5-6. Three pitfall traps (20L buckets) were buried flush with the ground surface with the drift fence intersecting the centre of each bucket at sites 1-3 and site 5. Only two pitfall traps were installed at site 6 and none were installed at site 4 due to rocky ground inhibiting the ability to install the buckets. For the above reasons, no drift fence was installed at site 4. Six funnel traps were located along the drift fencing at each of these sites where one was installed. Additionally, six funnel traps were installed at site 4, however these were scattered within suitable habitat. A shade cloth covering each funnel trap was deployed to protect trapped species from exposure. |
| Cage traps | Four cage traps were placed at each site for four nights and were baited with a mixture of rolled oats, peanut butter and honey in addition to a variety of different meats. |
| Bat detectors | An Anabat SM4 bat call detector was deployed for one night at systematic sites 1–6 The bat detector was also deployed for two nights at additional areas of interest within the study area. |
| Active diurnal searches | Active diurnal searches were undertaken concurrently with vegetation assessments throughout the study area. This technique involved intensive investigation of ground layer habitat features (such as under logs, rocks and leaf litter), low vegetation (under bark and tree stumps) for cryptic fauna, particularly reptiles. Searches were focussed during times of the day when reptile activity was likely to be at its peak. |
| Diurnal bird surveys | Birds were surveyed within each vegetation community for a total of at least one hour at multiple periods throughout the day, but with a particular focus during peak activity in the morning and around waterbodies. Incidental observations made whilst conducting other survey techniques were also recorded. Birds were identified from either direct observation or by their calls. |
| Nocturnal surveys | High-powered spotlights were used to survey nocturnal mammals (flying, arboreal and terrestrial), birds (active nocturnal species, and roosting diurnal species), reptiles and frogs in areas identified as suitable for nocturnal EVNT species and at each systematic trapping site. |
| Camera trapping | Camera traps (motion-sensing infrared cameras) were utilised at systematic fauna survey sites 1–6 to target fauna that may be too cryptic to be detected by other trapping and survey techniques. |

### 2.5.4 Survey effort

The survey effort employed for each of the fauna survey techniques is outlined in **Table 6**. However, it should be noted that fauna species were continually observed throughout the survey period and incidental records were frequently obtained throughout the survey. Any observations, tracks, scats or other signs of fauna were recorded with reference to the location and habitat type.

## Table 6 Fauna survey effort for each technique

| Method | Site survey effort | Total survey effort |
|---|---|---|
| Elliott traps | Sites 1 – 80 trap nights (20 traps x 4 nights)<br>Sites 2 – 80 trap nights (20 traps x 4 nights)<br>Sites 3 – 80 trap nights (20 traps x 4 nights)<br>Sites 4 – 80 trap nights (20 traps x 4 nights)<br>Sites 5 – 80 trap nights (20 traps x 4 nights)<br>Sites 6 – 80 trap nights (20 traps x 4 nights) | 480 trap nights |
| Pitfall traps | Site 1 - 12 trap nights (3 traps x 4 nights)<br>Site 2 - 12 trap nights (3 traps x 4 nights)<br>Site 3 - 12 trap nights (3 traps x 4 nights)<br>Site 4 - Nil<br>Site 5 - 12 trap nights (3 traps x 4 nights)<br>Site 6 - 8 trap nights (2 traps x 4 nights) | 56 trap nights |
| Funnel traps | Site 1 – 24 trap nights (6 traps x 4 nights)<br>Site 2 – 24 trap nights (6 traps x 4 nights)<br>Site 3 – 24 trap nights (6 traps x 4 nights)<br>Site 4 – 24 trap nights (6 traps x 4 nights)<br>Site 5 – 24 trap nights (6 traps x 4 nights)<br>Site 6 – 24 trap nights (6 traps x 4 nights) | 144 trap nights |
| Cage traps | Site 1 – 16 trap nights (4 traps x 4 nights)<br>Site 2 – 16 trap nights (4 traps x 4 nights)<br>Site 3 – 16 trap nights (4 traps x 4 nights)<br>Site 4 – 16 trap nights (4 traps x 4 nights)<br>Site 5 – 16 trap nights (4 traps x 4 nights)<br>Site 6 – 16 trap nights (4 traps x 4 nights) | 96 trap nights |
| Echolocation call detection | 1 detector x 8 nights | 8 detector nights |
| Diurnal active search | 2 person-hours x 2 people x 8 days | 32 person-hours |
| Diurnal bird survey | 20 person-minutes x 2 people x 8 days | 5.3 person-hours |
| Spotlight/ nocturnal searches | 1-hour search x 2 people x 6 nights | 12 person-hours |
| Camera trapping | 3 cameras x 8 nights | 24 trap nights |

# 3 Desktop Analysis Results

## 3.1 Database searches

The EPBC Act PMST (DAWE, 2020a) and WO Database extract (DES, 2020b) are included in Appendix B and Appendix C, respectively. The WO extract and PMST identified seven EVNT flora species, 10 EVNT fauna species and 11 migratory fauna species as potentially occurring within the study area.

### 3.1.1 Protected wildlife and essential habitat

Several protected wildlife (vulnerable and endangered) and essential habitat areas are State mapped to occur to the south of the study area, however all these areas are >2.3kms from the study area (QLD Globe, 2020).

### 3.1.2 Protected areas

There are two MSES protected areas mapped to the southwest of the study area, which include the Rungulla Resources Reserve (RR) and Rungulla National Park (NP). The nearest boundary of the Rungulla RR occurs ~200m to the west of the central western boundary of the study area (QLD Globe, 2020; DES, 2020d) (Appendix A). Additionally, the nearest boundary of the Rungulla NP occurs ~1km to the south of the southernmost portion of the study area, with all other parts of Rungulla NP occurring >2km from the study area (QLD Globe, 2020; DES, 2020d) (Appendix A).

### 3.1.3 Environmentally Sensitive Areas (ESAs)

No ESAs are shown within the study area on the map of ESAs (DES, 2020d). However, several ESAs are mapped nearby, which include:

- Category A ESA – Rungulla NP
- Category C ESA – Rungulla RR

These areas are considered as ESAs under the Eligibility criteria and standard conditions for mining lease activities (Version 1.1).

### 3.1.4 Watercourses and wetlands

Numerous VM Act watercourses/drainage features occur within the study area (QLD Globe, 2020). The study area is primarily dominated by first order watercourses, which are State mapped across the study area. A small section of a second order watercourse is located within the eastern portion of the study area; however, this watercourse is mapped to skirt the boundary of the study area. Most State mapped first and second order watercourses within the study area drain into Agate Creek, a fourth order watercourse that dissects the central portion of the study area, flowing from the south east to north west. However, first order watercourses within the northern most portion of the study area drain to the north into Cave Creek (QLD Globe, 2020).

No wetlands of international importance (Ramsar wetlands) are located within the study area. One wetland of general ecological significance occurs >5.5km's to the north west of the study area, however no wetlands of high ecological significance are present (QLD Globe, 2020; DES, 2020c).

### 3.1.5 Threatened ecological communities

No threatened ecological communities (TECs), as defined under the EPBC Act, were identified as potentially occurring within a 20km radius of the study area on the PMST.

### 3.1.6 Threatened and near threatened flora species

A total of seven EVNT flora species were returned in the database searches. These included two species from the PMST (DAWE, 2020a; see appendix B) and five species from the WO extract (DES, 2020b; see Appendix C). **Table 7** shows all EVNT flora species recorded from the database searches and their status under State and Commonwealth legislation, as well as their likelihood of occurring within the study area.

Appendix D provides justification for the likelihood of occurrence determination for each species. Of the seven flora species returned in the desktop analyses, four were considered to have a high likelihood of occurring within the study area and two were considered to have a moderate likelihood of occurrence. The remaining species was considered to have a low likelihood of occurring. Additional details on the classification of the likelihood of occurrence is included in Appendix D.

### 3.1.7 Threatened and near threatened fauna species

A total of 10 EVNT fauna species were returned from the database searches. These included 10 species from the PMST (DAWE, 2020a, see Appendix B) and one of the same species (Koala) from the WO extract (DES, 2020b, see Appendix C). The results of these searches have been combined in **Table 8**, which also provides an assessment of the potential likelihood for each of these species to occur within the study area. Appendix D provides justification for how the potential likelihood of occurrence was determined for each species.

Three species were identified as being moderately likely to occur in the study area and the remaining seven species were considered to have a low likelihood of occurring.

### 3.1.8 Migratory species

The EPBC Act PMST identified 11 migratory terrestrial species with potential to occur within 20km of the study area, none of which were returned within a WO extract of all species within 20km of the study area. All of these were deemed to have a low likelihood of occurring within in the study area (**Table 9**).

## Table 7 Near threatened and threatened flora species identified from database searches

| Status[1] | | Family | Scientific name | Common name | Source[2] | WO records | Likelihood of occurrence |
|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | | | |
| E | - | Asteraceae | *Pluchea punctata* | - | WO | 2 | Moderate |
| V | V | Cycadaceae | *Cycas platyphylla* | - | PM | 0 | Low |
| NT | - | Leguminosae | *Labichea brassii* | - | WO | 7 | High |
| NT | - | Myrtaceae | *Leptospermum pallidum* | - | WO | 2 | High |
| LC | V | Poaceae | *Dichanthium setosum* | - | PM | 0 | Moderate |
| V | - | Rutaceae | *Drummondita calida* | - | WO | 1 | High |
| V | - | Solanaceae | *Solanum carduiforme* | - | WO | 2 | High |

1. Status: LC = Least Concern, V = Vulnerable, NT = Near Threatened
2. 20km search radius for records. WO = Wildlife online database, PM = EPBC Act Protected Matters Report

## Table 8 Near threatened and threatened fauna species identified from database searches

| Status[1] | | Family | Scientific name | Common name | Source[2] | WO records | Likelihood of occurrence |
|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | | | |
| **BIRDS** | | | | | | | |
| E | V | Accipitridae | *Erythrotriorchis radiatus* | Red goshawk | PM | 0 | Low |
| E | E | Estrildidae | *Erythrura gouldiae* | Gouldian finch | PM | 0 | Low |
| E | E | Rostratulidae | *Rostratula australis* | Australian painted snipe | PM | 0 | Low |
| E | CE, M, Ma | Scolopacidae | *Calidris ferruginea* | Curlew sandpiper | PM | 0 | Low |
| V | V | Tytonidae | *Tyto novaehollandiae kimberli* | Masked owl | PM | 0 | Low |
| **MAMMALS** | | | | | | | |
| LC | E | Dasyuridae | *Dasyurus hallucatus* | Northern quoll | PM | 0 | Low |
| E | V | Emballonuridae | *Saccolaimus saccolaimus nudicluniatus* | Bare-rumped sheathtail bat | PM | 0 | Low |
| E | V | Megadermatidae | *Macroderma gigas* | Ghost bat | PM | 0 | Moderate |
| V | V | Phascolarctidae | *Phascolarctos cinereus* | Koala | WO/PM | 3 | Moderate |
| E | V | Rhinolophidae | *Rhinolophus robertsi* | Large-eared horseshoe bat | PM | 0 | Moderate |

1. Status: LC = Least Concern, V = Vulnerable, E = Endangered, CE = Critically Endangered, M = Migratory, Ma = Marine
2. 20km search radius for records. WO = Wildlife online database, PM = EPBC Act Protected Matters Report

## Table 9 Migratory terrestrial fauna species identified from database searches

| Status[1] | | Family | Scientific name | Common name | Source[2] | WO records | Likelihood of occurrence |
|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | | | |
| **BIRDS** | | | | | | | |
| SLC | M, Ma | Apodidae | *Apus pacificus* | Fork-tailed swift | PM | 0 | Low |
| SLC | M, Ma | Cuculidae | *Cuculus optatus* | Oriental cuckoo | PM | 0 | Low |
| SLC | M, Ma | Hirundinidae | *Hirundo rustica* | Barn swallow | PM | 0 | Low |
| SLC | M, Ma | Motacillidae | *Motacilla cinerea* | Grey wagtail | PM | 0 | Low |
| SLC | M, Ma | Motacillidae | *Motacilla flava* | Yellow wagtail | PM | 0 | Low |
| SLC | M, Ma | Pandionidae | *Pandion haliaetus* | Osprey | PM | 0 | Low |
| SLC | M, Ma | Scolopacidae | *Actitis hypoleucos* | Common sandpiper | PM | 0 | Low |
| SLC | M, Ma | Scolopacidae | *Calidris acuminata* | Sharp-tailed sandpiper | PM | 0 | Low |
| E | CE, M, Ma | Scolopacidae | *Calidris ferruginea* | Curlew sandpiper | PM | 0 | Low |
| SLC | M, Ma | Scolopacidae | *Calidris melanotos* | Pectoral sandpiper | PM | 0 | Low |
| SLC | M, Ma | Scolopacidae | *Gallinago hardwickii* | Latham's snipe | PM | 0 | Low |

1. Status: SLC = Special Least Concern, E = Endangered, CE – Critically Endangered, M = Migratory, Ma = Marine.
2. 20km search radius for records. WO = Wildlife online database, PM = EPBC Act Protected Matters Report

## 3.2 Regional Ecosystem mapping

The study area is located within a broad area of remnant vegetation, as shown on the Vegetation Management Supporting Map (DNRME, 2020), which classifies remnant vegetation under the VM Act. DNRME (2020) and QLD Globe (2020) shows the study area to contain seven remnant regional ecosystems (REs) that are shown in **Table 10**. State mapped REs occur as distinct REs and do not occur as heterogenous polygons.

**Table 10 State mapped regional ecosystems within the study area**

| RE Code | VM Act status | Biodiversity status | REDD short description |
|---|---|---|---|
| RE 2.10.5a | Least concern | No concern at present | *Acacia shirleyi* woodland and *Triodia pungens* hummock grassland on scarps and stony ledges. |
| RE 2.11.1a | Least concern | No concern at present | Eucalyptus woodland and deciduous woodland on stony hills on folded sediments. |
| RE 9.3.20 | Least concern | No concern at present | *Eucalyptus microneural +/- Corymbia spp. +/- Eucalyptus leptophleba* woodland on alluvial plains. |
| RE 9.5.10a | Least concern | No concern at present | *E. microneura +/- Terminalia spp.* low woodland on sand sheets |
| RE 9.11.16 | Least concern | No concern at present | *E. crebra +/- C. erythrophloia* or *Corymbia pocillum* woodland on steep to rolling hills. |
| RE 9.11.30b | Least concern | No concern at present | *Acacia leptostachya* low woodland with emergent on stony and rocky metamorphic hills. |
| RE 9.12.11 | Least concern | No concern at present | *Eucalyptus crebra* and/or *Eucalyptus whitei +/- Corymbia erythrophloia* open woodland on steep to rolling hills on igneous rocks. |

## 3.3 Geology mapping

Detailed surface geology mapping for the study area was obtained from QLD Globe (2020). The geology of the study area is shown in **Table 11**.

**Table 11 Detailed surface geology descriptions for the study area**

| Rock Unit | Lithological Summary | Dominant Rock | Rock Type | Age |
|---|---|---|---|---|
| Robin Hood Granodiorite (Sgr) | Pink to grey hornblende-biotite granodiorite with quartz phenocrysts | Granitoid | Intrusive unit | Silurian |
| Dead Horse Metabasalt (PLd) | Metabasalt, locally pillowed, hyaloclastic and/or amygdaloidal; minor metadolerite, and metagabbro (unmapped) and interbedded sandstone. | Mafites (Lavas, clastics and high-level intrusives | Stratified unit (Including volcanic and metamorphic) | Paleoproterozoic |
| Hampstead Sandstone (Jh) | Clayey, commonly pebbly, quartzose sandstone and conglomerate | Arenite | Stratified unit (Including volcanic and metamorphic) | Middle to late Jurassic |

| Rock Unit | Lithological Summary | Dominant Rock | Rock Type | Age |
|---|---|---|---|---|
| Daniel Creek Formation (PLa) | Mudstone, siltstone, and fine subfeldspathic sandstone, locally calcareous and/or dolomitic. Grades into mica schist, quartzite, and minor calc-silicate rocks. | Arenite-mudrock | Stratified unit (Including volcanic and metamorphic) | Paleoproterozoic |
| Black Soil Andesite (Pvab) | Greyish-green locally sparsely porphyritic augite-hypersthene-basaltic andesite with agate-filled amygdales; probably includes intrusive equivalents | Mafites (lavas, clastics and high-level intrusives) | Stratified unit (Including volcanic and metamorphic) | Early Permian |
| Qa-QLD (Qa) | Clay, silt, sand and gravel, flood-plain alluvium | Alluvium | Stratified Unit (Including volcanic and metamorphic) | Quarternary |
| Corbett Formation (PLco) | Greenish grey mudstone (+/- chloritoid); grades into mica schist (+/- staurolite, andalusite, sillimanite, garnet) | Pelite | Stratified Unit (Including volcanic and metamorphic) | Paleoproterozoic |
| CPIR-Kennedy Province (CPir) | Mainly buff, paly grey to dark grey or brown, aphyric to highly porphyritic, intrusive rhyolite; commonly flow-banded; locally grades into microgranite | Felsites (Lavas, clastics and high-level intrusives) | Intrusive unit | Late Carboniferous – Early Permian |
| TQr-QLD (TQr) | Clay, silt, sand, gravel and soil; colluvial and residual deposits (generally on older land surfaces) | Colluvium | Stratified Unit (Including volcanic and metamorphic) | Late Tertiary - Quarternary |

## 3.4 Available literature

No previous literature pertaining to flora and fauna assessments from within the study area were available for review.

# 4 Flora Survey Results

## 4.1 Vegetation communities

### 4.1.1 VM Act Regional Ecosystems

Six vegetation communities equating to VM Act regional ecosystems were ground-truthed within the study area. These communities included RE 2.10.5a, 9.3.13, 9.3.26, 9.5.10a, 9.11.16 and 9.12.11 which were mapped as single vegetation units. Ground-truthed descriptions of these communities are provided below and floristic structure and composition information is provided in Appendix E. All ground-truthed REs have a 'least concern' VM Act status and a 'no concern at present' biodiversity status, except for REs 9.3.13 and 9.3.26, which both have an 'of concern' biodiversity status.

Minor to moderate impacts from cattle grazing and agricultural land-use practices were observed in all vegetation communities, particularly riparian and other communities along or near watercourses.

#### RE 2.10.5a

This RE dominated sandstone scarps, outcrops and plateaus within the study area. These areas were generally dominated by a sparse scattering of Paperbark gums, with associated tree species including *Corymbia spp.* and Northern cypress pine (*Callitris intratropica*). Lancewood was also locally dominant in some areas. The sub-canopy layer was typically dominated by *Acacia* spp., such as the Showy wattle (*Acacia leptostachya*) and *Acacia julifera*. The shrub layer was generally dominated by the previously mentioned *Acacia* species and Quinine bush (*Petalostigma banksii*), with other species such as Soap bush (*Alphitonia excelsa*) and Tar Grevillia (*Grevillia mimosoides*) often being associated with the shrub layer. Groundcover within this community was sparse during both surveys, with evidence of annual forbs, such as Bunched Gomphrena (*Gomphrena flaccida*) and Oldman's cap (*Polycarpaea corymbosa*), being abundant on plateaus and associated drainage areas during wet periods. A variety of grass species were also observed, including Firegrass (*Schizachyrium fragile*), *Aristida spp.*, Spinifex (*Triodia sp.*), River grass (*Arundinella nepalensis*), and Lemon-scented grass (*Cymbopogon bombycinus*). The species richness of the ground layer within this community in the study area is likely to be heavily impacted by the wet-dry cycle, as many annual forbs were found to be desiccated within this community.

#### RE 9.3.13

This community occurred along several of the State mapped watercourses within the study area. Most notably, this community was present along the fourth order watercourse, Agate Creek. The canopy layer within this community contained species including River red gum (*Eucalyptus camaldulensis*), Weeping tea-tree (*Melaleuca fluviatilis*), and Swamp box (*Lophostemon grandiflorus*), with the relative dominance of these species switching along the length of the watercourse. Black tea-tree was occasionally dominant within the canopy layer; however, was most frequently dominant within the sub-canopy layer. Other canopy species also occurred within the sub-canopy layer, however, less frequently. The shrub layer often included Black tea-tree, however shrub species from the surrounding communities also infiltrated this stratum of RE 9.3.13. Rubber vine (***Cryptostegia grandiflora*) was found to occur within this community, with evidence of ripe seeds and flowering individuals climbing high into the crowns of dominant trees. The ground layer was generally dominated by a variety of grass species, which includes Green panic (**Megathyrsus maximus*), Indian, Forest and Pitted bluegrass (**Bothriochloa pertusa*, *B. bladhii*, and *B. decipiens*), Queensland bluegrass (*Dichanthium sericeum*), *Panicum sp.* and Pigeon grass (*Setaria surgens*). A variety of Rattlepods (*Crotalaria spp.*) were also abundant within the ground layer of this community.

### RE 9.3.26

This community occurred within a small overflow section of Agate Creek to the south east of the mine pit. This area was characterised by an abundance of black soil, a very sparse to sparse canopy and woody shrub layers, and a variety of grass species. Dominant trees within this community primarily consist of Gilbert river box (*Eucalyptus microneura*), with other species, including Broad-leaved carbine (*Corymbia confertiflora*) and River red gum, being scattered associates. Across the extent of this community, a species of *Tephrosia* was the dominant shrub. Other species, such as Rattlepods (*Crotalaria spp.)* were also common, however less abundant. A variety of grass species were present within this community; however, many tussock and smaller species were heavily impacted by cattle grazing, resulting in identification to species level being difficult. A permanent water trough for cattle was present within this community, which likely facilitates the increased grazing pressure compared to other locations within the study area.

### RE 9.5.10a

This community was dominant within the lower flood plains of the study area. The canopy layer of this community was dominated by Gilbert river box, however other species such as Desert bloodwood (*Corymbia terminalis*) and Cooktown ironwood (*Erythrophleum chlorostachys*) were also encountered. The density of the sub-canopy layer within this community varied throughout the study area. In some areas, the sub-canopy layer was very sparse to sparse, containing a similar assemblage to the canopy layer with sporadic other species such as Yellowberry bush (*Denhamia cunninghamii*) being present. However, in other areas, the sub-canopy layer was mid-dense to dense and dominated by Gulbarn (*Melaleuca citrolens*). The shrub layer was generally sparse and dominated by Conkerberry (*Carissa lanceolata*). The ground layer was impacted by cattle in many areas leading to tussock and other palatable grass and forb species being difficult to identify. Where identifiable, the dominant species within the ground layer of this community generally comprise *Aristida* spp., Black speargrass (*Heteropogon contortus*), Kangaroo grass (*Themeda triandra*) and Queensland bluegrass.

### RE 9.11.16 & RE 9.12.11

The floristic and structural components of these two communities throughout the study area are very similar and the main different between these communities is the surface geology on which they occur. RE 9.11.16 occurs within the north eastern portion of the study area on folded metamorphics, whereas RE 9.12.11 occurs within the southern and central portions of the study area on igneous rocks. Both communities were dominated by Narrow-leaved ironbark, with a variable sub-canopy to shrub layer that may include a combination of Quinine bush, Showy wattle, Silver oak (*Grevillea parallela*), Soapbush, or several other species. The ground layer in these communities were typically dominated by *Aristida spp*., Kangaroo grass or Black speargrass. These communities occur on the steep slopes or crests of hills, or on the low undulations at the base of hills within the study area.

### 4.1.2 Non-remnant vegetation

Only small sections within the study area were comprised of non-remnant vegetation. These included the existing Agate Creek pit, waste rock dump, run of mine, mining camp, workshop facilities, and a previously cleared area within the north east portion of the ML.

### 4.1.3 EPBC Act TECs

No vegetation communities consistent with EPBC Act TECs were ground-truthed to occur within the study area, therefore any impacts to, or management of, EPBC Act TECs will not be discussed further in this report.

### 4.1.4 Environmentally Sensitive Areas

No ESAs are State mapped, or were ground-truthed, to occur within the study area. One Category A ESA, the Rungulla NP, is State mapped to the southwest of the study area and one Category C ESA, the Rungulla RR, is also State mapped to the southwest of the study area. It should be noted that the study area occurs within the 2km buffer zone of the Rungulla NP Category A ESA. ESA buffer zones are discussed further in Section 6.4 of this report.

No ground-truthed REs equate to ESAs under the Code of Environmental Compliance for Mining Lease Activities.

## 4.2 Flora species

A total of 147 flora species from 51 families were recorded within the study area (Appendix F). Most flora species observed are common and widespread within similar habitats in the Gulf Plains and Einasleigh Uplands bioregions. Floristic composition throughout the study area was generally consistent with several State mapped RE units and all identified species are common within similar habitats throughout the local area and broader region. Several invasive non-native (pest) flora species were observed throughout the study area. A full list of flora species identified during flora surveys is included in Appendix E.

No threatened flora species, as listed under the NC Act and EPBC Act, were identified to occur within the study area.

A total of 17 non-native pest flora species were identified within the study area (Appendix F). Most of the pest flora species identified within the study area are environmental weeds or flora introduced for the purpose of pasture improvement. However, one of these species, Rubber Vine, is listed as a Category 3 restricted invasive flora under the *Biosecurity Act 2014*. Rubber Vine was found to occur within riparian vegetation along Agate Creek.

# 5 Fauna Survey Results

## 5.1 Fauna habitat features

The study area provides a variety of habitat for a range of fauna species, which primarily occur as micro- and macro-habitats within woodland communities, riparian vegetation and watercourses, and unique features such as sandstone formations.

Lowland woodland vegetation communities within the study area were generally very open and provided few unique habitat features for fauna. Leaf litter and small, isolated occurrences of large woody debris were found in these habitats along with the occasional tree hollow for fauna species to occupy. Shrubs were generally sparse, however provide some shelter values for local fauna where they did occur. Flowering and fruiting eucalypts in these areas are also likely to provide resources for local fauna at certain times of the year. Overall, these open woodland communities generally provide a variety of habitat features for small to moderate sized reptiles and mammals, moderate to large sized grazing animals, and birds. However, habitat features for fauna within these areas are well represented within the surrounding region and the study area does not support any unique habitat features within the ground-truthed open woodland communities. Woodland communities on hillslopes and crests generally provide more shelter locations for small mammals and reptiles as loose rocks and woody debris was more abundant. However, other habitat values to local fauna were generally similar to those observed within the low open vegetation communities.

Riparian vegetation and ephemeral watercourses within the study area provide a variety of habitat features for local fauna. Locally unique features that are not present within other areas of the study area generally include the temporal presence of water and occasionally denser vegetation for fauna to shelter within. These areas also provide valuable connectivity corridors for fauna throughout the local landscape.

Sandstone formations within the study area form part of the broader Gregory Range, where several endemic and/or habitat-restricted species are known to occur. Two of these species, the Gilbert ground gecko and Silver-eyed velvet gecko were identified to occur on sandstone within the study area. Other unique features present within sandstone formations include weathered under-hangs, crevices, and boulder piles which provides a variety of shelter options for a range of fauna. Additionally, areas of dense leaf litter and piles of large woody debris were also observed within these formations, providing additional shelter and resources for local fauna.

The presence of highly mobile fauna species (i.e. birds, bats and some arboreal mammals) is likely to be influenced by seasonal characteristics such as rainfall as many of these species disperse to areas where trees are flowering or fruiting. Resultantly, habitat features and suitability for many of these species may vary seasonally, causing species diversity to fluctuate as species seek out resources within the region.

## 5.2 Fauna species

Numerous fauna species were identified within the study area over the survey period using both active and passive survey techniques. A full list of fauna species identified during field assessments is included in Appendix G. The following sections provide a brief discussion of the species observed for each taxonomic group.

### 5.2.1 Birds

A total of 49 bird species were observed within the study area during field assessments (Appendix G). All the identified species are generally common in similar habitats throughout the region. No NC Act or EPBC Act EVNT or migratory species were identified to occur on site. Birds were abundant in all parts of the study area; however, were most frequently observed within the vicinity of standing water and/or flowering trees.

### 5.2.2 Mammals

A total of 22 mammal species were positively identified within the study area during field assessments (Appendix G). Evidence of two non-native (pest) species—Cattle (**Bos taurus*) and European rabbits (**Oryctolagus cuniculus*)—were identified during the survey. Pest species are discussed further in Section 5.2.5 of this report.

Microbats were the most species-rich mammal group detected during the survey. The survey effort resulted in identification of 14 microbat species within the study area. All these are listed as least concern under the NC Act and are not listed under the EPBC Act. The Microbat Call Interpretation Reports from the surveys are included in Appendix H. All of the identified mammal species are generally common in similar habitats throughout the region.

### 5.2.3 Reptiles

A total of 18 reptile species were identified within the study area during field assessments (Appendix G), however geckos (Gekkonidae) and skinks (Scincidae) were the most species-rich reptile families observed within the study area. Most of the identified species are generally common in similar habitats throughout the region, however one non-native and two recently described gecko species were identified within the study area. These species include the Asian house gecko (**Hemidactylus frenatus*), Gilbert ground gecko (*Lucasium iris*) and Silver-eyed velvet gecko (*Oedura argentea*), respectively. Non-native pest species are discussed further in Section 5.2.5 of this report.

The Gilbert ground gecko, which was described in early November 2020 and is not currently evaluated under the NC Act and EPBC Act, was found within the study area. This species has a restricted range that was previously only known to occur within the vicinity of Gilberton Station. However, the detection of this species within the study area represents an ~20km range extension for this poorly known and recently described species (Vanderduys *et al.*, 2020). Similarly, the Silver-eyed velvet gecko was also found within the study area. This species was described in late 2018 and is only known to occur in sandstone habitats from the Gregory Range and nearby sandstone outcropping at Bulleringa National Park (Hoskin *et al.*, 2018). Overall, both species show close affiliations with sandstone habitats, are poorly known and have restricted distributions.

### 5.2.4 Amphibians

Four amphibian species, including the invasive Cane toad (**Rhinella marina*), were identified within the study area (Appendix F). The remaining three amphibian species were the Bumpy rocket frog (*Litoria inermis*), Naked tree frog (*Litoria rubella*), and Ornate burrowing frog (*Platyplectrum ornatum*), all of which are common within the local area and surrounding region. Non-native pest species are discussed further in Section 5.2.5 of this report.

### 5.2.5 Pest fauna species

Evidence of four pest fauna species was identified during field assessments, which included:

- Asian house gecko
- Cane toad,
- Cattle, and
- European rabbit

These non-native species are common within the local area and surrounding region. Cane toads were observed during active nocturnal searches in moderate abundances within the vicinity of standing water during the May survey and were less frequently observed during the December survey. Cattle were observed to be concentrated around water sources throughout the study area during both surveys and consequently cattle impacts were greatest around these areas. These impacts included deep tracks in muddy soil, scats, worn tracks and grazing impacts to vegetation communities. European Rabbits were incidentally observed throughout the study area and Asian House Gecko's were incidentally heard around the mining camp.

# 6 Significant Environmental Matters

The following sections detail the relevant MSES and MNES ground-truthed within the study area.

## 6.1 Regulated vegetation

### 6.1.1 Regional ecosystems

Six remnant vegetation communities were ground-truthed as present in the study area, distinguished primarily by differences in key canopy species and land-zone. These communities are RE 2.10.5a, 9.3.13, 9.3.26, 9.5.10a, 9.11.16 and 9.12.11. All these communities have a 'least concern' VM Act status and a 'no concern at present' biodiversity status, except for REs 9.3.13 and 9.3.26, which have an 'of concern' biodiversity status. No vegetation communities ground-truthed within the study area equate to a MSES under the Queensland environmental offsets framework.

### 6.1.2 Remnant vegetation associated with a watercourse

Remnant vegetation associated with a watercourse shown on the VM Act watercourse and drainage feature map is classified as a MSES under the Queensland environmental offsets framework. There are several VM Act State mapped watercourse and drainage features within the study area (QLD Globe, 2020) (Appendix A). The extent to which the remnant vegetation associated with these watercourses is considered a protected matter is determined by the bioregional context and stream order of the watercourse or drainage feature. The structural category of the vegetation community is used to determine significant impact thresholds.

All vegetation communities within the study area are classified as remnant vegetation. Therefore, the extent of vegetation communities within the defined distance of the banks of the State mapped watercourse/drainage features is a MSES. The study area is located within a non-coastal bioregion and the relevant defining distance for REs associated with a watercourse are shown in **Table 12**.

**Table 12 Defined distance for REs associated with a watercourse (non-coastal bioregions) as shown in the Queensland Environmental Offsets Policy V1.8**

| Watercourse stream order | Distance from defining bank (m) |
|---|---|
| 1 or 2 | 25 |
| 3 or 4 | 50 |

Clearing of vegetation within the defined distance of the State mapped watercourse or drainage features should be avoided where possible. Where impacts are unavoidable, the following criteria are used to determine whether the impacts are significant, therefore triggering environmental offset liability:

- Clearing occurs within 5m of the defining bank of the feature, AND
- The following area thresholds are exceeded[1]:

[1] Clearing area and width thresholds are dependent on the structural category of the RE as defined in the REDD. All relevant REs mapped and ground-truthed within the study area have a 'sparse', very sparse' or grassland structural category and therefore only the relevant thresholds for these communities are presented here.

- Greater than 25m wide for linear infrastructure (grassland, RE 9.3.26)
- Greater than 20m wide for linear infrastructure (all other mapped REs)
- Greater than 5ha for non-linear infrastructure (grassland, RE 9.3.26)
- Greater than 2ha for non-linear infrastructure (all other mapped REs).

Any clearing of remnant vegetation within 5m of the defining banks of these mapped watercourse or drainage features that is also in excess of the relevant clearing thresholds may be classified as a significant residual impact. In such case, the provision of an environmental offset may be required under the Queensland environmental offsets framework.

## 6.2 Connectivity areas

The study area occurs within a broad area of remnant vegetation that is typically comprised of open woodland communities and riparian vegetation dominated by River red gums and Melaleuca species. Additionally, the Rungulla NP protected area is located to the southwest of the study area, which provides important values to flora and fauna within the local region. Most open woodland habitats within the study area are similar to those within the surrounding region and provide fewer fine scale fauna connectivity values compared to riparian vegetation and sandstone formations within the study area. Riparian vegetation along watercourses provide important connectivity corridors for a variety of fauna and flora species, which facilitate these species in occupying the local landscape by providing shelter and other resources. Additionally, sandstone formations within the study area form part of the broader Gregory Range and provide important connectivity corridors for a variety of fauna and flora. These formations are particularly important for species endemic to these formations, including the Gilbert ground gecko and Silver-eyed velvet gecko. As the study area occurs to the north east of the Rungulla NP, these sandstone formations and riparian areas also provide connectivity values for the dispersal of fauna in and out of this protected area.

The landscape fragmentation and connectivity (LFC) tool is a decision support tool to assist in identifying and quantifying an significant impact on connectivity for an individual impact area. This GIS tool measures the extent and arrangement of the current regulated vegetation against the extent that would remain if a prescribed activity were to occur. As no proposed disturbance footprint for any future development of the study area is available, this tool can not be utilised. However, to avoid potential impacts to local endemic or habitat restricted species, it is recommended that future development of the study area avoids impacts to sandstone formations. This will minimise impacts to regionally unique habitat for flora and fauna within the study area.

## 6.3 Watercourse habitat and wetlands

The study area does not contain any wetland protection areas or wetlands of high ecological significance as shown on the map of referrable wetlands (DES, 2020c). The watercourses present within the study area are not ‘high ecological value waters’ as identified under the Environmental Protection (Water) Policy 2009. Additionally, no wetlands of international importance (Ramsar wetlands) are located within the study area. Disturbance to watercourse features present within the study area should be avoided where possible to minimise impacts to local environmental values.

## 6.4 Protected areas and ESAs

Several protected areas and ESAs were identified to occur to the south west of the study area during desktop and ground-truthing assessments. These areas are described below with project related considerations highlighted for each.

### Protected areas

Protected areas are MSES under the Environmental offsets framework. Protected areas State mapped to the south west of the study area include the Rungulla NP and Rungulla RR (Appendix A). As these protected areas do not occur within the study area they are unlikely to be significantly impacted by project activities within the study area.

### ESAs

Two protected areas that equate to ESAs under the EP Regulation (2008) were State mapped to occur to the south west of the study area. These areas include the Rungulla NP and Rungulla RR, which equate to a Category A and Category C ESA, respectively (Appendix A). An assessment of the proposed action within the ML in relation to ESAs is limited to new development and activity buffers and considerations for these ESAs are outlined within condition A13 of the *Eligibility criteria and standard conditions for mining lease activities – Version 1.1* (As applicable to ML 100030) and are described in **Table 13**. No other ESAs relevant to the Agate Creek mine were ground-truthed within the study area.

**Table 13 EP Regulation (2008) ESAs and activity buffers and considerations**

| Feature | EP Regulation (2008) ESA category | ESA buffers and considerations |
|---|---|---|
| | | Mining lease activities[1] |
| Rungulla National Park | National Parks are classified as a Category A ESAs | Activities must not be carried out within 2km of a Category A ESA |
| Rungulla Resources Reserve | Resource Reserves are classified as a Category C ESA[2] | N/A[2] |

1 Buffers and relevant other considerations were sourced from condition A13 of the '*Eligibility criteria and standard conditions for mining lease activities – Version 2'*.

2 In order to carry out exploration activities within a Category C ESA, the relevant administering authorities (and the Environmental Protection Agency[1]) need to be consulted prior to activities taking place. If it is determined through consultation that additional conditions are necessary, the holder must comply with those conditions[1,2].

## 6.5 Protected wildlife and essential habitat

No areas of protected wildlife (vulnerable or endangered) habitat or essential habitat are State mapped to occur within the study area (QLD Globe, 2020) (Appendix A) and none was located during field assessments. Therefore, it is unlikely that any areas of protected wildlife (vulnerable or endangered) habitat or essential habitat will be significantly impacted by development within the study area.

## 6.6 Conservation significant species

### 6.6.1 Conservation significant flora species

Desktop searches revealed seven conservation significant flora species with the potential to occur within 20km of the study area, of which none were detected within the study area during field assessments. However, likelihood of occurrence assessments determined that six of these species had a moderate to high likelihood of occurring within the study area. Potential impacts to, and management strategies for, these species are described below.

#### *Pluchea punctata*

*Pluchea punctata* is listed as endangered under the NC Act and is not listed under the EPBC Act. Wildnet searches revealed two local records of this species within a 20km buffer of the study area (DES, 2020b), which are located along Rungulla Rd. within the Rungulla National Park, ~6km to the south of the study area. This species was considered to have a moderate likelihood of occurring within the study area based on key assessment criteria in **Table 1**. However, despite the moderate likelihood of occurrence, this species was not detected during field assessments.

This species is endemic to Queensland and is known from a single locality near Forsayth in north Queensland. Little information is available on habitat preferences for this species, however is it has been documented to occur on hill slopes with Gilbert river box and *Triodia spp*. (FoA, 2015). Hill slopes within the study area are generally dominated by Narrow-leaved ironbark and not Gilbert river box, which occurs as a dominant species within the low, broad flood plains within the study area. Spinifex (*Triodia spp*.) were dominant within the ground layer in small patches throughout the study area, but these patches occurred in Narrow-leaved ironbark dominated areas that were generally on hill crests. Overall, this species was not identified to occur within the study area and it is considered that suitable habitat for this species is not present within the study area. Therefore, it is unlikely that significant impacts will occur to this species as a result of mining activity within the study area.

#### *Labichea brassii*

*Labichea brassii* is listed as near threatened under the NC Act and is not listed under the EPBC Act. Wildnet searches revealed seven local records of this species within a 20km buffer of the study area (DES, 2020b), which are located ~4km to the south of the study area within Rungulla National Park. This species was considered to have a high likelihood of occurring within the study area based on key assessment criteria in **Table 1**. However, despite the high likelihood of occurrence, this species was not detected during field assessments.

This poorly known species is confined to northern Queensland and is known from Mt Mulligan in the north and extending south west to Agate Creek. Preferred habitat for this species includes vegetation along creeks and in riverbeds, however locally it has also been recorded to occur on sparse woodland on sandstone plateaus in RE 2.10.2x1 (FoA, 1998; Ford 2010). Sandstone plateaus and scarps were found to occur within and near to the north and north western portions of the study area, which equate to potentially suitable habitat for this species in addition to the Agate Creek watercourse. No information is available on the flowering times of this species; however, it is considered to be readily distinguishable from other species in the study area based on information provided within FoA (1998). Overall, field assessments did not identify this species to be present within the study area despite extensive surveys in potentially suitable habitat, particularly within potential watercourse habitat. As this species was not detected during baseline assessments, it is considered unlikely that this species will be significantly impacted by activities within suitable habitat within the study area.

### *Leptospermum pallidum*

*Leptospermum pallidum* is listed as near threatened under the NC Act and is not listed under the EPBC Act. This species was not identified within the study area during baseline assessments, however Wildnet searches revealed two local records of this species within a 20km buffer of the study area (DES, 2020b), which are located ~7 and 15km to the south of the study area within Rungulla National Park. This species was considered to have a high likelihood of occurring within the study area based on key assessment criteria in **Table 1**. However, despite the high likelihood of occurrence, this species was not detected during field assessments.

This distinctive species has a restricted distribution within northern Queensland, with most records occurring around the Greenvale area, however this species has also been recorded to occur at Porcupine Gorge, north of Hughenden, within the Cobbold Gorge Nature Refuge and within the Rungulla National Park (Bean, 1992; Ford, 2010). Locally, this species has been observed on a low sandstone hill among large boulders with a metamorphic substrate within RE 2.10.5x1 (Ford, 2010). RE 2.10.5a is the dominant community on sandstone scarps and plateaus within the study area, which comprises a similar floristic structure to RE 2.10.5x1. *L. pallidum* is considered to be readily recognisable from other species identified within the study area during baseline assessments. However, despite extensive surveys in potentially suitable habitat, it was not detected during baseline assessments. As this species was not detected during baseline assessments, it is considered unlikely that this species will be significantly impacted by activities within suitable habitat within the study area.

### Bluegrass

Bluegrass (*Dichanthium setosum*) is listed as least concern under the NC Act and as vulnerable under the EPBC Act. Wildnet searches revealed no local records of this species within a 20km buffer of the study area (DES, 2020b) and the nearest records of this species are ~100km to the south east (ALA, 2020). However, the study area is on the north western edge of the modelled distribution for this species (DES, 2020e). Additionally, potentially suitable, but degraded, habitat for this species was considered to occur within the study area. Overall, it is considered that this species has a moderate likelihood of occurring within the study area based on key assessment criteria in **Table 1**. However, despite the moderate likelihood of occurrence, this species was not detected during field assessments.

This species is identified to occur on heavy soils (predominantly cracking clays or alluvium, often in Gilgai's) in woodland or open woodland usually dominated by Brigalow (*Acacia spp.*) and/or *Eucalyptus* species. The climatic range of this species includes tropical to subtropical areas that are markedly seasonal, with suitable habitat drying out for part of the year (DES, 2020e and references therein). Potentially suitable habitat for this species within the study area includes lowland flood plains dominated by Gilbert river box (RE 9.5.10a) and the Agate Creek overflow area, which has a high proportion of black soil and is dominated by RE 9.3.26. All these potentially suitable habitats for this species within the study area are heavily impacted by cattle grazing, which is one of the key threats to this species (DES, 2020e and references therein) and results in habitat for this species being degraded within the study area. Other threats to this species include habitat loss through clearing for pasture improvement and cropping, frequent fires, invasive flora species, and demographic effects from small population size (DES, 2020e and references therein).

This species was not detected within the study area during baseline assessments, despite the study area occurring within the modelled distribution for this species and potentially suitable habitat for this species occurring within the study area.

### *Drummondita calida*

*Drummondita calida* is listed as vulnerable under the NC Act and is not listed under the EPBC Act. Wildnet searches revealed the presence of one local record of this species within a 20km buffer of the study area (DES, 2020b), which is located ~4km to the south west of the study area within Rungulla National Park. This species was considered to have a high likelihood of occurring within the study area based on key assessment criteria in **Table 1**. However, despite the high likelihood of occurrence, this species was not detected during field assessments.

Within Queensland, this species is found between Bulleringa National park to the southern end of the Gregory Range. Locally, this species has been located on very exposed and sparse low shrubland on bare sandstone plateaux to low open woodland on sandstone with large boulders. This species has a very conspicuous corky fissured stem, however the overall appearance of the plant is primarily driven by habitat, with taller individuals in woodland and shorter plants in more open and exposed situations (Ford, 2010). Within the local area, this species is noted to be locally common and has been observed in REs 2.10.2x1, 2.10.2, 2.10.5x2 and 2.7.2 (Ford, 2010). RE 2.10.5a is the dominant community on sandstone scarps and plateaus within the study area, therefore the study area affords potentially suitable local habitat for this species based on ground-truthing results.

As this species was not detected during baseline assessments, it is considered unlikely that this species will be significantly impacted by activities within suitable habitat within the study area. Although this species is unlikely to be significantly impacted by development of the study area it is recommended that development within potentially suitable habitat for this species (i.e., areas ground-truthed as RE 2.10.5a) is avoided.

### *Solanum carduiforme*

*Solanum carduiforme* is listed as vulnerable under the NC Act and not listed under the EPBC Act. Wildnet searches revealed the presence of two local records of this species within a 20km buffer of the study area (DES, 2020b), which are located ~5km to the south west of the study area. This species was considered to have a high likelihood of occurring within the study area based on key assessment criteria in **Table 1**. However, despite the high likelihood of occurrence, this species was not detected during field assessments.

This species is documented as being extremely rare, inadequately known and was previously only known to occur in the Lawn Hill area. However, it has recently been recorded from the Bungle Bungle region and Prince Regent River area of WA and there are records of this species from the Cobbold Gorge Nature Refuge and Rungulla National Park. This species is an erect, clonal herb or subshrub to 50 cm with densely pubescent leaves with stellate hairs and prickles (to 8 mm long) on all parts of the leaf. Leaves are concolorous with deep, oblong to broadly triangular lobes. Prickles are also present on all parts of the plant (FoA, 1982; Ford, 2010). Broadly, this species is documented to grow on conglomerate rock formations (FoA, 1982; Ford, 2010). However, to the south of the study area, this species is noted to grow on sandstone areas either with minimal soil on pavements or amongst spinifex on deep sandy soil. Local REs that this species has been associated with include REs 2.10.5x2 and 2.10.2x1 (Ford, 2010). RE 2.10.5a is the dominant community on sandstone scarps and plateaus within the study area, therefore the study area affords potentially suitable local habitat for this species based on ground-truthing results.

Several small Potato bush (*Solanum ellipticum*) individuals were found within the study area; however, these individuals lacked the deep, oblong to broadly triangular lobes that are consistent with the description of *S. carduifrome*. As this species was not detected during baseline assessments, it is considered unlikely that this species will be significantly impacted by activities within unsuitable habitat within the study area.

### 6.6.2 Conservation significant fauna species

Desktop searches revealed 21 conservation significant fauna species or their habitat to potentially occur within 20km of the study area, of which none were detected within the study area during field assessments. However, likelihood of occurrence assessments determined that three of these species had a moderate to high likelihood of occurring within the study area. Potential impacts to, and management strategies for, these species are described below.

The conservation status of the Gilbert Ground Gecko has not yet been evaluated under the NC Act or EPBC Act due to the recency of this species being described. Therefore, the potential for significant impacts to this species from development of the study area is discussed below. This will support future approvals if the Gilbert Ground Gecko is subsequently assessed as being an EVNT species under the NC Act or EPBC Act.

#### Ghost Bat

The Ghost bat (*Macroderma gigas*) is listed as endangered under the NC Act and as vulnerable under the EPBC Act. Wildnet searches did not reveal the presence of local records of this species within a 20km buffer of the study area (DES, 2020b). However, this species was considered to have a moderate likelihood of occurring within the study area based on key assessment criteria in **Table 1**. Despite the moderate likelihood of occurrence, this species was not detected during field assessments.

Ghost bats are sparsely distributed across northern Australia, with disjunct strongholds (often associated with a single maternity roost) on the central Queensland coast, Top End in the Northern Territory, and the Pilbara and Kimberley regions in Western Australia. Population trends among known roosts are poorly understood, with counts rare and by varying methods. Population estimates are approximately 7,000 to 9,000 individuals (McKenzie & Hall, 2008), with certain individual roosts making up over 5% of that figure.

Ghost bats utilise various sites as roosts depending on the purpose. Night roosts are temporary and used during foraging spells at night—these can include rock crevices and shallow overhangs or mine adits. Day roosts are in limestone or sandstone caves, large granite boulder scree or mine adits and are usually deep and entirely dark through the day (generally by having small openings), holding stable temperatures and relatively high humidity (TSSC, 2016b). When breeding, Ghost bats coalesce, sometimes forming large colonies (generally 30–200 individuals). The entire regional population of Ghost bats can be represented at a single roost during breeding. However, males disperse widely during the wet season, occurring in pairs or small groups, and occupy a variety of dark higher humidity roost sites (TSSC, 2016b). Information from Churchill (2008) is similar to observations made by Pettigrew *et al.* (1986) in regard to the Ghost Bat's breeding season. Both state that mating occurs in May with pups born in late July and early August.

Ghost bats forage in various, generally open, habitats such as tropical savannah woodlands, but may also forage in more dense habitats such as rainforests. This species is carnivorous, with a broad diet comprised of small mammals including other bats, birds, reptiles, frogs and large insects. This species has a variety of foraging strategies, including perching in vegetation to ambush passing prey and gleaning surfaces such as the ground while in flight (Hourigan, 2011).

Populations in parts of northern Australia have declined significantly in the last couple of decades. The main threatening processes effecting Ghost bat populations are thought to be cave disturbance, habitat loss (destruction of natural caves or collapse/reworking of old mine adits), collision with barbed-wire fences, contamination by mine residue and disease (Woinarski *et al*, 2014). Recently, Cane Toads have been strongly implicated in the observed decline of Ghost bats at Riversleigh (QLD) and from other sites in the Northern Territory since their arrival in 2001, with declines of over 90% recorded from sites in Kakadu, including the loss of major breeding sites (TSSC 2016b). Unlike their Asian relative *Megaderma lyra*, Ghost bats lack resistance to the bufonid toxin (Shine *et al*., 2016) and a deceased individual found in Kakadu cave with a Cane Toad in its oesophagus confirmed predation on the invasive species (White *et al.,* 2016).

Ground-truthing assessments did not reveal the presence of suitable roosting habitat within the study area. Large sandstone escarpments occur outside the northern portions of the study area, which may provide suitable roosting habitat for this species. However, ground-truthing assessments determined that suitable roost habitat for this species does not occur within the study area. Conversely, the study area supports suitable foraging habitat for this species, particularly as this species utilised a wide variety of habitats for foraging. However, suitable foraging habitat within the study area is widely represented within the broader region and no echolocation calls were recorded from this species during either survey. Overall, it is considered that development of the study area is unlikely to significantly impact any populations of Ghost bat as no suitable day-roost habitat was present within the study area.

### Koala

The Koala (*Phascolarctos cinereus*) is listed as vulnerable under both the NC Act and EPBC Act. Wildnet searches revealed the presence of three local records of this species within a 20km buffer of the study area (DES, 2020b) and this species was considered to have a moderate likelihood of occurring within the study area based on key assessment criteria in **Table 1**. Despite the moderate likelihood of occurrence, this species was not detected during field assessments.

The study area is mapped to occur on the western boundary of the modelled distribution of the Koala and is within an "inland" habitat context for the Koala within the *EPBC Act Referral Guidelines for the vulnerable Koala (2014)*. Koala habitat can be broadly defined as any forest or woodland containing species that are known food trees. The diet of the Koala is mainly restricted to foliage of certain *Eucalyptus* spp.; however, it may also consume foliage of related genera, including *Corymbia* spp., *Angophora* spp. and *Lophostemon* spp. (DAWE, 2020b). As most of the study area is dominated by potential food trees for the Koala, it is broadly considered that most of the study area is habitat for this species. However, reliable soil moisture and fertility are also important factors in determining Koala habitat (DoE, 2014). Most of the study area is dominated by plains and slopes that do not retain soil moisture for extended periods throughout the year. Additionally, sandstone formations within the study area typically comprise nutrient poor soils and are therefore not overly fertile. Vegetation communities along Agate Creek within the study area represents the most suitable habitat for the Koala. However, this riparian vegetation is marginal, and Agate Creek itself is a highly ephemeral watercourse. The broader area supports larger watercourses with denser riparian vegetation, which likely provide more suitable habitat for local Koala populations. Local records of this species are all located from 16 to 20kms to the east and northeast of the study area in open woodland communities similar to those ground-truthed within the study area.

As this species was considered as having a moderate likelihood of occurring within the study area a habitat assessment was conducted in accordance with the *EPBC Act Referral Guidelines for the vulnerable Koala (2014)*. The outcome of this assessment was that, while there are no local records of this species that are of significant relevance to the study area, the site contains habitat that may be suitable to the Koala (**Table 14**). Key outcomes from the habitat assessment tool were:

- There is no evidence of any Koalas within 2km of the edge of the impact area within the last 10 years.
- Emergent trees of at least two species that are known as Koala food trees are present.
- The study area is part of a contiguous landscape.
- The study area has some degree of dog or vehicle threat present.
- Habitat within the study area is unlikely to be important for achieving the interim recovery objective.

**Table 14 Koala habitat assessment**

| Attribute | Score | Habitat assessment | |
|---|---|---|---|
| Koala occurrence | 0 | Desktop studies | DAWE (2020x) states that the Koala, or Koala habitat, is likely to occur within a 20km buffer from the study area. Additionally, DES (2020b) identified three local records of the Koala within 20km of the study area. However, a review of these records (QLD Globe, 2020) identified that these occurrences were all pre 2000. |
| | | Field studies | Searches throughout the study area revealed no evidence of Koalas during baseline assessments. |
| Vegetation structure and composition | 2 | Ground-truthing assessments revealed that the study area is mostly dominated by Eucalypt woodlands of varying structural complexity. Throughout these woodlands, a variety of known food trees for the Koala were identified, which were dominated by the Gilbert river box, River red gum, and Narrow-leaved ironbark. | |
| Habitat connectivity | 2 | A combination of desktop and field studies revealed that the study area is part of a contiguous landscape above 1000ha in size. | |
| Key existing threats | 1 | There is potential for a low to moderate level of traffic within the study area during project operations.<br>No wild dogs or Dingoes were identified within the study area during baseline assessments, however there is the potential for Dingoes to occur.<br>Key existing threats has been scored as 1 (medium) as there is at least some threat from vehicle strike and dog attack present. | |

| Attribute | Score | Habitat assessment |
|---|---|---|
| Recovery value | 0 | The interim recovery objectives for koalas within the project area include:<br>• Protect and conserve the quality and extent of habitat refuges for the persistence of the species during droughts and periods of extreme heat, especially in riparian environments and other areas with reliable soils moisture and fertility.<br>• Maintain the quality, extent and connectivity of large areas of koala habitat surrounding habitat refuges.<br>The study area is mostly dominated by open woodland communities on plains and slopes where soil moisture and fertility is not reliable. Riparian habitat dominated by River red gum within the study area occurs along highly ephemeral watercourses where soil moisture may persist for longer periods. However, riparian habitat within the study area is marginal with few very large trees. Larger watercourses with more dense riparian vegetation are present within the surrounding region, which likely provide greater value to koala recovery objectives within inland areas.<br>Overall, it is considered that potential Koala habitat within the study area is unlikely to be important for achieving the interim recovery objectives for Koalas in inland areas. |
| Total score | 5 | Decision: Habitat potentially critical to the survival of the Koala – an assessment of significance is required. |

While the study area supports potentially suitable habitat for the Koala, given the absence of any evidence of this species occurring within the study area, it is important to consider the following characteristics for the assessment of significance of the study area to this species:

- A habitat score of five represents a moderate habitat value and, in this case, the score is based entirely on habitat suitability as local records of this species are within 16 to 20km of the study area and are all >20 years old.
- The scale of disturbance within the study area is low compared to the size of the surrounding area of remnant vegetation. Any clearing within the study area is not likely to impact broader connectivity values for this species.

On this basis, it is unlikely that development the study area will result in a significant impact to any local individuals or populations of Koala that may occur in the area.

Due to the lack of any evidence of this species occurring within the study area during field assessments, no recent local records, and a relatively minor loss of potentially suitable habitat for this species within the study area, it is unlikely that development of the study area will:

- Lead to a long-term decrease in the size of any local populations of Koala;
- Reduce the area of occupancy of any local populations;
- Fragment any population into multiple populations;
- Adversely affect habitat critical to the survival of the Koala;
- Disrupt the breeding cycle of an important population;

- Modify, destroy, remove or isolate, or decrease the availability or quality of habitat to the extent that the Koala is likely to decline;
- Result in invasive species that are harmful to Koalas becoming established in Koala habitat;
- Introduce disease that may cause the species to decline; or
- Interfere substantially with the recovery of the species.

Overall, it is considered unlikely that there will by any significant impacts to local populations of Koala within the study area.

### Large-eared Horseshoe Bat

The Large-eared horseshoe bat (*Rhinolophus robertsi*) is listed as endangered under the NC Act and as vulnerable under the EPBC Act. Wildnet searches did not reveal the presence of local records of this species within a 20km buffer of the study area (DES, 2020b). However, this species was considered to have a moderate likelihood of occurring within the study area based on key assessment criteria in **Table 1**. Despite the moderate likelihood of occurrence, this species was not detected during field assessments.

This species is restricted to northern Queensland, ranging from Iron Range National Park south to Townsville and west to the karst regions of Chillagoe (TSSC, 2016a and references therein). The distribution of this species is considered to be continuous on a broad scale. However, fine scale connectedness between populations may be low due to land clearing and it is suggested to occur in low densities even within core habitats. Across its occurrence, this species is found in lowland rainforest, forest-lined creeks within open eucalypt forest, *Melaleuca* forest with rainforest understorey, open savannah woodland and tall riparian woodland of *Melaleuca* spp.*, Eucalyptus tereticornis* and *Corymbia tessellaris*. Within these habitats, this species prefers to forage within relatively dense stands of vegetation, however it has been identified to infrequently forage in woodland and in open, cleared areas (TSSC, 2016a and references therein).

It is thought that this species mainly roosts in tree hollows and vegetation, or in open habitats such as under creek banks and road culverts, in rockpiles, and relatively shallow caves in drier times. However, it is also an opportunistic cave and mine-dweller, taking advantage of disused underground mines. Although, it is not an obligate cave- or mine-dwelling species (TSSC, 2016a and references therein).

The study area may provide potentially suitable foraging and roosting habitat for this species, particularly in sheltered areas where vegetation is thicker. However, in general, vegetation within the study area is comprised of open woodland communities, which may not be preferable habitat to individuals of this species. These habitats are similar to those represented within the broader region, therefore no unique habitat values for this species are present within the study area. Baseline assessments did not detect the calls of this species despite eight detector nights in various habitats throughout the study area. Therefore, as evidence of this species was not detected during baseline assessments and no unique or generally preferable habitat for this species occurs within the study area it is considered unlikely that this species will be significantly impacted by development within the study area.

### Gilbert Ground Gecko

The status of the Gilbert ground gecko (*Lucasium iris*) is not currently evaluated under the NC Act and EPBC Act due to the recency of the scientific paper describing this species being published in November 2020 (Vanderduys *et al.*, 2020). As a precautionary measure, an assessment of significant impacts to this species within the study area are discussed below with reference to information published within Vanderduys *et al.* (2020).

This species is endemic to the western Einasleigh Uplands bioregion in a localised area of the Gregory Range on Gilberton Station. This is the most range restricted of any *Lucasium* species within Australia and is the only Endemic *Lucasium* species to Queensland. The occurrence of this species within the study area represents a range extension (~20km) of the previously known extent of occurrence of this species. Although small, this range extension provides valuable insight into the occurrence of this species within the local area, particularly as the study area is just outside of the modelled area of occupancy (AOO) for this species. Within its known distribution, this species is known to occur on low rocky hills with many small escarpments, talus slopes and washout areas. Specifically, this species has been identified to occur within REs 2.10.5, 9.11.28, and 9.11.16. Current data does not suggest that this species fits any IUCN threatened category.

One individual of this species was identified within the central western portion of the study area on sandstone formations. The vegetation community that this individual was located within (RE 2.10.5a) supports habitat preferences for this species published within Vanderduys *et al.* (2020). RE 9.11.16, which is noted to be a community that this species occurs within in Vanderduys *et al.* (2020) was also ground-truthed within the study area, however no individuals of this species were identified within this ground-truthed community within the study area. Although this species is not currently listed, development within the study area is unlikely to significantly impact this species.

## 6.7 Pest species

Four non-native fauna species were identified within the study area during field assessments: Cane toad, Asian house gecko, European rabbit and domesticated Cattle. Various introduced flora species were also identified during the survey. These included a variety of species generally considered environmental weeds as well as pasture improvement species and a restricted invasive species (Rubber Vine) according to the *Biosecurity Act* (2014).

Cane toads occurred at low densities in proximity to standing water during spotlighting surveys. The Cane toad is common in a variety of habitat types throughout Queensland, including arid regions where populations disperse during the wet season and contract to permanent water sources such as cattle dams as ephemeral systems dry out (Letnic *et al.*, 2014). Management of toad populations in arid regions may therefore rely on restricting Cane toad access to artificial water sources. The spread of Cane toads across tropical Australia has been implicated in population declines of many large vertebrate predator species (Burnett, 1997), including the Ghost bat (TSSC, 2016c), which may occur in the study area.

Asian house geckos were incidentally detected at the mine camp during the surveys, however, were not found outside of this area. This species is widespread in urban areas within northern Australia, however, has the potential to establish within natural environments (Barnett, 2017). The most important factors facilitating the expansion of this species into natural woodland environments is propagule pressure (i.e., relative abundance of this species at the urban edge) and the number of years since this species established in the urban area (Barnett, 2017). As this species was detected in low abundances within areas of infrastructure within the study area it is unlikely that the presence of this species will have a notable impact on natural environments in the near future.

European rabbits were incidentally observed within open woodland communities within the study area. This species is a major agricultural and environmental pest in Australia, incurring environmental and economic impacts by eating pasture and crops, competing with native animals, causing soil erosion and preventing the regeneration of native vegetation. Although widespread and abundant throughout much of Australia, it is recommended that rabbit populations within the study area are managed to reduce impacts to local landholders and the environment (DAF, 2020).

The current land use for the local area is cattle grazing and cattle were identified within the study area. Excessive stocking of cattle may result in a variety of environmental impacts, particularly around watering points within the study area, where minor to moderate cattle impacts are already evident.

One Category 3 restricted invasive flora species under the *Biosecurity Act 2014* was identified within the study area during field assessments (Rubber Vine), which occurs broadly within the surrounding region.

The *Biosecurity Act 2014* outlines a general biosecurity obligation (GBO). The GBO identifies that everyone is responsible for managing biosecurity risks that are:

- Under their control; and
- That they know, or should reasonably know, about.

Under the GBO, individuals and organisations whose activities pose a biosecurity risk must:

- Take all reasonable and practical steps to prevent or minimise each biosecurity risk;
- Minimise the likelihood or causing a 'biosecurity event', and limit the consequences if such an event is caused; and
- Prevent or minimise the harmful effects a risk could have, and not do anything that might make any harmful effects worse.

Overall, it is recommended that all reasonable and practical steps to manage pest flora and fauna species identified within the study area are taken.

# 7 Conclusions and Recommendations

## 7.1 Local biodiversity and values

A total of 93 fauna species (49 birds, 22 mammals, 18 reptiles, and four amphibians) and 147 flora species (from 51 families) were identified within the study area during field assessments. Therefore, the study area contains moderate to high biodiversity for the local area and provides an array of values to local flora and fauna.

Most of the study area is comprised of open woodlands dominated by Gilbert river box and Narrow-leaved ironbark with a sparse shrub and grass understory. These open woodlands primarily provide habitat features for reptiles, small to large mammals and birds. While slopes dominated by Narrow-leaved ironbark and Lancewood provide similar habitat features to these open woodlands, these areas are often more floristically and structurally complex, providing greater amounts of refugia for reptiles and small mammals and a variety of microhabitats for flora to occupy. RE 2.10.5a woodland communities provide the most unique habitat, which two species identified during baseline assessments are endemic to; the Gilbert ground gecko and Silver-eyed velvet gecko. Additionally, several flora species within the local area are also heavily reliant on these sandstone-based woodlands. Sandstone features within areas of RE 2.10.5a also provide topographical complexity and an abundance of habitats, such as weathered overhangs, dense leaf litter, crevices, and areas of large, strewn boulders, for a variety of species. Ephemeral watercourses within the study area, particularly Agate Creek, also provide unique values within the study area. Although similar watercourses are present within the surrounding region, these features provide connectivity values and valuable resources to local fauna and flora.

The variety of landscape features provided diverse habitat features across the study area. These are influenced by vegetation community type, landform characteristics and land use practices. Most local biodiversity and ecological values within the study area are likely to be widely present or available within the broader region. However, several features, such as water availability during the dry season and sandstone features within areas of RE 2.10.5a, are likely to provide high ecological value to the study area. It is recommended that development within these areas is avoided, where possible, to reduce impacts to local biodiversity values.

## 7.2 Significant environmental matters and ESAs

Below is an overview of significant environmental matters and ESAs ground-truthed within the study area. Project considerations associated with these matters and areas are described below.

### 7.2.1 Regulated vegetation

#### Remnant vegetation associated with a watercourse

Most of the study area is dominated by remnant vegetation, with the exception of a few small areas of previous disturbance. There are several first to fourth order watercourses that traverse through the study area. Remnant vegetation associated with these watercourses within the relevant defined distances (see section 6.1.2) is a MSES. The clearing of vegetation within these defined distances can result in offset requirements under the Queensland environmental offsets framework. Therefore, it is recommended that any development of the study area avoids the clearing of this vegetation type, where possible, and the clearing thresholds identified in Section 6.1.2 are considered where clearing is unavoidable.

### 7.2.2 Protected areas and ESAs

Several protected areas and ESAs were identified to occur adjacent to the study area during desktop and ground-truthing assessments. These areas are described below with project related considerations provided for each.

Protected areas are MSES under the Environmental offsets framework. Protected areas mapped within close proximity to the study area include the Rungulla NP and Rungulla RR, which occur to the south and west of the study area (Appendix A). ML 100030 does not directly overlap with either of these two protected areas, however the 2km Category A ESA buffer for the Rungulla NP overlaps the southern portion of the ML. An Environmental Authority variation application may be required for any activities that cannot meet the eligibility criteria and comply with the standard conditions relating to the Category A ESA buffer.

### 7.2.3 Threatened species

No threatened species were identified to occur within the study area during desktop and ground-truthing assessments. However, several threatened flora and fauna species were determined to have a moderate or high likelihood of occurring within the study area. These species include those that are restricted to, or have high local affiliations with sandstone outcrops. Although extensive survey effort during optimal times of detection did not identify these species within the study area during baseline assessments, it is recommended that disturbance to these sandstone outcrops be avoided.

## 7.3 Pest management

Several pest flora and fauna species were identified to occur within the study during field assessments (see Sections 4.2.1 and 5.2.5). The pest species identified are common throughout the local and broader region, all have the potential to impact biodiversity values within the study area. Therefore, where reasonable and practical, it is recommended that the pest flora and fauna species are managed in accordance with obligations under the Biosecurity Act (2014) to reduce impact of pest species to threatened flora and fauna species and their habitats.

Additionally, several introduced pasture improving flora species identified within the study area are considered as environmental weeds. It is recommended that pasture improving flora species are not encouraged to establish within the study area.

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# APPENDIX A

Maps

# LANEWAY RESOURCES

# AGATE CREEK

## STATE-MAPPED REGIONAL ECOSYSTEMS

**LEGEND**

- Watercourse
- Mining Lease (ML 100030)

**State-Mapped Regional Ecosystems**

- Category A or B area that is least concern
- Category X area that is non-remnant
- Water

0 250 500 metres

| | |
|---|---|
| Coordinate System: | GDA 1994 MGA Zone 54 |
| Scale: | 1:20,000 at A3 |
| Project Number: | 623.20155 |
| Date: | 14-Jan-2021 |
| Drawn by: | AJ |
| Reviewed by: | SH |

Data Sources:
Vegetation Management Watercourse and Drainage Feature Map (1:100000 and 1:250000) – Queensland except South East Queensland Version 4.0, and Vegetation Management Regional Ecosystem Map - Version 11.0, and Mining Lease (ML 100030 only) datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2021.
Imagery Sources: 50cm resolution Maxar GE01 Australia 2018 Satellite Imagery Service: © ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

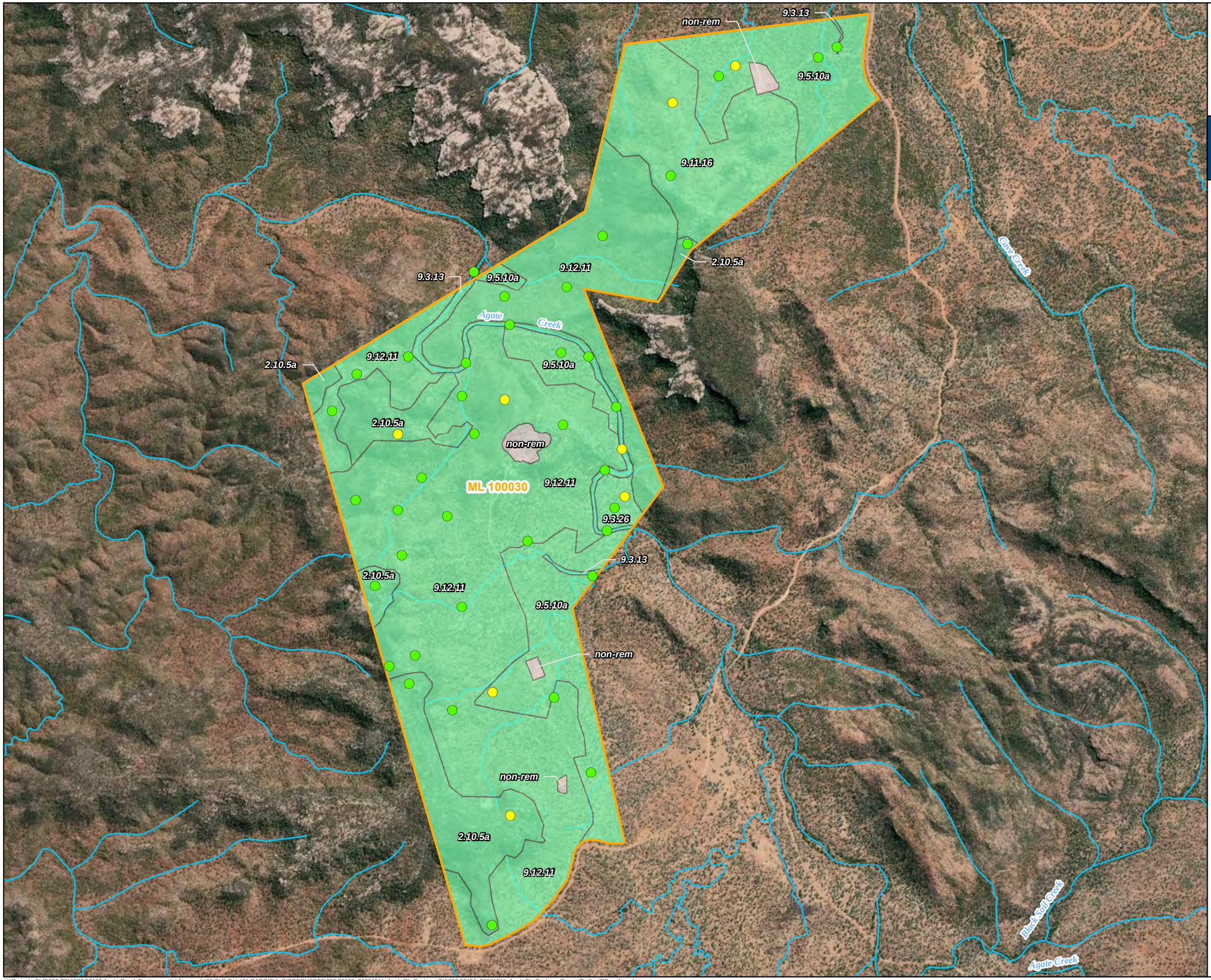
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# LANEWAY RESOURCES

# AGATE CREEK

## GROUND-TRUTHED REGIONAL ECOSYSTEMS




**LEGEND**

- Secondary Site
- Quaternary Site
- Watercourse
- Mining Lease (ML 100030)

**Ground-Truthed Regional Ecosystems**

- Least Concern
- Non-remnant

0 250 500 metres

| | |
|---|---|
| Coordinate System: | GDA 1994 MGA Zone 54 |
| Scale: | 1:20,000 at A3 |
| Project Number: | 623.20155 |
| Date: | 18-Jan-2021 |
| Drawn by: | AJ |
| Reviewed by: | SH |

Data Sources:
Vegetation Management Watercourse and Drainage Feature Map (1:100000 and 1:250000) – Queensland except South East Queensland Version 4.0, and Mining Lease (ML 100030 only) datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2021; Secondary Site, Quaternary Site, and Ground-Truthed Regional Ecosystems datasets: derived from Ecological Field Survey data - SLR Consulting (2020).
Imagery Sources: 50cm resolution Maxar GE01 Australia 2018 Satellite Imagery Service: © ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

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# LANEWAY RESOURCES

# AGATE CREEK

## FAUNA SURVEY

Site 4

Site 2

Site 6

ML 100030

Site 3

Site 5

Site 1

**LEGEND**

- IR Camera
- Bat Detector
- Cage Trap
- Drift Line
- Elliot Line
- Mining Lease (ML 100030)

0 250 500 metres

| | |
|---|---|
| Coordinate System: | GDA 1994 MGA Zone 54 |
| Scale: | 1:20,000 at A3 |
| Project Number: | 623.20155 |
| Date: | 14-Jan-2021 |
| Drawn by: | AJ |
| Reviewed by: | SH |

Data Sources:
Mining Lease (ML 100030 only) dataset: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2021; IR Camera, Bat Detector, Cage Trap, Drift Line, Elliot Line, and Watercourse datasets: SLR Consulting (2020).
Imagery Sources: 50cm resolution Maxar GE01 Australia 2018 Satellite Imagery Service: © ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

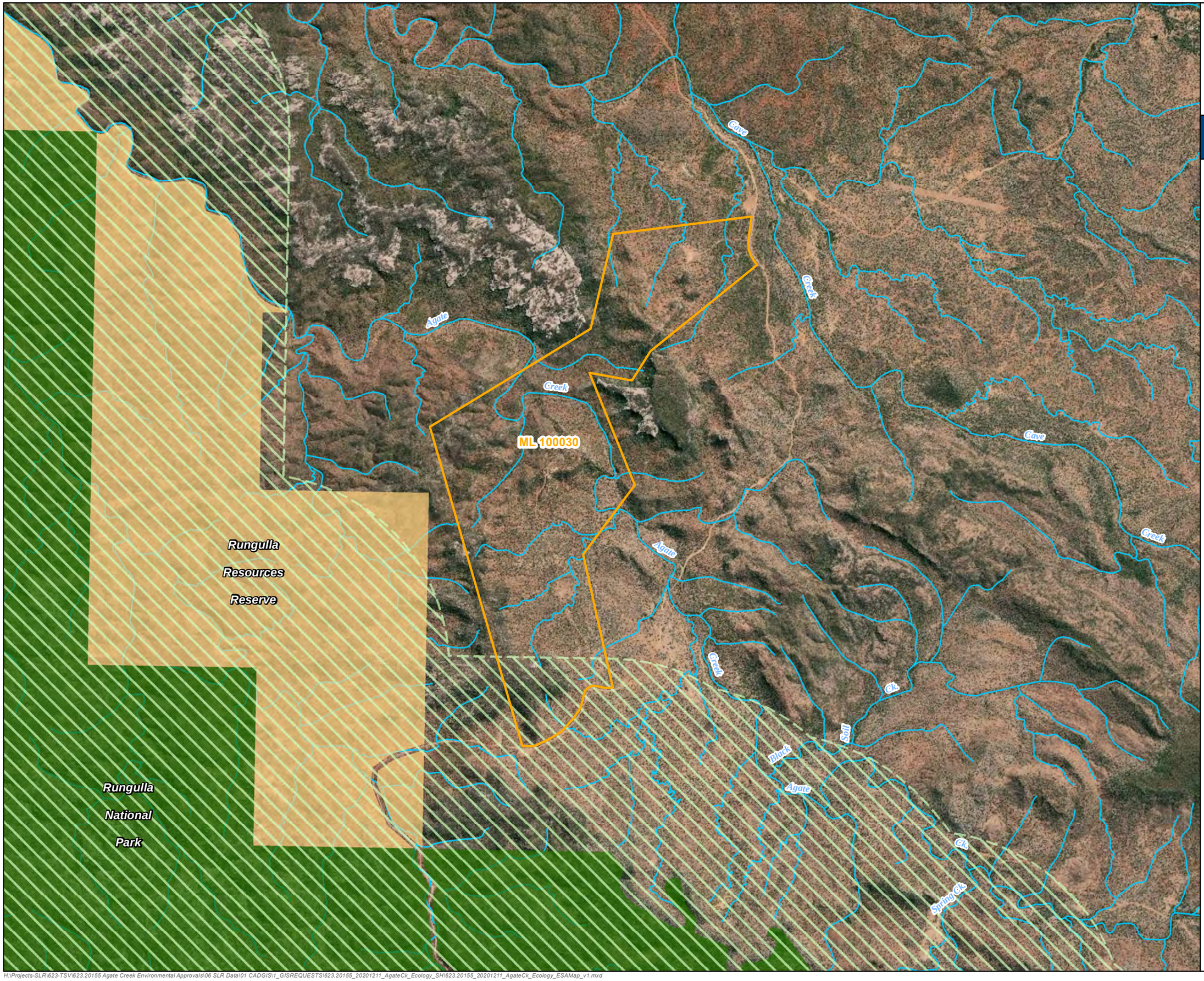
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# LANEWAY RESOURCES

# AGATE CREEK

## ENVIRONMENTALLY SENSITIVE AREAS




**LEGEND**

- Watercourse
- Mining Lease (ML 100030)
- 2km Buffer from National Park
- National Park (Cat. A ESA)
- Resources Reserve (Cat. C ESA)

0 500 1,000 metres

| | |
|---|---|
| Coordinate System: | GDA 1994 MGA Zone 54 |
| Scale: | 1:35,000 at A3 |
| Project Number: | 623.20155 |
| Date: | 15-Jan-2021 |
| Drawn by: | AJ |
| Reviewed by: | SH |

Data Sources:
Vegetation Management Watercourse and Drainage Feature Map (1:100000 and 1:250000) – Queensland except South East Queensland Version 4.0, 2km Buffer from National Park, National Park (Cat. A ESA), Resources Reserve (Cat. C ESA), and Mining Lease (ML 100030 only) datasets: © State of Queensland (Department of Natural Resources, Mines, and Energy) 2021.
Imagery Sources: 50cm resolution Maxar GE01 Australia 2018 Satellite Imagery Service: © ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

SLR

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# APPENDIX B

EPBC Act Protected Matters Report

Australian Government
Department of the Environment and Energy

# EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

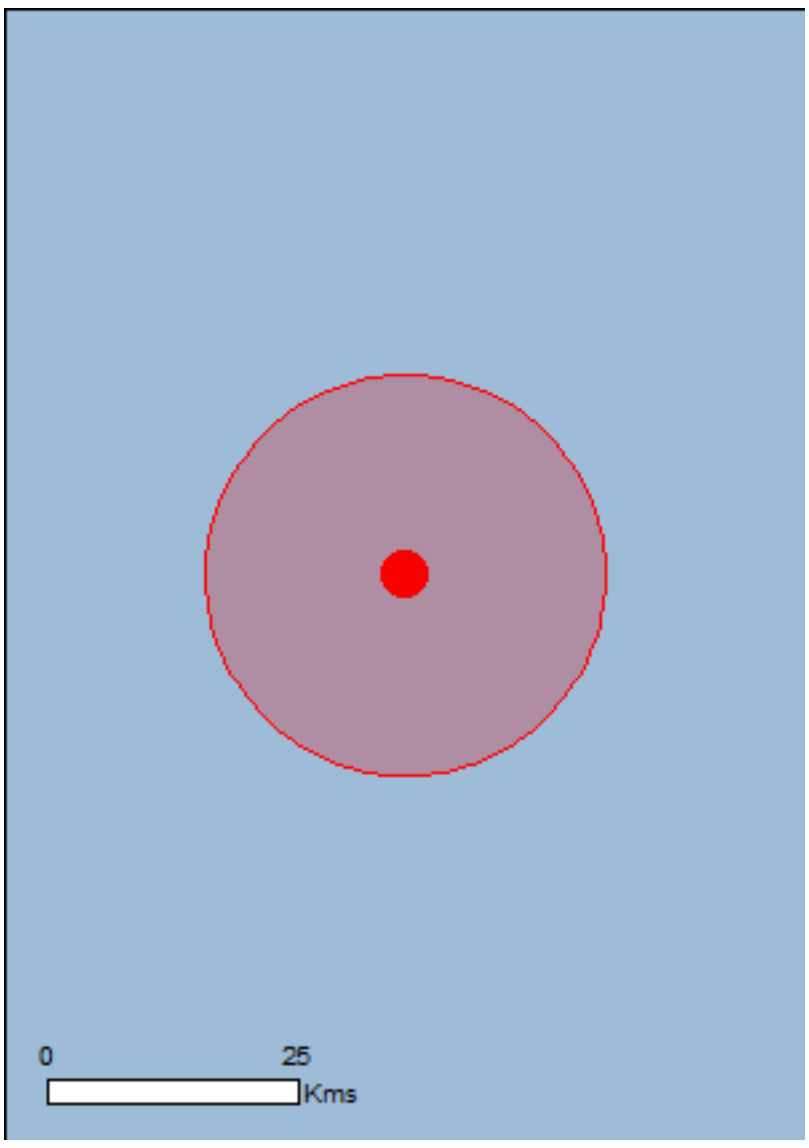
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 14/02/20 12:01:34


Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

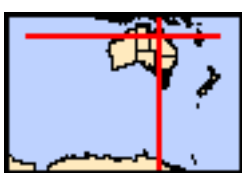
Caveat
Acknowledgements


This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 20.0Km



# Summary

## Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

| | |
|---|---|
| World Heritage Properties: | None |
| National Heritage Places: | None |
| Wetlands of International Importance: | None |
| Great Barrier Reef Marine Park: | None |
| Commonwealth Marine Area: | None |
| Listed Threatened Ecological Communities: | None |
| Listed Threatened Species: | 12 |
| Listed Migratory Species: | 11 |

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

| | |
|---|---|
| Commonwealth Land: | None |
| Commonwealth Heritage Places: | None |
| Listed Marine Species: | 18 |
| Whales and Other Cetaceans: | None |
| Critical Habitats: | None |
| Commonwealth Reserves Terrestrial: | None |
| Australian Marine Parks: | None |

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

| | |
|---|---|
| State and Territory Reserves: | 4 |
| Regional Forest Agreements: | None |
| Invasive Species: | 14 |
| Nationally Important Wetlands: | None |
| Key Ecological Features (Marine) | None |

# Details

## Matters of National Environmental Significance

| Listed Threatened Species | | [ Resource Information ] |
|---|---|---|
| Name | Status | Type of Presence |
| Birds | | |
| Calidris ferruginea<br>Curlew Sandpiper [856] | Critically Endangered | Species or species habitat may occur within area |
| Erythrotriorchis radiatus<br>Red Goshawk [942] | Vulnerable | Species or species habitat likely to occur within area |
| Erythrura gouldiae<br>Gouldian Finch [413] | Endangered | Species or species habitat known to occur within area |
| Rostratula australis<br>Australian Painted Snipe [77037] | Endangered | Species or species habitat may occur within area |
| Tyto novaehollandiae  kimberli<br>Masked Owl (northern) [26048] | Vulnerable | Species or species habitat may occur within area |
| Mammals | | |
| Dasyurus hallucatus<br>Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331] | Endangered | Species or species habitat may occur within area |
| Macroderma gigas<br>Ghost Bat [174] | Vulnerable | Species or species habitat likely to occur within area |
| Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)<br>Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104] | Vulnerable | Species or species habitat may occur within area |
| Rhinolophus robertsi<br>Large-eared Horseshoe Bat, Greater Large-eared Horseshoe Bat [87639] | Vulnerable | Species or species habitat may occur within area |
| Saccolaimus saccolaimus  nudicluniatus<br>Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889] | Vulnerable | Species or species habitat may occur within area |
| Plants | | |
| Cycas platyphylla<br>a cycad [55796] | Vulnerable | Species or species habitat may occur within area |
| Dichanthium setosum<br>bluegrass [14159] | Vulnerable | Species or species habitat likely to occur within area |

| Listed Migratory Species | | [ Resource Information ] |
|---|---|---|
| * Species is listed under a different scientific name on the EPBC Act - Threatened Species list. | | |
| Name | Threatened | Type of Presence |
| Migratory Marine Birds | | |
| Apus pacificus<br>Fork-tailed Swift [678] | | Species or species habitat likely to occur within area |
| Migratory Terrestrial Species | | |
| Cuculus optatus<br>Oriental Cuckoo, Horsfield's Cuckoo [86651] | | Species or species habitat may occur within area |
| Hirundo rustica<br>Barn Swallow [662] | | Species or species habitat may occur within area |
| Motacilla cinerea<br>Grey Wagtail [642] | | Species or species habitat may occur within area |
| Motacilla flava<br>Yellow Wagtail [644] | | Species or species habitat may occur within area |
| Migratory Wetlands Species | | |
| Actitis hypoleucos<br>Common Sandpiper [59309] | | Species or species habitat may occur within area |
| Calidris acuminata<br>Sharp-tailed Sandpiper [874] | | Species or species habitat may occur within area |
| Calidris ferruginea<br>Curlew Sandpiper [856] | Critically Endangered | Species or species habitat may occur within area |
| Calidris melanotos<br>Pectoral Sandpiper [858] | | Species or species habitat may occur within area |
| Gallinago hardwickii<br>Latham's Snipe, Japanese Snipe [863] | | Species or species habitat may occur within area |
| Pandion haliaetus<br>Osprey [952] | | Species or species habitat likely to occur within area |

## Other Matters Protected by the EPBC Act

| Listed Marine Species | | [ Resource Information ] |
|---|---|---|
| * Species is listed under a different scientific name on the EPBC Act - Threatened Species list. | | |
| Name | Threatened | Type of Presence |
| Birds | | |
| Actitis hypoleucos<br>Common Sandpiper [59309] | | Species or species habitat may occur within area |
| Anseranas semipalmata<br>Magpie Goose [978] | | Species or species habitat may occur within area |
| Apus pacificus<br>Fork-tailed Swift [678] | | Species or species habitat likely to occur |

| Name | Threatened | Type of Presence within area |
|---|---|---|
| [Ardea alba](#)<br>Great Egret, White Egret [59541] | | Species or species habitat likely to occur within area |
| [Ardea ibis](#)<br>Cattle Egret [59542] | | Species or species habitat may occur within area |
| [Calidris acuminata](#)<br>Sharp-tailed Sandpiper [874] | | Species or species habitat may occur within area |
| [Calidris ferruginea](#)<br>Curlew Sandpiper [856] | Critically Endangered | Species or species habitat may occur within area |
| [Calidris melanotos](#)<br>Pectoral Sandpiper [858] | | Species or species habitat may occur within area |
| [Chrysococcyx osculans](#)<br>Black-eared Cuckoo [705] | | Species or species habitat may occur within area |
| [Gallinago hardwickii](#)<br>Latham's Snipe, Japanese Snipe [863] | | Species or species habitat may occur within area |
| [Haliaeetus leucogaster](#)<br>White-bellied Sea-Eagle [943] | | Species or species habitat may occur within area |
| [Hirundo rustica](#)<br>Barn Swallow [662] | | Species or species habitat may occur within area |
| [Merops ornatus](#)<br>Rainbow Bee-eater [670] | | Species or species habitat may occur within area |
| [Motacilla cinerea](#)<br>Grey Wagtail [642] | | Species or species habitat may occur within area |
| [Motacilla flava](#)<br>Yellow Wagtail [644] | | Species or species habitat may occur within area |
| [Pandion haliaetus](#)<br>Osprey [952] | | Species or species habitat likely to occur within area |
| [Rostratula benghalensis (sensu lato)](#)<br>Painted Snipe [889] | Endangered* | Species or species habitat may occur within area |
| **Reptiles** | | |
| [Crocodylus johnstoni](#)<br>Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773] | | Species or species habitat may occur within area |

# Extra Information

## State and Territory Reserves [ Resource Information ]

| Name | State |
|---|---|
| Cobbold Gorge | QLD |
| Rungulla | QLD |
| Rungulla | QLD |
| Stuarts Spring | QLD |

## Invasive Species [ Resource Information ]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

| Name | Status | Type of Presence |
|---|---|---|
| **Birds** | | |
| Columba livia<br>Rock Pigeon, Rock Dove, Domestic Pigeon [803] | | Species or species habitat likely to occur within area |
| Passer domesticus<br>House Sparrow [405] | | Species or species habitat likely to occur within area |
| Streptopelia chinensis<br>Spotted Turtle-Dove [780] | | Species or species habitat likely to occur within area |
| **Frogs** | | |
| Rhinella marina<br>Cane Toad [83218] | | Species or species habitat known to occur within area |
| **Mammals** | | |
| Bos taurus<br>Domestic Cattle [16] | | Species or species habitat likely to occur within area |
| Canis lupus familiaris<br>Domestic Dog [82654] | | Species or species habitat likely to occur within area |
| Equus caballus<br>Horse [5] | | Species or species habitat likely to occur within area |
| Felis catus<br>Cat, House Cat, Domestic Cat [19] | | Species or species habitat likely to occur within area |
| Oryctolagus cuniculus<br>Rabbit, European Rabbit [128] | | Species or species habitat likely to occur within area |
| Sus scrofa<br>Pig [6] | | Species or species habitat likely to occur within area |
| **Plants** | | |
| Acacia nilotica subsp. indica<br>Prickly Acacia [6196] | | Species or species habitat may occur within area |
| Cryptostegia grandiflora<br>Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913] | | Species or species habitat likely to occur within area |
| Parkinsonia aculeata<br>Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, | | Species or species |

| Name | Status | Type of Presence |
| --- | --- | --- |
| Horse Bean [12301]<br><br>Vachellia nilotica | | habitat likely to occur within area |
| Prickly Acacia, Blackthorn, Prickly Mimosa, Black Piquant, Babul [84351] | | Species or species habitat likely to occur within area |

# Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods.  Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc).  In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

# Coordinates

-18.9972 143.5455

# Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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# APPENDIX C

Wildlife Online Database Extract

Queensland Government

# Wildlife Online Extract

Search Criteria: Species List for a Specified Point
Species: All
Type: Native
Status: Rare and threatened species
Records: All
Date: All
Latitude: -18.9972
Longitude: 143.5455
Distance: 20
Email: sharte@slrconsulting.com
Date submitted: Friday 14 Feb 2020 11:00:15
Date extracted: Friday 14 Feb 2020 11:10:06

The number of records retrieved = 6

**Disclaimer**

As the DSITIA is still in a process of collating and vetting data, it is possible the information given is not complete. The information provided should only be used for the project for which it was requested and it should be appropriately acknowledged as being derived from Wildlife Online when it is used.

The State of Queensland does not invite reliance upon, nor accept responsibility for this information. Persons should satisfy themselves through independent means as to the accuracy and completeness of this information.

No statements, representations or warranties are made about the accuracy or completeness of this information. The State of Queensland disclaims all responsibility for this information and all liability (including without limitation, liability in negligence) for all expenses, losses, damages and costs you may incur as a result of the information being inaccurate or incomplete in any way for any reason.

| Kingdom | Class | Family | Scientific Name | Common Name | I | Q | A | Records |
|---|---|---|---|---|---|---|---|---|
| animals | mammals | Phascolarctidae | *Phascolarctos cinereus* | koala | | V | V | 3 |
| plants | land plants | Asteraceae | *Pluchea punctata* | | | E | | 2/2 |
| plants | land plants | Caesalpiniaceae | *Labichea brassii* | | | NT | | 7/7 |
| plants | land plants | Myrtaceae | *Leptospermum pallidum* | | | NT | | 2/2 |
| plants | land plants | Rutaceae | *Drummondita calida* | | | V | | 1/1 |
| plants | land plants | Solanaceae | *Solanum carduiforme* | | | V | | 2/2 |

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992.* The codes are Extinct in the Wild (PE), Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (C) or Not Protected ( ).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999.* The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

Records – The first number indicates the total number of records of the taxon for the record option selected (i.e. All, Confirmed or Specimens).
This number is output as 99999 if it equals or exceeds this value. The second number located after the / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.

# APPENDIX D

Potential Occurrence of EVNT Species

**Table D1 Likelihood of occurrence assessments for EVNT flora identified in Protected Matters Search Tool and Queensland Government Wildlife Online searches in a 20km radius from the study area**

| Status[1] | | Family | Scientific name | Common name | Source[2] | WO records | Ecology | Potential to occur in the study area |
|---|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | | | | |
| E | - | Asteraceae | *Pluchea punctata* | - | WO | 2 | This species is endemic to Queensland and is known from a single locality near Forsayth in north Queensland. Little information is available on habitat preferences for this species, however is it has been documented to occur on hill slopes with Gilbert River Box and *Triodia spp.* (FoA, 2015). | **Moderate** -There are two records of this species occurring within 20km of the study area (DES, 2020b) and ground-truthed vegetation communities were similar to those that this species is described to occur within. Overall, it is considered that this species has a moderate likelihood of occurring within the study area due to the presence of local records and potential habitat for this species. |
| V | V | Cycadaceae | *Cycas platyphylla* | - | PM | 0 | Cycads are a distinct family of plants that, in some species, have a very localised distribution. This species is known from the Petford district on the north-western Atherton Tableland, and a disjunct population about 250km to the south of Wandovale station. In both localities, it occurs in open grassy ironbark-dominated woodland on shallow loamy soils on stony slopes over acid to intermediate volcanics (Hill, 1992). | **Low** – There are no local records of this species occurring within 20km of the study area (DES, 2020b). As there are no local records of this species and the study area occurs outside of the modelled distribution of this species, it is considered that this species has a low likelihood of occurring within the study area. Additionally, no individuals of this distinctive family of plants were identified within the study area. |
| NT | - | Leguminosae | *Labichea brassii* | - | WO | 7 | This poorly known species is confined to northern Queensland and is known from Mt Mulligan in the north and extends south west to Agate Creek (FoA, 1998). Preferred habitat for this species includes vegetation along creeks and in riverbeds, however locally it has also been recorded to occur on sparse woodland on sandstone plateaus in RE 2.10.2x1 (FoA, 1998; Ford 2010). | **High** – There are seven records of this species occurring within 20km of the study area (DES, 2020b). Due to the presence of local records and potential habitat within the study area (RE 2.10.5a) it is considered that this species has a high likelihood of occurring within suitable habitat within the study area. |
| NT | - | Myrtaceae | *Leptospermum pallidum* | - | WO | 2 | This species has a restricted distribution within northern Queensland, with most records occurring around the Greenvale area, however this species has also been recorded to occur at Porcupine Gorge, north of Hughenden, within the Cobbold Gorge Nature Refuge and within the Rungulla National Park (Bean, 1992; Ford, 2010). Locally, this species has been observed on low sandstone hills among large boulders with a metamorphic substrate within RE 2.10.5x1 (Ford, 2010). | **High** – There are two records of this species occurring within 20km of the study area (DES, 2020b). Due to the presence of local records and ground-truthed regional ecosystems (RE 2.10.5a) within the study area equating to known local habitat for this species it is considered that this species has a high likelihood of occurring within suitable habitat within the study area. |
| LC | V | Poaceae | *Dichanthium setosum* | - | PM | 0 | This species occurs in inland QLD and NSW, with Queensland populations in the southern and central Brigalow Belt, the Central Queensland Highlands and the Einasleigh Uplands between Charters Towers and Georgetown. Other scattered records occur in the Cape York Peninsula and Northwest Highlands. It is found in moderately disturbed areas such as cleared woodland and grassy roadside remnants. It is typically associated with heavy black soils and red-brown loams with clay subsoil (DES, 2020e and references therein). | **Moderate** - The nearest local record of this species is ~100km to the south east of the study area, which is the northernmost available record of this species (ALA, 2020). The study area is on the north-western boundary of the modelled distribution of this species (DES, 2020e) and potentially suitable habitat for this species is present within the study area. Overall, it is considered that this species has a moderate likelihood of occurring within the study area. |
| V | - | Rutaceae | *Drummondita calida* | - | WO | 1 | Within Queensland, this species is found between Bulleringa National park to the southern end of the Gregory Range. Locally, this species has been located on very exposed and sparse low shrubland on bare sandstone plateaux to low open woodland on sandstone with large boulders. This species has a very conspicuous corky fissured stem, however the overall appearance of the plant is primarily driven by habitat, with taller individuals in woodland and shorter plants in more open and exposed situations (Ford, 2010). Within the local area, this species is noted to be locally common and has been observed in REs 2.10.2x1, 2.10.2, 2.10.5x2 and 2.7.2 (Ford, 2010). | **High** – There is one record of this species occurring within 20km of the study area (DES, 2020b). Due to the presence of a local record and ground-truthed regional ecosystems (RE 2.10.5a) within the study area equating to known local habitat for this species it is considered that this species has a high likelihood of occurring within suitable habitat within the study area. |

| Status[1] | | Family | Scientific name | Common name | Source[2] | WO records | Ecology | Potential to occur in the study area |
|---|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | | | | |
| V | - | Solanaceae | *Solanum carduiforme* | - | WO | 6 | An extremely rare, inadequately known species previously only known to occur in the Lawn Hill area of north-western QLD. However, it has recently been recorded from the Bungle Bungle region and Prince Regent River area of WA and is also recorded from the Cobbold Gorge Nature Refuge and Rungulla National Park. This species grows on conglomerate rock formations. This species is an erect, clonal herb or subshrub to 50 cm with densely pubescent leaves with stellate hairs and prickles (to 8 mm long) on all parts of the leaf. Leaves are concolorous with deep, oblong to broadly triangular lobes. Prickles are also present on all parts of the plant (FoA, 1982; Ford, 2010). Within the Gilbert River and Rungulla Stations this species is noted to grow on sandstone areas either with minimal soil on pavements or amongst spinifex on deep sandy soil. Local REs that this species has been associated with include RE 2.10.5x2 and 2.10.2x1 (Ford, 2010). | **High** – There are six records of this species occurring within 20km of the study area (DES, 2020b). Due to the presence of local records and ground-truthed regional ecosystems (RE 2.10.5a) within the study area equating to known local habitat for this species it is considered that this species has a high likelihood of occurring within suitable habitat within the study area. |

1. Status: LC = Least Concern, NT = Neat Threatened, V = Vulnerable, E = Endangered

2. Source: WO = Queensland Government Wildlife Online Database Extract (20km radius search area), PM = EPBC Act Protected Matters Report

**Table D2 Likelihood of occurrence assessments for EVNT fauna identified in Protected Matters Search Tool and Queensland Government Wildlife Online searches in a 20km radius from the study area**

| Status[1] | | Family | Scientific name | Common name | Source[2] | WO records | Ecology | Potential to occur in the study area |
|---|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | | | | |
| **BIRDS** | | | | | | | | |
| E | V | Accipitridae | *Erythrotriorchis radiatus* | Red Goshawk | PM | 0 | This species prefers open forests and woodland with a mosaic of vegetation types, particularly near riverine systems and permanent water where there is an abundance of prey species (DAWE, 2020b and reference therein). The home range in northern Australia has been reported up to 200km$^2$, with indications it may be even larger (Aumann & Baker-Gabb, 1991). | **Low**— There are no local records of this species within 20km of the study area (DES, 2020b) and the study area does not occur within the core distribution of this species (Menkhorst *et al*., 2017). Additionally, habitat within the study area is suggested as being of low quality to this species due to the absence of permanent water. Overall, it is considered that this species has a low likelihood of occurring within the study area. |
| E | E | Estrilidae | *Erythrura gouldiae* | Gouldian Finch | PM | 0 | Sparsely distributed across northern Australia from the Kimberley region to central north Queensland. This species inhabits tropical open woodlands dominated by *Eucalyptus* trees with ground cover of tall native grasses, such as Sorghum (Morcombe, 2003). Gouldian Finch also occur in thickets of vegetation along streams and gorges and the margins of mangroves. This species requires daily access to fresh water and becomes restricted to rock outcrops with permanent pools during the dry season (Menkhorst *et al.*, 2017). | **Low** – There are no local records of this species within 20km of the study area (DES, 2020b) and the study area occurs to the south of the modelled distribution of this species within north eastern Queensland (Menkhorst *et al.*, 2017). Overall, it is considered that this species has a low likelihood of occurring within the study area based on desktop results. Additionally, field observations identified no permanent water on site and that local watercourses are highly ephemeral. |
| E | E | Rostratulidae | *Rostratula australis* | Australian Painted Snipe | PM | 0 | This species has been recorded at wetland sites throughout much of Australia but is most common in the eastern states. The Australian Painted Snipe is a distinct species but can be hard to detect due to its cryptic and crepuscular behaviour. This species typically occurs in shallow freshwater wetlands and other permanently or temporarily inundated areas, particularly where rank tussocks of grasses, sedges, rushes or reeds are present (DAWE, 2020b; Morcombe, 2003). | **Low** – There are no local records of this species within 20km of the study area (DES, 2020b) and the study area does not contain and suitable habitat (wetlands). Overall, it is considered that this species has a low likelihood of occurring within the study area. |
| E | CE, M, Ma | Scolopacidae | *Calidris ferruginea* | Curlew Sandpiper | PM | 0 | This species occurs around the coasts of Australia from Cairns south. It is also quite widespread inland, with scattered records occurring in the Gulf of Carpentaria. This species mainly occurs on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets, lagoons and also around non-tidal swamps, lakes, and lagoons near the coast, foraging on mudflats and nearby shallow water (DAWE, 2020b and references therein). | **Low** – There are no local records of this species within 20km of the study area (DES, 2020b). The study area is inland and does not contain the coastal and aquatic habitats required for this species. Overall, it is considered that this species has a low likelihood of occurring within the study area. |
| V | V | Tytonidae | *Tyto novaehollandiae kimberli* | Masked Owl (northern) | PM | 0 | In Queensland, the northern subspecies of the Masked Owl occurs along the southern rim of the Gulf of Carpentaria, Cape York Peninsula and south at least as far as the Atherton Tablelands (DAWE, 2020b and references therein). The species has been recorded in a variety of habitats including riverside forests, rainforest, open forest and paperbark swamps and is known to occupy home-ranges of over 1,000ha in the non-breeding season. | **Low** – There are no local records of this species within 20km of the study area (DES, 2020b) and the study area does not occur within the modelled distribution of this sub-species of the Masked Owl (Menkhorst *et al*., 2017). Overall, it is considered that this sub-species has a low likelihood of occurring within the study area. |
| **MAMMALS** | | | | | | | | |
| LC | E | Dasyuridae | *Dasyurus hallucatus* | Northern Quoll | PM | 0 | Across its range the Northern Quoll utilises a wide variety of habitats; in Queensland it favours high-relief areas with shallow soils, high boulder cover and low fire frequency close to permanent water (DAWE, 2020b and references therein). | **Low** – There are no local records of this species within 20km of the study area (DES, 2020b) and the nearest other records of this species are ~150km to the north east and ~230km to the south east of the study area (ALA, 2020). Additionally, the study area does not occur within the core distribution of this species (Van Dyck, 2013) and there is no permanent water within or near the study area. Overall, it is considered that this species has a low likelihood of occurring within the study area. |
| E | V | Emballonuridae | *Saccolaimus saccolaimus nudicluniatus* | Bare-rumped Sheathtail Bat | PM | 0 | This species is known to occupy tropical woodland and tall open forests in lowland areas, preferably coastal eucalypt forests with high rainfall, along the northeast coast of Queensland (Churchill, 2008). Roosts have been recorded in tree hollows (DAWE, 2020b and references therein). | **Low** – There are no local records of this species within 20km of the study area (DES, 2020b) and the study area is outside of the modelled distribution of this species (Van Dyck, 2013). Overall, it is considered that this species has a low likelihood of occurring within the study area. |

| Status[1] | | Family | Scientific name | Common name | Source[2] | WO records | Ecology | Potential to occur in the study area |
|---|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | | | | |
| E | V | Megadermatidae | *Macroderma gigas* | Ghost Bat | PM | 0 | The distribution of this species is discontinuous across Australia with two ranges in Queensland: coastal and near-coastal eastern Queensland, from Cape York to near Rockhampton, and western Queensland (DAWE, 2020b and references therein). It has been recorded hunting in rainforest, deciduous vine thicket, open woodland, spinifex, black soil and grassland habitats. Ghost Bats roost in caves, boulder piles, shallow escarpments and mines, and have very specific roosting requirements with respect to temperature and humidity (TSSC, 2016b). | **Moderate** – There are no local records of this species within 20km of the study area (DES, 2020b), however the study area occurs within the modelled distribution for this species (Van Dyck, 2013). Sandstone escarpments within close proximity to the study area may afford suitable roosting habitat for this species. Therefore, there is the potential that this species may utilise the study area for foraging. Overall, it is considered that this species has a moderate likelihood of occurring within the study area. |
| V | V | Phascolarctidae | *Phascolarctos cinereus* | Koala | WO/PM | 3 | This species range includes the eastern half of Queensland in sclerophyll forest and woodland (Menkhorst & Knight, 2011). While being widespread, suitable feed species and leaf moisture are the primary determinants of habitat suitability and populations are in decline due to a wide range of threats (DAWE, 2020b and references therein). | **Moderate**- There are three local records of this species within 20km of the study area (DES, 2020b) and the study area occurs within the modelled distribution for this species (Van Dyck, 2013). The study area is mostly dominated by *Eucalyptus* species, which may comprise suitable food resources for this species, particularly River Red Gums along the Agate Creek watercourse. Overall, it is considered that this species has a moderate likelihood of occurring within the study area. This is due to local records being >20yrs old and northern populations of the Koala occurring sparsely in suitable habitat throughout their range. Additionally, despite Eucalyptus species being abundant throughout the study area, favoured species such as River red gum are only found along watercourses with leaf moisture likely being low in other areas due to the dry and hilly terrain. |
| E | V | Rhinolophidae | *Rhinolophus robersti* | Large-eared Horseshoe Bat | PM | 0 | This species is restricted to northern Queensland, ranging from Iron Range National Park south to Townsville and west to the karst regions of Chillagoe (TSSC, 2016 and references therein). This species is found in lowland rainforest, forest-lined creeks within open eucalypt forest, *Melaleuca* forest with rainforest understorey, open savannah woodland and tall riparian woodland of *Melaleuca* spp., *Eucalyptus tereticornis* and *Corymbia tessellaris*. The species is an opportunistic cave and mine-dweller and takes advantage of disused underground mines but also roosts in trees and other vegetation (TSSC, 2016a and references therein). | **Moderate** - There are no local records of this species within 20km of the study area (DES, 2020b). However, the study area occurs on the western boundary of the modelled distribution for this species and potentially suitable habitat for this species is located within the study area. Overall, it is considered that this species has a moderate likelihood of occurring within the study area. |

1. Status: LC – Least Concern, V = Vulnerable, E = Endangered, CE = Critically Endangered, M = Migratory, Ma = Marine
2. Source: WO = Queensland Government Wildlife Online Database Extract (20km radius search area), PM = EPBC Act Protected Matters Report

**Table D3 Likelihood of occurrence assessments for migratory fauna identified in the Protected Matters Search Tool and Queensland Government Wildlife Online searches in a 20km radius of the study area.**

| Status[1] | | Family | Scientific name | Common name | Source[2] | WO records | Ecology | Potential to occur in the study area |
|---|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | | | | |
| BIRDS | | | | | | | | |
| SLC | M, Ma | Apodidae | *Apus pacificus* | Fork-tailed Swift | PM | 0 | The Fork-tailed Swift is a non-breeding visitor to all States and territories of Australia. This species is known to utilise cliffs and beaches and to hunt above various habitat types including rainforest and open forests ahead of storm fronts (Higgins, 1999). Swifts are hardly ever seen to land except at nests, and when they do they cling to vertical surfaces rather than perching upright like swallows (Menkhorst *et al.*, 2017). This species has been noted to forage in high-flying flocks 100s of meters above the ground or canopy (Menkhorst *et al.*, 2017). | **Low –** There are no local records of this species within 20km of the study area. The occurrence of this species within the vicinity of the study area is likely to correspond with the presence of storm fronts travelling across the landscape. During these instances, it is likely that this species will only occupy the air space above the study area for short periods of time as this species rarely lands except to nest, which does not occur within Australia. Overall, it is considered that terrestrial habitats relevant to the study area and proposed disturbance constitute unsuitable habitat for this species. |
| SLC | M, Ma | Cuculidae | *Cuculus optatus* | Oriental Cuckoo | PM | 0 | This species is widespread in the northern and eastern parts of Australia, inhabiting rainforest margins, monsoon forest, vine scrubs, riverine thickets, wetter, densely canopied eucalypt forests, paperbark swamps and mangroves (Morcombe, 2003). | **Low –** There are no local records of this species within 20km of the study area and preferred habitat for this species is not present within the study area. Overall, it is considered that this species has a low likelihood of occurring within the study area. |
| SLC | M, Ma | Hirundinidae | *Hirundo rustica* | Barn Swallow | PM | 0 | This species is typically found patchily along the north coast of the mainland, typically found open country in coastal lowland utilising a wide variety of habitats (DES, 2021 and references therein). | **Low –** There are no local records of this species within 20km of the study area and the study area is outside of the modelled distribution of this species within Australia. Therefore, it is considered that this species has a low likelihood of occurring within the study area. |
| SLC | M, Ma | Motacillidae | *Motacilla cinerea* | Grey Wagtail | PM | 0 | A scarce but regular visitor to Australia (October to April), this species is infrequently recorded in the Northern Territory and Queensland. It prefers montane forests and forested areas close to water, with a preference for fast flowing rocky watercourses and waterfalls. However, this species may also occur at beaches and rock pools during migration (Menkhorst *et al.*, 2017). | **Low –** There are no local records of this species within 20km of the study area and preferred habitat for this species is not present within the study area. Overall, it is considered that this species has a low likelihood of occurring within the study area. |
| SLC | M, Ma | Motacillidae | *Motacilla flava* | Yellow Wagtail | PM | 0 | This species is a rare but regular migrant to coastal areas within Australia. It typically inhabits open habitats, often near water and occasionally on drier inland plains and edges of mangroves (Morcombe, 2003). | **Low –** There are no local records of this species within 20km of the study area. It is considered that habitat for this species within the study area is degraded or absent as water bodies are scarce within the study area and inland plains within the study area support no unique features for this species. Overall, it is considered that this species has a low likelihood of occurring within the study area. |
| SLC | M, Ma | Pandionidae | *Pandion haliaetus* | Osprey | PM | 0 | Found on the coasts, interior and many offshore islands of Australia, this species occurs in coastal habitats and terrestrial wetlands of tropical and temperate Australia. This species may travel inland along major rivers in its northern distribution (DAWE, 2021b and references therein). | **Low –** There are no local records of this species within 20km of the study area and preferred habitat for this species is not present within the study area. Overall, it is considered that this species has a low likelihood of occurring within the study area. |
| SLC | M, Ma | Scolopacidae | *Actitis hypoleucos* | Common Sandpiper | PM | 0 | Widespread but patchy distribution along all coastlines of Australia. Found in coastal wetlands and inland wetlands with varying levels of salinity (DAWE, 2021b and references therein). Most commonly found in muddy or rocky shores of estuaries, deltas of streams, banks upstream, lakes, pools, billabongs, reservoirs, and dams. | **Low –** There are no local records of this species within 20km of the study area and preferred habitat for this species is not present within the study area. Overall, it is considered that this species has a low likelihood of occurring within the study area. |
| SLC | M, Ma | Scolopacidae | *Calidris acuminata* | Sharp-tailed Sandpiper | PM | 0 | This species occurs around the entire coast of Australia outside its breeding season, where it is found in a broad range of permanent or ephemeral water bodies, primarily brackish (DAWE, 2021b and references therein). It prefers muddy edges of shallow fresh or brackish wetlands, and use flooded paddocks, sedge lands and other ephemeral wetlands. | **Low –** There are no local records of this species within 20km of the study area and preferred habitat for this species is not present within the study area. Overall, it is considered that this species has a low likelihood of occurring within the study area. |
| E | CE, M, Ma | Scolopacidae | *Calidris ferruginea* | Curlew Sandpiper | PM | 0 | This species occurs around the coasts of Australia and is quite widespread inland, with scattered records occurring in the Gulf of Carpentaria, with wide-spread records along the coast south of Cairns. This species mainly occurs on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets, lagoons and also around non-tidal swamps, lakes, and lagoons near the coast, foraging on mudflats and nearby shallow water (DAWE, 2021b and references therein). | **Low –** There are no local records of this species within 20km of the study area and preferred habitat for this species is not present within the study area. Overall, it is considered that this species has a low likelihood of occurring within the study area. |

| Status[1] | | Family | Scientific name | Common name | Source[2] | WO records | Ecology | Potential to occur in the study area |
|---|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | | | | |
| SLC | M, Ma | Scolopacidae | *Calidris melanotos* | Pectoral Sandpiper | PM | 0 | This species occurs around the coasts of Australia and is quite widespread inland, with scattered records occurring in the Gulf of Carpentaria and wide-spread records along the coast south of Cairns. This species mainly occurs on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets, lagoons and also around non-tidal swamps, lakes, and lagoons near the coast, foraging on mudflats and nearby shallow water (DAWE, 2021b and references therein). | **Low –** There are no local records of this species within 20km of the study area and preferred habitat for this species is not present within the study area. Overall, it is considered that this species has a low likelihood of occurring within the study area. |
| SLC | M, Ma | Scolopacidae | *Gallinago hardwickii* | Latham's Snipe | PM | 0 | This species is distributed along the east coast of Australia from Cape York Peninsula south to south eastern Australia. It occurs in permanent and ephemeral wetlands with low to dense vegetation up to 2000m above sea level (DAWE, 2020b and references therein). This species is known to occur close to humans and human activity (i.e., near roads, railways, airfields, commercial or industrial complexes) (DAWE, 2020b and references therein). Though it is described as utilising areas of permanent or temporary inundation, including streams in a wide range of habitat types, literature and records indicate that it does not occur in dense, closed-canopy rainforest and vine forest (DAWE, 2020b and references therein). | **Low –** There are no local records of this species within 20km of the study area and preferred habitat for this species is not present within the study area. Overall, it is considered that this species has a low likelihood of occurring within the study area. |

1. Status: SLC – Special Least Concern, E = Endangered, CE = Critically Endangered, M = Migratory, Ma = Marine

2. Source: WO = Queensland Government Wildlife Online Database Extract (20km radius search area), PM = EPBC Act Protected Matters Report

# APPENDIX E

Ground-truthed Vegetation Communities

**Table E1 Floristic composition and structure of ground-truthed REs within the study area with a short REDD (Regional Ecosystem Description Database) provided**

| Description and status | Ground-truthed floristic composition and structure | Representative photograph |
|---|---|---|
| **RE 2.10.5a**<br><br>**VMA Status:** Least concern<br>**Biodiversity Status:** No concern at present<br><br>**REDD short description:**<br>*Acacia shirleyi* woodland and *Triodia pungens* hummock grassland on scarps and stony ledges. | T1: Sparse 7 – 10m<br>• *Eucalyptus chartaboma* (CD-A), *Acacia julifera ssp. julifera* (CD-A), *Acacia shirleyi* (CD-A), *Callitris intratropica* (A), *Alphitonia excelsa* (A).<br>T2: Sparse 4 – 6m<br>• *A. julifera ssp. julifera* (D), *Acacia leptostachya* (SD-A), *C. intratropica* (A), *Grevillea glauca* (A), *Petalostigma banksia* (A), *Alphitonia excelsa* (A).<br>S1: Sparse to Mid-dense 0.5 – 2.5m<br>• *A. leptostachya* (D), *Grevillea decora* (A), *Terminalia aridicola* (A), *P. banksii* (A), *A. excelsa* (A), *Pandorea pandorana* (A), *Premna tomentosa* (A), *Persoonia falcata* (A), *Grevillea mimosoides* (A).<br>G: Very sparse to Sparse 0 - 0.5m<br>• *Schizachyrium fragile* (CD), *Eriachne ciliata* (CD-A), *Aristida sp.* (CD-A), *Gomphrena flaccida* (A), *Polycarpaea corymbosa* (A), Triodia sp. (A), *Cheilanthes spp.* (A), *Bidens bipinnata* (A). |  |
| **RE 9.3.13**<br><br>**VMA Status:** Least concern<br>**Biodiversity Status:** Of concern<br><br>**REDD short description:**<br>*Melaleuca spp.*, *Eucalyptus camaldulensis* and *Casuarina cunninghamiana* fringing open forest on streams and channels. | T1: Sparse to Mid-dense 10 - 15m<br>• *Eucalyptus camaldulensis* (CD-SD), *Melaleuca fluviatilis* (CD-SD), *Lophostemon grandiflorus* (A).<br>T2: Sparse to Mid-dense 5 – 9m<br>• *M. fluviatilis* (CD-A), *Melaleuca bracteata* (CD-A), *L. grandiflorus* (A), *E. camaldulensis* (A), *Ficus opposita* (A).<br>S1: Sparse 0.5 – 2.5m<br>• *M. fluviatilis* (CD-A), *M. bracteata* (CD-A) ***Cryptostegia grandiflorus* (A), *F. opposita* (A), *Exocarpus latifolius* (A).<br>G: Mid-dense to Dense 0 - 0.5m<br>• **Megathyrsus maximus* (D), *Crotalaria novae-hollandiae* (A) *Crotalaris verrucosa* (A), *Crotalaria medicaginea* (A), *Bothriochloa spp.* (A), **Themeda quadrivalvis* (A), *Dichanthium sericium* (A), *Ammannia multiflora (A), B. bipinnata* (A). |  |

| Description and status | Ground-truthed floristic composition and structure | Representative photograph |
|---|---|---|
| **RE 9.3.26**<br><br>**VMA Status:** Least concern<br>**Biodiversity Status:** Of concern<br><br>**REDD short description:**<br>Mixed grassland to open grassland including *Eragrostis sp*., *Aristida sp*., *Enneapogon sp*., *Iseilema sp*., *Chloris sp*., or *Dichanthium sp*. on non-basalt derived alluvial deposits. | T1: Very sparse 10.6 –11.8m<br>• *Eucalyptus microneura* (D).<br>T2: Very sparse 5 – 7m<br>• *E. microneura* (D).<br>S1: Very sparse to Sparse 0.5 – 2.4m<br>• *Tephrosia sp.* (D), *Carissa lanceolata* (A), *Denhamia cunninghamii* (A), *Capparis mitchelli* (A), *Erythroxyllum australe* (A), *Melhania oblongifolia* (A).<br>G: Sparse – Mid-dense 0 - 0.5m<br>• *D. sericeum* (D), *Aristida sp.* (SD), *Grewia savannicola* (A), *C. verrucosa* (A), *Glycine sp.* (A), *Heteropogon contortus* (A). |  |
| **RE 9.5.10a**<br><br>**VMA Status:** Least concern<br>**Biodiversity Status:** No concern at present<br><br>**REDD short description:**<br>*Eucalyptus microneura +/- Terminalia spp.* low woodland on sand sheets. | T1: Sparse 10.5 – 14m<br>• *E. microneura* (D).<br>T2: Very sparse 5-9m<br>• *E. microneura* (CD-SD), *Melaleuca citrolens* (CD-A), *Diospyros humilis* (A), *Vachellia bidwillii* (A), *D. cunninghamii* (A).<br>S1: Very sparse to Sparse 0.5 – 3m<br>• *E. australe* (CD-A), *C. lanceolata* (CD-SD), *Alphitonia excelsa* (A), *V. bidwillii* (A), *Petalostigma pubescens* (A), *Atalaya hemiglauca* (A).<br>G: Sparse 0 - 0.5m<br>• *D. sericeum* (CD-A), *Aristida sp.* (CD-SD) *Themeda triandra* (A), *Heteropogon contortus* (A), *C. lanceolata* (A). |  |

| Description and status | Ground-truthed floristic composition and structure | Representative photograph |
|---|---|---|
| **RE 9.11.16**<br><br>**VMA Status:** Least concern<br>**Biodiversity Status:** No concern at present<br><br>**REDD short description:**<br>*Eucalyptus crebra* +/- *Corymbia erythrophloia* or *Corymbia pocillum* woodland on steep to rolling hills. | T1: Sparse 12 – 15m<br>• *Eucalyptus crebra* (D).<br>T2: Very sparse 4 – 7m<br>• *E. crebra (CD), A. leptostachya (CD-A)*, *Terminalia aridicola* (SD), *A. excelsa* (A), *D. cunninghamii* (A).<br>S1: Very sparse 0.5 – 3m<br>• *Petalostigma banksii* (D), *V. bidwillii* (A), *A. excelsa* (A), *Indigofera sp.* (A), *G. mimosoides* (A).<br>G: Sparse 0 - 0.5m<br>• *Aristida sp.* (D), **Stylosanthes scabra* (A), *P. banksii* (A), *Enneapogon lindleyanus* (A), *H. contortus* (A), *Glycine sp.* (A). |  |
| **RE 9.12.11**<br><br>**VMA Status:** Least concern<br>**Biodiversity Status:** No concern at present<br><br>**REDD short description:**<br>*E. crebra* and/or *Eucalyptus whitei* +/- *C. erythrophloia* open woodland on steep to rolling hills on igneous rocks. | T1: Very sparse to Mid-dense 7 – 10m<br>• *E. crebra* (D, SD, or A), *A. shrileyi* (D, SD, or A), *Corymbia erythrophloia* (A), *Erythrophleum chlorostachys* (A).<br>T2: Very sparse to Sparse 2.5 – 5m<br>• *P. banksia* (CD-A), *A. excelsa* (SD-A), *T. aridicola* (A), *A. excelsa* (A), *G. parallela* (A), *G. glauca* (A), *G. mimosoides* (A).<br>S1: Very sparse to Sparse 0.5 – 2m<br>• *P. banksii* (CD), *A. excelsa* (A), *C. lanceolata* (CD-A), *E. australe* (A), *A. leptostachya* (A), *Acacia disparrima* (A), *Acacia gonoclada* (A).<br>G: Sparse – Mid-dense 0 - 0.5m<br>• *A. contortus* (D), *Cymbopogon bombycinus* (A), *Themeda triandra* (A), *S. fragile* (A), *Zornia sterlingii* (A) *Brunoniella acaulis* (A), *Aristida* sp. (A), *B. bipinnata* (A). |  |

# APPENDIX F

Flora Species List

## Table F1 Flora species recorded within the study area

| Status | | Family | Scientific name | Common name | Regional Ecosystem | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | 2.10.5a | 9.3.13 | 9.3.26 | 9.5.10a | 9.11.16 | 9.12.11 |
| LC | - | Acanthaceae | *Brunoniella acaulis* | Blue trumpet | | | | | | X |
| LC | - | Acanthaceae | *Rostellularia adscendens* | Pink tongues | | | | | X | X |
| LC | - | Amaranthaceae | *Achyranthes aspera* | Chaff weed | | | | | X | X |
| LC | - | Amaranthaceae | *Gomphrena flaccida* | Bunched Gomphrena | X | | | | | |
| * | - | Amaranthaceae | *Gomphrena celosioides* | Gomphrena weed | | X | | | | |
| LC | - | Apocynaceae | *Carissa lanceolata* | Konkerberry | | | | X | | X |
| ** | - | Apocynaceae | *Cryptostegia grandiflora* | Rubber Vine | | X | | | | |
| LC | - | Araliaceae | *Trachymene glaucifolia* | Wild parsnip | X | | | | | |
| * | - | Asteraceae | *Bidens bipinnata* | Bidens | X | | | X | X | X |
| * | - | Asteraceae | *Emilia sonchifolia* | Lilac tasselflower | | | | | | X |
| LC | - | Asteraceae | *Pterocaulon sphacelatum* | Fruit-salad plant | | | | | X | X |
| * | - | Asteraceae | *Xanthium occidentale* | Noogoora burr | | X | | | | |
| LC | - | Bignoniaceae | *Dolichandrone heterophylla* | Lemonwood | | | | X | | X |
| LC | - | Bignoniaceae | *Pandorana pandorana* | Wonga vine | X | | | | | |
| LC | - | Boraginaceae | *Trichodesma zeylanicum* | Camel bush | | X | | | | |
| LC | - | Burseraceae | *Canarium australasicum* | Mango bark | | | | | | X |
| LC | - | Byttneriaceae | *Waltheria indica* | Sleepy morning | | | | X | | X |
| LC | - | Capparaceae | *Capparis mitchellii* | Native Orange | X | | | | X | |
| LC | - | Caryophyllaceae | *Polycarpaea corymbosa* | Oldman's cap | X | | | | | |
| LC | - | Celastraceae | *Denhamia cunninghamii* | Yellowberry bush | | | | X | X | X |

| Status | | Family | Scientific name | Common name | Regional Ecosystem | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | 2.10.5a | 9.3.13 | 9.3.26 | 9.5.10a | 9.11.16 | 9.12.11 |
| LC | - | Cleomaceae | *Cleome viscosa* | Tickweed | X | X | X | X | X | X |
| LC | - | Combretaceae | *Terminalia aridicola* | Arid peach | X | | | X | X | X |
| LC | - | Convolvulaceae | *Evolvulus alsinoides* | Dwarf Ipomoea | X | | | X | X | X |
| LC | - | Convolvulaceae | *Ipomoea sp.* | Morning glory | X | | | | | |
| LC | - | Convolvulaceae | *Xenostegia tridentata* | Arrow-leaf morning glory | | | | | X | X |
| LC | - | Cucurbitaceae | *Cucumis sp.* | Melon | | | | | | X |
| LC | - | Cupressacaceae | *Callitris intratropica* | Coast cypress pine | X | | | | | |
| LC | - | Ebenaceae | *Diospyros humilis* | Queensland ebony | | | | X | | X |
| LC | - | Erythroxylaceae | *Erythroxylum australe* | Cocaine bush | X | | | X | X | X |
| LC | - | Erythroxylaceae | *Erythroxylum ellipticum* | Brown plum | X | | | X | X | X |
| LC | - | Euphorbiaceae | *Croton arnhemicus* | Hard cascarilla | | | | | | X |
| * | - | Euphorbiaceae | *Euphorbia hirta* | Asthma plant | | | | | X | X |
| LC | - | Euphorbiaceae | *Euphorbia sp.* | Spurge | | | | X | | |
| LC | - | Lamiaceae | *Clerodendrum floribundum* | Lolly bush | | | | X | | |
| * | - | Lamiaceae | *Mesosphaerum suaveolens* | Hyptis | X | X | X | X | X | X |
| LC | - | Lamiaceae | *Premna tomentosa* | Teak | | | | | X | X |
| LC | - | Lauraceae | *Cassytha sp.* | Devils twine | | | | | X | |
| LC | - | Laxmanniaceae | *Lomandra multiflora* | Many-flowered mat-rush | | | | | | X |
| LC | - | Lecythidaceae | *Planchonia careya* | Cocky apple | | | | | | X |
| LC | - | Leguminosae (Fabaceae) | *Abrus precatorius* | Crab's eye | | | | | | X |
| LC | - | Leguminosae (Mimosaceae) | *Acacia disparrima* | Southern salwood | | | | | X | X |
| LC | - | Leguminosae (Mimosaceae) | Acacia galioides | - | | | | | X | X |

| Status | | Family | Scientific name | Common name | Regional Ecosystem | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | 2.10.5a | 9.3.13 | 9.3.26 | 9.5.10a | 9.11.16 | 9.12.11 |
| LC | - | Leguminosae (Mimosaceae) | *Acacia gonoclada* | Ganambureng | | | | | | X |
| LC | - | Leguminosae (Mimosaceae) | *Acacia julifera ssp. julifera* | Catkin wattle | X | | | | | |
| LC | - | Leguminosae (Mimosaceae) | *Acacia leptostachya* | Showy wattle | X | | | | X | X |
| LC | - | Leguminosae (Mimosaceae) | *Acacia orthocarpa* | Pilbara weeping wattle | | | | | X | X |
| LC | - | Leguminosae (Mimosaceae) | *Acacia shirleyi* | Lancewood | X | | | | | |
| LC | - | Leguminosae (Fabaceae) | *Aeschynomene sp.* | - | | | | | | X |
| LC | - | Leguminosae (Caesalpiniaceae) | *Chamaecrista absus* | Four-leafed cassia | X | | | | | |
| * | - | Leguminosae (Fabaceae) | *Clitoria ternatea* | Blue butterfly pea | | | | | | X |
| LC | - | Leguminosae (Fabaceae) | *Crotalaria medicaginea* | Trefoil rattlepod | | X | X | | | |
| LC | - | Leguminosae (Fabaceae) | *Crotalaria novae-hollandiae* | New Holland rattlepod | | X | X | | | |
| LC | - | Leguminosae (Fabaceae) | *Crotalaria verrucosa* | Blue-flowered rattlepod | | X | X | | | |
| LC | - | Leguminosae (Caesalpiniaceae) | *Erythrophleum chlorostachys* | Cooktown ironwood | X | | | X | X | X |
| LC | - | Leguminosae (Fabaceae) | *Hovea longipes* | Brush Hovea | X | | | | | |
| LC | - | Leguminosae (Fabaceae) | *Indigofera hirsuta* | Hairy indigo | X | | | | X | X |
| LC | - | Leguminosae (Fabaceae) | *Indigofera linifolia* | Narrow-leafed indigo | | | | X | | |
| LC | - | Leguminosae (Fabaceae) | *Indigofera linnaei* | Birdsville indigo | | | | X | | |
| LC | - | Leguminosae (Fabaceae) | *Indigofera pratensis* | Forest indigo | X | | | | X | X |
| LC | - | Leguminosae (Fabaceae) | *sp.* | - | X | | | | X | X |
| LC | - | Leguminosae (Caesalpiniaceae) | *Lysiphyllum cunninghamii* | Kimberly bauhinia | | X | | | | |
| LC | - | Leguminosae (Fabaceae) | *Rhynchosia minima* | Least snout-bean | | | | x | X | X |
| LC | - | Leguminosae (Fabaceae) | *Sesbania cannabina* | Yellow pea bush | | | | | | X |
| * | - | Leguminosae (Fabaceae) | *Stylosanthes scabra* | Stylo | X | | | X | X | X |

| Status | | Family | Scientific name | Common name | Regional Ecosystem | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | 2.10.5a | 9.3.13 | 9.3.26 | 9.5.10a | 9.11.16 | 9.12.11 |
| LC | - | Leguminosae (Mimosaceae) | *Tephrosia sp.* | - | | | X | X | | |
| LC | - | Leguminosae (Fabaceae) | *Uraria lagopodioides* | Velcro pea | X | | | | X | X |
| LC | - | Leguminosae (Mimosaceae) | *Vachellia bidwillii* | Corkwood wattle | | | | X | | X |
| LC | - | Leguminosae (Mimosaceae) | *Zornia sp.* | - | | | | | | X |
| LC | - | Leguminosae (Fabaceae) | *Zornia stirlingii* | - | | | | | | X |
| LC | - | Lythraceae | *Ammannia multiflora* | Jerry-jerry | | X | | | | |
| LC | - | Malvaceae | *Abutilon sp.* | Mallow | | | | | | X |
| LC | - | Malvaceae | *Hibiscus meraukensis* | Merauke Hibuscus | X | | | X | X | X |
| * | - | Malvaceae | *Malvastrum americanum* | Spiked Malvastrum | | | | | | X |
| LC | - | Menispermaceae | *Tinospora smilacina* | Snake vine | X | | | X | X | X |
| LC | - | Moraceae | *Ficus opposita* | Sandpaper fig | | X | | | | |
| LC | - | Myrtaceae | *Corymbia confertiflora* | - | | | X | X | | |
| LC | - | Myrtaceae | *Corymbia dallachiana* | Dallachy's ghost gum | | | | X | X | X |
| LC | - | Myrtaceae | *Corymbia tessellaris* | Moreton Bay ash | | X | | | | |
| LC | - | Myrtaceae | *Eucalyptus camaldulensis* | River red gum | | X | | | | |
| LC | - | Myrtaceae | *Eucalyptus chartaboma* | Paperbark gum | X | | | | | |
| LC | - | Myrtaceae | *Eucalyptus crebra* | Narrow-leaved ironbark | | | | X | X | X |
| LC | - | Myrtaceae | *Eucalyptus microneura* | Gilbert River box | | | | X | X | X |
| LC | - | Myrtaceae | *Lophostemon grandiflorus* | Swamp box | | X | | | | |
| LC | - | Myrtaceae | *Melaleuca bracteata* | Black tea-tree | | X | | | | |
| LC | - | Myrtaceae | *Melaleuca citrolens* | Gularn | | X | | | | |
| LC | - | Myrtaceae | *Melaleuca fluviatilis* | Weeping tea-tree | | X | | | | |

| Status | | Family | Scientific name | Common name | Regional Ecosystem | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | 2.10.5a | 9.3.13 | 9.3.26 | 9.5.10a | 9.11.16 | 9.12.11 |
| LC | - | Myrtaceae | *Melaleuca nervosa* | Fibrebark | | | | X | | |
| LC | - | Orchidaceae | *Cymbidium canaliculatum* | Black orchid | | X | X | X | X | X |
| LC | - | Orobanchaceae | *Buchnera linearis* | Blackrod | | | | | | X |
| * | - | Passifloraceae | *Passiflora foetida* | Stinking passionflower | X | | | | | |
| LC | - | Pentapetaceae | *Melhania oblongifolia* | Melhania | X | | | X | X | X |
| LC | - | Phyllanthaceae | *Breynia oblongifolia* | Coffee bush | | | | | | X |
| LC | - | Phyllanthaceae | *Flueggea virosa* | Common bushweed | | X | | | | X |
| LC | - | Picrodendraceae | *Petalostigma banksii* | Quinine bush | X | | | X | X | X |
| LC | - | Picrodendraceae | *Petalostigma pubescens* | Quinine | | | | X | | |
| LC | - | Pittosporaceae | *Bursaria incana* | Prickly pine | X | | | | | X |
| LC | - | Poaceae | *Aristida sp.* | - | | | | X | X | X |
| LC | - | Poaceae | *Aristida calycina* | Dark wire grass | | | | | X | X |
| LC | - | Poaceae | *Arundinella nepalensis* | River grass | X | | | | X | X |
| LC | - | Poaceae | *Bothriochloa bladhii* | Bluestem | | X | | | | |
| LC | - | Poaceae | *Bothriochloa decipiens* | Pitted bluegrass | | X | | | | |
| * | - | Poaceae | *Bothriochloa pertusa* | Indian bluegrass | | X | | | | |
| LC | - | Poaceae | *Chrysopogon fallax* | Golden-beard grass | | | | X | | |
| LC | - | Poaceae | *Cymbopogon bombycinus* | Lemon-scented grass | X | | | | X | X |
| LC | - | Poaceae | *Dichanthium sericeum* | Queensland bluegrass | | X | | | | |
| LC | - | Poaceae | *Enneapogon lindleyanus* | Lindley nineawn | | | | | X | X |
| LC | - | Poaceae | *Enneapogon polyphyllus* | Leafy nineawn | X | | | | | |
| LC | - | Poaceae | *Eriachne ciliata* | Wanderrie grass | X | | | | X | X |

| Status | | Family | Scientific name | Common name | Regional Ecosystem | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | 2.10.5a | 9.3.13 | 9.3.26 | 9.5.10a | 9.11.16 | 9.12.11 |
| LC | - | Poaceae | *Heteropogon contortus* | Black speargrass | | | | X | X | X |
| LC | - | Poaceae | *Heteropogon triticeus* | Giant speargrass | | | | | X | X |
| * | - | Poaceae | *Megathyrsus maximus* | Guinea grass | | X | | | | |
| * | - | Poaceae | *Melinis repens* | Red Natal grass | | | | | | X |
| LC | - | Poaceae | *Panicum sp.* | Panic grass | | X | | | | |
| LC | - | Poaceae | *Schizachyrium fragile* | Fire grass | X | | | X | X | X |
| LC | - | Poaceae | *Setaria surgens* | Pigeon grass | | X | | | | |
| LC | - | Poaceae | *Sporobolus caroli* | Fairy grass | | X | | | | |
| * | - | Poaceae | *Themeda quadrivalvis* | Grader grass | | X | | | | |
| LC | - | Poaceae | *Themeda triandra* | Kangaroo grass | | | | X | X | X |
| LC | - | Poaceae | *Triodia sp.* | Spinifex | | | | | X | X |
| LC | - | Portulacaceae | *Calandrinia uniflora* | - | | | | X | | |
| * | - | Portulacaceae | *Portulaca oleracea* | Common purslane | | | | X | | |
| LC | - | Proteaceae | *Grevillea decora* | - | X | | | | | |
| LC | - | Proteaceae | *Grevillea glauca* | Bushman's clothes peg | | | | | | X |
| LC | - | Proteaceae | *Grevillea mimosoides* | Tar Grevillea | | | | | x | X |
| LC | - | Proteaceae | *Grevillea parallela* | Silver oak | X | | | X | X | X |
| LC | - | Proteaceae | *Grevillea striata* | Beefwood | | | | X | X | X |
| LC | - | Proteaceae | *Hakea arborescens* | Common Hakea | | | | | X | X |
| LC | - | Proteaceae | *Hakea lorea* | Bootlace oak | | | | X | | |
| LC | - | Proteaceae | *Persoonia falcata* | Wild pear | X | | | | | |
| LC | - | Pteridaceae | *Cheilanthes brownii* | Rock fern | X | | | | | |

| Status | | Family | Scientific name | Common name | Regional Ecosystem | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | 2.10.5a | 9.3.13 | 9.3.26 | 9.5.10a | 9.11.16 | 9.12.11 |
| LC | - | Pteridaceae | *Cheilanthes nitida* | Rock fern | X | | | | | |
| LC | - | Pteridaceae | *Cheilanthes sieberi* | Rock fern | X | | | | | |
| LC | - | Santalaceae | *Exocarpos latifolius* | Native cherry | | X | | | | |
| LC | - | Santalaceae | *Santalum lanceolatum* | Northern sandalwood | X | | | | | |
| LC | - | Sapindaceae | *Atalaya hemiglauca* | Whitewood | | | | X | | |
| LC | - | Sapindaceae | *Dodonaea physocarpa* | - | | | | | X | X |
| LC | - | Sapotaceae | *Sersalisia sericea* | Mongo | | | | | | X |
| * | - | Solanaceae | *Datura ferox* | Long-spined thorn-apple | | X | | | | |
| LC | - | Solanaceae | *Solanum ellipticum* | Potato bush | | | | | X | X |
| LC | - | Sparrmanniaceae | *Grewia savannicola* | Dog's balls | | | | X | X | X |
| LC | - | Rhamnaceae | *Alphitonia excelsa* | Soap tree | X | | | X | X | X |
| LC | - | Rubiaceae | *Coelospermum reticulatum* | Medicine bush | X | | | | | |
| LC | - | Rubiaceae | *Larsenaikia ochreata* | Native gardenia | X | | | | X | X |
| LC | - | Rubiaceae | *Pavetta granitica* | - | | | | | X | |
| LC | - | Taccaceae | *Tacca leontopetaloides* | Polynesian arrowroot | | | | | | X |
| LC | - | Violaceae | *Afrohybanthus enneaspermus* | Lady's slipper | | | | | | X |
| LC | - | Vitaceae | *Cayratia trifolia* | Bush grape | | X | X | | | |

Status: LC = Least Concern, * = non-native to Australia, ** = species that is a restricted invasive plant in Queensland.

NCA = *Nature Conservation Act 1992,* EPBC = *Environment Protection and Biodiversity Conservation Act 1999*

# APPENDIX G

Fauna Species List

**Table G1 Fauna species recorded within the study area**

| Status | | Family | Scientific name | Common name | Survey site | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | 1 | 2 | 3 | 4 | 5 | 6 | Incidental |
| **BIRDS** | | | | | | | | | | | |
| LC | - | Anatidae | *Anas superciliosa* | Pacific black duck | | | | | | | X |
| LC | - | Podicepidae | *Tachybaptus novaehollandiae* | Australasian grebe | | | | | | | X |
| LC | - | Columbidae | *Geophaps scripta* | Squatter Pigeon | | | | | | | X |
| LC | - | Columbidae | *Ocyphaps lophotes* | Crested pigeon | X | | | | | | X |
| LC | - | Columbidae | *Geopelia striata* | Peaceful dove | X | | X | X | | | X |
| LC | - | Columbidae | *Phaps chalcoptera* | Common bronzewing | X | X | | | | | X |
| LC | - | Podargidae | *Podargus strigoides* | Tawny frogmouth | X | | | | | | X |
| LC | - | Eurostopodidae | *Eurostopodus argus* | Spotted nightjar | | | | | | | X |
| LC | - | Accipitridae | *Aquila audax* | Wedge-tailed eagle | | | | | | | X |
| LC | - | Accipitridae | *Accipiter fasciatus* | Brown goshawk | | | X | X | | | X |
| LC | - | Accipitridae | *Haliastur sphenurus* | Whistling kite | | | | | | | X |
| LC | - | Accipitridae | *Milvus migrans* | Black kite | | | | | | | X |
| LC | - | Falconidae | *Falco berigora* | Brown falcon | | X | | | | | X |
| LC | - | Gruidae | *Grus rubicunda* | Brolga | | | | | | | X |
| LC | - | Otididae | *Ardeotis australis* | Australian bustard | | | | X | | | |
| LC | - | Cacatuidae | *Calyptorhynchus banksii* | Red-tailed black-cockatoo | X | | | | | | X |
| LC | - | Cacatuidae | *Cacatua galerita* | Sulphur-crested cockatoo | | | | | | | X |
| LC | - | Cacatuidae | *Eolophus roseicapillus* | Galah | | | | | | | X |
| LC | - | Cuculidae | *Centropus phasianinus* | Pheasant coucal | | | | X | | | |
| LC | - | Cuculidae | *Scythrops novaehollandiae* | Channel-billed cuckoo | | | | X | | | |
| LC | - | Strigidae | *Ninox novaeseelandiae* | Southern boobook | | | | X | X | | X |
| LC | - | Psittacidae | *Platycercus adscitus* | Pale-headed rosella | X | X | X | X | | X | X |
| LC | - | Psittacidae | *Aprosmictus erythropterus* | Red winged parrot | | | | X | | | |
| LC | - | Psittacidae | *Trichoglossus haematodus moluccanus* | Rainbow lorikeet | X | X | | | | | X |
| LC | - | Halcyonidae | *Dacelo leachii* | Blue-winged kookaburra | X | X | | | | | X |
| LC | - | Halcyonidae | *Dacelo novaeguineae* | Laughing kookaburra | | | X | | | | X |
| LC | - | Ptilonorhynchidae | *Ptilonorhynchus nuchalis* | Great bowerbird | | | | | | | X |
| LC | - | Acanthizidae | *Gerygone albogularis* | White-throated gerygone | | | | | | | X |
| LC | - | Acanthizidae | *Smicrornis brevirostris* | Weebill | X | | | | | | X |
| LC | - | Pardalotidae | *Pardalotus striatus* | Striated pardalote | X | | X | | | | X |
| LC | - | Meliphagidae | *Entomyzon cyanotis* | Blue-faced honeyeater | X | | | | | | X |
| LC | - | Meliphagidae | *Manorina flavigula* | Yellow-throated miner | X | | X | | | | X |
| LC | - | Meliphagidae | *Melithreptus albogularis* | White-throated honeyeater | X | | X | X | | | |
| LC | - | Meliphagidae | *Philemon corniculatus* | Noisy Friarbird | X | X | | X | X | X | X |
| LC | - | Meliphagidae | *Philemon citreogularis* | Little friarbird | | X | | | | | |
| LC | - | Campephagidae | *Coracina novaehollandiae* | Black-faced cuckoo-shrike | X | | X | X | | | X |
| LC | - | Oriolidae | *Oriolus sagittatus* | Olive-backed oriole | | | X | | | | |

| Status | | Family | Scientific name | Common name | Survey site | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | 1 | 2 | 3 | 4 | 5 | 6 | Incidental |
| LC | - | Artamidae | *Artamus minor* | Little woodswallow | | X | X | | | | X |
| LC | - | Corcoracidae | *Struthidea cinerea* | Apostlebird | | | | | | | X |
| LC | - | Artamidae | *Cracticus nigrogularis* | Pied butcherbird | X | | X | X | | X | X |
| LC | - | Artamidae | *Cracticus torquatus* | Grey butcherbird | | X | X | | | | X |
| LC | - | Artamidae | *Strepera graculina graculina* | Pied currawong | X | X | X | | X | X | X |
| LC | - | Artamidae | *Cracticus tibicen* | Australian magpie | X | | X | X | | | X |
| LC | - | Rhipiduridae | *Rhipidura leucophrys* | Willie wagtail | X | | | | | | X |
| LC | - | Rhipiduridae | *Rhipidura albiscapa* | Grey Fantail | | X | | | | | |
| LC | - | Corvidae | *Corvus orru* | Toressian Crow | X | X | X | X | | | X |
| LC | - | Monarchidae | *Grallina cyanoleuca* | Magpie lark | | | | | | | X |
| LC | - | Nectariniidae | *Dicaeum hirundinaceum* | Mistletoebird | X | | X | X | | | X |
| LC | - | Estrildidae | *Taeniopygia bichenovii* | Double-barred finch | | | X | | | | |
| **MAMMALS** | | | | | | | | | | | |
| * | - | Bovidae | *Bos taurus* | European cattle | | | X | X | | | X |
| LC | - | Emballonuridae | *Saccolaimus flaviventris* | Yellow-bellied sheathtail bat | | | | X | X | X | X |
| LC | - | Emballonuridae | *Taphozous troughtoni* | Troughton’s sheathtail bat | | | | X | X | X | X |
| LC | - | Potoroidae | *Aepyprymnus rufescens* | Rufous bettong | X | | | | | | X |
| * | - | Leporidae | *Oryctolagus cuniculus* | European rabbit | | | | | | | X |
| LC | - | Macropodidae | *Macropus robustus* | Common wallaroo | | | | X | | X | X |
| LC | - | Macropodidae | *Macropus giganteus* | Eastern grey kangaroo | | | | | | | X |
| LC | - | Miniopteridae | *Miniopterus australis* | Little bent-wing bat | | | X | | | | |
| LC | - | Miniopteridae | *Miniopterus orianae* | Eastern bent-wing bat | | | | X | X | X | X |
| LC | - | Molossidae | *Chaerephon jobensis* | Greater northern freetail bat | | X | X | X | X | X | X |
| LC | - | Molossidae | *Ozimops lumsdenae* | Northern freetail bat | | | X | X | X | | X |
| LC | - | Molossidae | *Ozimops ridei* | Ride’s freetail bat | | | | | | | X |
| LC | - | Rhinolophidae | *Rhinolophus megaphyllus* | Eastern Horseshoe Bat | X | | | | | | X |
| LC | - | Vespertilionidae | *Chalinolobus nigrogriseus* | Hoary wattled bat | | | | X | X | X | X |
| LC | - | Vespertilionidae | *Nyctophilus sp.* | Long-eared bat | | | X | | | | |
| LC | - | Vespertilionidae | *Scotorepens balstoni* | Inland broad-nosed bat | X | | | | | | X |
| LC | - | Vespertilionidae | *Scotorepens greyii* | Little broad-nosed bat | X | X | X | X | X | | X |
| LC | - | Vespertilionidae | *Scotorepens sanborni* | Northern broad-nosed bat | | | X | X | | | X |
| LC | - | Vespertilionidae | *Vespadelus troughtoni* | Eastern cave bat | X | | X | X | X | X | X |
| LC | - | Vespertilionidae / Molossidae | *Chalinolobus nigrogriseus / Ozimops ridei* | Hoary wattled bat / Ride’s freetail bat | | | | | | | X |
| LC | - | Vespertilionidae | *Chalinolobus nigrogriseus / Scotorepens greyii* | Hoary wattled bat / Little broad-nosed bat | | | | X | | X | X |
| LC | - | Vespertilionidae | *Scotorepens greyii / Scotorepens sanborni* | Little broad-nosed bat / Northern broad-nosed bat | | | | X | X | | X |
| **REPTILES** | | | | | | | | | | | |
| LC | - | Elapidae | *Acanthophis antarcticus* | Common death adder | | | | | | | X |
| LC | - | Elapidae | *Demansia papuanensis* | Greater black whip snake | | | | | | | X |
| LC | - | Diplodactylidae | *Amalosia rhombifer* | Zigzag velvet gecko | | X | | X | | X | |

| Status | | Family | Scientific name | Common name | Survey site | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NCA | EPBC | | | | 1 | 2 | 3 | 4 | 5 | 6 | Incidental |
| LC | - | Scincidae | *Ctenotus sp.* | - | X | | | | | | |
| LC | - | Diplodactylidae | *Diplodactylus platyurus* | Eastern fat-tailed gecko | | | | | | X | |
| LC | - | Gekkonidae | *Gehyra dubia* | Dubious dtella | | | | X | | | X |
| LC | - | Gekkonidae | *Gehyra einasleighensis* | Einasleigh rock dtella | | | | X | X | | |
| LC | - | Gekkonidae | *Heteronotia binoei* | Bynoe's gecko | | | | X | X | X | X |
| * | - | Gekkonidae | *Hemidactylus frenatus* | Asian house gecko | | | | | | | X |
| LC | - | Gekkonidae | *Oedura argentea* | Silver-eyed velvet gecko | | | | | X | | X |
| NE | NE | Diplodactylidae | *Lucasium iris* | Gilbert ground gecko | | | | | X | | |
| LC | - | Diplodactylidae | *Oedura castelnaui* | Northern velvet gecko | | X | | | | X | |
| LC | - | Pygopodidae | *Lialis burtonis* | Burton’s legless lizard | | | | X | | | |
| LC | - | Scincidae | *Carlia munda* | Shaded-litter rainbow skink | X | X | | | | | |
| LC | - | Scincidae | *Carlia schmeltzii* | Robust rainbow skink | | | X | | | | |
| LC | - | Scincidae | *Cryptoblepharus sp.* | - | | | | | | X | |
| LC | - | Scincidae | *Morethia taeniopleura* | Fire-tailed skink | | | X | | | | X |
| LC | - | Varanidae | *Varanus tristis* | Black-headed monitor | | | | X | | | X |
| **AMPHIBIANS** | | | | | | | | | | | |
| * | - | Bufonidae | *Rhinella marina* | Cane toad | | | X | | X | | X |
| LC | - | Hylidae | *Litoria inermis* | Bumpy rocket frog | | | | | | | X |
| LC | - | Hylidae | *Litoria rubella* | Desert tree frog | | | | | | | X |
| LC | - | Limnodynastidae | *Platyplectrum ornatum* | Ornate burrowing frog | | | X | | | | |

Status: NE = Not Evaluated, LC = Least Concern , * = non-native to Australia

NCA = *Nature Conservation Act 1992,* EPBC = *Environment Protection and Biodiversity Conservation Act 1999*

# APPENDIX H

Microbat Call Interpretation Reports

# Microbat Call Identification Report

| | |
|---|---|
| **Prepared for ("Client"):** | SLR Consulting |
| **Survey location/project name:** | Agate Creek (Forsayth area) |
| **Survey dates:** | 25-29 May 2020 |
| **Client project reference:** | 623-20155-0002 |
| **Job no.:** | SLR-2005 |
| **Report date:** | 31 July 2020 |

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## Methods

### Data received

*Balance! Environmental* received 4314 full-spectrum audio files (WAV files), recorded over five consecutive nights (25th – 29th May 2020) using an Anabat Swift detector (Titley Scientific, Brisbane). GPS coordinates saved in the metadata for each recording indicate the detector was deployed at a new site each night.

### Bat-call analysis

The data were processed in three steps using *Anabat Insight* (Version 1.9.4; Titley Scientific, Brisbane):

1. All WAV files were scanned with a 'noise' filter to separate files containing only non-bat background noise from those with potentially identifiable calls.

2. WAV files that passed the 'noise' filter (*i.e.* contained bat calls) were then processed through a Decision Tree analysis to group calls with similar pulse characteristics (e.g. characteristic frequency, slope, duration) and apply tentative species labels.

3. Each "species" group was reviewed manually to verify and/or correct species labels by comparing call spectrograms and derived metrics with those of regionally relevant reference calls and published call descriptions (*e.g.* Reinhold *et al.* 2001; Milne 2002). For expediency of processing, for groups where calls were recorded in large quantity, once the constituent species of the group were identified for each night, the rest of the calls were left assigned only to the group label.

Species identification was also guided by considering probability of occurrence based on published distributional information (Churchill 2008; van Dyck *et al.* 2013) and/or records held in Atlas of Living Australia (http://www.ala.org.au).

### Reporting standard

The format and content of this report follows Australasian Bat Society standards for the interpretation and reporting of bat call data (Reardon 2003), available on-line at http://www.ausbats.org.au/.

Species nomenclature follows Jackson & Groves (2015).

## Results & Discussion

The noise filtration process excluded 3085 WAV files from further analysis. Some 1307 bat calls were identified in the remaining 1233 WAV files. More than 90% (1186) of the calls were recorded on the final night of deployment (29th May; see **Table 1**); and over half of those calls were from a single difficult-to-differentiate species group (*Chalinolobus nigrogriseus / Scotorepens greyii / S. sanborni*).

Twelve species were reliably identified from 549 (42%) of the recorded calls (**Table 1**, top section). The other 758 calls were assigned to three undifferentiated species-groups, all of which represented species that were otherwise positively identified (see lower portion of **Table 1**).

**Table 1** Microbat species recorded during the Agate Creek survey, 25-29 May 2020. Number of calls allocated per night to each species or "unresolved" species group

| Night of: | 25/5 | 26/5 | 27/5 | 28/5 | 29/5 | Species Total |
|---|---|---|---|---|---|---|
| **Positively identified calls** | | | | | | |
| *Rhinolophus megaphyllus* | 2 | | | | | 2 |
| *Chalinolobus nigrogriseus* | | | | 16 | 163 | 179 |
| *Nyctophilus* sp. | | | 1 | | | 1 |
| *Scotorepens balstoni* | 1 | | | | 4 | 5 |
| *Scotorepens greyii* | 2 | 1 | 68 | 3 | 27 | 101 |
| *Scotorepens sanborni* | | | 2 | | 9 | 11 |
| *Vespadelus troughtoni* | 2 | | 2 | 1 | 26 | 31 |
| *Miniopterus australis* | | | 4 | | | 4 |
| *Miniopterus orianae* | | | | | 3 | 3 |
| *Chaerephon jobensis* | | 3 | 3 | 5 | 175 | 186 |
| *Ozimops lumsdenae* | | | 1 | | 8 | 9 |
| *Ozimops ridei* | | | | | 17 | 17 |
| **Unresolved calls** | | | | | | |
| *C. nigrogriseus / S. greyii* | | | | 4 | 631 | 635 |
| *C. nigrogriseus / O. ridei* | | | | | 117 | 117 |
| *S. greyii / S. sanborni* | | | | | 6 | 6 |
| Detector-night Total | 7 | 4 | 81 | 29 | 1186 | 1307 |

## References


Churchill, S. (2008). *Australian Bats.* Jacana Books, Allen & Unwin; Sydney.

Jackson, S. and Groves, C. (2015). *Taxonomy of Australian Mammals*. CSIRO Publishing, Melbourne.

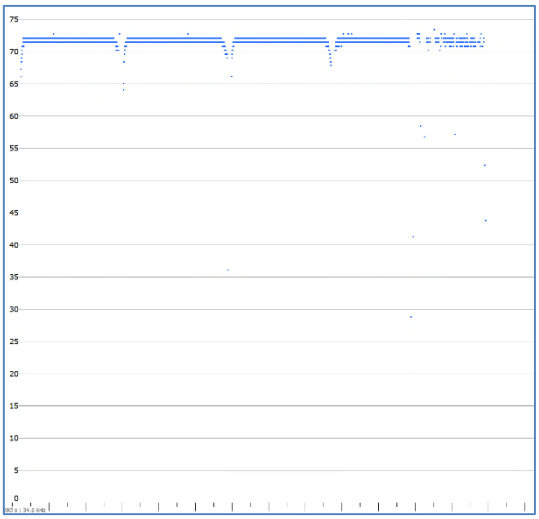
Milne, D.J. (2002). *Key to the Bat Calls of the Top End of the Northern Territory*. Technical Report No. 71, Parks and Wildlife Commission of the Northern Territory, Darwin.

Reardon, T. (2003). Standards in bat detector based surveys. *Australasian Bat Society Newsletter* **20**, 41-43.

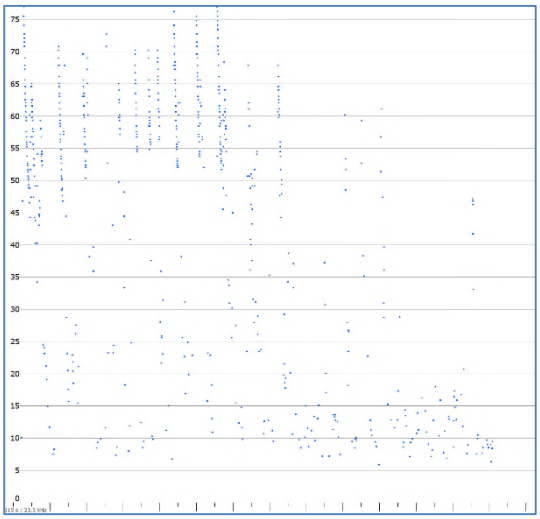
Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). *Key to the bat calls of south-east Queensland and north-east New South Wales*. Department of Natural Resources and Mines, Brisbane.

van Dyck, S., Gynther, I. and Baker, A. (ed.) (2013). *Field Companion to the Mammals of Australia*. New Holland; Sydney.

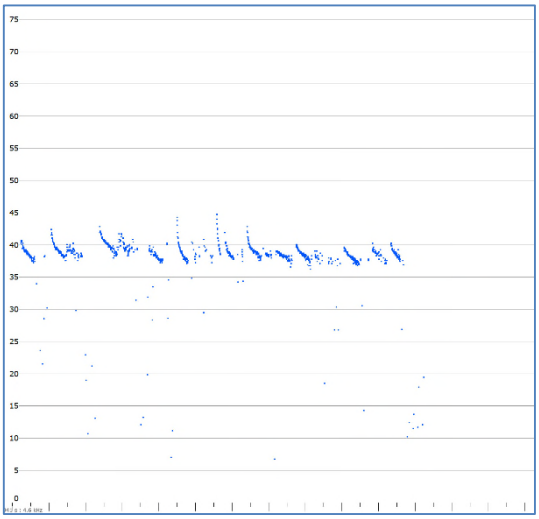
**Appendix 1** Representative call sequences recorded at Agate Creek, 25-29 May 2020.
*x*-axis = 10 ms per tick-mark; time between pulses removed (i.e. compressed view)



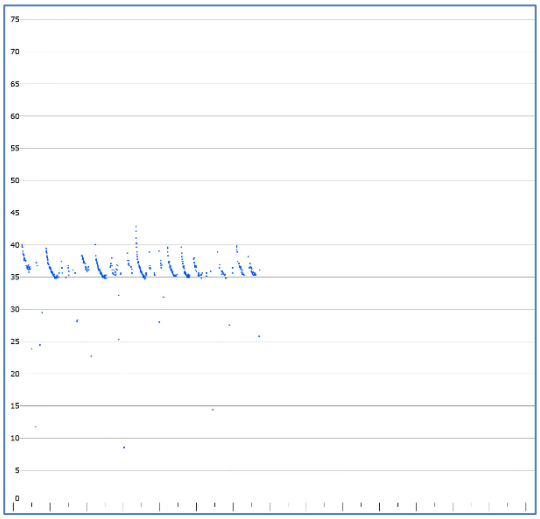
*Rhinolophus megaphyllus*



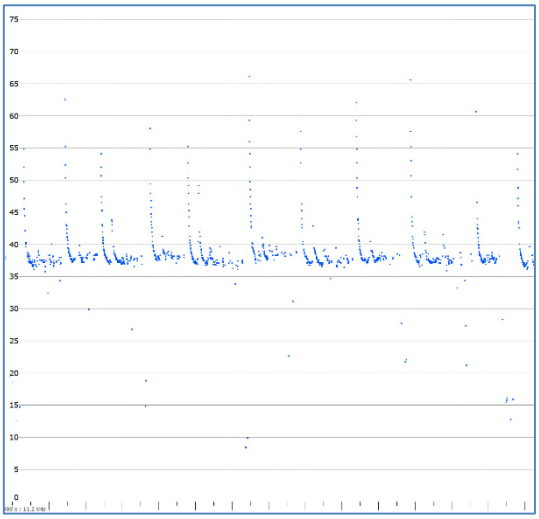
*Nyctophilus* sp.



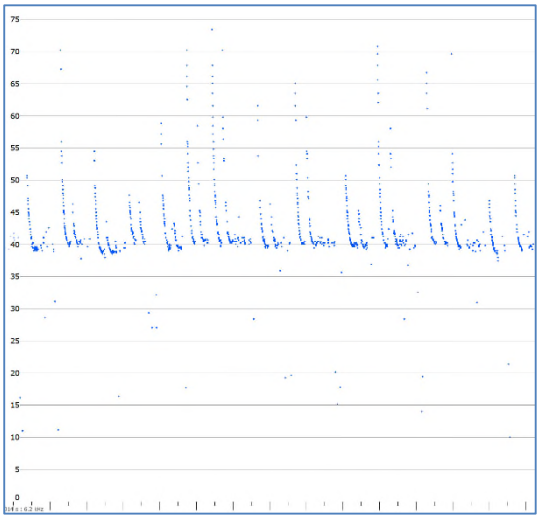
*Chalinolobus nigrogriseus*



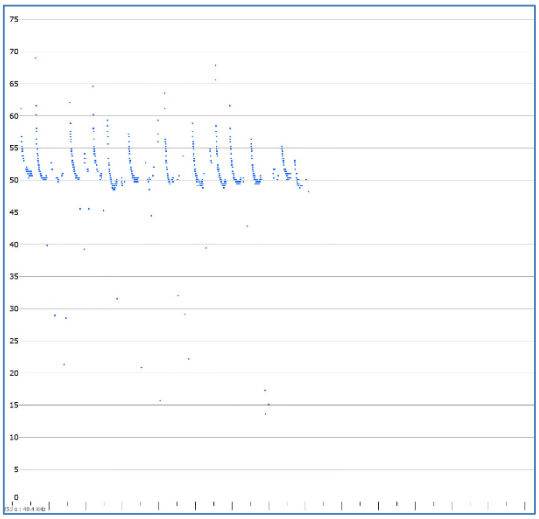
*Scotorepens balstoni*



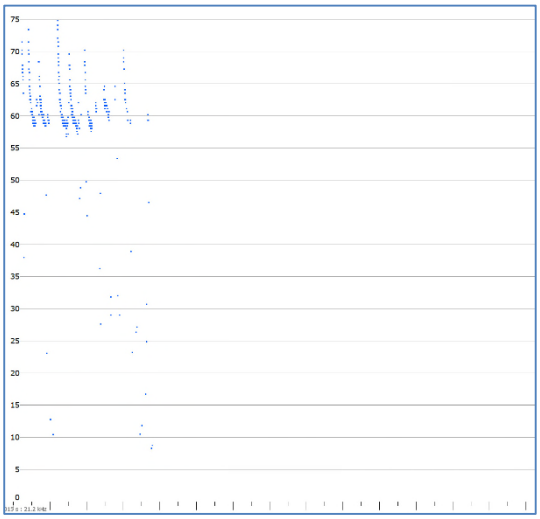
*Scotorepens greyii*



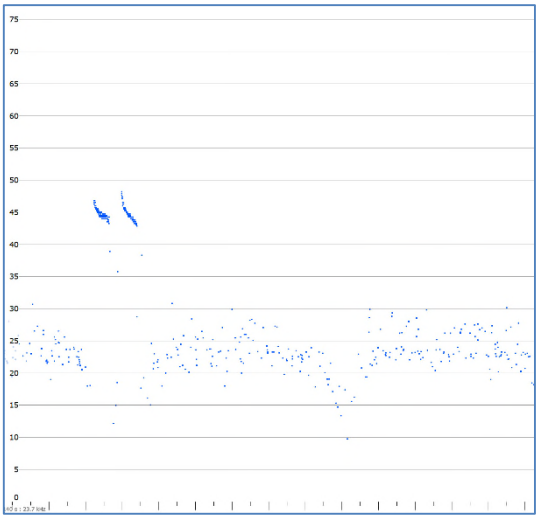
*Scotorepens sanborni*



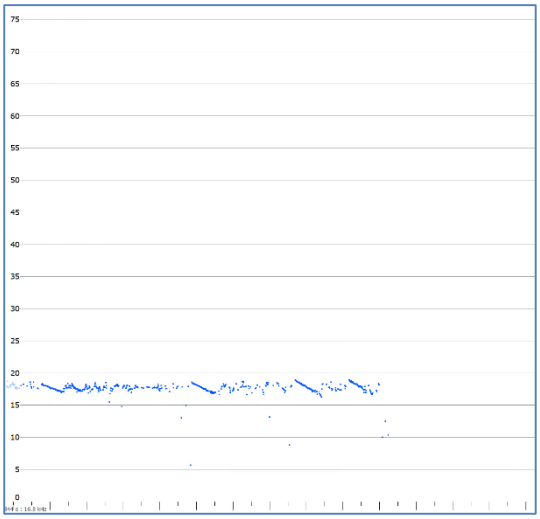
*Vespadelus troughtoni*



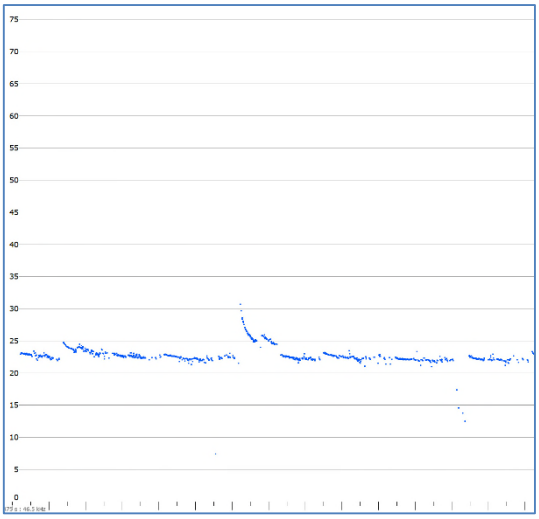
*Miniopterus australis*



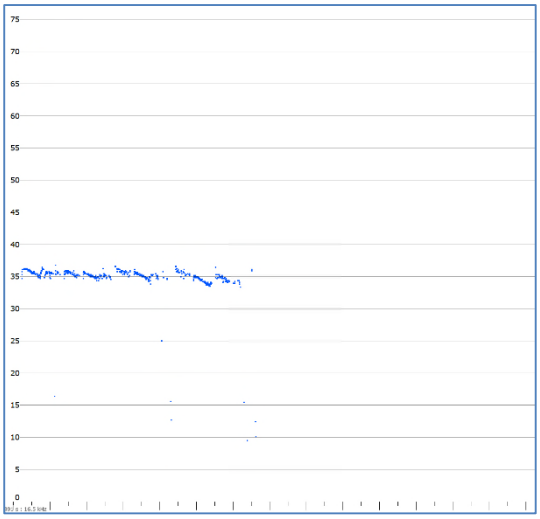
*Miniopterus orianae*



*Chaerephon jobensis*



*Ozimops lumsdenae*



*Ozimops ridei*

# Microbat Call Identification Report

| | |
|---|---|
| **Prepared for ("Client"):** | SLR Consulting |
| **Survey location/project name:** | Agate Creek (Forsayth area) |
| **Survey dates:** | 30 November – 3 December 2020 |
| **Client project reference:** | |
| **Job no.:** | SLR-2008 |
| **Report date:** | 7 January 2021 |

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## Methods

### Data received

*Balance! Environmental* received 4080 full-spectrum audio files (WAV files), recorded over four consecutive nights (30th November – 3rd December 2020) using a Song Meter SM4BAT-FS detector (Wildlife Acoustics, Maynard MA, USA).

### Bat-call analysis

The data were processed in three steps using *Anabat Insight* (Version 1.9.7; Titley Scientific, Brisbane):

1. All WAV files were scanned with a 'noise' filter to separate files containing only non-bat background noise from those with potentially identifiable calls.
2. WAV files that passed the 'noise' filter (*i.e.* contained bat calls) were then processed through a Decision Tree analysis to group calls with similar pulse characteristics (e.g. characteristic frequency, slope, duration) and apply tentative species labels.
3. Each "species" group was reviewed manually to verify and/or correct species labels by comparing call spectrograms and derived metrics with those of regionally relevant reference calls and published call descriptions (*e.g.* Reinhold *et al.* 2001; Milne 2002).

Species identification was also guided by considering probability of occurrence based on published distributional information (Churchill 2008; van Dyck *et al.* 2013) and/or records held in Atlas of Living Australia (http://www.ala.org.au).

### Reporting standard

The format and content of this report follows Australasian Bat Society standards for the interpretation and reporting of bat call data (Reardon 2003), available on-line at http://www.ausbats.org.au/.

Species nomenclature follows Jackson & Groves (2015).

## Results & Discussion

The noise filtration process excluded 2384 WAV files from further analysis. Some 1781 bat calls were identified in the remaining 1696 WAV files.

More than 96% (1718) of the calls were positively identified to one of ten unique species (see upper section of **Table 1**). The other 63 "unresolved" calls each had characteristics that were potentially attributable to two or more species. These calls were allocated to two multi-species groups (see bottom section of **Table 1**), representing three species that were otherwise reliably identified from calls with more definitive features.

**Table 1** Microbat species recorded during the Agate Creek survey, November-December 2020. Number of calls allocated per night to each species or "unresolved" species group

| Night: | 30/11/2020 | 1/12/2020 | 2/12/2020 | 3/12/2020 | Species Total |
|---|---|---|---|---|---|
| **Positively identified calls** | | | | | |
| *Rhinolophus megaphyllus* | | | | 1 | 1 |
| *Chalinolobus nigrogriseus* | 20 | 6 | 9 | 62 | 97 |
| *Scotorepens greyii* | 4 | 1 | | 10 | 15 |
| *Scotorepens sanborni* | 2 | | | 9 | 11 |
| *Vespadelus troughtoni* | 6 | 129 | 5 | 39 | 179 |
| *Miniopterus orianae* | 1 | 2 | 3 | 3 | 9 |
| *Chaerephon jobensis* | 59 | 160 | 380 | 78 | 677 |
| *Ozimops lumsdenae* | 4 | 1 | | 5 | 10 |
| *Saccolaimus flaviventris* | 10 | 5 | 5 | 5 | 25 |
| *Taphozous troughtoni* | 24 | 381 | 281 | 8 | 694 |
| **Unresolved calls** | | | | | |
| *C. nigrogriseus* or *S. greyii* | 15 | | 3 | 33 | 51 |
| *S. greyii* or *S. sanborni* | 3 | 1 | | 8 | 12 |
| Detector-night Total | 148 | 686 | 686 | 261 | 1781 |

## References


Churchill, S. (2008). *Australian Bats.* Jacana Books, Allen & Unwin; Sydney.

Jackson, S. and Groves, C. (2015). *Taxonomy of Australian Mammals*. CSIRO Publishing, Melbourne.

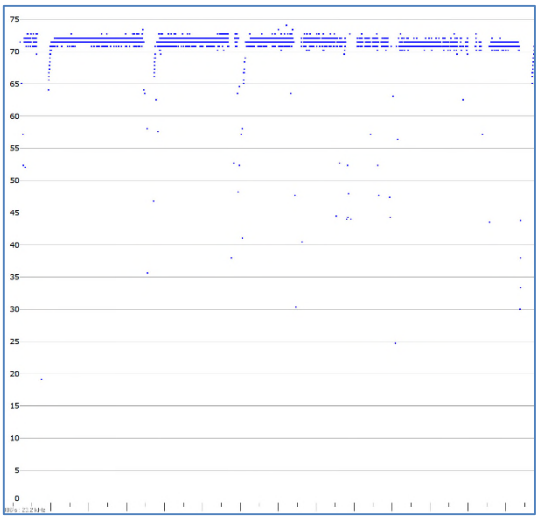
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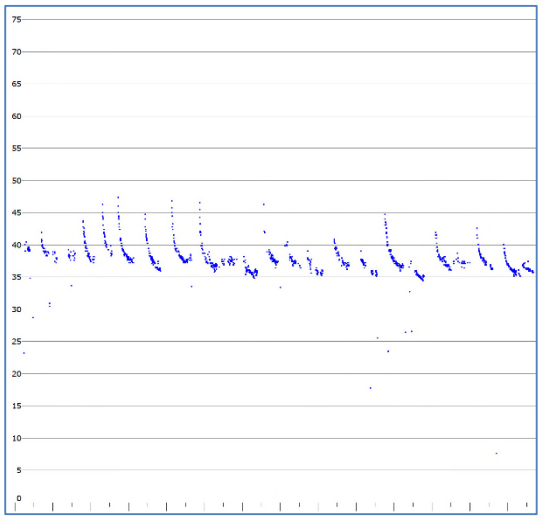
Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). *Key to the bat calls of south-east Queensland and north-east New South Wales*. Department of Natural Resources and Mines, Brisbane.

van Dyck, S., Gynther, I. and Baker, A. (ed.) (2013). *Field Companion to the Mammals of Australia*. New Holland; Sydney.

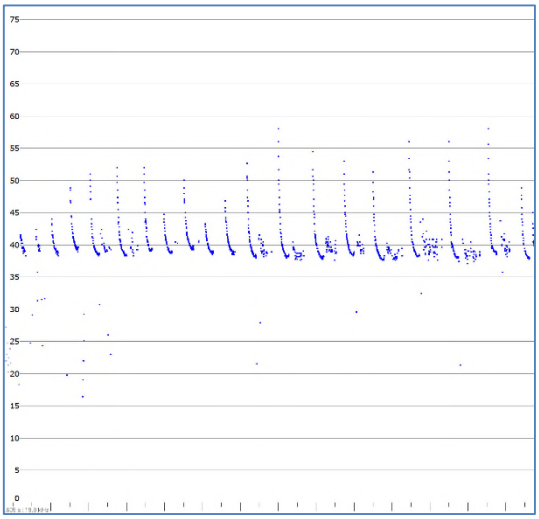
**Appendix 1** Representative call sequences recorded at Agate Creek, November-December 2020.
*x*-axis = 10 ms per tick-mark; time between pulses removed (i.e. compressed view)



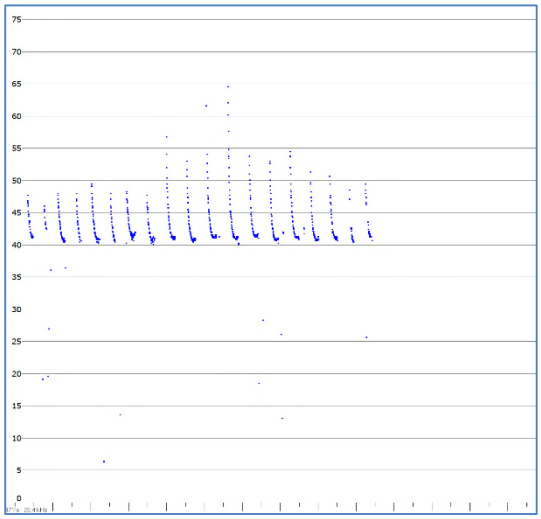
*Rhinolophus megaphyllus*



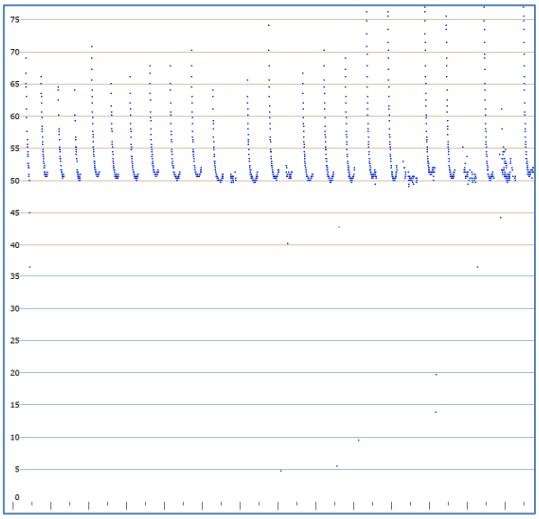
*Chalinolobus nigrogriseus*



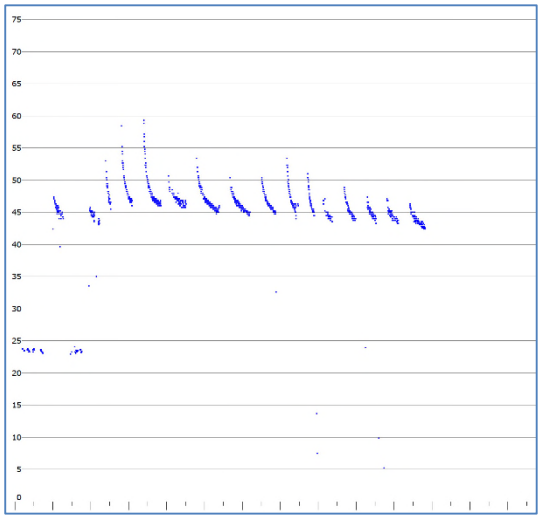
*Scotorepens greyii*



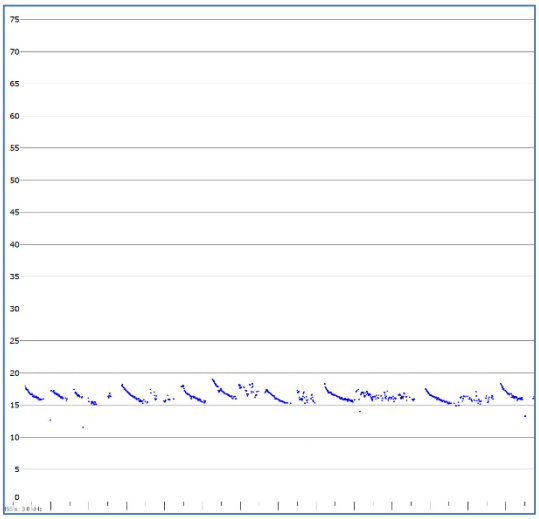
*Scotorepens sanborni*



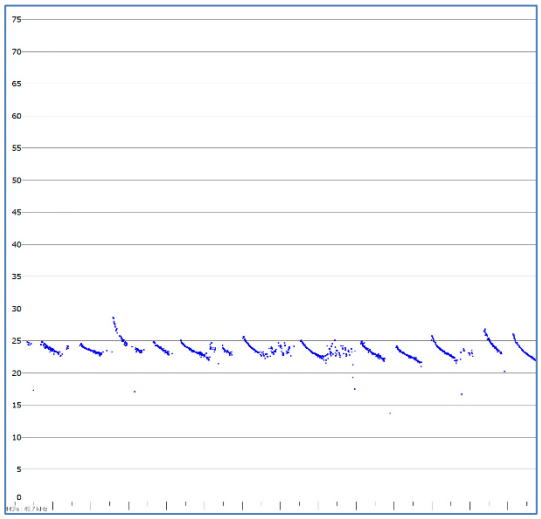
*Vespadelus troughtoni*



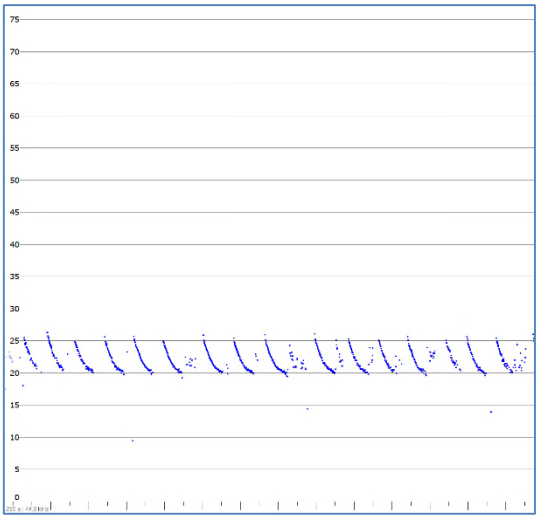
*Miniopterus orianae*



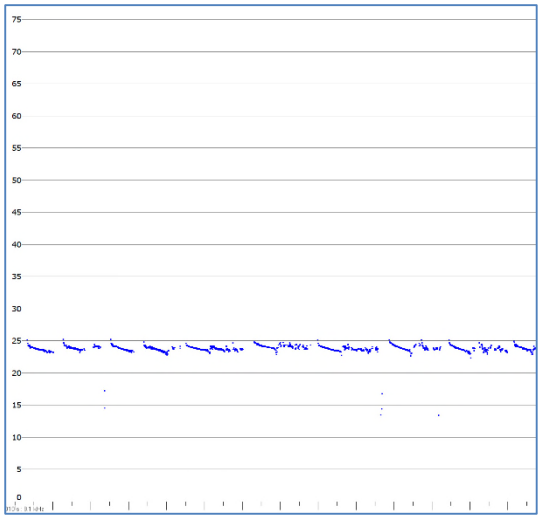
*Chaerephon jobensis*



*Ozimops lumsdenae*



*Saccolaimus flaviventris*



*Taphozous troughtoni*

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# Appendix D: Compensation Agreement

# LANEWAY RESOURCES

**ACN 003 049 714**

| | | |
|---|---|---|
| Mail Address<br>GPO Box 1164<br>Brisbane Qld 4001<br>Australia | Level 9 Waterfront Place<br>1 Eagle St<br>Brisbane Qld 4000<br>Australia | Phone: +61 7 3108 3500<br>Fax: +61 7 3108 3501<br>Email: admin@lanewayresources.com.au |


# Mining Lease

# Compensation Agreement

## Between

# Laneway Resources

# and

# Estate of H.B. Terry

# "Howlong Station"

### Lot 2 on Plan SP242983

## Locally known as Old Robinhood Station

### Covering Lease

# ML 100030

***(Mineral Resources Act 1989)***

Ref.: Laneway#498/bm

# COMPENSATION AGREEMENT

**THIS AGREEMENT** is made on the day of May 2017 **BETWEEN** Laneway Resources Limited of PO Box 1164, Brisbane, QLD 4001, in the State of Queensland (hereinafter called "**the MINER**") of the One Part

**AND** Peter Terry and Richard Terry and Simon Terry as personal representatives of the Estate of H.B. Terry under Instrument no. 712177810 of c/- Howlong Station, MS 169, Forsayth QLD 4871, in the State of Queensland (hereinafter called "**the LANDOWNER**") of the Other Part

**WHEREAS:**

A. **The LANDOWNER** is the registered owner of Lot 2 on SP242983 (TL 236580) in the Parish of Blackwell, County of Victor, which is hereinafter called "**the said Property**".

B. **The MINER** is the applicant for Mining Lease No. **(ML) 100030** located within the Georgetown Mining District, which application and any Mining Lease granted under the Mineral Resources Act 1989 in respect of such application and any variations of such Mining Lease and any Mining Lease granted in substitution therefore or in addition thereto or arising out of an amalgamation thereof with any other Mining Lease, is hereinafter called "**the Mining Lease".**

C. The land which is subject to **the Mining Lease** as outlined in red on the plan in Attachment 1 hereto includes part of the said Property and that part of the said Property which is included in **the Mining Lease** and having an approximate surface area of 467 hectares is hereinafter called "**the Mining Lease Land**".

D. **The MINER** and **the LANDOWNER** have agreed that **the MINER** will pay compensation to **the LANDOWNER** in respect of **the Mining Lease Land** on the terms and conditions hereinafter contained.

**NOW THIS AGREEMENT WITNESSES** that in consideration of the premises and the mutual covenants and agreements herein contained the parties hereto agree as follows:-

## 1 Use and Possession

1.1 **The LANDOWNER** and **the MINER** acknowledge and agree that, subject to the terms of this Agreement, **the MINER** shall only be entitled to occupy **the Mining Lease Land** in accordance with **the Mining Lease**.

1.2 **The LANDOWNER** acknowledges and agrees that following the grant of **the Mining Lease, the MINER** shall, subject to clause 2.7, be entitled to the exclusive use and possession of **the Mining Lease Land** to the exclusion of **the LANDOWNER** during the term of **the Mining Lease**.

1.3 **The MINER** will at all times conduct mining activities on **the Mining Lease Land** in strict accordance with all terms and conditions of the relevant Environmental Authority/s as issued by the Department of Environment and Heritage Protection (DEHP) against **the Mining Lease**. **The MINER** will serve a copy of the current Environmental Authority on **the LANDOWNER** including any amendments to the Environmental Authority as issued by DEHP from time to time.

1.4 The **LANDOWNER** consents to the grant of **the Mining Lease** and all activities lawfully carried out under **the Mining Lease** including any future exploration works within the **Mining Lease Land**.

1.5 The **LANDOWNER** must not, and must ensure that its family, employees, agents, contractors and other invitees do not interfere with or cause or permit to be interfered with the activities of the **MINER** lawfully carried out under **the Mining Lease**.

## 2 Compensation

2.1 **The MINER** shall provide to **the LANDOWNER** as and by way of compensation:

(a) the sum of [redacted] (called the "**Upfront Compensation**");

(b) a sum during each year of **the Mining Lease** to be calculated in each instance and paid in accordance with clause 2.3 of this Agreement (called the "**Annual Payment**");

(c) a total sum of [redacted] as a contribution to David Alexander Terry's ('David Terry') expenses to relocate the fossicking camp on the **Property** if he considers it necessary ("**Relocation Compensation**"). The Relocation Compensation is subject to the grant of the **Mining Lease** to the **MINER** and is payable by the **MINER**:

(i) within 45 days of the commencement of mining activities by the **MINER** on the **Mining Lease**;

(ii) regardless of whether David Terry relocates the fossicking camp or not; and

(d) regardless of the matters in clauses 5 and 6 of this Agreement.

2.2 The Upfront Compensation shall be paid:

(a) despite clause 4,by paying the amount of [redacted] on the first date on which all parties have executed this Agreement; and

(b) by paying the amount of [redacted] within thirty (30) days from the date on which **the Mining Lease** is granted,

subject in each case to prior receipt by the **MINER** of an appropriate invoice from the **LANDOWNER** for the Upfront Compensation.

2.3 The Annual Payment will be, for each year of **the Mining Lease**, either:

(a) [redacted]; or

(b) [redacted] for each year during which at least one "**Trigger Event**' occurs.

2.4 The Annual Payment shall be paid:

(a) if a Trigger Event occurs, by paying the amount of [redacted] within 45 days of the commencement of the first activity which is a Trigger Event in that year; and

(b) for any year in which a Trigger Event does not occur, by paying the amount of [redacted] on the anniversary of the grant of the **Mining Lease** and, in the case of the final year of the term of the **Mining Lease**, the day that is the 20th anniversary of the date that the **Mining Lease** was granted,

subject in each case to prior receipt by the **MINER** of an appropriate invoice from the LANDOWNER for the Annual Payment.

*Note: by way of example, for the fourth year of the term of the **Mining Lease**, if a Trigger Event first occurs 21 days after the third anniversary of the grant of **the Mining Lease**, then an Annual Payment of [redacted] is payable 66 days after that third anniversary, otherwise an Annual Payment of [redacted] is payable on the fourth anniversary of the grant of **the Mining Lease** (in each case, subject to prior receipt of an appropriate invoice).*

2.5 For the purposes of clauses 2.3 and 2.4:

(a) a "**Trigger Event**" is one of:

(i) blasting, extraction or processing of ore in the area of **the Mining Lease**; or

(ii) haulage of ore from the area of **the Mining Lease,**

and does not include exploration activities;

(b) each year commences on the day of the year that **the Mining Lease** was granted.

2.6 The parties acknowledge that the **MINER** has statutory obligations to address safety risks during mining operations, however fencing of the **Mining Lease** boundary shall not otherwise be required. In the event **the MINER** causes the death of a beast owned by **the LANDOWNER**, **the MINER** shall pay **the LANDOWNER** [redacted] per cow and [redacted] per herd bull. A cattle grid shall be supplied and installed by **the MINER** at the new intersection of the Mine Haul road and any fence constructed within the Project Area. The **MINER** may elect to install fencing within the Project Area as it sees fit.

2.7 Subject to the **MINER'S** statutory obligations (including the matters referred to in clause 2.6 above), the **LANDOWNER'S** cattle are and shall be free to graze within the **Mining Lease Land**. Subject to both the **MINER'S** statutory obligations (including the matters referred to in clause 2.6 above, and having regard to safety of all persons during mining activities being paramount) and clause 2.9 below, whilst there are any of the **LANDOWNER'S** cattle on the **Mining Lease Land**, the **MINER** grants to the **LANDOWNER** an irrevocable licence to enter upon the **Mining Lease Land** with or without vehicles for any purposes reasonably associated with conducting the **LANDOWNER'S** grazing operations.

2.8 The **MINER** must, at its cost and expense, take out and maintain public liability insurance in respect of the activities under the **Mining Lease** for each and every public liability occurrence to a limit of indemnity not less than [redacted] The **MINER** must, if requested by the **LANDOWNER**, provide to the **LANDOWNER**, once in each year of the **Mining Lease**, a certificate of currency of insurance or such other written evidence that is acceptable to the **LANDOWNER**, acting reasonably, providing proof that the **MINER** has effected the insurance policy that it is required to take out under this clause.

2.9 If the **LANDOWNER** or any other person at the **LANDOWNER**'s direction intends to enter upon the **Mining Lease Land** pursuant to clause 2.7 above, the person must before entering the **Mining Lease Land** satisfy all site induction requirements that the **MINER** may reasonably request.

## 3 Settlement of all Claims and Indemnity

3.1 **The LANDOWNER** acknowledges that the compensation payment pursuant to Clause 2 hereof is in full satisfaction of all claims for land and in full satisfaction of all claims for compensation which **the LANDOWNER** has or may have, whether under the provisions of the *Mineral Resources Act 1989* or otherwise, and whether in relation to the Property or otherwise, in respect of the application for grant of **the Mining Lease**.

3.2 The **LANDOWNER** releases the **MINER** from any further liability under the *Mineral Resources Act 1989* (Qld) ('MRA') in respect of compensation for the activities carried out under **the Mining Lease**.

3.3 The **LANDOWNER** indemnifies the **MINER** against any claim for compensation or damages under the MRA or otherwise that may be made against the **MINER** in relation to the Mining Lease by:

(a) David Alexander Terry; or

(b) Cobbold Gorge Tours Pty Ltd, or any other person with any legal or equitable interest in the tourism business operated at the time of entry into this Agreement,

provided that the claim does not directly arise from any action by the **MINER** in material breach of either the **Mining Lease** or this Agreement.

## 4 Agreement Conditional

This Agreement is subject to and conditional upon the lodging of this Agreement with the Mining Registrar pursuant to the provisions of Section 279 of the *Mineral Resources Act 1989* and the parties hereto shall do all such things as shall be reasonably necessary or desirable to effect the lodging of this agreement with the Mining Registrar.

## 5 Roads and other infrastructure

5.1 The **LANDOWNER** agrees that it may wish to continue to use vehicle tracks, haulage roads, water storage facilities, and other similar infrastructure within ML100030 identified in Attachment 2 (called "**the Remaining Infrastructure**"), and does not require **the MINER** to rehabilitate the Remaining Infrastructure at the end of the Mining Lease.

5.2 The **LANDOWNER** agrees to execute further written agreements with the **MINER**:

(a) to identify Remaining Infrastructure;

(b) to give effect to the agreement in clause 5.1 above;

(c) to disclose to the effect in clause 5.1 above to DEHP (or its successor).

5.3 The parties acknowledge that the **MINER** is obligated to enter into an agreement or agreements with the Etheridge Shire Council (Council) and the Department of Transport and Main Roads (DTMR) regarding maintenance of the Gilberton Road (called a "**Road Maintenance Agreement**").

5.4 The **MINER** agrees to:

(a) provide to each of the Council and DTMR a copy of the Expert Report of Dale Lorraway Civil Engineering Services Pty Ltd dated 27 October 2016;

(b) within 14 days of entering into a Road Maintenance Agreement, provide a copy of such agreement to the **LANDOWNER**;

(c) comply with the terms of each Road Maintenance Agreement as if the terms of each Road Maintenance Agreement was incorporated in this Agreement.

5.5 The **MINER** further agrees to, at its own expense:

(a) use its best endeavours to, subject to clause 5.6:

(i) have a minimum of 3km of Gilberton Road re-sheeted within 45 days of the occurrence of the first Trigger Event (as that term is defined in clause 2.5) during the term of the Mining Lease; and

(ii) have a further minimum of 12km of Gilberton Road re-sheeted prior to 1 April in the year following the occurrence of the first Trigger Event during the term of the Mining Lease; and

(b) supply to the **LANDOWNER** three grids for Forsayth-Gilberton Road within thirty (30) days from the date on which **the Mining Lease** is granted.

5.6 For the avoidance of doubt, the **MINER**:

(a) will not be required to comply with clauses 5.5(a)(i) or 5.5(a)(ii) if, despite using its best endeavours to obtain any necessary statutory approval, all necessary statutory approvals for the work in those clauses to be undertaken; and

(b) will not be relinquished of its obligations under clause 5.5(a) if it is a requirement of the Council and/or the DMTR that a person other than the **MINER** is required to carry out the re-sheeting of Forsayth-Gilberton Road.

5.7 If, despite using its best endeavours, the **MINER** is not able to comply with its obligations under clause 5.5, the **MINER** must use its best endeavours to re-sheet 15 km of Forsayth-Gilberton Road as soon as it is reasonably able to.

5.8 The **LANDOWNER** agrees to:

(a) permit the **MINER** to access and use water held within dams and other water infrastructure of the **Property** for the purposes of the **MINER** conducting road maintenance activities, on the condition that the **MINER** agrees to pay to the **LANDOWNER** the amount of [redacted] per mega litre of water extracted. The **MINER** agrees that the **LANDOWNER** is not obliged to permit access for a specified period if the **LANDOWNER**, acting reasonably, gives no less than 14 days prior written notice to the **MINER** that all available water is required for watering of the **LANDOWNER'S** stock. If the **LANDOWNER** gives such a notice, the **LANDOWNER** agrees that it cannot make any demand or take any other step in reliance on the undertaking at clause 5.4(c) until and unless the **LANDOWNER** demonstrates to the **MINER'S** reasonable satisfaction that there is no available water taking into account the **LANDOWNER'S** reasonable requirements for water of the **LANDOWNER'S** stock;

(b) if the **LANDOWNER** is lawfully able to supply the gravel (including gravel for the purposes of activities referred to in clauses 5.4 to 5.7 above) to the **MINER**, permit the **MINER** to obtain from the **LANDOWNER** from a site identified by the **LANDOWNER** acting reasonably the supply of gravel required for re-sheeting and road maintenance for Gilberton Road, including for the re-sheeting in clause 5.5 of this Agreement, at no charge to the **MINER**.

## 6 Further Assurance

**The LANDOWNER** will execute every such deed, instrument or assurance and do every such thing for further or more effectually securing the rights and interest of

to or in **the Mining Lease** or any part or parts thereof pursuant to this Agreement as shall by **the MINER** be reasonably required.

**The LANDOWNER** agrees to participate in good faith in negotiations with **the MINER** in relation to any consents that **the MINER** may reasonably request in relation to any renewals of the **Mining Lease**.

## 7 Dispute Resolution

7.1 All disputes under this Agreement must be resolved in accordance with this Clause 7.

7.2 In the event that a dispute arises in relation to this Agreement, a party may give a notice of the dispute to the other party which details the nature of the dispute.

7.3 If a notice is given under clause 7.2, the **LANDOWNER** and the **MINER** must in the first instances use reasonable endeavours to resolve the dispute by negotiation.

7.4 If a dispute is not resolved under clause 7.3, the **LANDOWNER** and the **MINER** may appoint a mutually agreed mediator to mediate the dispute in accordance with the Australian Institute of Arbitrators and Mediators Medication Rules, and in the absence of agreement, either party may apply to the Queensland president of the Australian Institute of Arbitrators and Mediators for the appointment of a mediator.

7.5 If the dispute is not resolved within 20 business days of the date of the dispute notice, either party may seek to resolve the dispute in a court of competent jurisdiction.

## 8 Assignment

8.1 The parties acknowledge that this Agreement will be binding on the parties' successors and assigns.

8.2 Subject to clause 8.5, the **LANDOWNER** may assign its rights and interests in the **Property,** but only if the **LANDOWNER** first procures the proposed assignee to execute a deed (a 'Deed of Assignment') which is effective to assume the **LANDOWNER's** liabilities and obligations under this Agreement.

8.3 If the **LANDOWNER** transfers **the said Property** or any interest in it, the **LANDOWNER** must notify the **MINER** of the transfer and the name and address of the transferee within 10 business days of the transfer date.

8.4 If the **MINER** transfers **the Mining Lease** or any interest in it, the **MINER** must notify the **LANDOWNER** of the transfer and the name and address of the transferee within 10 business days of the transfer date.

8.5 The parties acknowledge and agree that:

(a) the **LANDOWNER** is not required to comply with clause 8.2 for an assignment or transfer from the **LANDOWNER** to David Terry of the interest in the **Property** that David Terry has been gifted under the will of

the late H.B. Terry; and

(b) the Deed of Assignment will not include the indemnity contained in clause 3.3(a).

## 9 No Termination for Breach

Neither party may terminate this Agreement for a breach of this Agreement by the other party, but all other remedies are available to a party in respect of a breach of this Agreement by the other party.

## 10 Variation

This Agreement may only be amended or varied by the written agreement of the parties.

## 11 Confidentiality

11.1 Neither party may disclose the amount of compensation contemplated in this Agreement to another person without the other party's prior written consent, which consent must not be unreasonably withheld.

11.2 A party may make the following disclosures without the consent of the other party:

(a) to David Alexander Terry;

(b) to the party's legal or financial advisers;

(c) to the party's other consultants;

(d) to a potential purchaser of **the said Property** or an interest in **the Mining Lease**;

(e) to a related body corporate, as defined in section 50 of the *Corporations Act 2001* (Cth);

(f) required by law, including disclosure to any stock exchange; and

(g) as order or required by any court, tribunal or authority.

## 12 Severability

If any provision of this Agreement is determined to be invalid, unlawful or unenforceable for any reason then:

(a) that part will, to the extent of the invalidity, unlawfulness or unenforceability, be severed from the rest of this Agreement; and

(b) the remaining terms will continue to be valid and enforceable to the fullest extent permitted by law.

## 13 Stamp Duty and Costs

Any stamp duty hereon shall be paid by **the MINER**.

## 14 GST

14.1 Terms used in this clause that are defined in the *A New Tax System (Goods and Services Tax) Act 1999* (Cth) and the related imposition Acts of the Commonwealth have the meeting given in that Act.

14.2 The consideration for a Supply made under or in connection with this document includes GST.

14.3 If a Supply made under or in connection with this document is a Taxable Supply, then at or before the time the consideration for the Supply is payable the entity making the Supply (the "**Supplier**") must give the Recipient a Tax Invoice for the Supply.

14.4 Where a Tax Invoice is given by the Supplier, the Supplier warrants that the Supply to which the Tax Invoice relates is a Taxable Supply and that it will remit the GST (as stated on the Tax Invoice) to the Australian Taxation Office.

## 15 Interpretation

15.1 It is hereby agreed and declared that in this Agreement, unless a contrary intention appears:

(a) the expression "**the LANDOWNER**" shall mean and include **the LANDOWNER** and its executors, administrators, heirs and successors in title and assigns;

(b) the expression "**the MINER**" shall mean and include **the MINER** and its successors and assigns;

(c) every word in the singular number shall be construed as including the plural number, and every word in the plural number shall be construed as including the singular number;

(d) every word of the masculine gender shall be construed as including the feminine gender;

(e) references to statutes shall include all statutes amending, consolidating or replacing the statutes referred to;

(f) headings are for convenience only and shall not affect the construction of this Agreement.

15.2 The **MINER** acknowledges and agrees that the persons comprising the **LANDOWNER** at the date of this document ('the Personal Representatives') enter into and perform this Agreement and the transactions it contemplates only as personal representatives of the estate of the late Harold Byrne Terry ('the Estate'), except where expressly stated otherwise. This applies also in respect of any past and future conduct (including omissions) relating to this Agreement or those transactions. For the avoidance of doubt, this clause does not limit the operation of clauses 9.1 and 15.1(a).

15.3 While the **LANDOWNER** is the Personal Representatives, under and in

connection with this Agreement and those transactions and conduct the Personal Representatives' liability (including for negligence) is limited to the extent it can be satisfied out of the assets of the Estate. The Personal Representatives need not pay any such liability out of other assets.

15.4 While the **LANDOWNER** is the Personal Representatives, the **MINER** may only do the following (but any resulting liability remains subject to this clause):

(a) approve and participate in, and otherwise benefit from, any form of insolvency administration of the Estate but only with respect to Estate assets;

(b) exercise rights and remedies with respect to Estate assets, including set off;

(c) exercise contractual rights; and bring any other proceedings against the Personal Representatives, seeking relief or orders that are not inconsistent with the limitations in this clause,

and may not otherwise:

(d) bring proceedings against the Personal Representatives;

(e) take any steps to have the Personal Representatives placed into any form of insolvency administration (but this does not prevent the appointment of a receiver, or a receiver and manager, in respect of the Estate's assets); or

(f) seek by any means (including set off) to have a liability of the Personal Representatives to that party (including for negligence) satisfied out of any assets of the Personal Representatives other than Estate assets.

15.5 For the avoidance of doubt, all matters expressed in this document, as being limited to the assets of the Estate, or which limit the liability of the Personal Representatives, apply only while the **LANDOWNER** is the Personal Representatives.

## 16 Notices

Any notice in writing required to be given by either party to the other may, without prejudice to any other mode of service, be forwarded by prepaid certified mail service addressed in the case of **the MINER** to:

c/- Chairman
Laneway Resources Limited
PO Box 1164
BRISBANE QLD 4001

and in the case of **the LANDOWNER** to:

Simon Terry
C/- "Howlong Station"
MS 1698
Forsayth QLD 4871

or at such other respective address as may have been notified in writing for such purpose and any notice so posted (whether received or not and if received whenever received) shall be deemed to have been received on the seventh day (excluding Saturdays, Sundays and public holidays) after the same was posted.

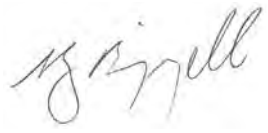
## 17 Counterparts

This Agreement may be executed in any number of counterparts (whether in original or a copy transmitted by facsimile or email) all of which when executed and taken together will constitute this Agreement.

**IN WITNESS WHEREOF** the parties hereto have executed this Agreement the day and year first hereinbefore written.

**Signed by the MINER**

**Executed by Laneway Resources Limited in accordance with Section 127 of the Corporations Act 2001:-**

| | | |
|---|---|---|
| Stephen Bizzell | Director |  |
| Name | Position | Signature |
| Paul Marshall | Company Secretary |  |
| Name | Position | Signature |

**Signed by the LANDOWNER**

| | |
|---|---|
| Peter Terry | Signature |

Witnessed by:-

| | |
|---|---|
| Name | Signature |
| Richard Terry | Signature |

Witnessed by:-

| | |
|---|---|
| Name | Signature |

_____ _____

Simon Terry Signature

Witnessed by:-

_____ _____

Name Signature

**IN WITNESS WHEREOF** the parties hereto have executed this Agreement the day and year first hereinbefore written.

**Signed by the MINER**

**Executed by Laneway Resources Limited in accordance with Section 127 of the Corporations Act 2001:-**

| Name | Position | Signature |
|---|---|---|
| Name | Position | Signature |

**Signed by the LANDOWNER**

Peter Terry — Signature

Witnessed by:-

Name — Signature

Richard Terry — Signature

Witnessed by:-

Name — Signature

Simon Terry — Signature

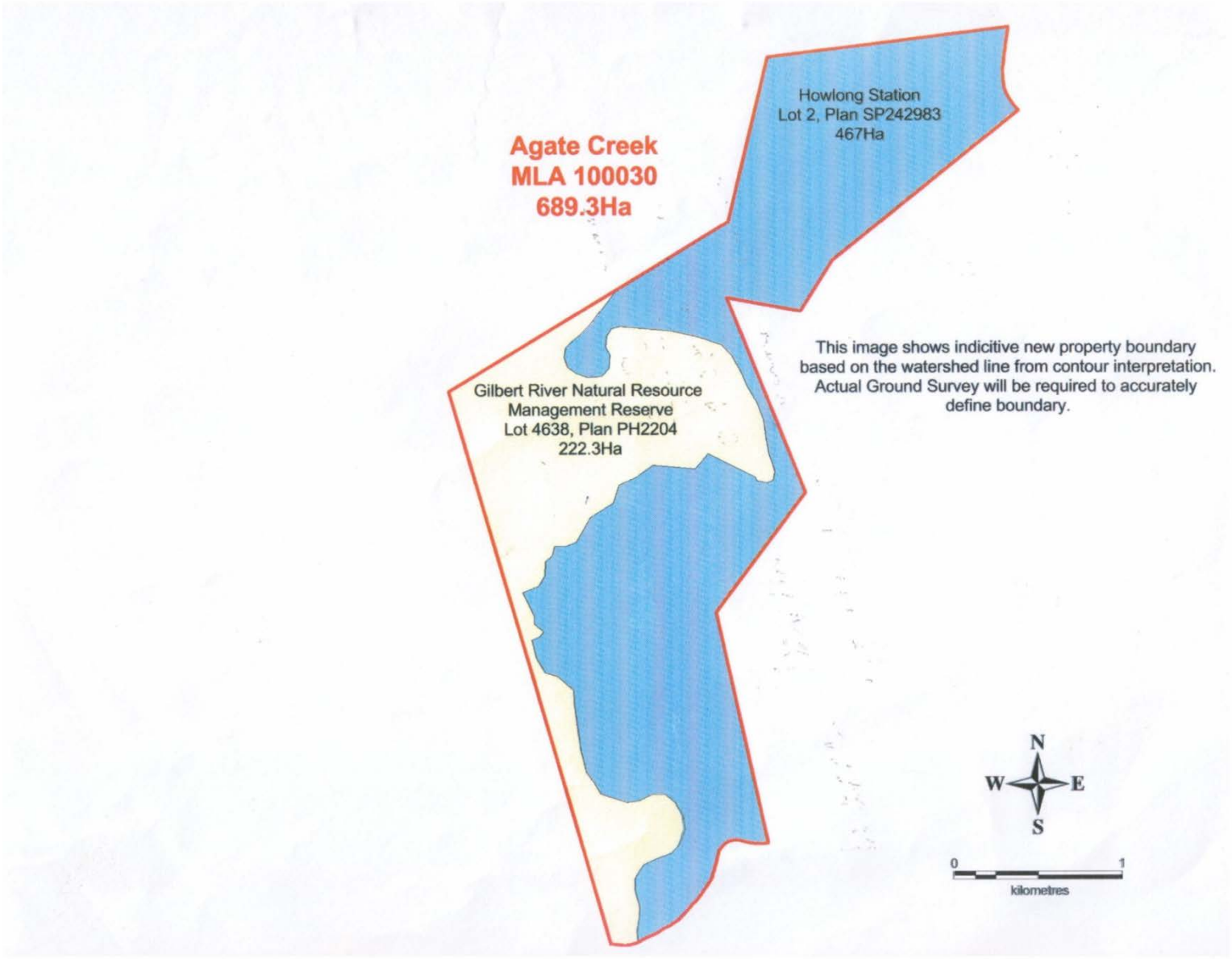
Simon Terry

Simon Terry  Signature

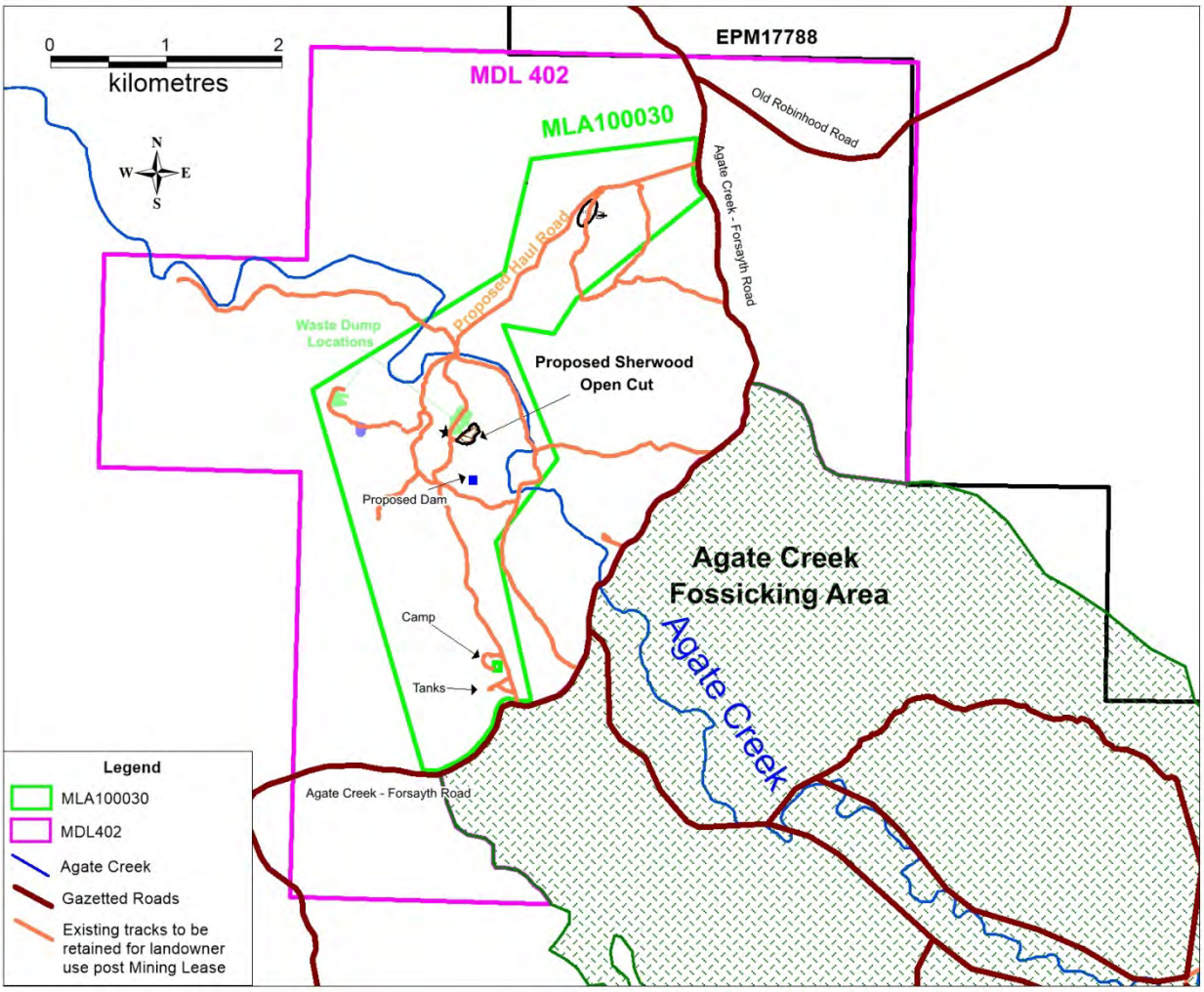
Witnessed by:-

Name  Signature

# ATTACHMENT 1


Agate Creek
MLA 100030
689.3Ha
Howlong Station
Lot 2, Plan SP242983
467Ha
Gilbert River Natural Resource
Management Reserve
Lot 4638, Plan PH2204
222.3Ha
This image shows indicitive new property boundary based on the watershed line from contour interpretation. Actual Ground Survey will be required to accurately define boundary.
N
W
E
S
0
1
kilometres

# ATTACHMENT 2


0
1
2
kilometres
N
W
E
S
EPM17788
MDL 402
MLA100030
Old Robinhood Road
Agate Creek - Forsayth Road
Proposed Haul Road
Waste Dump Locations
Proposed Sherwood Open Cut
Proposed Dam
Camp
Tanks
Agate Creek Fossicking Area
Agate Creek
Agate Creek - Forsayth Road
Legend
MLA100030
MDL402
Agate Creek
Gazetted Roads
Existing tracks to be retained for landowner use post Mining Lease

# Appendix E: Agate Creek Gold Mine Flood Impact Assessment (ATC Williams, 2022)

# REPORT

**WULGURU TECHNICAL SERVICES PTY LTD**
ABN: 79 644 301 655

## Agate Creek Gold Mine

## Flood Impact Assessment

121208-01-FIA-R01-RevA
JULY 2022



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## Document Control

| | |
|---|---|
| Project Name: | Agate Creek Gold Mine |
| Document Title: | Flood Impact Assessment |
| File Location: | \\atcscmvpfps01\Synergy\Projects\121\121208 Agate Creek Gold Mine\01 EA Amendment and PRCP Assistance\Project Data\Water Management\Documents\Text |
| Document Number: | 121208-01-FIA-R01-RevA.docx |

### Revision History

| Revision | Issue | Issue Date | Prepared by | Reviewed by |
|---|---|---|---|---|
| A | Draft Issue | 27/07/2022 | Matt Johnson | Nick Brown |
| | | | | |
| | | | | |
| | | | | |

### Issue Register

| Distribution List | Format |
|---|---|
| Wulguru Technical Services | PDF |
| | |

### ATC Williams Company Details

| | |
|---|---|
| Prepared By: | Matt Johnson |
| Approved By: | Nick Brown |
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# 1 INTRODUCTION

## 1.1 Background

Agate Creek Gold Mine (ACGM), owned and operated by Laneway Resources (LWR), is proposed to expand its current mining operation from 45,000 tpa to 250,000 tpa as part of the mine's Stage 2 expansion phase. Laneway was granted mining lease (ML) 100030 on February 2019 and currently operates within Environmental Authority (EA) EPSL03068015 (dated 6 September 2021). Due to the proposed increase to mining operations, an approval and EA amendment is required to mine in excess of 240,000 tpa.

### 1.1.1 Current Operations

Agate Creek activities currently encompass the extraction of gold ore and waste rock from the Sherwood open Cut Pit situated at approximately the midpoint of ML100030. Ore is transported to the ROM pad where it is temporarily stockpiled. Waste rock is transported to the Sherwood Waste Rock Dump WRD on-site. LWR currently extract up to 45,000 tpa.

### 1.1.2 General Arrangement of the Proposed Expansion

LWR are proposing to expand current operations across the Sherwood and Sherwood West resource areas under ML100030, extracting up to 250,000 tpa across 6 individual open cut pits. The expansion of operations will include the following mine domains:

- Six open cut pits;
- Four waste rock dumps (WRDs);
- Topsoil stockpile areas;
- Expanded administrative buildings and other mining infrastructure (roads, camp etc.);
- 0.4 Ha expanded Run of Mine (ROM) pad;
- Magazine;
- Water storages; and
- Sediment ponds.

Refer to Figure 002 in **Appendix A** for the key site details.

Ore is to be transported off site to Georgetown for processing. Access to Agate Creek is to remain as Rungulla Road/Agate Creek Road /Cobb Road and onto Georgetown via Forsayth Road.

## 1.2 Scope of Works

ATC Williams (ATCW) Pty Ltd have been engaged by Wulguru Technical Services (WTS) Pty Ltd to assist with site investigations and the documentation required for the major EA amendment and in support of the Progressive Rehabilitation and Closure Plan (PRCP) of Agate Creek mine site. The site investigations required by WTS include the following:

- Water Management Plan (WMP);
- Flood Impact Assessment (FIA);
- Waste Rock Dump (WRD) Concept Design and Management Plan.

This report outlines a Flood Impact Assessment (FIA) for the Agate Creek Gold Mine site. In accordance with the DES guideline for PRC plans (PRCP) **[8]**, pit voids should be outside the 0.1% (1 in 1000 year event) floodplain as they are classified as Non-use Management Areas (NUMAs). Floodplain modelling for the significant watercourse (Agate Creek) through the mine lease was therefore required to estimate the extents of the 0.1% floodplain.



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## 1.3 Legal and Regulatory Requirements

The mining lease (ML) ML100030 and current operation is under an active Environmental Authority EPSL03068015 (the EA), granted 6 September 2021. The mine is part of the larger Agate Creek Gold Project, which also includes a mineral development licence (MDL402), and exploration permits for areas north of the mine (EPM17788 and EPM26460). However, this project focuses only on the mine area within ML100030 and an EA Amendment to expand the site operations.

Legislation and regulatory requirements therefore apply to the site and operations due to the environmental risks associated with the proposed mining activities. The following legal and regulatory guidelines have been used as a reference when developing this report:

- Australian Rainfall and Runoff (ARR) 2019 **[3]**
- Progressive rehabilitation and closure plans (PRC plans) 2021 **[8]**

## 1.4 Report Summary and Structure

The Flood Impact Assessment has been prepared using the available data, in accordance with the relevant guidelines. A RORB hydrological model and TUFLOW 2D hydraulic model was developed to estimate the 0.1% AEP (1 in 1000 year event) floodplain extents for Agate Creek that runs through the mine lease (ML100030). The 0.1% AEP floodplain of Agate Creek is clear of all proposed voids and no changes to the site layout are proposed due to the floodplain extents. It is noted that should a crossing over Agate Creek be required as part of future stages, a revised flood model should be developed to estimate any upstream impacts due to a culvert/structure over the creek. It is also recommended that the flood model be revised as part of the detailed design phase when detailed elevation data and images of the Agate Creek floodplain are available.

This report is structured in the following sections:

**Section 2:** Provides a brief description of the project site and the regional climate.

**Section 3:** Presents an overview of the hydrology and hydraulic modelling methodology.

**Section 4:** Presents the 1D hydrological results and flood frequency analysis.

**Section 5:** Presents the 2D hydraulic model parameters adopted.

**Section 6:** Discusses the results from the hydraulic model.

**Section 7:** States the conclusions and recommendations.



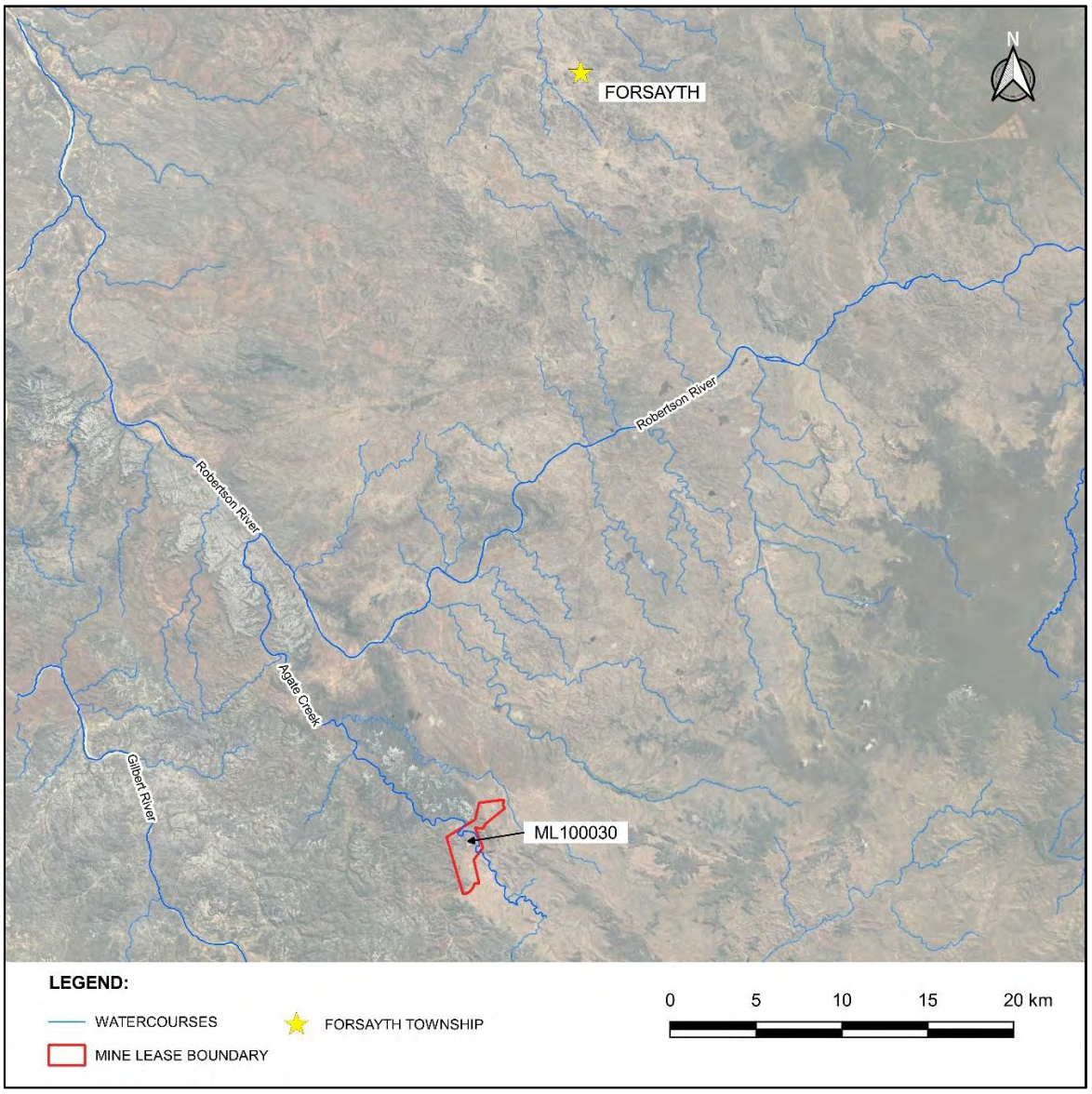
TAILINGS.WATER.WASTE.

# 2 SITE DESCRIPTION

## 2.1 Site Location

Agate Creek Gold Mine site is located approximately 40 km south-west (Rungulla Road) of Forsayth, Far North Queensland. The mine is part of the larger Agate Creek Gold Project, which also includes a mineral development licence MDL402, and exploration permits for areas north of the mine (EPM17788 and EPM26460). However, this project focuses only on the mine area within ML100030, as shown on **Diagram 1.** Typical site conditions are shown in **Photo 1.**

**DIAGRAM 1: SITE LOCALITY MAP**






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**PHOTO 1: TYPICAL SITE CONDITIONS**



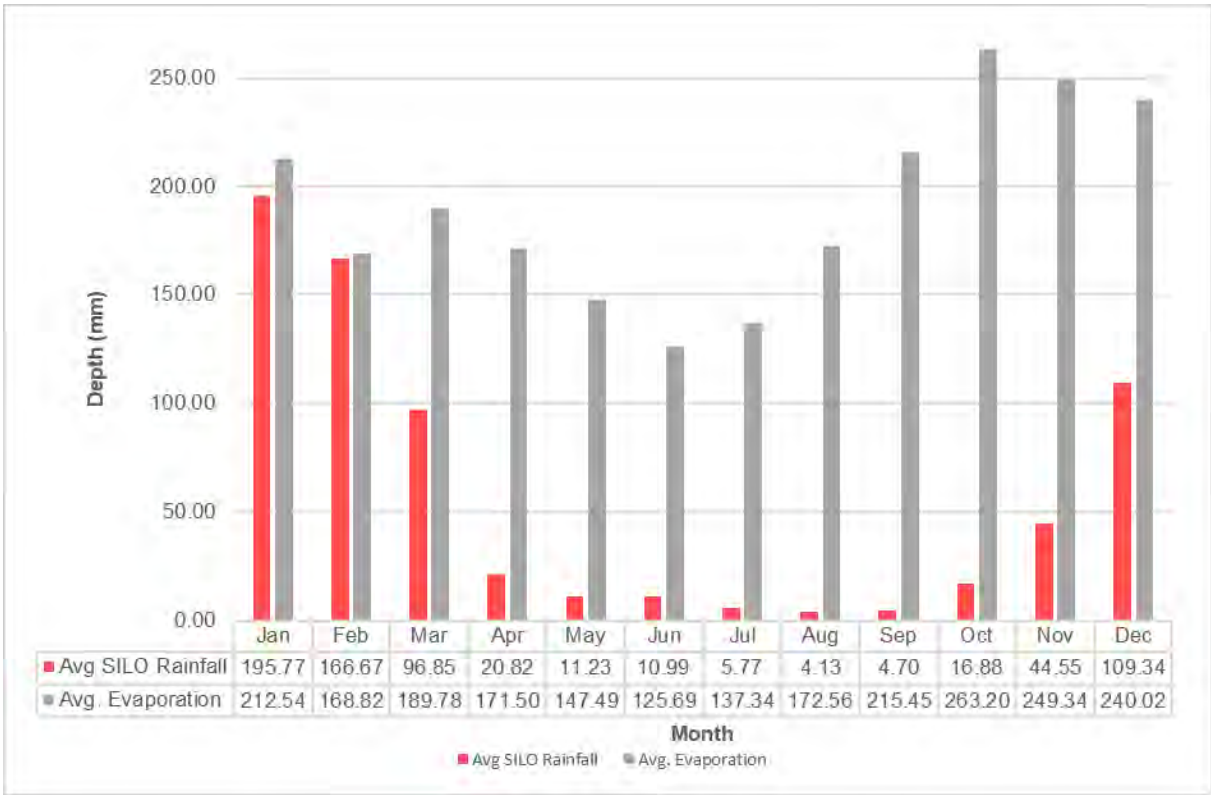
## 2.2 Climate

The ACGM site is located in the Far North Queensland region which has a tropical climate characterised by a distinct wet season (December – March) and dry season (April – November). Annual average rainfall is approximately 1085 mm, with most falling during the wet season. The nearest meteorological weather station to the site is the Bureau of Meteorology's (BoM) Robinhood Station located some 24.4 km to the northeast of the site. The Robinhood weather station does not have long-term evaporation data, which is a key factor in the assessment of surface water management. Therefore, for the purposes of this assessment evaporation data has been sourced from the SILO Data Drill program **[13]** specific to the site location.



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**GRAPH 1: RAINFALL AND EVAPORATION MONTHLY AVERAGES**




Rainfall data can significantly vary when affected by broader weather patterns, such as 'El Niño Southern Oscillation', and additional tropical cyclones that occur among November and April **[5]**. For instance, Agate Creek has experienced as much as 235 mm in a single January day and as much as 813 mm in a single month (February) **[5]**.

## 2.3 Hydrological Characteristics and Topography

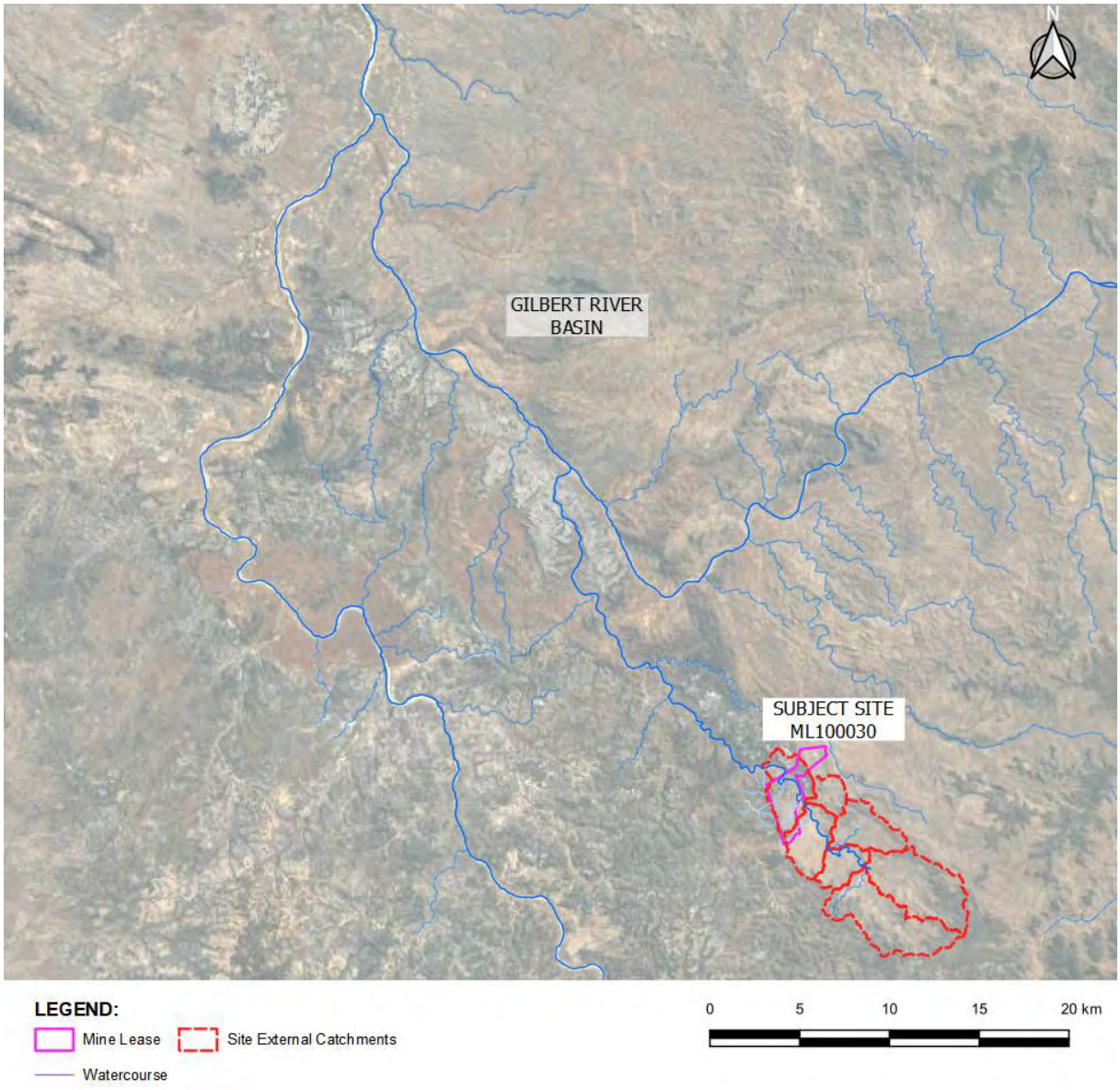
### 2.3.1 Regional Context

The ACGM site forms part of the Gilbert River catchment located within the wider regional Gilbert basin in Far North Queensland. The site has few ephemeral waterways directly discharging to Agate Creek which is the immediate receiving watercourse for the site, located centrally within the mine lease running from east to northwest. Agate Creek subsequently discharges northwest until it intersects Robertsons River, approximately 23 km northwest of the site. The Robertsons River then joins the Gilbert River, located approximately 26 km downstream from the point of confluence of Agate Creek and Robertsons River. The Gilbert River travels further downstream by approximately 361 km until it reaches the Gulf of Carpentaria which is the final discharge point for the Gilbert basin. The regional watercourses are depicted on **Diagram 2**, noting that the mine lease has a large upstream catchment of approximately (64.8 km$^2$) that discharges through the site as Agate Creek.



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**DIAGRAM 2: REGIONAL DRAINAGE**




## 2.3.2 Site Context

The subject site is located on a valley within Agate Creek. The site is bordered to the east and west by an existing ridge and to the south by the Rungulla Road. The majority of the site drains centrally to Agate Creek that has a large upstream catchment as described in **Section 2.3.1**. Elevation data over the lease ranges between approximately RL 422 m to RL 529 m. Local drainage lines at the site are depicted in **Diagram 3.**



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**DIAGRAM 3: LOCAL DRAINAGE**




## 2.4 Site Features

Key elements of the proposed project site associated with the water management system are as follows:

- Open cut Pits;
- Waste Rock Dumps (WRD);
- Haul roads;
- ROM Pad;
- Sediment Dams
- Water Storage Dam;

These elements are depicted on **Figure 001** attached in **Appendix A**.



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## 2.5 Available Data

Data for use in this project was obtained from a variety of sources, these included:

- Elevation Data as a 5 m gridded data set provided by Wulguru Technical Services **[16]**
- ELVIS Digital Terrain Data (DTM). Shuttle Radar Topography Mission (SRTM)-derived 1 Second data was available for the site. This is approximately 30 m gridded data **[10]**;
- Google Imagery **[9]**;
- Australian Rainfall and Runoff (ARR) Data Hub data **[3]**;
- Bureau of Meteorology (BOM) IFD data **[5]**;
- Water Monitoring Information Portal gauge data **[15]**;



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# 3 METHODOLOGY

## 3.1 Review of Existing Data

A review of the available data listed in **Section 2.5** was conducted for the site and proposed mine development. The review of background data included importing the data such as topography and imagery, converting to suitable formats (if required), and highlighting any knowledge gaps or errors within the datasets. It is noted that the adopted elevation data and aerial imagery are both coarse satellite datasets, as no detailed site specific information was made available for the development of this report.

## 3.2 Catchment Modelling

### 3.2.1 1D Hydrological Modelling

A hydrological model for Agate Creek through the ACGM was developed with the model outlet set downstream of the mine site / mine lease. The model was developed in RORB software, which is a runoff and streamflow routing program used to calculate flood hydrographs from rainfall and other channel inputs **[12]**.

Specific hydrological modelling details are provided in **Section 4**.

### 3.2.2 2D Hydraulic Modelling

A 2D TUFLOW **[4]** model was then developed to map flood behaviour through the site. An inflow hydrograph and a direct rainfall approach was adopted to model Agate Creek flows as well as localised overland flow paths across the site. This hydraulic model was used to produce flood mapping outputs.

Specific hydraulic modelling details are provided in **Section 5**.

## 3.3 Sensitivity Testing

Sensitivity testing was conducted to assess how the model behaved due to changes in the major model parameters and hydrological inflows. The sensitivity scenarios that were modelled included:

- Manning's 'n' (+ 50%);
- Increase to the inflow hydrograph (+ 30%);
- Grid sizes to optimise run time versus peak flow and mapping accuracy.

It should be noted that limited data was available at the time of this study, and further information regarding the existing creek conditions along with a detailed site survey should be obtained as part of the detailed design phase for the project. This may require revision to this report if there are changes to the key input parameters.

## 3.4 Flood Map Outputs

Several flood mapping outputs were produced following the TUFLOW modelling and are presented in **Appendix B**. The mapping outputs include:

0.1% AEP Flood Event:

a. Maximum Flood Depth;
b. Maximum Water Surface Elevations;
c. Maximum Velocities;



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# 4 1D HYDROLOGICAL MODEL

## 4.1 Background

A 1D hydrological model was developed in RORB version 6.45 **[12]** to analyse the peak flow at the critical locations by selecting the critical duration and associated ARR temporal pattern. The hydrograph was then used for the 2D hydraulic modelling. The peak flow estimates were also compared to ARR's Regional Flood Frequency Estimation Tool (RFFE) to validate the model.

## 4.2 Model Development

The Agate Creek catchment boundaries were estimated from the available ELVIS Shuttle Radar Topography Mission (SRTM) **[10]** elevation data. Recommended ARR and RORB parameters were adopted in the model development for Queensland sites. The RORB lag parameter followed ARR's recommended formula based on catchment area **[3]**; as the RORB lag parameter was developed from a series of calibrated models for several QLD gauges.

**Table 1** summarises the key model inputs adopted in the model.

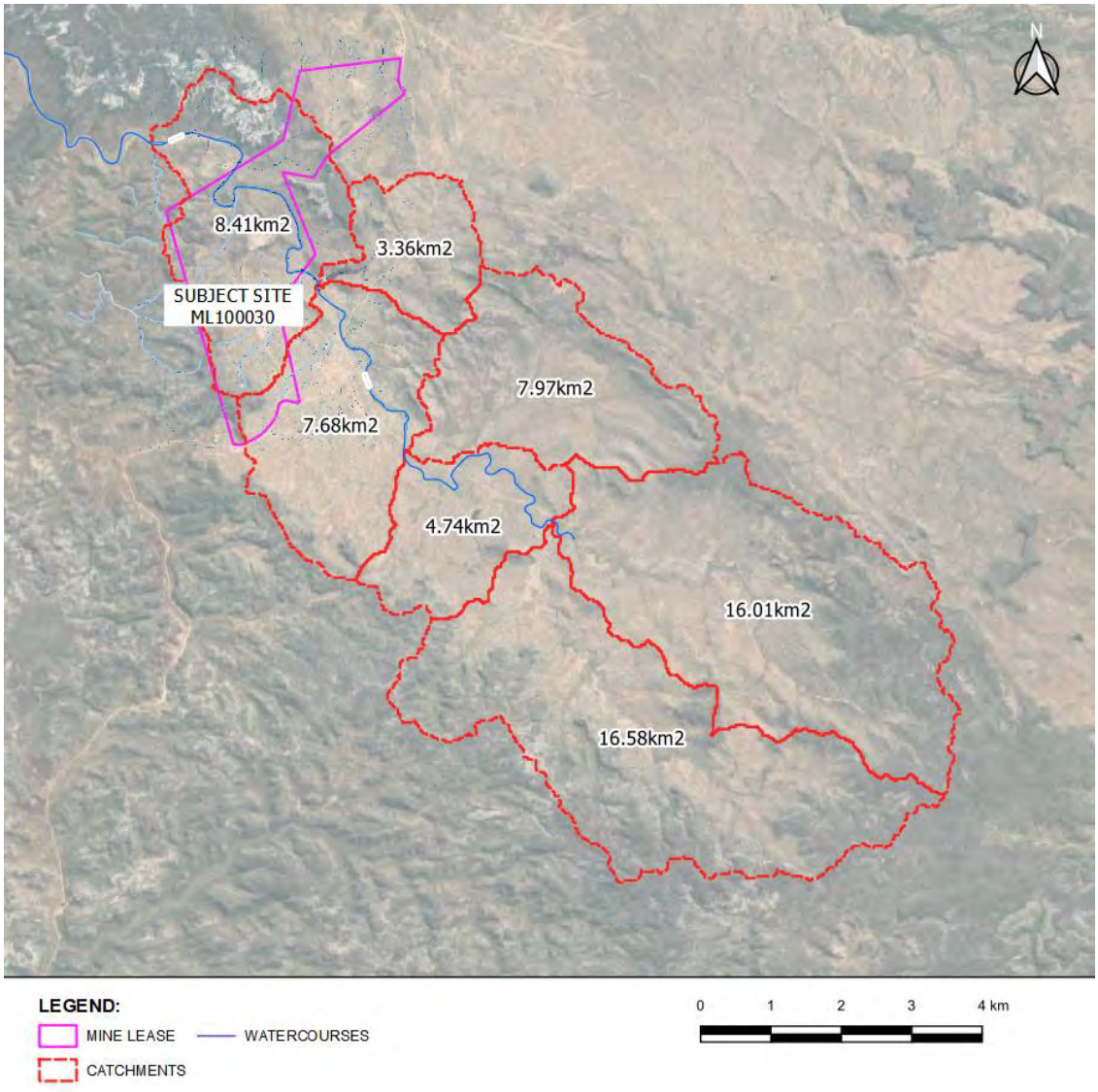
**TABLE 1: RORB MODEL INPUTS**

| Parameter | Value |
|---|---|
| | **Agate Creek (D/S of Mine Site)** |
| Total Area (ha) | 64.8 $km^2$ |
| Catchment Type | Natural |
| $K_c$ (lag parameter) | 8.02<br>(as per Eqn 7.6.8 in ARR **[3]**) |
| Non-linearity 'm' value | 0.80 |
| Initial Loss<br>Continuing Loss | 24 mm<br>6.3 mm/hr |
| Pre-burst Applied | No (given the low pre-burst values under the median condition) |
| Areal Reduction Factors | Yes |



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**DIAGRAM 4: MODELLED CATCHMENTS**




## 4.3 Results

The RORB model results are presented in **Table 2** using the methodology described in the preceding sections and compared to the RFFE tool outputs **[2]**. The critical duration event was selected based on the median peak flow for the catchment outlet location.



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**TABLE 2: RFFE COMPARISON AT AGATE CREEK**

| Annual Exceedance Probability % (AEP) | RFFE Tool Peak Flow ($m^3/s$) | | | RORB Peak Flow ($m^3/s$) |
|---|---|---|---|---|
| | Lower Confidence Limit (5%) | Discharge | Higher Confidence Limit (5%) | Median Event |
| 50 | 22 | 54 | 131 | 45 |
| 20 | 45 | 103 | 243 | 102 |
| 10 | 59 | 145 | 357 | 126 |
| 5 | 73 | 190 | 500 | 160 |
| 2 | 90 | 260 | 748 | 208 |
| 1 | 105 | 319 | 988 | 271 |

The RFFE results demonstrate that the RORB model produces reasonable estimates and are well within the confidence limits of the RFFE tool for the peak flows. No further refinement of the RORB model was conducted due to the conceptual assessment of this report and conservative approach taken in estimating the floodplain extents (refer to **Section 6.4**). The RORB model is therefore considered appropriate for use to estimate the 0.1% AEP hydrograph, noting that no losses were applied to the 0.1% AEP event in RORB. The model results have also been sensitivity tested to consider the impacts of higher peak flows through Agate Creek, refer to **Section 6.3**.



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# 5 2D HYDRAULIC MODEL

## 5.1 Background

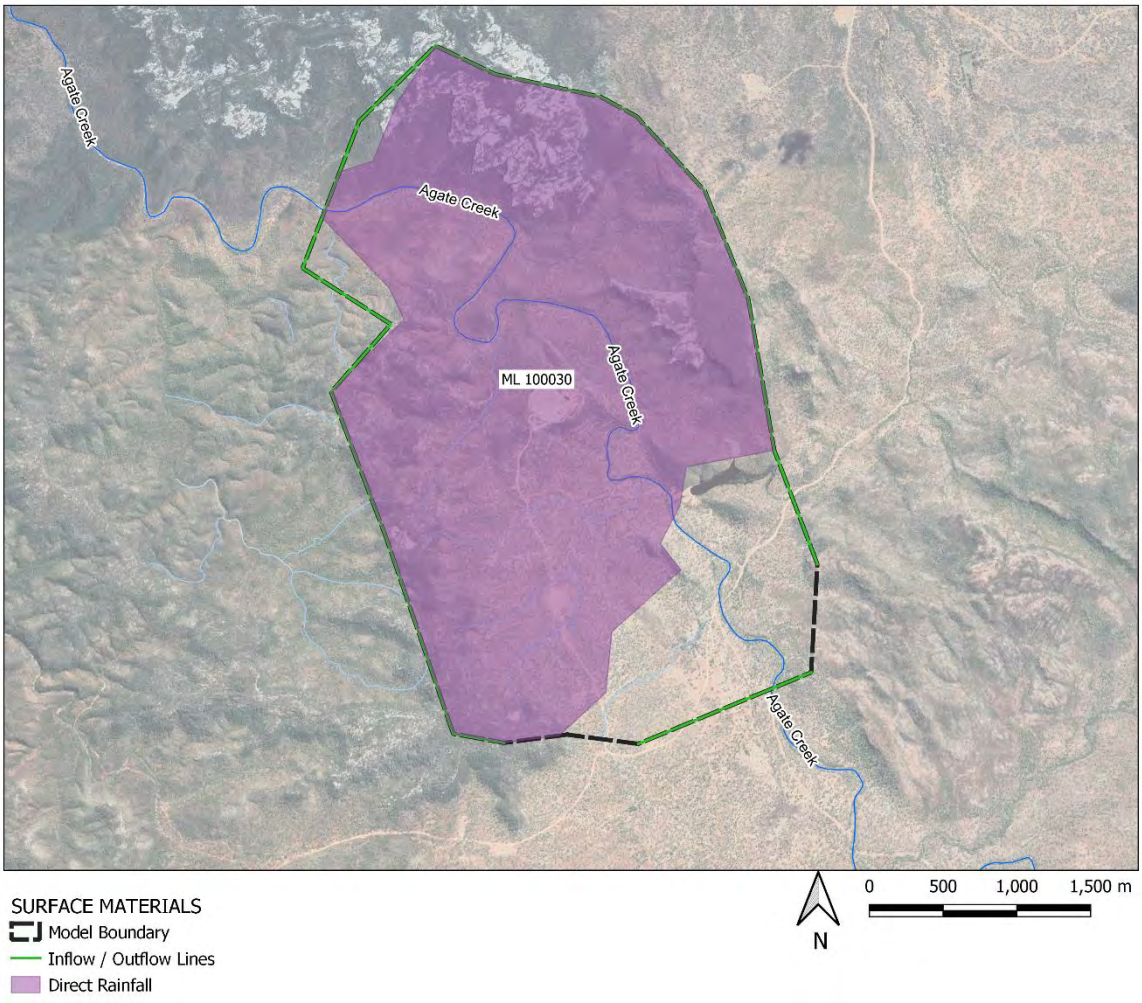
To investigate the potential flooding through the site a flood assessment was conducted using a 2D hydraulic model. TUFLOW software was used for the hydraulic model as it is an advanced 1D/2D/3D computer simulation software that is internationally recognised for hydraulic modelling accuracy, speed and workflow efficiency **[4]**. The software is frequently adopted for regional flooding investigations and urban drainage assessments.

## 5.2 Model Parameters

### 5.2.1 Model Extent

The modelled extent is depicted in **Diagram 5.**

**DIAGRAM 5: TUFLOW MODEL EXTENTS**




### 5.2.2 Direct Rainfall and Inflow Hydrographs

Direct rainfall was adopted over the mine site area, whist an inflow hydrograph was used at the upstream end of the model extents to represent flow within Agate Creek. The rainfall and hydrograph adopted represented the critical duration based on the RORB outputs for the median peak flow of the 0.1% AEP event with no losses. The inputs are presented in **Table 3** and **Graph 1**.



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**GRAPH 2: 0.1% AEP AGATE CREEK INFLOW HYDROGRAPH**

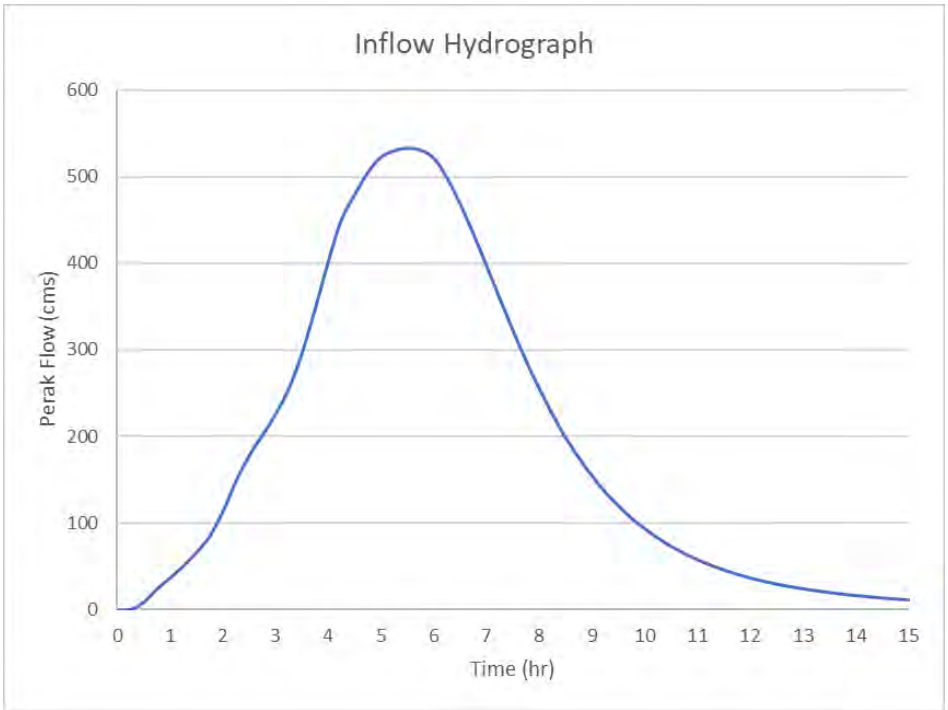



**TABLE 3: TEMPORAL TEMPLATES ADOPTED**

| AEP (%) | Duration_Temporal Pattern |
|---|---|
| 0.1 | 6 hour_10 |

5.2.3 Stormwater Infrastructure

No relevant or known stormwater infrastructure exists within the extents of the model domain. **It should be noted that at the time of this flood study, no information regarding a culvert/crossing over Agate Creek to connect the eastern and western areas of the mine site was available, and as such no infrastructure was included in the model**. Any future culvert/crossing over Agate Creek has the potential to worsen the upstream flood extents depending on the drainage design. A revised flood model should therefore be undertaken when design details are known (i.e size of culvert/crossing, road heights, inlet/outlet infrastructure) to check the flood extents against the outcomes of this report.

5.2.4 Model Boundary Conditions

Outflow boundary conditions were placed as illustrated on **Diagram 5**. The outflow boundary conditions were modelled as free-draining outlets with slopes approximated from the elevation data (0.5% was adopted to Agate Creek). It was assumed that Agate Creek is not impacted by backwater or tailwater levels at this location.

5.2.5 Surface Roughness and Losses

The default surface roughness was modelled as a depth-varying Manning's 'n' value, and aerial imagery indicates similar vegetation conditions over the undisturbed site areas and the external catchments. **Diagram 6** illustrates the surface materials adopted in the modelling.

A depth-varying Manning's 'n' value was adopted for the natural grasses due to the relatively high natural grassland over the catchment surfaces and sheet flow conditions being dominant within the flatter areas of the catchment. The parameters adopted for all surfaces are illustrated in **Table 4**.



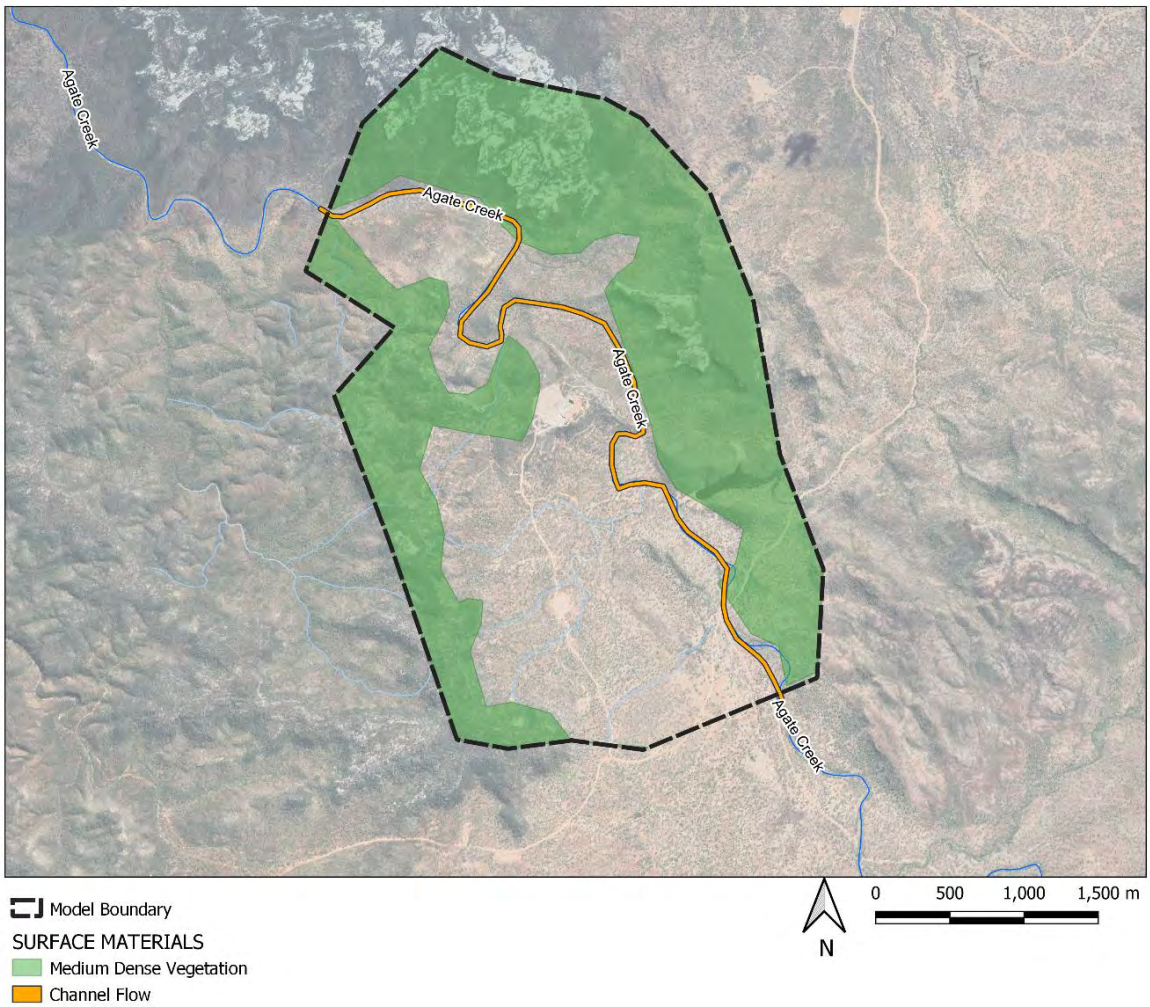
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**TABLE 4: MANNING'S SURFACE ROUGHNESS PARAMETERS**

| Description | Manning's 'n' | Infiltration (IL, CL) (mm) | Losses Direct Rainfall Depth (IL, CL) (mm) |
|---|---|---|---|
| Floodplain (default where not overlayed by a material below) | Depth varying:<br>Depth = 0 m to < 0.3 m, n = 0.2<br>Depth ≥ 0.3 m, n = 0.050 | 0, 0 | 0, 6.3 |
| Medium Density Trees | 0.075 | 0, 0 | 0, 6.3 |
| Channel Flow | 0.030 | 0, 0 | |

The above values are assumed using Innovyze's recommended 2D Manning's 'n' values **[11]** as well as Brisbane City Council's Manning's Roughness document **[7]**.

**DIAGRAM 6: SURFACE MATERIALS ADOPTED**






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### 5.2.6 Model Time Step and Grid Size

The model was initially run with a 30 m grid size to assess the model performance. This grid size was iteratively reduced to 5 m to optimise the run times whilst providing accurate results. The model also adopted TUFLOW's SGS (Sub-Grid Sampling) capability to enable accurate modelling outputs and practical run times. An adaptive time step was adopted, with 1 second being the minimum set value.

## 5.3 Model Scenarios

The following scenario was modelled:

- 0.1% AEP (existing conditions to determine Agate Creek floodplain)

The results are discussed in **Section 6**.



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# 6 RESULTS

## 6.1 Flood Depths and Elevations

The mapped results of the hydraulic modelling are provided in **Appendix B**. The results indicate that flooding of Agate Creek overtops the creek's banks and generally follows the watercourse alignment. The 0.1% event maximum flood depths vary from shallow depths on the outer banks to approximately 6-8 m in deeper areas of the creek. Flow predominately runs along the eastern extents of the proposed mine development area and flows to the northwest.

Pit 5 within the southern portion of the mine development area was found to have the least freeboard to the estimated flood levels at approximately 6 m. All remaining pit voids were well clear of the of the floodplain.

## 6.2 Velocities

The flood event velocities are of high magnitude within the creek due to the relatively narrow channel and high peak flows. In the 0.1 % AEP event, velocity over the inundated Agate Creek floodplain vary between 0.5 - 5 m/s. Overland flow velocities from local gullies within the site were of less magnitude at only 0.5 m/s to 1.5 m/s. However, noting that localised velocities within the mine development area should be assessed as part of a site specific detailed design of diversion bunds and drains for the site features.

## 6.3 Sensitivity Testing

The results of the sensitivity testing demonstrated that the model was not significantly sensitive to a change in Manning's 'n' in the surrounding vegetated areas. A 50% increase in all of the Manning's 'n' values resulted in the average maximum water elevations raising by approximately 0.3 m in Agate Creek. A 30% increase in peak flows resulted in an average increase of approximately 0.25 m to the water surface elevations within Agate Creek. Both sensitivity testing scenarios did not result in any of the voids being inundated by the 0.1% AEP event floodplain.

The selected grid size was found to produce accurate results with minimal mass balance errors, and reducing the grid size further did not result in significantly different results to those presented in this FIA.

## 6.4 Development Implications

The key mine development area, in addition to the existing and proposed voids are all clear of the 0.1% floodplain extents in accordance with the PRCP Guidelines **[8]**. **Appendix B** illustrates a conservative floodplain extent approximated from the maximum flood depths and elevations outputs. Pit 5 was found to have the least freeboard to the 0.1% floodplain water surface elevation at approximately 6 m above the adjacent maximum water surface elevations. The sensitive testing confirmed the importance of accurate input data, and the model should be revised in the detailed design phase when more accurate elevation data and photos of the Agate Creek floodplain are made available. Furthermore, any future infrastructure proposed over Agate Creek may have the potential to change the outcomes of this report, and the flood model should therefore be revised as part of future detailed drainage designs. This is important as any changes to the natural flow path may result in increased flood levels due to the varying terrain and flood widths of Agate Creek. These aspects must be considered for the detailed design phase to confirm there are no voids proposed within the floodplain.

# 7 SUMMARY AND CONCLUSION

This Flood Impact Assessment (FIA) report was developed to assist with the EA Amendment and Progressive Rehabilitation and Closure Plan (PRCP) for the Agate Creek Gold Mine. The results indicate that Agate Creek floodplain traverses through the subject mine lease (ML100030), with the major mine development features outside of the floodplain extents. Specifically, it was found that the proposed open cut pits (voids) are not impacted by the 0.1% AEP flood event. This is in accordance with Non-use Mining Areas (NUMA) as per the DES PRCP guidelines.

It should be noted that a key input to the flood model was the underlying elevation file adopted for the site. The elevation file provided was a relatively coarse satellite dataset, and the flood model should therefore be checked when detailed site survey is made available. Furthermore, no crossing/culvert over Agate Creek was proposed as part of this assessment for the initial mining operational period. Any future crossings/culverts proposed over the creek should therefore be reassessed to determine any potential upstream or downstream flood impacts to mine development areas.



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# 8 REFERENCES


**[1]** Australian Rainfall and Runoff (2022), 'ARR Data Hub', available from: https://data.arr-software.org/

**[2]** Australian Rainfall and Runoff (2022), 'Regional Flood Frequency Estimation Tool (RFFE)', available from: https://rffe.arr-software.org/limits.html

**[3]** Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2019, Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia

**[4]** BMT (2018) 'TUFLOW Classic/HPC User Manual'

**[5]** Bureau of Meteorology (BOM) 'Design Rainfall Data System (2016)', available from: http://www.bom.gov.au/water/designRainfalls/revised-ifd/

**[6]** Bronze Digital Atlas of Australia, "Weather of Agate Creek, QLD," [Online]. Available: http://www.bonzle.com/c/a?a=p&p=241233&cmd=sp&d=w&c=1&x=143%2E50505&y=%2D18%2E933525&w=28640&mpsec=0

**[7]** Brisbane City Council (2003) 'Natural Channel Design Guidelines' Brisbane City Council, Brisbane, Australia

**[8]** Department of environment and Science (DES) (2021), 'Progressive rehabilitation and closure plans (PRC plans)'

**[9]** Google Earth, accessed 2022, available from: https://earth.google.com/

**[10]** Intergovernmental Committee on Surveying and Mapping (2022), 'Elevation and Depth - Foundation Spatial Data', available from: https://elevation.fsdf.org.au

**[11]** Innovyze (2021) 'Recommended Manning's 'n' values - Open Channel', Innovyze Help Centre

**[12]** Laurenson, E.M. et al. (2010), 'Rorb Version 6 User Manual', Monash University Department of Civil Engineering in conjunction with HARC and Melbourne Water Corporation

**[13]** Queensland Government, "SILO - Australian climate data from 1889 to yesterday," 2022. [Online]. Available: https://www.longpaddock.qld.gov.au/silo/point-data/

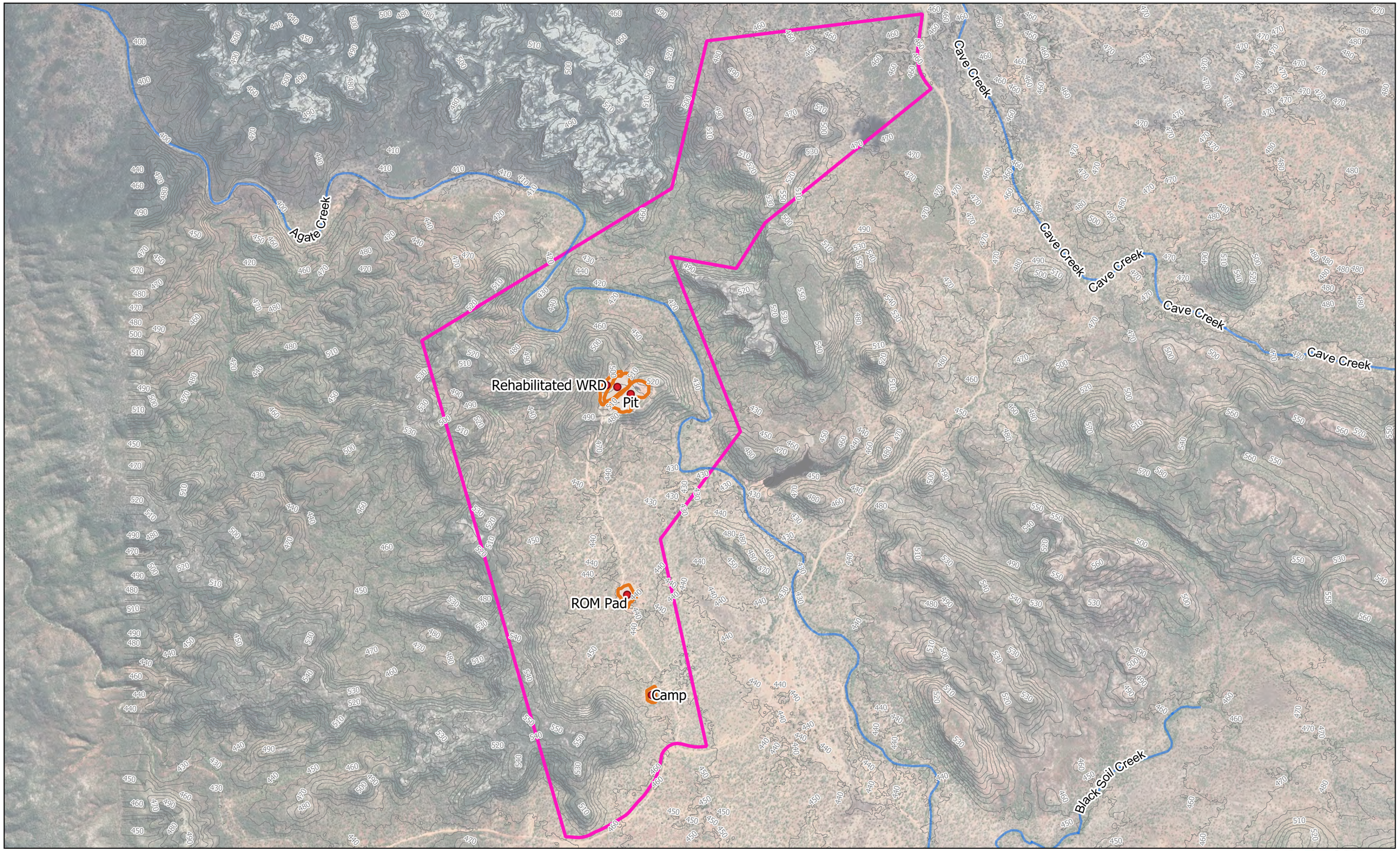
**[14]** Queensland Government, "Northern Queensland fossicking," 2022. [Online]. Available: https://www.qld.gov.au/recreation/activities/areas-facilities/fossicking/north-qld/agate-creek.

**[15]** Queensland Government, "Water Monitoring Information Portal," 2022, available from: https://water-monitoring.information.qld.gov.au/

**[16]** World DEM (2022) ' WorldDEM Neo' available from: https://www.intelligence-airbusds.com/imagery/reference-layers/worlddem/

# APPENDICES

# APPENDIX A – ATCW CONCEPT FIGURES




- LABLES
- MINE LEASE
- EXISTING FEATURES
- EXISTING CONTOURS 10m
- MAJOR WATERCOURSES

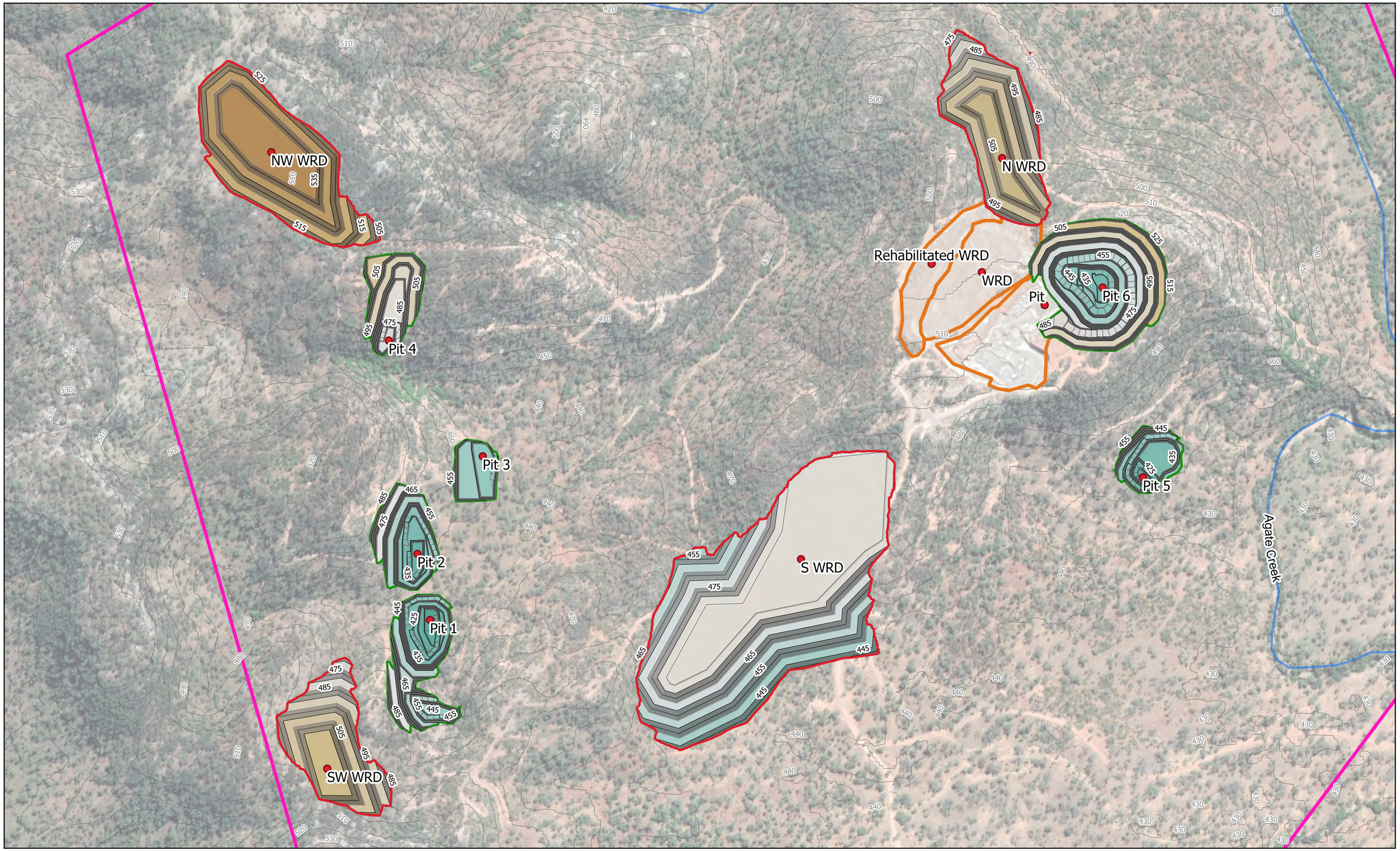
FIGURE 001
EXISTING FEATURES
AGATE CREEK GOLD MINE

N

0 500 1,000 1,500 m

REF: 116091.17 DATE: 2022-07-27

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- LABLES
- MINE LEASE
- EXISTING FEATURES
- WRD FOOTPRINTS
- PIT FOOTPRINTS
- EXISTING CONTOURS 10m
- AGATE CREEK

WRD & PIT DESIGN

- 400.00
- 437.50
- 475.00
- 512.50
- 550.00

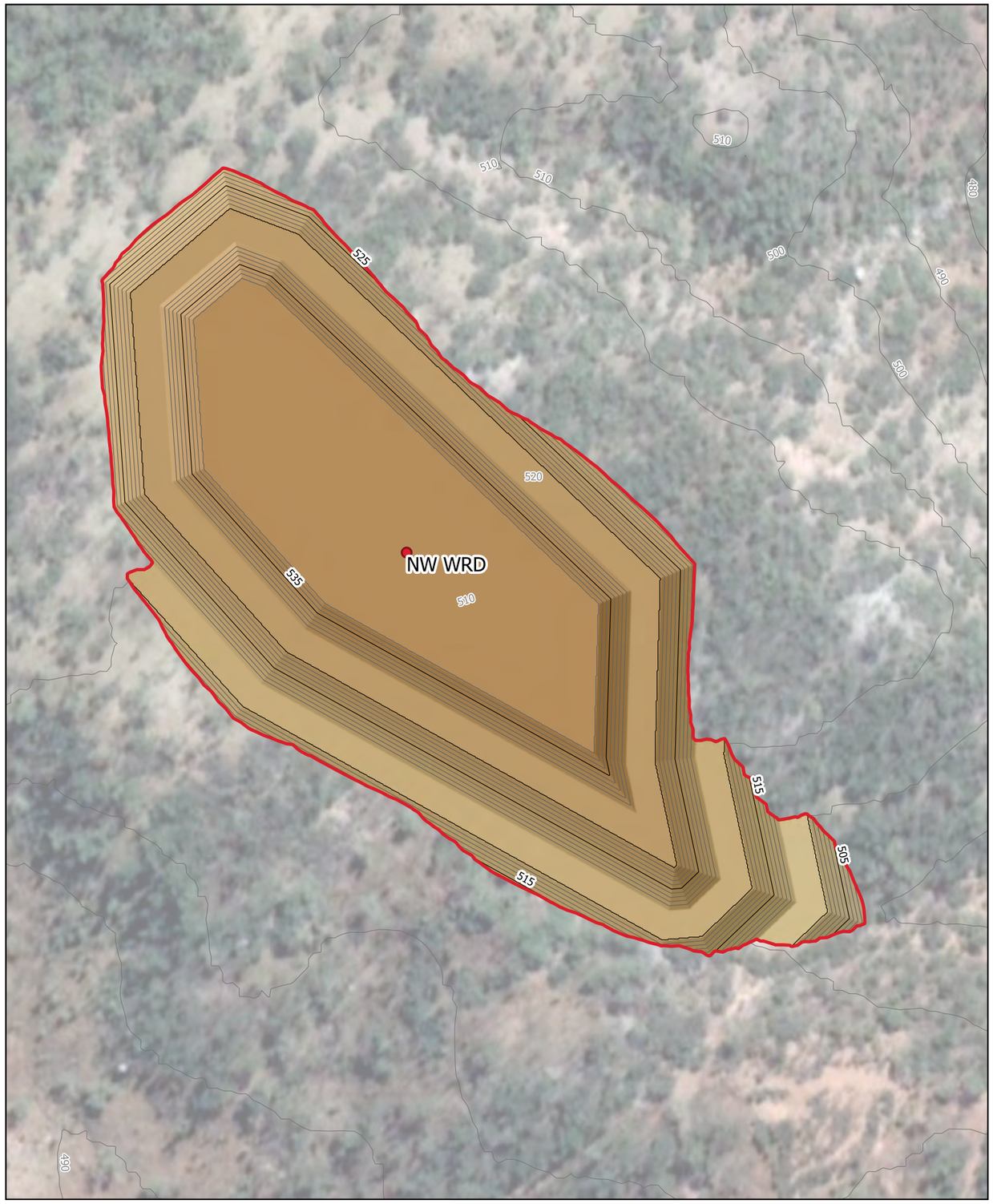
FIGURE 002
PROPOSED LAYOUT
AGATE CREEK GOLD MINE

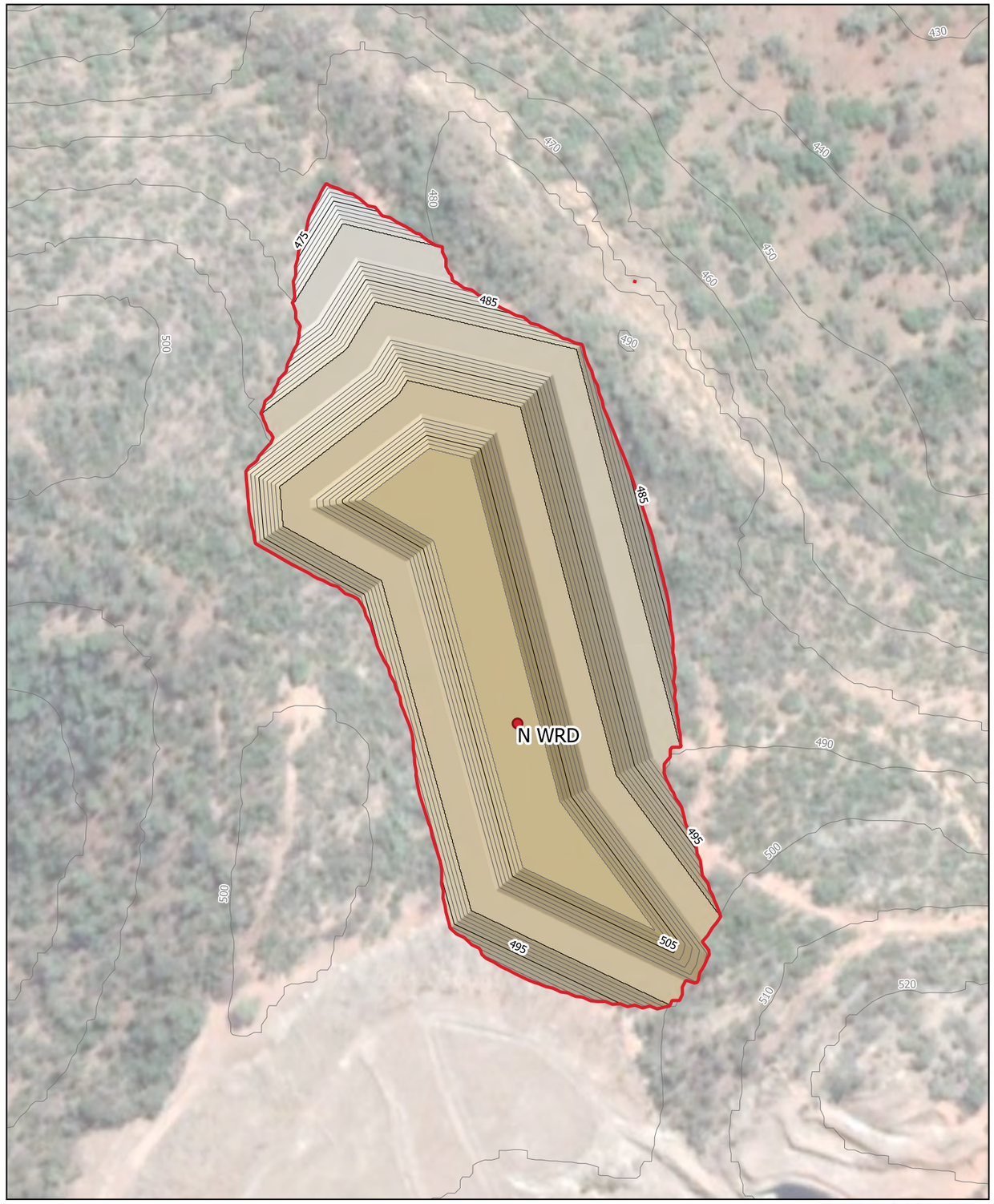
N

0 100 200 300 m

REF: 116091.17 DATE: 2022-07-27

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LABLES
MINE LEASE
WRD FOOTPRINTS
EXISTING CONTOURS 10m

WRD DESIGN
400.00
437.50
475.00
512.50
550.00

FIGURE 003
PROPOSED NORTH-WEST & NORTH WASTE ROCK DUMP
AGATE CREEK GOLD MINE

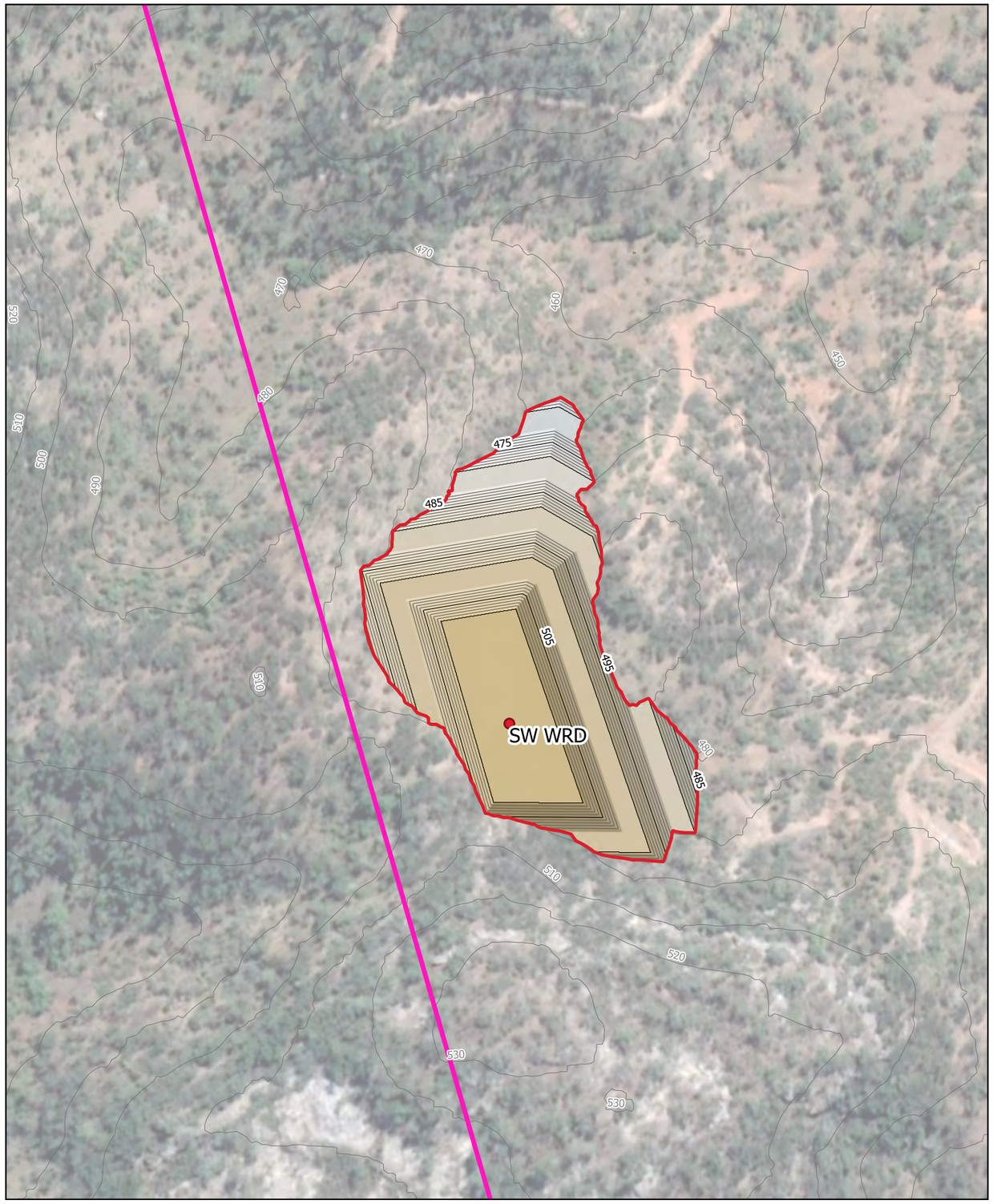
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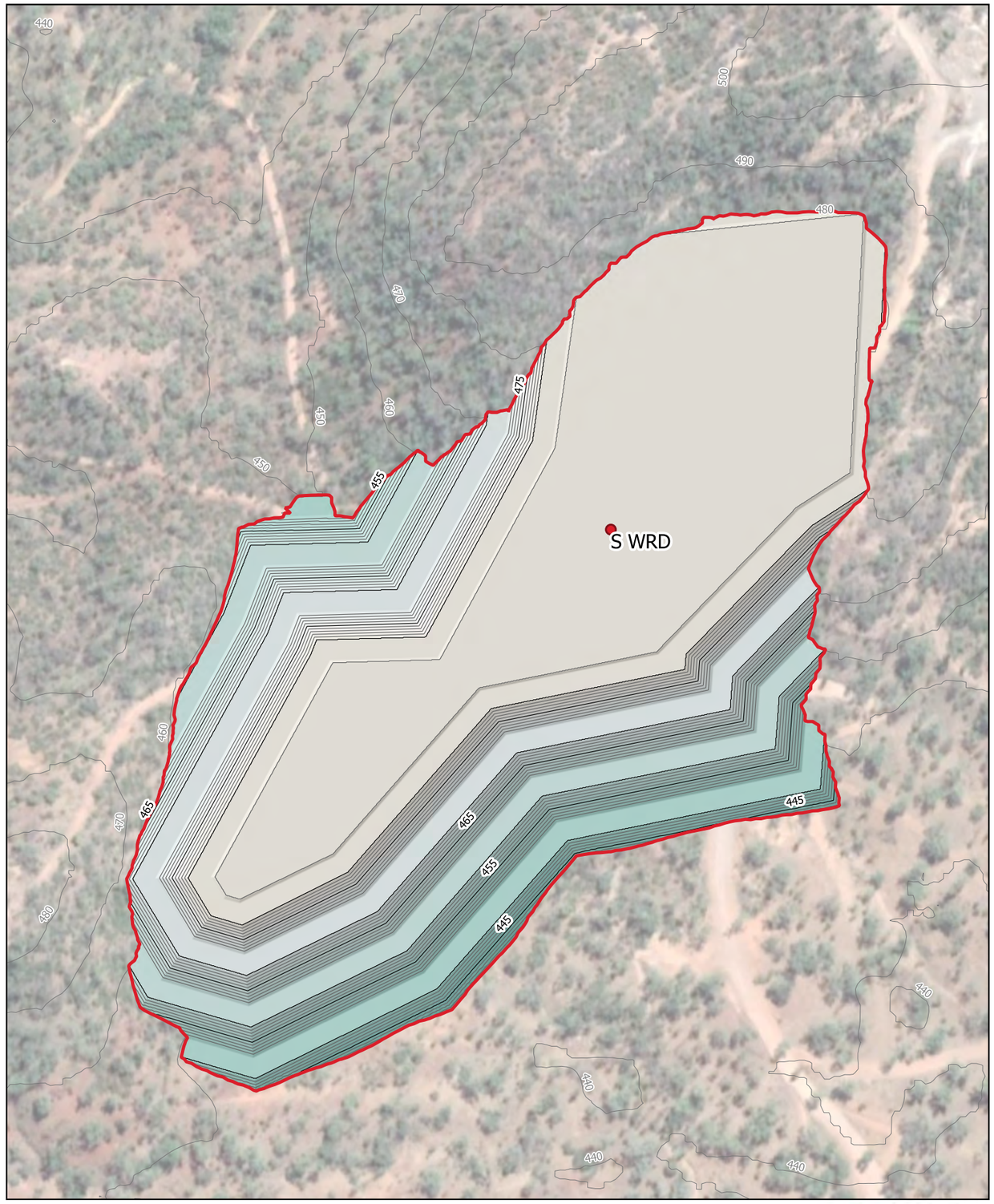
0 50 100 150 m

ATC WILLIAMS

REF: 116091.17 DATE: 2022-07-27

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- LABLES
- MINE LEASE
- WRD FOOTPRINTS
- EXISTING CONTOURS 10m

WRD DESIGN
- 400.00
- 437.50
- 475.00
- 512.50
- 550.00

FIGURE 004
PROPOSED SOUTH-WEST & SOUTH WASTE ROCK DUMP
AGATE CREEK GOLD MINE

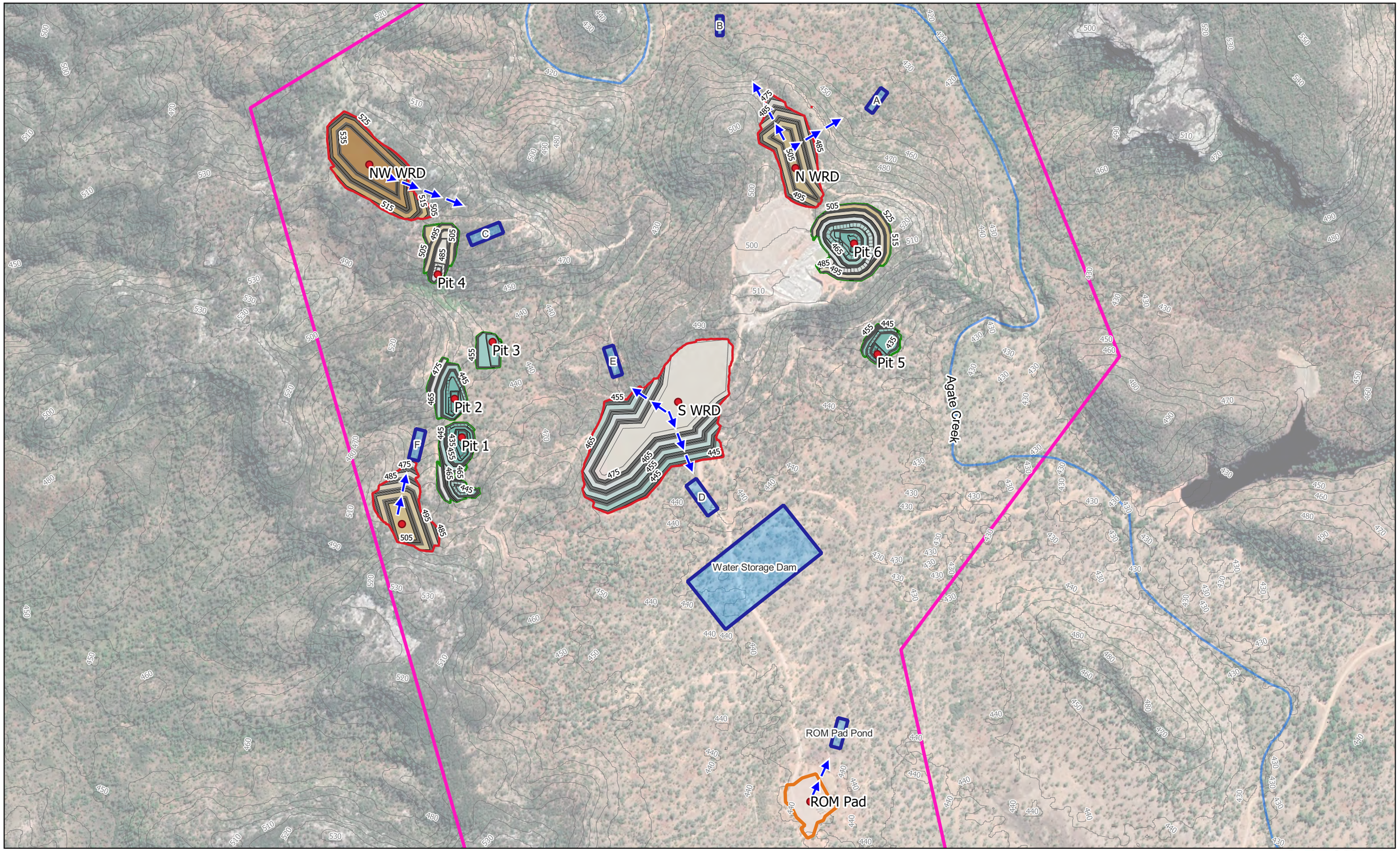
N

0 50 100 150 m

ATC WILLIAMS

REF: 116091.17 DATE: 2022-07-27

*S:\Projects\121\121208 Agate Creek Gold Mine\01 EA Amendment and PRCP Assistance\Project Data\Civil\Data and Calcs\QGIS\NK\AgateCreek NK.qgz*




- LABLES
- MINE LEASE
- EXISTING FEATURES
- WRD FOOTPRINTS
- PIT FOOTPRINTS
- EXISTING CONTOURS 10m
- AGATE CREEK
- FLOW PATH
- SEDIMENT PONDS / WATER SRORAGE

WRD & PIT DESIGN

- 400.00
- 437.50
- 475.00
- 512.50
- 550.00

FIGURE 005
PROPOSED WATER MANAGEMENT PLAN
AGATE CREEK GOLD MINE

N

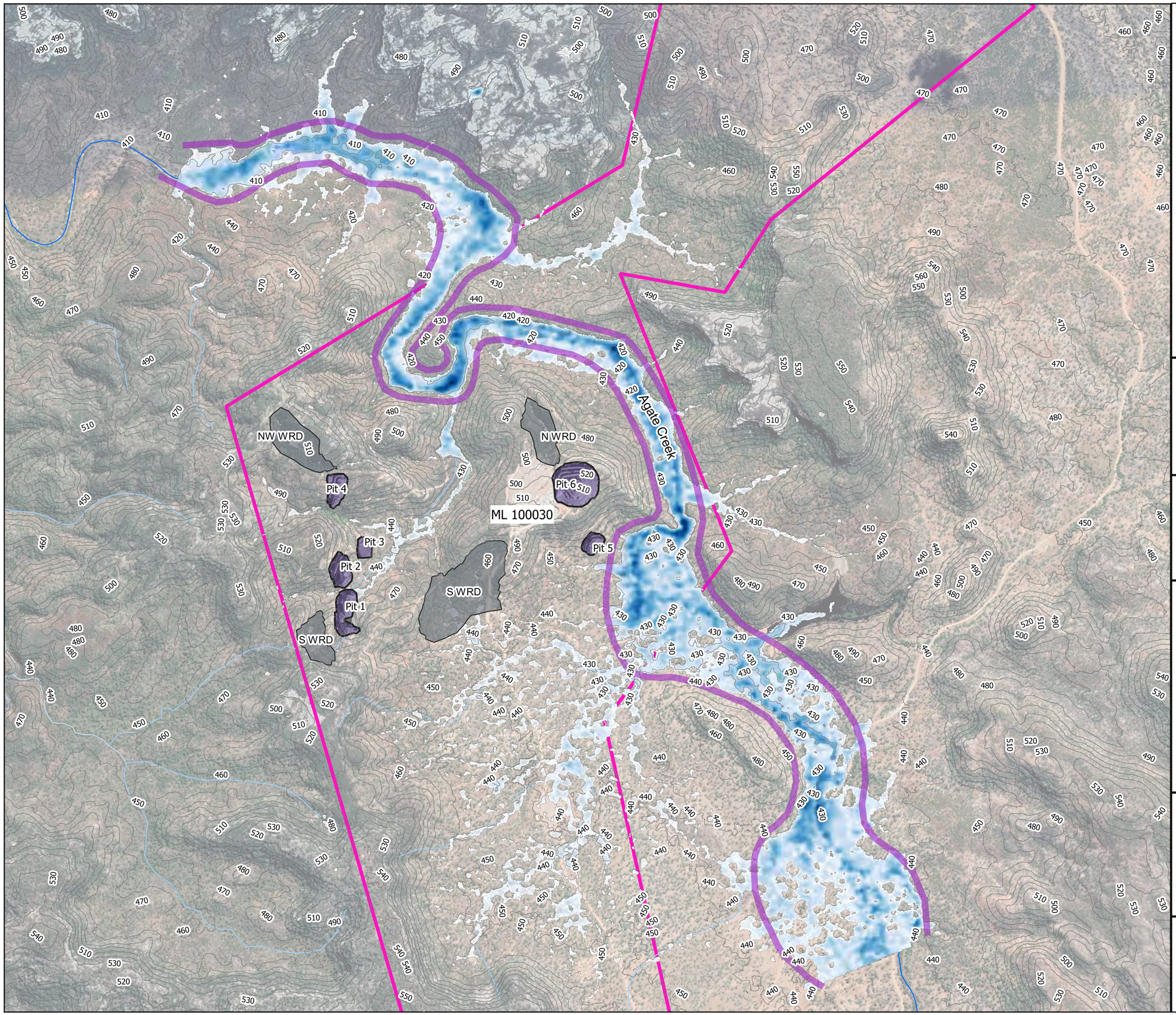
0 200 400 600 m

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# APPENDIX B – FLOOD MAPPING OUTPUTS

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## LEGEND

- MINE LEASE
- EXISTING SITE CONTOURS 10m
- ASSUMED FLOODPLAIN EXTENTS

MAXIMUM WATER DEPTH (m)

- < = 0.1
- 0.1 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8

FIGURE 001

0.1% AEP Maximum Water Depth

AGATE CREEK GOLD MINE

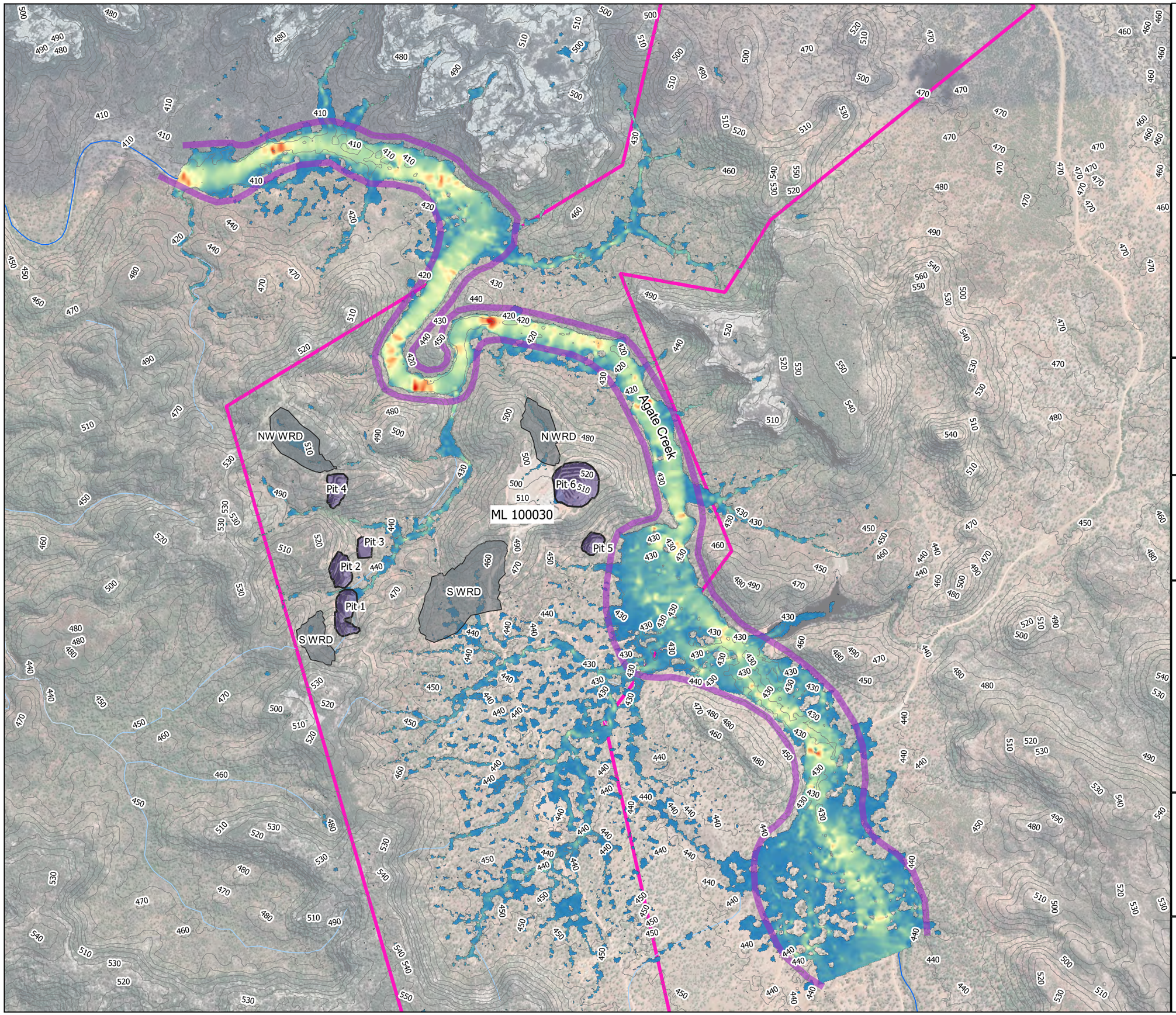
N

0 300 600 900 m

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REF: 116091.17 DATE: 2022-07-27

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## LEGEND

- MINE LEASE
- EXISTING SITE CONTOURS 10m
- ASSUMED FLOODPLAIN EXTENTS

MAXIMUM VELOCITY (m/s)

- 0.0
- 1.0
- 2.0
- 3.0
- 4.0
- 5.0
- 6.0

FIGURE 002

0.1% AEP Maximum Velocity

AGATE CREEK GOLD MINE

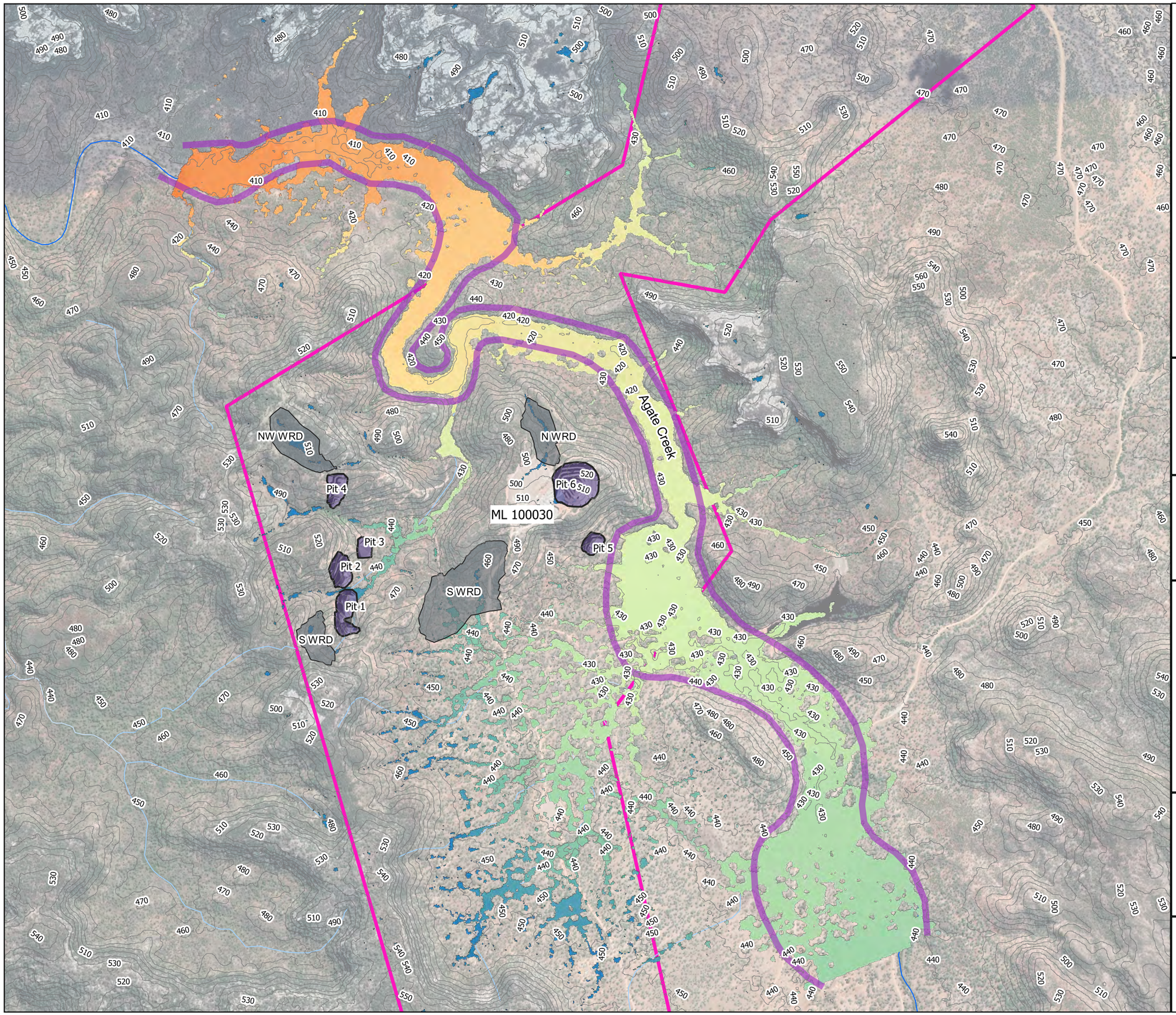
N

0 300 600 900 m

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## LEGEND

- MINE LEASE
- EXISTING SITE CONTOURS 10m
- ASSUMED FLOODPLAIN EXTENTS

MAXIMUM WATER ELEVATION (RL m)

- 400
- 410
- 420
- 430
- 440
- 450

FIGURE 003

0.1% AEP Maximum Water Elevation

AGATE CREEK GOLD MINE

N

0 300 600 900 m

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# Appendix F: Agate Creek Gold Mine Water Management Plan (ATC Williams, 2022)

# REPORT

**WULGURU TECHNICAL SERVICES PTY LTD**
ABN: 79 644 301 655

## Agate Creek Gold Mine

## Water Management Plan

121208-01-WMP-R01-RevA
JULY 2022



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# 1 INTRODUCTION

## 1.1 Background

Agate Creek Gold Mine (ACGM), owned and operated by Laneway Resources (LWR), is proposed to expand its current mining operation from 45,000 tpa to 250,000 tpa as part of the mine's Stage 2 expansion phase. Laneway was granted mining lease (ML) 100030 on February 2019 and currently operates within Environmental Authority (EA) EPSL03068015 (dated 6 September 2021). Due to the proposed increase to mining operations, an approval and EA amendment is required to mine in excess of 240,000 tpa.

### 1.1.1 Current Operations

Agate Creek activities currently encompass the extraction of gold ore and waste rock from the Sherwood open Cut Pit situated at approximately the midpoint of ML100030. Ore is transported to the ROM pad where it is temporarily stockpiled. Waste rock is transported to the Sherwood Waste Rock Dump WRD on-site. LWR currently extract up to 45,000 tpa.

### 1.1.2 General Arrangement of the Proposed Expansion

LWR are proposing to expand current operations across the Sherwood and Sherwood West resource areas under ML100030, extracting up to 250,000 tpa across 6 individual open cut pits. The expansion of operations will include the following mine domains:

- Six open cut pits;
- Four waste rock dumps (WRDs);
- Topsoil stockpile areas;
- Expanded administrative buildings and other mining infrastructure (roads, camp etc.);
- 0.4 Ha expanded Run of Mine (ROM) pad;
- Magazine;
- Water storages; and
- Sediment ponds.

Refer to Figure 002 in **Appendix A** for the key site details.

Ore is to be transported off site to Georgetown for processing. Access to Agate Creek is to remain as Rungulla Road/Agate Creek Road /Cobb Road and onto Georgetown via Forsayth Road.

## 1.2 Scope of Works

ATC Williams (ATCW) Pty Ltd have been engaged by Wulguru Technical Services (WTS) Pty Ltd to assist with site investigations and the documentation required for the major EA amendment and in support of the Progressive Rehabilitation and Closure Plan (PRCP) of Agate Creek mine site. The following site investigations required by WTS include:

- Water Management Plan (WMP);
- Flood Impact Assessment (FIA);
- Waste Rock Dump (WRD) Concept Design and Management Plan.

This report addresses the requirement for a Water Management Plan. The overall purpose of this WMP is to provide a site surface water assessment, and to outline control measures to be implemented to prevent detrimental impact on receiving waters. This WMP will further inform



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necessary water management amendments to the EA and will inform part of the PRCP documentation.

The scope has been prepared to satisfy the conditions in the Department and Environment and Science (DES) guideline *'Preparation of Water Management Plans for Mining Activities'* ***[17]***. The WMP include the following;

- Contaminant Source Study;
- Site Water Balance and Model;
- Water Management System;
- Saline and Metalliferous, Drainage Prevention and Management Measures;
- Acid Rock Drainage Prevention and Management Measures
- Emergency and Contingency Planning; and,
- Monitoring and Review.

## 1.3 Report Summary and Structure

This Water Management Plan (WMP) has been prepared for ACGM to outline the proposed measures to meet regulatory and environmental objectives for the site. This WMP strategy includes several sediment ponds, and a large Water Storage Dam to contain sediment pond and pit pump-out in large/prolonged rainfall events. This will require long lengths of pipeline and significantly sized pumps to meet head requirements given the site topography. The WMP is constrained by the Agate Creek floodplain and the multiple natural gullies that flow through the site. Water management for the mine will therefore be complex due to the steep nature of the site, multiple natural gullies, very low on-site water demands, and the development areas being spread apart.

The worst-case scenario for water management has been considered in this WMP, which assumes all disturbed areas such as pits and WRDs are operational and have not been rehabilitated. This is due to the limited information which is currently available regarding mine development sequencing and staging. However, it should be noted that there are water management efficiencies that could be achieved to reduce the on-site water storages and transfer requirements, if a detailed progressive rehabilitation plan was developed in co-ordination with the mine development staging. It is therefore recommended that this WMP is updated when the mine development planning is further progressed and greater details regarding potential progressive rehabilitation strategies are understood.

The structure of this report, to address the above purpose and scope, is as follows:

**Section 2.0** - Provides a description of the project in the context of the proposed site water management strategy and site setting covering climatic and hydrological conditions.

**Section 3.0** - Presents an overview of the outcomes of the contaminant source study and the receiving environment water quality requirements.

**Section 4.0** - Outlines the mine stormwater runoff management system and key performance criteria.

**Section 5.0** - Presents details of the site operational water balance modelling, and reviews the overall hydrological performance based on the adopted water management layout.

**Section 6.0** - Presents details of the site post-closure phase water balance modelling, and reviews the overall hydrological performance.

**Section 7.0** - Presents a preliminary consequence category assessment for the site water storage dam and other structures

**Section 8.0** - Details site water monitoring and review requirements.

**Section 9.0** - Provides an overview of the emergency and contingency procedures on-site.



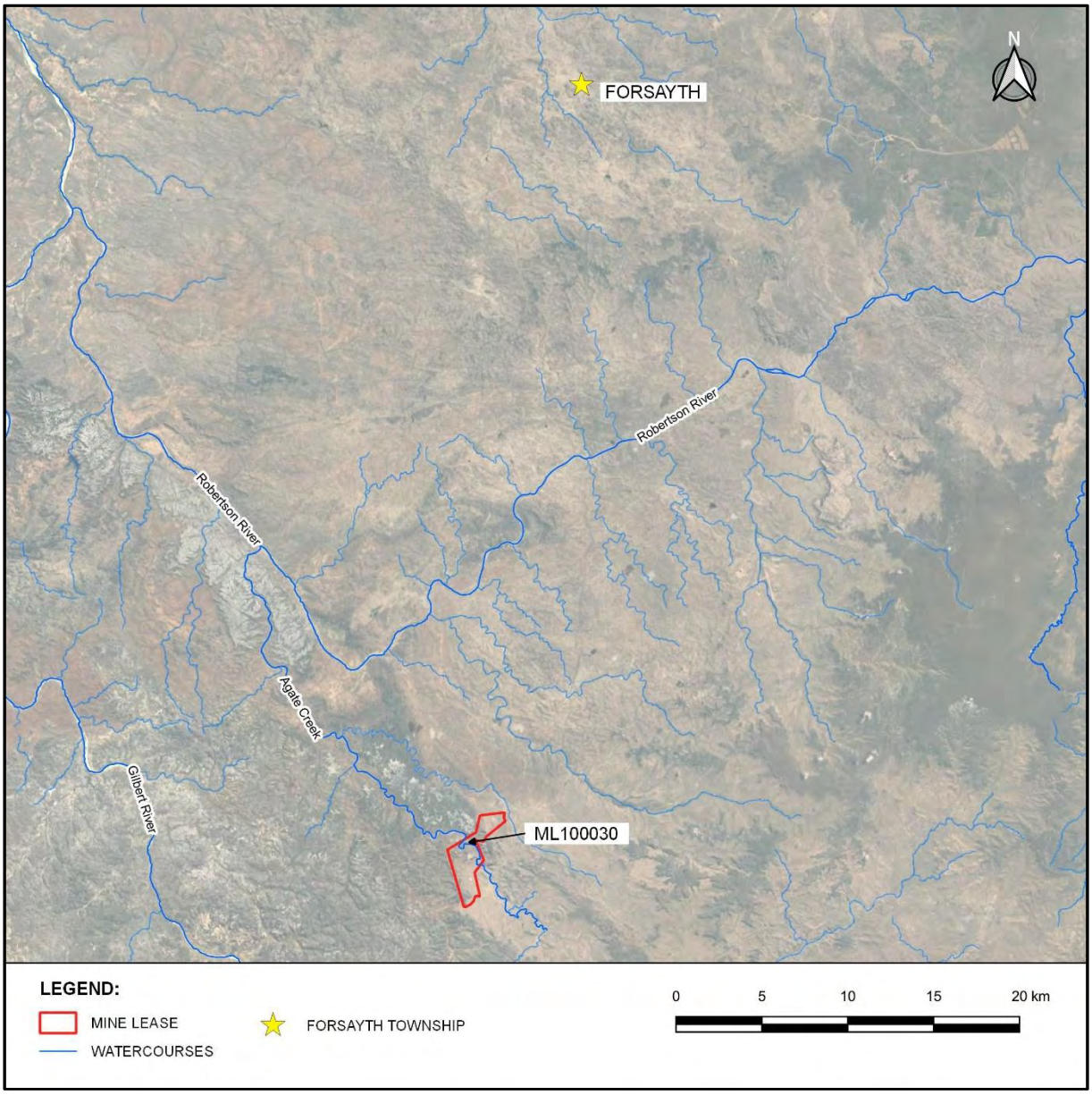
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# 2 SITE DESCRIPTION

## 2.1 Site Location

Agate Creek Gold Mine site is located approximately 40 km south-west (Rungulla Road) of Forsayth, Far North Queensland. The mine is part of the larger Agate Creek Gold Project, which also includes a mineral development licence MDL402, and exploration permits for areas north of the mine (EPM17788 and EPM26460). However, this assessment focuses only on the mine area within ML100030, as shown on **Diagram 1.** Typical site conditions are shown in **Photo 1**.

**DIAGRAM 1: SITE LOCALITY MAP**






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**PHOTO 1 – TYPICAL SITE CONDITIONS**



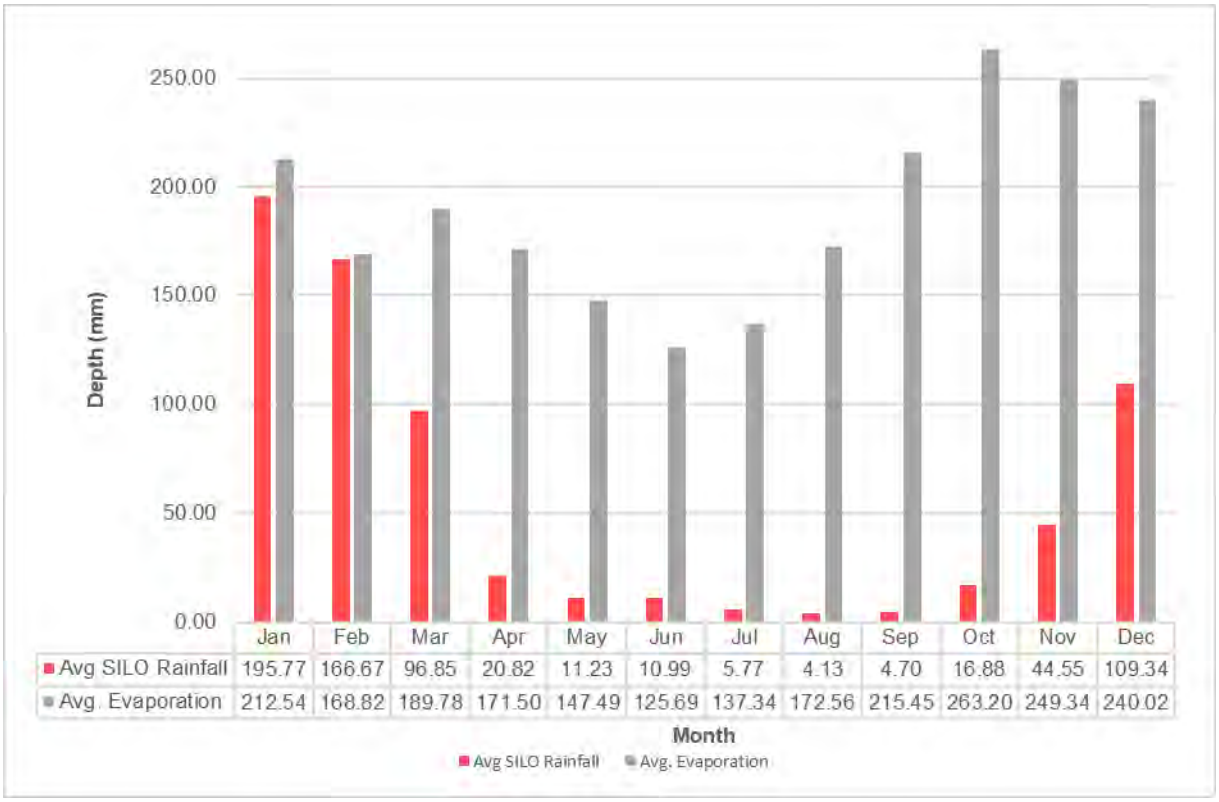
## 2.2 Climatic Conditions

The ACGM site is located in Far North Queensland region which has a tropical climate characterised by a distinct wet season (December – March) and dry season (April – November). Average annual rainfall is approximately 1085 mm, with most falling during the wet season. The nearest meteorological weather station to the site is the Bureau of Meteorology's (BoM) Robinhood Station located some 24.4 km to the northeast of the site. The Robinhood weather station does not have long term evaporation data, which is a key factor in the assessment of surface water management. Therefore, for the purposes of this assessment evaporation data has been sourced from the SILO Data Drill program **[26]** specific to the site location.



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**GRAPH 1: RAINFALL AND EVAPORATION MONTHLY AVERAGES**




Rainfall data can significantly vary when affected by broader weather patterns, such as 'El Niño Southern Oscillation', and additional tropical cyclones that occur among November and April **[12]**. For instance, Agate Creek has experienced as much as 235 mm in a single January day and as much as 813 mm in a single month (February) **[5]**.

## 2.3 Hydrological Characteristics and Topography

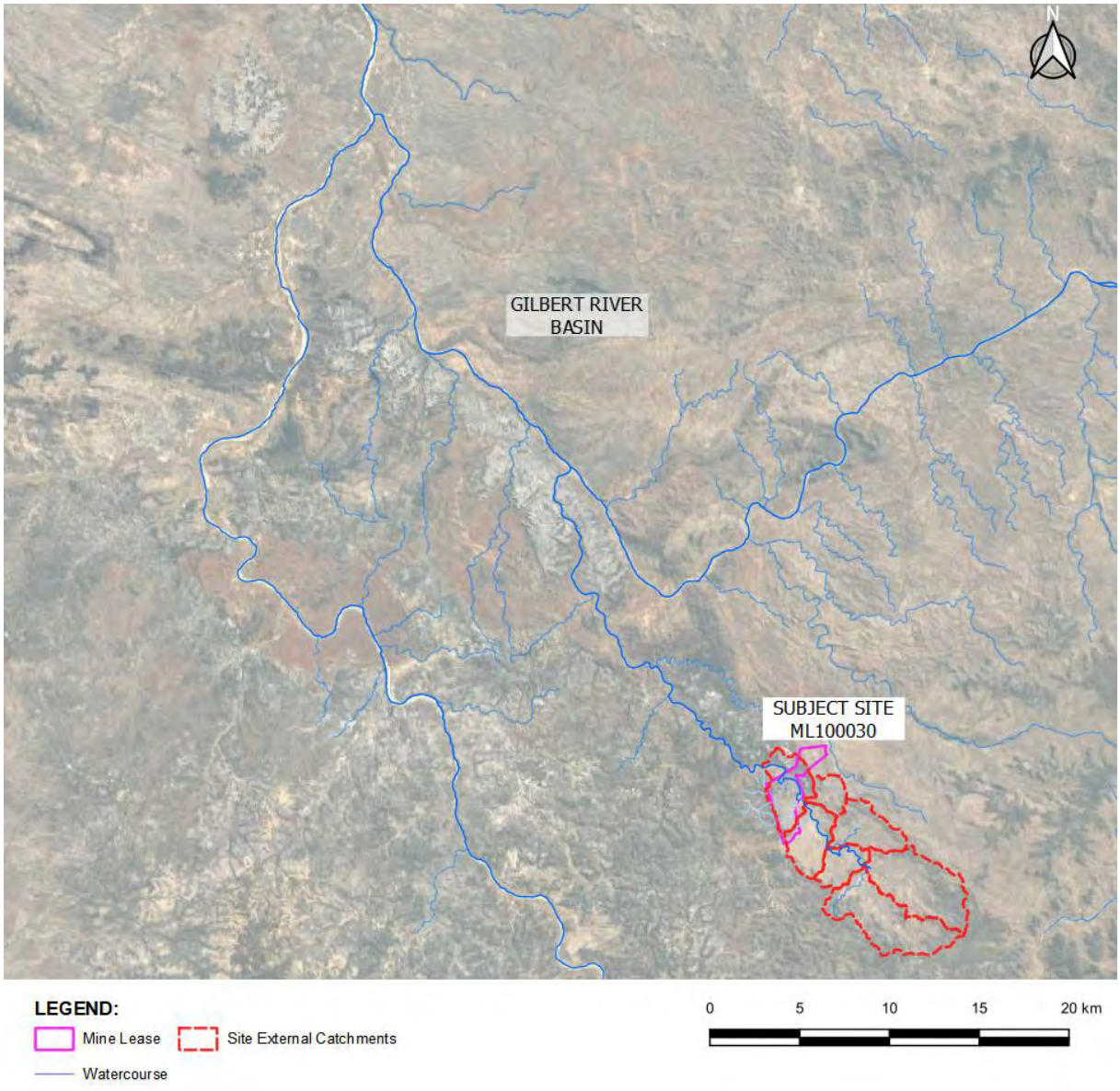
### 2.3.1 Regional Context

The ACGM site forms part of the Gilbert River catchment located within the wider regional Gilbert Basin in Far North Queensland. The site has ephemeral waterways directly discharging to Agate Creek which is the immediate receiving watercourse for the site, located centrally within the mine lease running from east to northwest. Agate Creek subsequently discharges northwest until it intersects Robertsons River, approximately 23 km northwest of the site. The Robertsons River then joins the Gilbert River, located approximately 26 km downstream from the point of confluence of Agate Creek and Robertsons River. The Gilbert River travels further downstream by approximately 361 km until it reaches the Gulf of Carpentaria on the northwest, which is the final discharge point for the entire Gilbert Basin. The regional watercourses are depicted on **Diagram 2.**



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**DIAGRAM 2: REGIONAL DRAINAGE**




### 2.3.2 Site Context

The subject site is located on a valley within the Agate Creek catchment. The site is bordered to the east and west by an existing ridge and to the south by the Rungulla Road. The majority of the site drains centrally to Agate Creek that has a large upstream catchment as described in **Section 3.2.1** . Elevation data over the entire lease ranges between approximately RL 422 m to RL 529 m. Local drainage lines at the site are depicted in **Diagram 3.**



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**DIAGRAM 3: LOCAL DRAINAGE**




## 2.4 Site Features

Key elements of the proposed project site associated with the water management system are as follows:

- Open Cut Pits;
- Waste Rock Dumps (WRD);
- Haul roads;
- ROM Pad;
- Sediment Ponds;
- Water Storage Dam;

These elements are depicted on **Figure 002** attached in **Appendix A**. Note that the worst-case scenario for water management has been considered in this WMP, which assumes all disturbed areas such as pits and WRDs are operational and have not been rehabilitated. This is due to the limited information that is currently available regarding mine development sequencing/staging. However, it should be made



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clear that there are significant water management efficiencies that could be achieved to reduce the on-site water storages and transfer requirements if a detailed progressive rehabilitation plan was developed in co-ordination with the mine development staging. It is therefore recommended that this plan is updated when the mine development planning is further progressed and greater details regarding potential progressive rehabilitation strategies are understood.

Furthermore, the elevation data used to develop this WMP is gridded satellite data and of low quality. A detailed site survey to accurately pick up the existing terrain elevation is required, and an update to this WMP should be conducted once this information is made available.

### 2.4.1 Open Cut Pits

There are six (6) proposed open cut pits which are all located on the central zone of the mine lease, with sizes ranging from approximately 377,000 m³ to 1.06 million m³ and an overall total of 4.6 million tonnes in terms of excavated volume.

### 2.4.2 Waste Rock Dump

There are four (4) waste rock dumps (WRD) within the ACGM site, proposed to store waste materials during mine operations. The WRDs will be constructed within the central area of the mine lease and are expected to store a total volume of some 4.6 million tonnes, with a combined footprint area of approximately 17.7 ha. Refer to ATCW's **121208.01-WRD-R01** WRD Management Plan **[1]** for further details.

### 2.4.3 Water Storage Dam

A Water Storage Dam (WSD) is proposed to be located southwest of the southern WRD. The storage is proposed to contain water for site demands, including dust suppression and other ancillary water demands. The storage has been nominally sized (refer **Section 5**) with a storage volume of some 250 ML and an indicative footprint of 4.5 ha. The storage has no external catchments, with pumped transfers to be received from the Pits and the Sediment ponds. In the event of the dam spilling, flows will travel east towards Agate Creek.

### 2.4.4 Sediment Ponds

Based on the location of the proposed WRDs, seven (7) sediment ponds are proposed to contain site water (sediment laden runoff) from the WRDs. Ponded waters within the sediment ponds will be transferred by pumping to the WSD. Further details of conceptual sizing of the sediment ponds are provided in **Section 4.3.1.** All sediment ponds will spill to the unnamed tributaries of Agate Creek, located to the east of the site.

It is noted that depending on the final design of the WRDs and the achievable drainage, additional sediment ponds may be required to ensure runoff from any disturbed areas are captured. This may also include other infrastructure or hardstand areas proposed as part of the operations.



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# 3 CONTAMINANT SOURCE STUDY

## 3.1 Background

Key objectives of this WMP are to maintain the integrity of the surface waters and groundwater at the project site, and to ensure that water quality does not adversely affect any environmental values or the health, welfare and amenity of people, fauna and land users by meeting statutory requirements and acceptable standards. The following sections outline the likely contaminants from disturbed operational areas.

## 3.2 Receiving Environment

### 3.2.1 Catchment Conditions

The ACGM site is located within the Gilbert River sub-basin which comprises an area of approximately 22,016 km² and includes nationally important wetlands, national parks, and bioregions. The river captures the northern slopes of Gregory range, western slope of Gilbert range, and southern slope of Newcastle range, travelling approximately 488 km before discharging into the Gulf of Carpentaria to the northwest. According to the *Regional Planning Interests Act 2014* ***[23]***, the project area and downstream waters are not located within a Strategic Environmental Area.

### 3.2.2 Regulatory Context

As outlined in **Section 1.1,** Laneway is currently undertaking investigations and documentation required for EA amendments and PRCP documentation for the ACGM expansion. Consequently, an Environmental Authority (EA) stipulating surface water monitoring locations and water quality objectives was not available at the time of this report. Notwithstanding, for the purposes of this assessment, proposed receiving environment monitoring locations have been provided by Laneway and are set out in **Table 1** and depicted on **Diagram 4**.

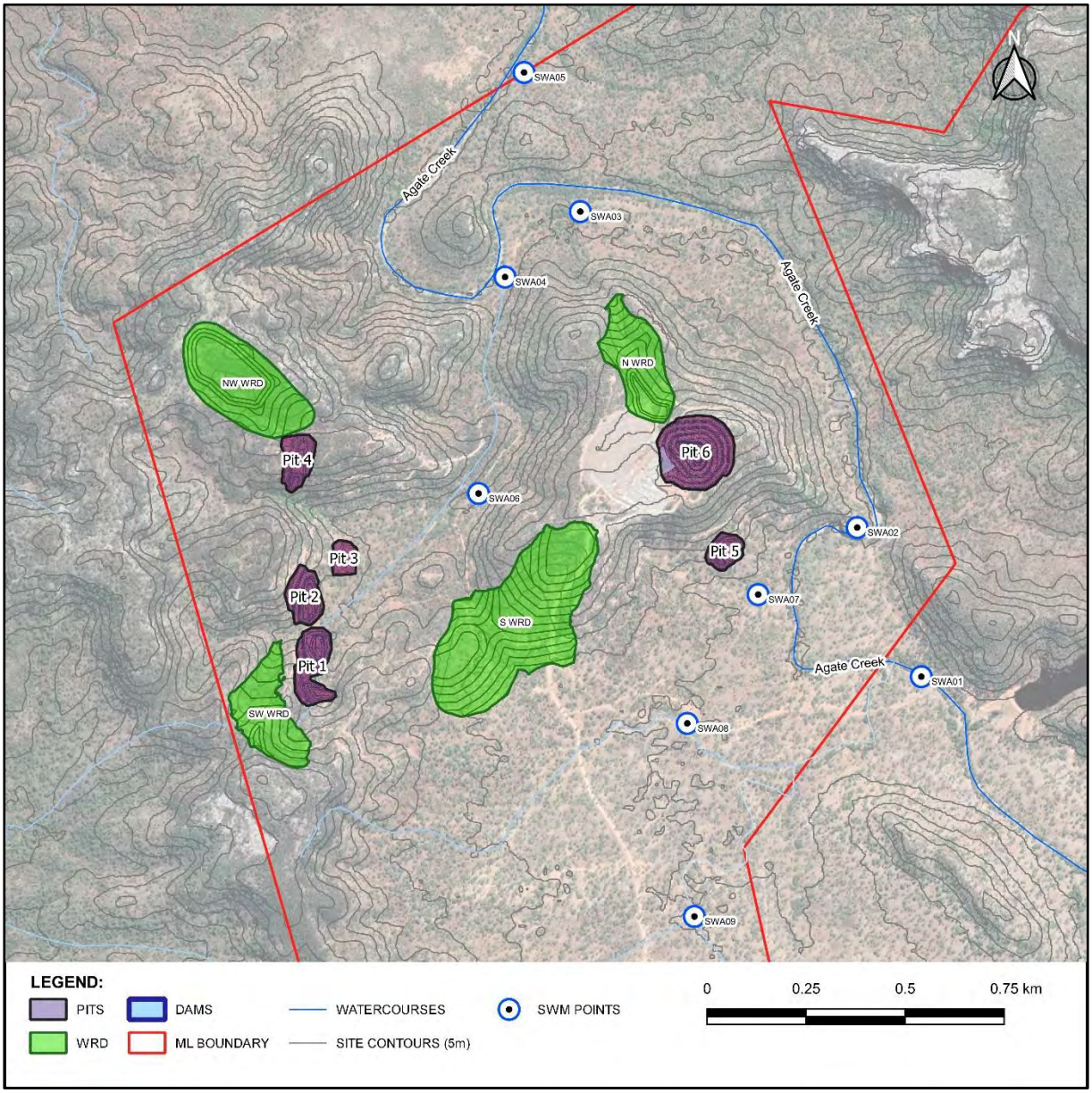
**TABLE 1: PROPOSED SURFACE WATER MONITORING POINTS (BY OTHERS)**

| Monitoring Points | Easting (GDA 94 Zone 55) | Northing (GDA 94 Zone 55) | Elevation (RL m) |
|---|---|---|---|
| **SWA01** | 768970 | 7897279 | 432 |
| **SWA02** | 768808 | 7897655 | 422 |
| **SWA03** | 768109 | 7898452 | 423 |
| **SWA04** | 767919 | 7898287 | 420 |
| **SWA05** | 767967 | 7898803 | 416 |
| **SWA06** | 767852 | 7897741 | 435 |
| **SWA07** | 768558 | 7897486 | 429 |
| **SWA08** | 768379 | 7897161 | 435 |
| **SWA09** | 768397 | 7896674 | 436 |



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## DIAGRAM 4: PROPOSED RECEIVING ENVIRONMENT MONITORING LOCATIONS




In lieu of guidance from EA specified limits, water quality and contaminant limits for the receiving environment have been adopted based on the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality Guidelines **[2]***. It is noted that specific guideline values for the north-east coast were not available at the time of this report and as such, values have been based on regional types. The proposed water quality and contaminant limits for the project site are outlined in **Table 2**.



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**TABLE 2: RECEIVING ENVIRONMENT TRIGGER AND CONTAMINANT LIMITS (ANZECC, 2018)**

| Quality Characteristic | Receiving Water Quality | Stream Sediment Quality | |
|---|---|---|---|
| | Trigger Levels | Trigger Level | Contaminant Limit |
| Electrical Conductivity | 250 µS/cm | N/A | N/A |
| pH | 6.0 (minimum)<br>7.5 (maximum) | N/A | N/A |
| Aluminium | 55 µg/L | N/A | N/A |
| Arsenic | 13 µg/L | 20 mg/kg | 70 mg/kg |
| Cadmium | 0.2 µg/L | 1.5 mg/kg | 10 mg/kg |
| Chromium | 1.0 µg/L | 80 mg/kg | 370 mg/kg |
| Copper | 1.4 µg/L | 65 mg/kg | 270 mg/kg |
| Lead | 3.4 µg/L | 50 mg/kg | 220 mg/kg |
| Mercury | 0.6 µg/L | 0.15 mg/kg | 1.0 mg/kg |
| Nickel | 11 µg/L | 1.0 mg/kg | 3.7 mg/kg |
| Zinc | 8.0 µg/L | 200 mg/kg | 410 mg/kg |

The above values should be updated once additional regulatory guidance is provided.

## 3.3 Environmental Values and Beneficial Users

Schedule 1 of the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* **[10]**, which is a subordinate legislation to the *Environmental Protection Act 1994* (EP Act) **[11]**, documents the waters for which the legislation applies that are either enhanced or protected, and specifies relevant environmental values (EV's) and Water Quality Objectives (WQO's). Review of Section 6 indicates that the Gilbert Basin does not currently have gazetted and mapped EV's or WQO's. Notwithstanding, generalised assessment under the Environmental Policy can be based on the nature of the receiving environment.

The receiving environment surrounding the project site is 'slightly to moderately disturbed' as a result of the impacts of low intensity cattle grazing, historical mining, and exploration activities in the area. The ANZECC guidelines **[2]** define 'slightly to moderately disturbed' systems as:

*"Ecosystems in which aquatic biological diversity may have been adversely affected to a relatively small but measurable degree by human activity."*

Based upon the hydrological domains downstream of the project site and potential downstream users, classification of Environmental Values (EV's) for the downstream environment may include:

- Aquatic Ecosystems;
- Stock Water;
- Irrigation; and,
- Cultural and Spiritual Values.

## 3.4 Geochemical Characterisation

The ACGM development involves open cut pit development, disposal of overburden waste rock material into waste rock dumps, handling of extracted ore and its subsequent transportation off site. Accordingly, the principal contaminant sources on site are the extracted waste rock and ore material from the open cut pit.



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Potential secondary contaminant sources are associated with secondary activities and infrastructure, such as road infrastructure, fuel storage and local drainage such as bunds around any buildings and/or workshops. These aspects must be confirmed and this section of the WMP may need to be updated to reflect the proposed operations.

### 3.4.1 Waste Rock Geochemical Characterisation

Characterisation of the material to be extracted from the open cut pits described in this section has been taken from the following key reference:

*Agate Creek Gold Mine – Waste Rock Characterisation (Appendix C)*, C&R Consulting (CRC) **[9].**

The report details a geochemistry investigation conducted in 2021, involving 260 samples recovered from 27 exploration drill holes across the six proposed pits. Samples were analysed at a NATA accredited laboratory using industry standard laboratory procedures for the characterisation of mine waste materials. A summary of the acid forming potential of waste rock is as follows:

- Applying the NAG(pH) and total sulphur geochemical classification criteria, it was found that most waste characterisation samples are NAF.
- Approximately 6 out of 260 samples are potentially acid forming (PAF) waste rock. The PAF samples are associated with either Pit 2, 5 or 6.
- Acid base accounting indicated that the majority of the samples contain more acid-neutralising than acid-generating minerals and are considered to be negligible to low risk.

**Note that the findings of the Waste Rock Characterisation report are not finalised, as additional test results from Pit 6 have not been included in the above statements. The outcomes of this WMP report may need to be updated following the final report findings**.

### 3.4.2 Static and Kinetic Leach Testing

**The results of this testing were not available at the time of developing this report. The outcomes of this WMP report therefore need to be updated following the findings of these results**.

## 3.5 Saline, Metalliferous and Acid Rock Drainage

One of the primary mechanisms for the mobilisation of metals occurs due to the production of acid from sulphuric material under oxidised conditions, with the transport of this acid as leachate when in contact with water, either as surface runoff or infiltration, causing acid rock drainage (ARD) **[9]**. The acid neutralizing capacity (ANC) of materials is also a significant factor in determining the potential for acid generation, with these materials providing a buffer capability **[9]**.

C&R Consulting **[9]** indicated a low presence of PAF waste rock at the ACGM site, as described in **Section 3.4.1**. The primary water quality concern would therefore relate to reduced pH and elevated sulphates, salts, and metals produced from contact with waste rock.

To alleviate concerns relating to water quality and minimising the effects of contact with disturbed site surfaces, high ANC buffer material is recommended to encapsulate any PAF material when it is identified (as per ATCW's recommendations in the WRD Concept Design report **[1]**). Stormwater generated from exposed waste rock is captured in the first instance, and subject to ongoing, long term water quality monitoring **(refer Section 6).** The outcome of the monitoring may be that this stormwater is fit for release to the receiving environment.

## 3.6 Receiving Environment Water Quality

Site water quality monitoring provides an overview of the likely contaminants existing within the water stored/collected on-site and the quality of water within the surface runoff and groundwater. Some historical water quality monitoring has been undertaken at ACGM based on the monitoring points identified in **Section 3.2.2**. However, as the site is not yet developed, no details of proposed site water quality characteristics are available at the time of developing this report. **Section 6** outlines the water



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quality monitoring methodology and required parameter suite. This section should be updated once further details relating to water quality are made available.

## 3.7 Potential Contaminant Sources

Based on a review of available geochemical characterisation results, the potential contaminant sources identified within the site are outlined in **Table 3. This table should be updated once further information regarding the mine development layout is available.**

**TABLE 3: POSSIBLE CONTAMINANT SOURCES**

| Possible Contaminate Source | Likely Contaminant |
|---|---|
| Water Storages | pH, EC, metals, sulphate |
| ROM Pad | Suspended solids, metals, sulphate |
| Waste Rock Dump | Suspended solids, metals, sulphate |
| Open Cut Pit | Arsenic, metals, sulphate |
| Administration offices and workshops | Hydrocarbons and chemicals |

## 3.8 Residual Contaminants

It is recommended that ACGM undertake a geochemical assessment of the residual pit waters after 12 months of operational groundwater and surface water sampling. This geochemical assessment could be undertaken as part of a revised/annual Receiving Environment Monitoring Program (REMP).



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# 4 STORMWATER MANAGEMENT SYSTEM

## 4.1 Stormwater Management Objectives

The key water management objective is to control and minimise the release of potentially mine-impacted water from the site, to ensure that the historical users and environmental values of the receiving environment are not detrimentally impacted. The stormwater systems that are likely to be encountered in relation to the project can be characterised as follows:

| | | |
|---|---|---|
| Clean Water | - | Stormwater occurring around the project area, but not in contact with active mining/operating areas. |
| Site Water | - | All water generated from mine affected areas and associated operating surfaces within the project area. |

Typical sources and characteristics, and the management of these waters are as follows:

- Clean water will remain unimpacted from site activities (i.e. possess water quality characteristics that are typical of mine affected conditions) and shall be diverted around mining/operating areas and discharged via effective hydraulic controls. A key objective of stormwater management is to prevent capture or containment of any clean water.
- Site water is to be captured and managed in relation to its water quality and the source of the water. Site water is to be managed through onsite water management structures to prevent uncontrolled release from the site. The key objective for site water management is to minimise catchment areas from which site water is generated, as well as maximising the containment of site water at its source, to enable direct reuse.

## 4.2 Water Management Strategy

### 4.2.1 Clean Water Management

Clean water diversion bunds/drains are proposed around the waste rock dumps and open cut pits to divert any upstream clean water away from the site. Clean water runoff discharges centrally to the tributaries of Agate Creek located within the subject site.

### 4.2.2 Site Water Management

The water management strategies with respect to the elements described in **Section 2.5**, are identified as follows:

| | |
|---|---|
| • Open Cut Pit | It is proposed that water contained within the Open Cut Pits is pumped to the Water Storage Dam over the operational period of the project (when required for mining operations). |
| • Water Storage Dam | The Water Storage Dam will contain site impacted runoff from the Open Cut Pits and dirty water from the sediment ponds. The operating objective for this storage is to maintain sufficient capacity to contain site water and limit overflow, as well as to provide make-up water for site water demands, namely dust suppression. |
| • Sediment ponds | Seven (7) sediment ponds are proposed to be operational on site, to capture and treat sediment-laden runoff from the WRDs. The objective with respect to water contacting these surfaces is to capture sediment within the sediment ponds, with the potential to release this water directly off-site, subject to water quality testing. |



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## 4.3 Site Water Infrastructure Requirements

No processing activities are proposed at ACGM. As a result, the site does not require process water dams or tailings storage facilities. Furthermore, deposition of waste rock will occur in such a way as to limit any potential interaction of any potentially acid-forming (PAF) rock with rainfall runoff. This will be achieved via NAF encapsulation of any PAF rock. Consequently, the water infrastructure proposed for the site is limited to sediment ponds designed to capture runoff from disturbed site areas.

Other minor disturbed areas such as hardstands and camp areas will need localised erosion and sediment control measures. A detailed Erosion and Sediment Control plan should be developed as part of the detailed design phase for the project.

### 4.3.1 Sediment Pond Sizing

Indicative sizes for the proposed sediment ponds were set by the following criteria:

- Spill risk of <20% (to achieve 80% hydraulic efficiency) as per the State Planning Policy (SPP) requirements **[22]** and generally in accordance with IECA **[21]**;

The required volume for the sediment storage was also determined based on the estimated soil loss of approximately 270 t/ha/yr (calculated using the RUSLE method **[21]**) and assumed clean out frequency of every six (6) months.

**Table 4** presents the design size capacities and dimensions for the sediment ponds.

**TABLE 4: SEDIMENT PONDS DETAILS**

| Pond | Catchment Area (ha) | Settling Zone Volume (ML) | Sediment Storage Volume (ML) | Total Storage Volume (ML) | Depth from Spillway (FSL) (m) | Length at FSL (m) | Width at FSL (m) |
|---|---|---|---|---|---|---|---|
| **A** | 1.72 | 2.7 | 0.2 | 3.9 | 2.5 | 75 | 23 |
| **B** | 2.73 | 4.1 | 0.3 | 4.4 | 2.7 | 85 | 27 |
| **C** | 5.84 | 6.5 | 0.7 | 7.2 | 2.7 | 103 | 33 |
| **D** | 7.92 | 8.8 | 0.9 | 9.7 | 2.9 | 113 | 37 |
| **E** | 5.84 | 6.5 | 0.7 | 7.2 | 2.7 | 103 | 33 |
| **F** | 3.24 | 4.2 | 0.4 | 4.6 | 2.6 | 88 | 28 |
| **Rom Pad** | 2.5 ha | 4.1 | 0.3 | 4.4 | 2.7 | 85 | 27 |

### 4.3.2 Water Storage Dam

The WSD is to be located to the southwest of the southern WRD and receives inputs from the Pits and Sediment ponds via pumped transfer. The geometric parameters of the proposed WSD are detailed in **Table 5**. The WSD incorporates a spillway which directs flows west towards Agate Creek and is proposed to have a spill risk of less than 1%.

**TABLE 5: WATER STORAGE DAM DETAILS**

| Parameter | Value |
|---|---|
| Indicative Depth (m) | 4.4 m |
| Total Storage to Emergency Spillway | 250 ML |
| Internal Batter Slopes | 1 (V) : 3 (H) |
| External batter Slopes | 1 (V) : 3 (H) |

*Note: a conservative approach in sizing the water storage dam has been adopted given the site water quality is not known at this stage. Therefore, the dam volume may be able to be reduced following further water quality testing and results for site impacted water.

## 4.4 Performance Assessment of Storages

### 4.4.1 Consequence Category

The benchmark reference relevant to consequence assessment and definition for design criteria in Queensland is the Department and Environment and Sciences guidelines: *Manual for assessing consequence categories and hydraulic performance of structures* (referred to as 'The Manual') **[16]**. Based on this manual, dams or containment structures classified as "Significant" or "High" consequence are referred to as regulated, with design criteria relating to their performance in The Manual. Storages with a "Low" consequence category are not regulated structures and do not have containment design criteria. A detailed assessment is included in **Section 7**.

The preliminary consequence category assessment undertaken for the site water management storages is presented in **Section 7.2** and is summarised in **Table 6.**

**TABLE 6: CONSEQUENCE CATEGORY**

| Storage | Assigned Consequence Category | Regulated Structure (Y/N) |
|---|---|---|
| Water Storage Dam | Significant | Y |
| Sediment Ponds | Low | N |

In accordance with The Manual **[16]**, regulated storages (structures defined as "Significant" or "High" consequence category) are required to accommodate a Design Storage Allowance (DSA) and Extreme Storm Surge (ESS).

### 4.4.2 Hydraulic Performance Criteria

#### *4.4.2.1 Design Storage Allowance*

The Design Storage Allowance (DSA) is the volume required to accommodate inflows during the wet season, thus preventing unauthorised release of water to the environment. The DSA must be available in each regulated structure (or network of linked containment systems with a shared DSA volume) on 1 November of each year. These DSA volumes must be assessed each year and are based on the actual available storage in each of the regulated structures.

The Manual **[16]** outlines two acceptable methods for calculating the DSA, namely:

1. Method of deciles; or,
2. Method of operational simulation.

The method of deciles utilises historical data to estimate probabilistic wet season rainfall depths and considers other process inputs over the wet season. Operational simulation accounts for the site water



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management system and is undertaken through site water balance modelling. Given that a water balance model has been developed for the site and there are several transfers proposed, an operational simulation has been used to determine the DSA volume. A 50% Design Simulation Margin (DSM) has also been added as per the DES guidelines **[16]**.

The DSA volume for the Water Storage Dam is presented in **Table 7**.

**TABLE 7: DSA BY OPERATIONAL SIMULATION – WATER STORAGE DAM**

| Parameter | Water Storage Dam |
|---|---|
| Consequence Category | Significant |
| Critical Wet Period | 1 Nov to 31 May |
| Design Risk | 5% AEP* |
| Calculated Runoff and Transfer Inputs | 165 ML |
| DSA (including 50% DSM) | 250 ML |

#### *4.4.2.2 Mandatory Reporting Level*

The Mandatory Reporting Level (MRL) is derived by selecting the highest volume required in a regulated dam to contain:

- The runoff from the contributing catchment of the particular dam for a 72-hour duration storm at a defined annual exceedance probability (AEP); and,
- A wave allowance at that AEP, as estimated using a recognised engineering method.

When the MRL is exceeded for a structure, the holder of the EA is required to inform the administering authority. MRL's for regulated structures at ACGM are listed in **Table 8.**

**TABLE 8: CALCULATED MRL – WATER STORAGE DAM**

| Parameter | Water Storage Dam |
|---|---|
| Design Risk | 1 in 10 AEP, 72hr event |
| Rainfall Total | 218.0 mm |
| Catchment Area | 4.5 ha |
| Runoff Coefficient | 1.0 |
| Extreme Storm Storage (ESS) Volume | 9.8 ML |
| Depth below Spillway Level to achieve ESS Volume | TBC in detailed design |
| Depth below Spillway Level to achieve Wave Allowance | TBC in detailed design |

#### *4.4.2.3 Emergency Spillway Requirements*

An emergency spillway is a mandatory requirement for any regulated dam, with design criteria for the spillway design based on The Manual **[16]** and reproduced in **Table 9.** Details of which need to be resolved as part of the detailed design phase for the project.



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**TABLE 9: SPILLWAY DESIGN CRITERIA**

| Design Criteria | Flood Passage | Flood Ingress Prevention |
|---|---|---|
| **Consequence Category for 'dam break'** | **Spillway capacity** | **Flood level for embankment crest levels** |
| Significant consequence | 1:100 AEP to 1:1,000 AEP | Spillway design flood peak level + wave run-up allowance for 1:10 AEP wind |

## 4.5 Site Drainage

### 4.5.1 Site Water Collection Drainage Design Criteria

Site water collection drains/bunds are used to facilitate the collection and conveyance of site water to the proposed open cut pits and waste rock dumps. These bunds are to be constructed around the proposed pits and WRDs to contain and convey any site water to the sediment ponds and minimise potential impacts to the downstream environment.

### 4.5.2 Clean Water Diversion Bunds/Drains Design Criteria

Clean water diversion drains are to be designed to accommodate a 1 in 100 annual exceedance probability (AEP) peak flow design storm event. This criterion has been adopted given the significance of clean water diversion drains to protect downstream mine infrastructure from local flood inundation.

## 4.6 Erosion and Sediment Control Measures

As per regulatory requirements, an Erosion and Sediment Control Plan (ESCP) is required for all stages of the mining plan. The Sediment ponds and Water Storage Dam are the primary treatment methods for onsite sediment capture and storage. All mine impacted waters shall report to these structures prior to discharges. Other minor disturbed areas such as hardstands and camp areas will need localised erosion and sediment control measures. A detailed Erosion and Sediment Control plan should be developed as part of the detailed design phase for the project.

A detailed ESCP must be prepared as part of the detailed design phase.



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# 5 OPERATIONAL WATER BALANCE ASSESSMENT

## 5.1 Objectives

A Water Balance Model has been developed to assess the proposed water management strategy, primarily as a means of assessing spill risk. A dynamic probabilistic simulation modelling approach, using GoldSim Pro version 12.1 **[20]**, was adopted for this purpose, based on a daily climatic record for the site. An integrated catchment yield analysis for the site catchments was also coupled with the water balance model (WBM). The model is based on the conditions outlined in this report, with the duration covering approximately three (3) years from 1 July 2022 to 30 June 2025. The objectives of this modelling are summarised as follows.

- Assess the performance of the proposed site water management systems.
- Quantify the site impacted water generated on site.
- Determine any additional water storage requirements and identify potential options for the short and long-term management of water at the site.

The water balance model is uncalibrated, as no measured data or observations related to the proposed water management system were available at the time of model development.

## 5.2 Modelling Assumptions

### 5.2.1 Assumptions

The following assumptions were made to develop the WBM.

- Water within the Water Storage Dam will be suitable for use within the mining circuit and for dust suppression activities.
- Sediment ponds are allowed to spill in large rainfall events or prolonged rainfall periods (<20% spill risk adopted)
- WRD and Pit catchments are isolated and all upstream clean flow catchments can be diverted around the disturbed areas.

### 5.2.2 Aerial and Surface Data

The following data was utilised throughout the assessment to characterize catchment areas and storage conditions.

- World DEM Neo 1 second DEM **[19]**;

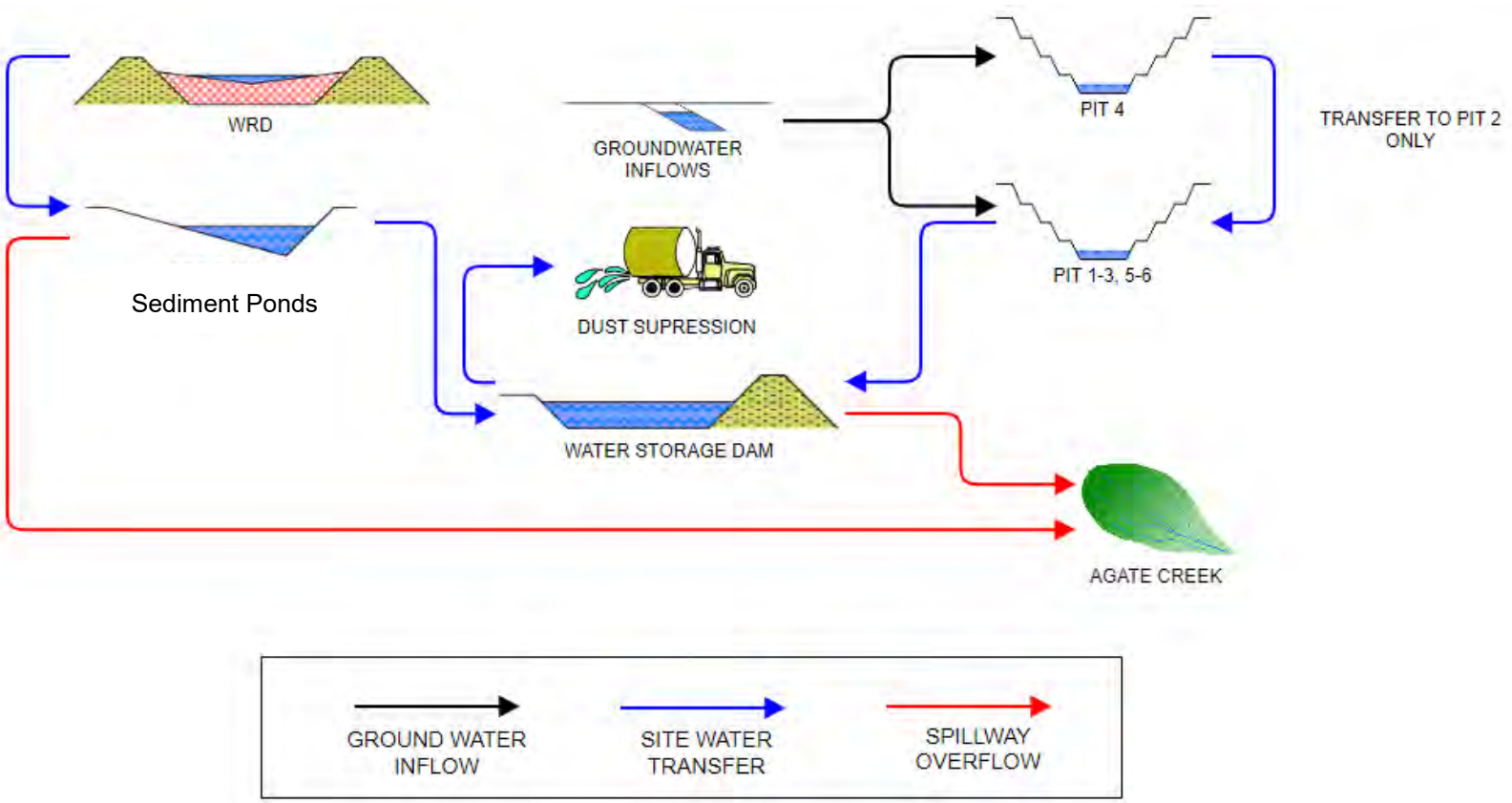
## 5.3 Model Inputs

The WBM has been developed to reflect expected site conditions within the modelling horizon. A flowchart demonstrating the model structure is presented in **Diagram 5**.



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## DIAGRAM 5: WBM FLOW DIAGRAM






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### 5.3.1 Storage Conditions

Primary water balance inputs for site storages are outlined in **Table 10**. A description of the storages is provided in **Section 2.4**, with details of the design criteria provided in **Section 4**. The total storage capacities of the water storages have been based on the footprint available within the site infrastructure area (refer **Figure 002** in **Appendix A)**.

**TABLE 10: MODELLED SITE STORAGE PROPERTIES**

| Storage | Storage Capacity (ML) | Initial Storage Volume (ML) |
|---|---|---|
| Water Storage Dam | 165.0 | Empty |
| Open Cut Pit 1 | 114.8 | Empty |
| Open Cut Pit 2 | 71.0 | Empty |
| Open Cut Pit 3 | 19.1 | Empty |
| Open Cut Pit 4 | 3.5 | Empty |
| Open Cut Pit 5 | 28.7 | Empty |
| Open Cut Pit 6 | 751.3 | Empty |
| Sediment Dam A | 2.7 | Empty |
| Sediment Dam B | 4.1 | Empty |
| Sediment Dam C | 6.5 | Empty |
| Sediment Dam D | 8.8 | Empty |
| Sediment Dam E | 6.5 | Empty |
| Sediment Dam F | 4.2 | Empty |
| Rom Pad Sediment Pond | 4.1 | Empty |

### 5.3.2 Groundwater Inflows

A hydrogeological study of the ACGM expansion was undertaken by C&R Consulting Pty Ltd (CRC) **[8]**. The groundwater monitoring network consists of ten (10) monitoring bores within the area of approximately 1.5 km² that incorporates all six proposed voids. The adopted groundwater inflow rates for the proposed pits presented in **Table 11** were selected based on the proximity of the monitoring bores to the proposed pits.

**TABLE 11: SITE STORAGE CAPACITIES**

| Storage | Bore CCWB | Max Inflow Rates (ML/day) |
|---|---|---|
| **PIT 1, 2, 3, 4** | CCWB519 | 0.004 |
| **PIT 5, 6** | CCWB519 | 0.008 |

### 5.3.3 Pumping Schedule

Site transfers, other than water sourcing for site demands (discussed in **Section 5.3.4**) are outlined in **Table 12**.

**TABLE 12: SITE TRANSFERS**

| Source | Destination | Rate | Activation Condition | Deactivation Condition |
|---|---|---|---|---|
| Pits 1-3, 5-6 | Water Storage Dam | 30 L/sec | Occurs when water volume within Open Cut Pit exceeds 3.5 ML | Deactivated when water depth within Open Cut Pit is at 0.5 m. |
| Pit 4 | Pit 2 | 30 L/sec | Occurs when water depth within Open Cut Pit exceeds 1.5 m. | Deactivated when water depth within Open Cut Pit is below 0.5 m. |
| Sediment Ponds | Water Storage Dam | 30 L/sec | Occurs when water volume within storage exceeds 1.0 ML | Deactivated when water volume within storage is below 0.5 ML |

### 5.3.4 Site Water Demands

Assumed site water demands for the project are outlined in **Table 13.**

**TABLE 13: SITE WATER DEMANDS**

| Source | Demand | Rate | Comment |
|---|---|---|---|
| Water Storage Dam | Dust Suppression | 0.2 ML/day | Active when rainfall is less than 5 mm/day |

### 5.3.5 Catchment Runoff Estimation

A SILO Data Drill specific to the site location was obtained from the Long Paddock Program **[26]**. Rainfall was modelled from this SILO data Drill and applied over the daily timestep. A description of the SILO data utilised in the WBM is provided in **Table 14**.

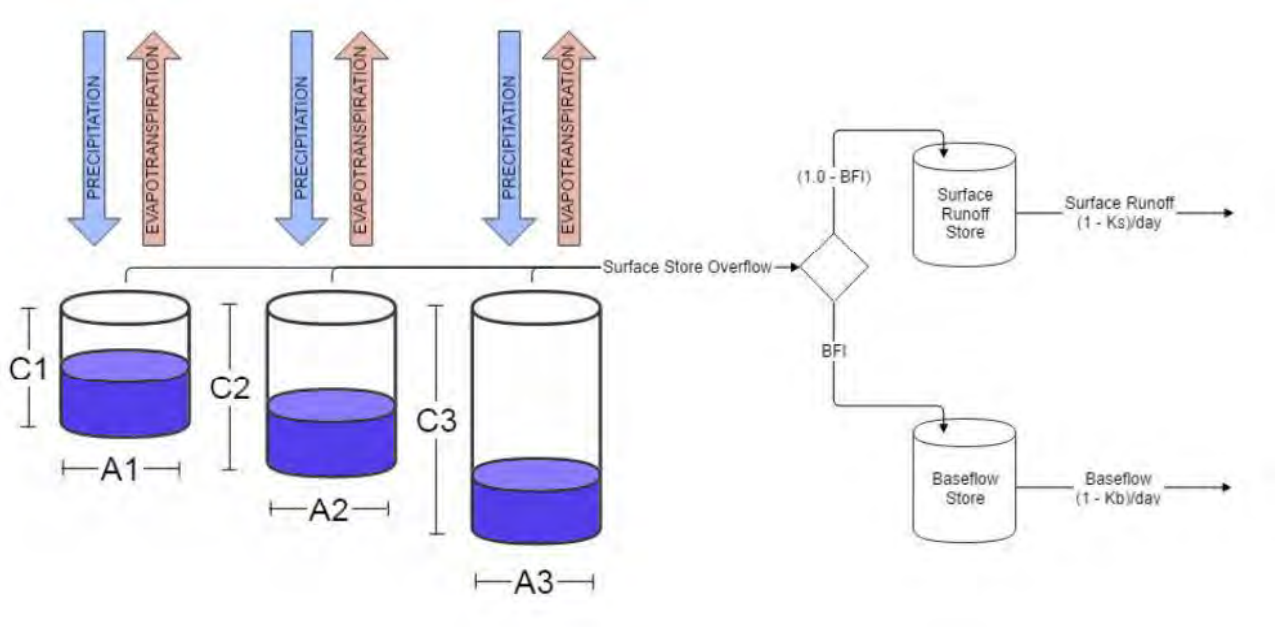
**TABLE 14: RAINFALL AND EVAPORATION INPUT DATA**

| Climate Data | Value | Data Source | Comments |
|---|---|---|---|
| Rainfall | Daily Rainfall Rate (mm/day) | Rainfall data sourced from the SILO Data Drill Program | Applied over surface areas of storages, and as an input parameter for estimation of surface runoff (AWBM) |
| Evaporation | Daily Evaporation Rate (mm/day) | Evaporation data sourced from the SILO Data Drill Program | Evaporation data is scaled by factors for each site storage to reflect water storage conditions and expected water quality |
| Evapo-transpiration | Daily Evapo-transpiration Rate (mm/day) | Rainfall data sourced from the SILO Data Drill Program | Evapo-transpiration is modelled as a potentially daily loss rate from surface stores within the AWBM model |

The Australian Water Balance Model (AWBM) **[4]** was utilised to simulate daily runoff from rainfall generated within the various sub-catchment types that are present on the project site. Catchment areas reporting to each storage have been assessed based on the layout provided by RVR (refer **Figure 001**).

**Diagram 6** represents a schematic of the AWBM model, reproduced from Boughton (2009) **[4]**.

**DIAGRAM 6: SCHEMATIC OF AWBM MODEL STRUCTURE**




Source: Boughton, 2009.**[4]**

Where:

| | |
|---|---|
| C1 - C3 | = Surface Storage Capacities |
| A1 - A3 | = Partial Areas Represented by Surface Storages |
| BFI | = Baseflow Index |
| $K_b$ | = Daily Baseflow Recession Constant |
| BS | = Current Volume in Baseflow Store |
| $K_S$ | = Daily Surface Flow Recession Constant |
| S | = Current Volume in Surface Store Routing |

The catchment types and the AWBM model parameters used to simulate these different catchment types and the average yields from these catchments are summarised in **Table 15**. Model parameters have been selected based on experience with similar water balance model studies and chosen to be slightly conservative in the context of this uncalibrated model. Runoff yields are calculated dynamically within the site water balance model using the AWBM and the determined runoff volumes are conveyed to site storage elements (dams) on a daily timestep basis.

**TABLE 15: AWBM MODEL PARAMETERS**

| Catchment Type | Split Areas (sum=1.0) | | | Storage Capacities (mm) | | | Average Surface Stores | Ks (day-1) | BFI | Kb (day-1) |
|---|---|---|---|---|---|---|---|---|---|---|
| | A1 | A2 | A3 | C1 | C2 | C3 | | | | |
| Natural | 0.134 | 0.433 | 0.433 | 12 | 120 | 250 | 162 mm | 0 | 0.3 | 0.8 |
| Hardstand | 1 | 0 | 0 | 10 | 10 | 0 | 10 mm | 0 | 0 | 1 |
| Waste | 0.2 | 0.8 | 0 | 10 | 300 | 0 | 242 mm | 0.9 | 0.2 | 0.9 |
| Open Cut | 0.1 | 0.9 | 0 | 5 | 20 | 0 | 18.5 mm | 0 | 0 | 1 |

Catchment types and areas were designated using the initial concept WRD and Pit design with areas of catchments outlined in **Table 16** and **Table 17** and outlined in **Diagram 7**.

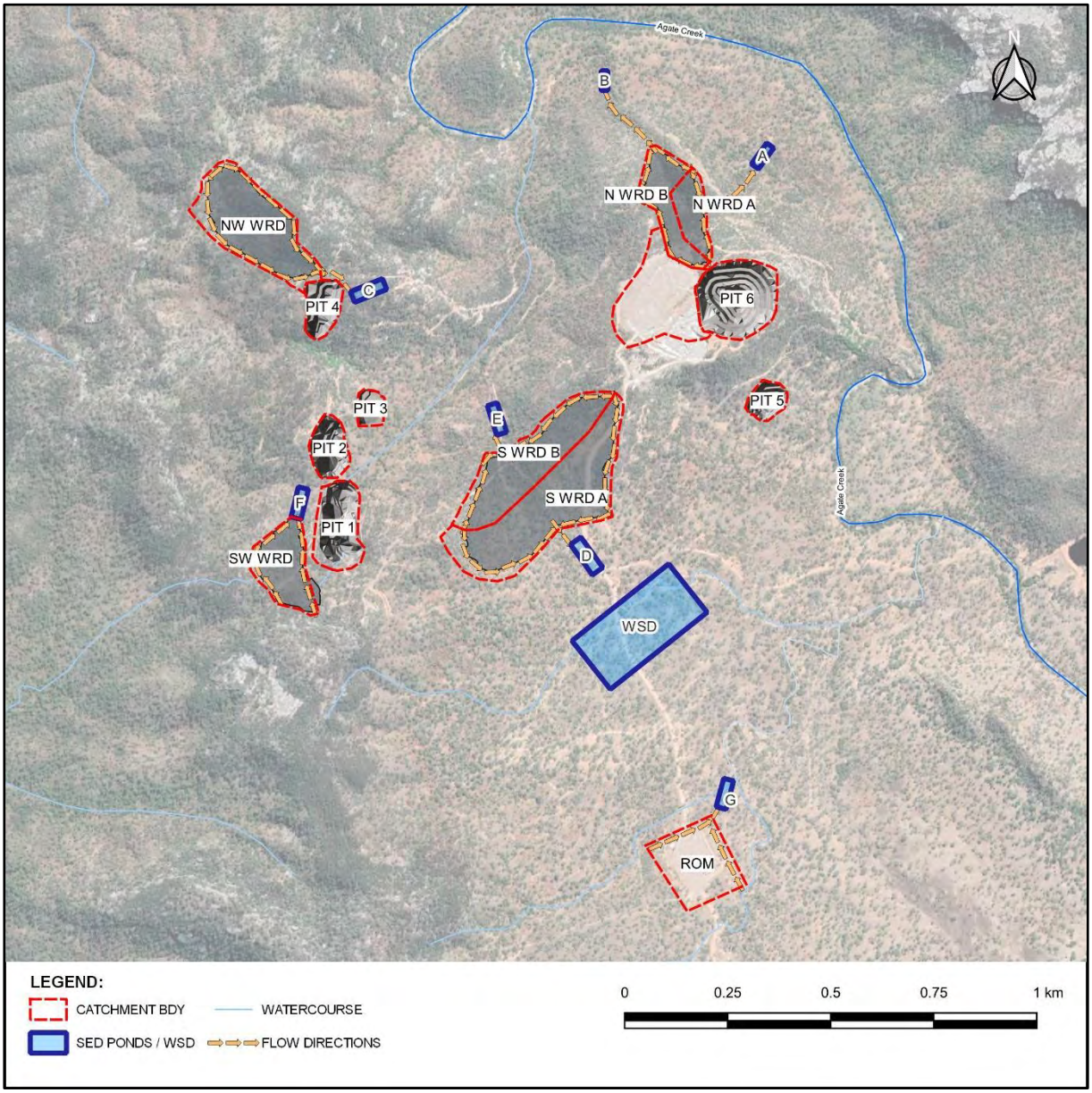
**TABLE 16: OPEN CUT PIT CATCHMENT AREA TYPES**

| Catchment Type | Catchment Area (ha) | | | | | |
|---|---|---|---|---|---|---|
| | Pit 1 | Pit 2 | Pit 3 | Pit 4 | Pit 5 | Pit 6 |
| Open Cut | 1.37 | 0.66 | 0.12 | 1.01 | 0.30 | 0.85 |
| Storage Area at FSL | 0.83 | 0.54 | 0.43 | 0.09 | 0.40 | 2.35 |
| **Total Catchment Area** | 2.20 | 1.20 | 0.55 | 1.10 | 0.70 | 3.20 |

**TABLE 17: WATER MANAGEMENT DAMS CATCHMENT AREA TYPES**

| Catchment Type | Catchment Area (ha) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Water Storage | Pond A | Pond B | Pond C | Pond D | Pond E | Pond E | ROM Pond |
| Hardstand | - | - | - | - | - | - | | 2.5 |
| Waste | - | 1.5 | 2.5 | 5.5 | 7.5 | 5.5 | 3.0 | |
| Storage Area at FSL | 4.50 | 0.17 | 0.23 | 0.34 | 0.43 | 0.34 | 0.24 | 0.23 |
| **Total Catchment Area** | 4.50 | 1.70 | 2.73 | 5.84 | 7.92 | 5.84 | 3.24 | 2.73 |

**DIAGRAM 7: SITE CATCHMENTS**




## 5.4 Model Results

A summary of the modelling results in the form of spill risks is provided in **Table 18**. These values represent the maximum modelled statistical likelihood of a storage experiencing a spill over the modelled period. The spill risk of regulated site structures with respect to containment criteria is discussed in **Section 4.4.2**.

**TABLE 18: MAXIMUM SPILL PROBABILITY OVER OPERATIONAL PERIOD**

| Storage | Spill Probability | Minimum Containment Criteria |
|---|---|---|
| Water Storage Dam | <1.0%* | 5.0% |
| Pits 1, 2, 3, 4, 5, 6 | <1.0% | N/A |
| Sediment pond A | <20% | N/A |
| Sediment pond B | <20% | N/A |
| Sediment pond C | <20% | N/A |
| Sediment pond D | <20% | N/A |
| Sediment pond E | <20% | N/A |
| Rom Pad Pond | <20% | N/A |

*Note: a conservative approach in sizing the water storage dam has been adopted given the site water quality is not known at this stage. Therefore, the dam volume may be able to be reduced following further water quality testing and results for site impacted water.

## 5.5 Performance Implications

Water balance results from the project site are presented in **Appendix B**, which are presented in the form of probability plots for the site storages. These plots depict percentile outcomes for storage volumes, of which the 99$^{th}$ percentile results represent water storage accumulation comparable to the 1% AEP wet season.

The water storage dam is classified as a 'Significant' consequence structure (refer **Section 4.4**) and therefore has a minimum containment criterion of 5% AEP. However, as the site water quality is not known at this stage this storage has been conservatively sized to have a spill risk less than 1%. There may be opportunities to reduce this volume once the pit and WRD runoff water quality is better understood.

The modelled storage volume for the Open Cut Pits is shown in **Appendix B**. Dewatering of the Pit occurs within the model, however the pits still accumulate water in moderate to major rainfall events illustrating the high rainfall that can be experienced for this region. **Table 19** presents the maximum storage volume for the 5% AEP, median condition volume, and maximum capacity at full supply level (FSL) of the proposed open cut pits. The model results indicate maximum modelled water storage volume for the median condition ranges from 0.3-2.2 ML only.

**TABLE 19: OPEN CUT PITS MODELLED STORAGE VOLUME SUMMARY**

| Pits | Max. Median Storage (5% AEP) ML | Max. Storage Volume (5% AEP) ML | Max Capacity (FSL) ML |
|---|---|---|---|
| **Pit 1** | 1.9 | 9.8 | 114.8 |
| **Pit 2** | 1.7 | 7.7 | 71.04 |
| **Pit 3** | 2.2 | 3.6 | 19.09 |
| **Pit 4** | 0.3 | 0.5 | 3.47 |
| **Pit 5** | 2.0 | 3.6 | 28.67 |
| **Pit 6** | 1.6 | 12.4 | 751.30 |

## 5.6 Key Assumptions

Due to the lack of site data, several assumptions had to be made in order to develop the WBM. The key assumptions are listed in **Table 20.**

**TABLE 20: KEY ASSUMPTIONS**

| Data | Recommendation |
|---|---|
| **Elevation Data** | Detailed site survey to be conducted to confirm pits storages, site contours, catchment delineations etc. WBM to be revised once adequate data is available. |
| **Groundwater Inflows** | To be confirmed via monitoring bores and pit water levels and WBM to be revised once further data is available. |
| **Water Quality** | Sediment Pond and Pit water and monitoring locations to be recorded at regular intervals. WBM to be updated once this information is known. |
| **AWBM Parameters** | On-site water management and runoff to be monitored where possible to allow calibration of WBM parameters. WBM may need updating to confirm assumptions. |

# 6 POST-CLOSURE WATER BALANCE ASSESSMENT

## 6.1 Objectives

The key objective of this water balance model (WBM) is to assess the water storage performance of the pits within the site for the post-closure period. This assessment will inform whether any mitigation measures are required for the post-closure scenario.

## 6.2 Data and Assumptions

A dynamic probabilistic simulation modelling approach, using GoldSim Pro version 12.1 **[20]**, was adopted for this purpose, based on a daily climatic record for the site. An integrated catchment yield analysis for the site catchments was also coupled with the water balance model (WBM). The model is based on the assumptions outlined in this section, with the duration over 30 years from 1 July 2022 to 30 June 2122.

The following assumptions were made to develop the WBM:

- Pump transfer to and from the Pits will cease during the post-closure phase.
- Inflows to the pits will only be limited to rainfall runoff and groundwater inflows.
- Stormwater runoff estimations in the WBM were undertaken using AWBM (**refer Section 5.3.5**) and the groundwater inflows detailed in **Section 5.3.2** were adopted.
- No outflows were modelled for the site other than the natural evaporation.
- The pits are assumed to be empty at the start of the post-closure scenario. Refer to **Section 5.3** for the adopted pit storage conditions.

## 6.3 Model Results

Outputs from the water balance modelling for each of the modelled storages are presented in **Appendix C.** Each graph provides a plot of maximum water elevation versus the model duration for each of the storages, presented as a combined plot for:

- Mean and median.
- Upper and lower bounds; and
- 5%, 25%, 75%, and 95% (percentiles)

A summary of the modelling results in the form of spill risks is provided in **Table 21.** These values represent the maximum modelled statistical likelihood of a storage experiencing a spill over the modelled period.

**TABLE 21: MAXIMUM SPILL PROBABILITY**

| Open Cut Pits | Spill Probability |
|---|---|
| **Pit 1** | ~10% |
| **Pit 2** | <1.0% |
| **Pit 3** | <1.0% |
| **Pit 4** | >99% |
| **Pit 5** | ~20% |
| **Pit 6** | <1.0% |

## 6.4 Performance Implications

Pits 2, 3, and 6 gradually increase in storage before fluctuating around a relatively consistent water level. Each of these pits achieve a less than 1% spill risk as each pit has a large volume available within each pit. Each of these pits also has a small contributing catchment, combined with high evaporation rates for the region.

However, it was found through the model development that Pits 1, 4 and Pit 5 will spill with the current pit geometry. Pit 4 is very likely to spill, whereas Pits 1 and 5 appear to only spill in rare events. This is due to the shallow wall level for these Pits and further consideration is therefore required as part of a the mine development and progressive rehabilitation plan. Depending on the water quality in each of the pits, they may need to be modified to increase the storage capacity or rehabilitated in such a way to reduce the risk of discharging pit water to the downstream environment. This plan should therefore be revised once water quality information is made available and the mine development plan is further progressed.

## 6.5 Key Assumptions

Due to the lack of site data, several assumptions had to be made in order to develop the WBM. The key assumptions are listed in **Table 22**.

**TABLE 22: KEY ASSUMPTIONS**

| Data | Recommendation |
|---|---|
| **Elevation Data** | Detailed site survey to be conducted to confirm pits storages, site contours, catchment delineations etc. WBM to be revised once adequate data is available. |
| **Groundwater Inflows** | To be confirmed via monitoring bores and pit water levels and WBM to be revised once further data is available. |
| **Water Quality** | Sediment Pond and Pit water and monitoring locations to be recorded at regular intervals. WBM to be updated once this information is known. |
| **AWBM Parameters** | On-site water management and runoff to be monitored where possible to allow calibration of WBM parameters. WBM may need updates to confirm assumptions. |

# 7 CONSEQUENCE CATEGORY ASSESSMENT

Dams, water storages and other related land-based containment structures associated with environmentally relevant activities under the *Environmental Protection Act 1994 (EP Act)* ***[11],*** are required to have a Consequence Category Assessment (CCA). This should be conducted to assess the potential consequences associated with 'dam break' and 'failure to contain' failure scenarios, and to outline if any specific considerations need to be included in the structure's design and operation. The following sections have been developed in accordance with the DES guidelines (referred to as 'The Manual') **[16]**.

The purpose of The Manual **[16]** is to:

- guide the assessment of the Consequence Category of all structures constructed as part of activities that require an EA or development approval.
- guide the determination of the structure/s that require formal documentation; and
- provide approved methods for specifying the design performance and monitoring requirements for those structures.

## 7.1 General Environmental Harm Assessment

### 7.1.1 Potential Surface Environment Impacts

The receiving environment includes ephemeral waterways, creeks, and rivers. The main receiving environment for the WSD and Sediment ponds within a 10 km flow path to the north includes:

- Agate Creek, (and its unnamed tributary on the western side of the creek); and
- Robertson River. The Robertson River flows into the Gilbert River approximately 26 km downstream from the confluence of Agate Creek and Robertson River.

In accordance with The Manual **[16]**, the Consequence Category Assessment (General Environmental Harm) is concerned with effects to areas with 'Significant Values' and 'Moderate Values'. The values are defined as follows.

- Significant Values
  - Matters of National Environmental Significance (MNES)
  - Matters of State Environmental Significance (MSES)
  - High Ecological Value (HEV) waters as per the Queensland Environmental Protection (Water) Policy 2009 (EPP Water) **[15]**.
- Moderate Values
  - Slightly or moderately disturbed waters as per the EPP Water
  - Wetlands of general ecological significance (GES) as mapped on the Queensland Government referable wetland mapping
  - Riverine areas, springs or lakes and associated flora and fauna.

The characteristics and exposure of these receiving environments is identified in the environmental assessment reports in **Appendix D** and **Appendix E**.

The relevant characteristics of Agate Creek (including its unnamed tributary to the south and north of the site) and the Robertson River in the context of environmental values, are assessed as described in the subsequent sections.

Due to the anticipated volume of release of waters from overtopping or dam break, a failure impact area of 2 km has been adopted. A dam break assessment once the site water storages are confirmed should be conducted to estimate the maximum runout distance.

### 7.1.2 Matters of National Environmental Significance

The Protected Matter Report (PMR) **[11]** for the project area is included in **Appendix D.** The PMR lists the MNES that are known to, are likely to, or may occur within a 5 km radius of the WSD and sediment ponds, including locations upstream and downstream of the project area, and locations in adjoining, but not hydrologically connected catchments.

The PMR lists several critically endangered, endangered, and vulnerable species as likely to occur, or may occur in the area. The critically endangered and endangered animals listed in the MNES report are summarised in **Table 23**. There are no MNES habitat areas or wetlands listed for the receiving environment in the PMR.

**TABLE 23: MNES LISTED CRITICALLY ENDANGERED AND ENDANGERED ANIMALS**

| Name | Scientific Name | Status | Comments |
|---|---|---|---|
| Curlew Sandpiper | Calidris Ferruginea | Critically Endangered | Species or species habitat may occur within area (Bird) |
| Australian Painted Snipe | Rostratula australis | Endangered | Species or species habitat may occur within area (Bird) |
| Gouldian Finch | Erythrura gouldiae | Endangered | Species or species habitat may occur within area (Bird) |
| Koala (combined populations of Queensland, New South Wales, and the Australian Capital Territory) | Phascolarctos cinereus | Endangered | Species or species habitat may occur within area (Mammal) |
| Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] | Dasyurus hallucatus | Endangered | Species or species habitat may occur within area (Mammal) |

### 7.1.3 Matters of State Environmental Significance

The MSES Environmental Report **[13]** for ML100030 (plus a 2 km buffer) is included in **Appendix D.** The MSES report lists the MSES that occur within the buffer area, including locations upstream and downstream of the project area. The identified MSES pertain to:

- Protected Areas – estates; and
- Regulated Vegetation – intersecting a watercourse.

These areas are shown in DES **[13]** and included in **Appendix D**, namely Map 3a and Map 4. The identified MSES are summarised in **Table 24**.

**TABLE 24: MSES LISTED VALUES**

| Value | Location | Comments |
|---|---|---|
| Protected Areas - estates | External to ML100030 and not part of the Agate Creek catchment. | This area is unlikely to be impacted as it is not part of the Agate Creek catchment. |
| Regulated vegetation – intersecting a watercourse | Internal to ML100030 and located on Agate Creek and its unnamed tributary within the subject site. | Majority of the site drains centrally to Agate Creek. The identified values will therefore be impacted by the proposed expansion. |

### 7.1.4 High Ecological Value Wetlands and Waterways

Assessment of the available MSES data **[13]** showed that no High Ecological Value (HEV) wetlands or waterways were identified in the receiving environment within a 2 km radius of the WSD or sediment ponds.

### 7.1.5 Aquatic Conservation Significance

Assessment of the available data MSES data **[13]** showed the following:

- Agate Creek and its unnamed tributary to the south of the site are mapped as 'High – Conservation Significance'

### 7.1.6 Bores

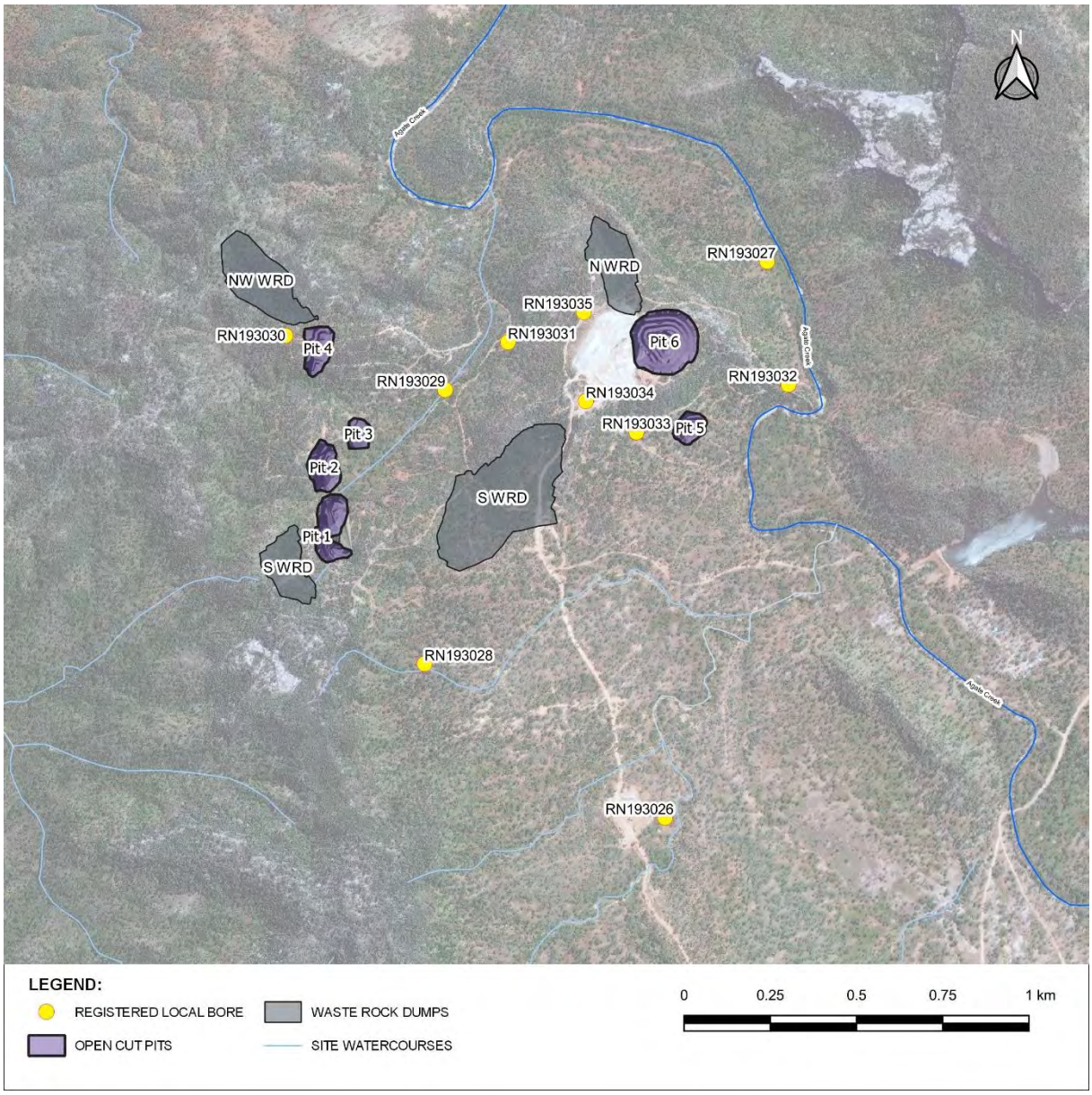
**Table 25** provides a summary of the local registered private bores within the proposed ML and adjacent areas. The location of the bores relative to the WSD and Sediment Ponds is presented in **Diagram 8**. All these bores are understood to be associated with landowner activities.

**TABLE 25: REGISTERED LOCAL BORES ON AND ADJACENT TO ML100030**

| RN | FACILITY_TYPE | FACILITY_STATUS | DRILLED_DATE | EASTING | NORTHING |
|---|---|---|---|---|---|
| 193026 | Sub-artesian | Existing | 6/06/2020 | 768402 | 7896465 |
| 193027 | Sub-artesian | Existing | 10/06/2020 | 768698 | 7898078 |
| 193028 | Sub-artesian | Existing | 16/06/2020 | 767704 | 7896911 |
| 193029 | Sub-artesian | Existing | 7/06/2020 | 767764 | 7897706 |
| 193030 | Sub-artesian | Existing | 8/06/2020 | 767300 | 7897863 |
| 193031 | Sub-artesian | Existing | 9/06/2020 | 767946 | 7897844 |
| 193032 | Sub-artesian | Existing | 11/06/2020 | 768760 | 7897721 |
| 193033 | Sub-artesian | Existing | 13/06/2020 | 768319 | 7897583 |
| 193034 | Sub-artesian | Existing | 14/06/2020 | 768172 | 7897673 |
| 193035 | Sub-artesian | Existing | 15/06/2020 | 768166 | 7897931 |

*Details provided by Queensland Globe and Business Queensland **[7]**. Accessed 09 June 2022.

**DIAGRAM 8: ADJACENT BORE LOCATIONS**




### 7.1.7 Local Infrastructure

As the site is in a rural region there is limited local infrastructure in proximity to the mine development. Approximately 3 km to the south of the subject site and along the southern boundary of the mine lease, Rungulla Road (an unsealed road) provides access to local landowners and to the site.

## 7.2 Consequence Category Assessment

### 7.2.1 Basis of Consequence Category Assessment

The structures were assessed against the requirements of the Manual **[16]** for operational site conditions. This involved a desktop review of potential harm associated with failure-to-contain scenarios, and the dam break scenario.

The criteria for Consequence Category assessments are based on the following failure event scenarios.

- Failure to Contain – Seepage

  Spills or release to ground/groundwater via seepage from the floor and/or sides of the structure.

- Failure to Contain – Overtopping

  Spills or releases from the structure that result from loss of containment due to overtopping of the structure.

- Failure to Contain – Dam Break

  Collapse of the structure due to any possible cause.

Under these scenarios, several modes of failure are possible as described below:

- A failure to contain scenario means a release from the structure that results from loss of containment due to excessive seepage, overtopping of the structure and/or other deficiencies in water management aspects of the storage. Although such a failure mechanism is typically non-flood producing, failure to contain events may involve the release of contaminants, which could endanger environmental values or human life/wellbeing.
- A dam break scenario involves the partial or complete collapse of a structure due to any possible cause.

The basis for assessment of Consequence Category from the Manual is reproduced in **Table 26.**

## TABLE 26: CONSEQUENCE CATEGORY ASSESSMENT CRITERIA

| Environmental Harm | Consequence Category | | |
|---|---|---|---|
| | **High** | **Significant** | **Low** |
| Harm to Humans | Location such that people are routinely present in the failure path and if present loss of life to greater than 10 people is expected[8].<br><br>Note: The requirement to consider the location of people in the failure path is only relevant to the 'dam break' scenario. | Location such that people are routinely present in the failure path and if present loss of life to 1 person or greater but less than 10 people is expected[7].<br><br>Note: The requirement to consider the location of people in the failure path is only relevant to the 'dam break' scenario. | Location such that people are not routinely present in the failure path and loss of life is not expected[7].<br><br>Note: The requirement to consider the location of people in the failure path is only relevant to the 'dam break' scenario. |
| | Location such that contamination of waters (surface and/or groundwater[9]) used for human consumption could result in the health of 20 or more people being affected[10]. | Location such that contamination of waters (surface and/or groundwater[8]) used for human consumption could result in the health of 10 or more people but less than 20 people being affected[9]. | Location such that contamination of waters (surface and/or groundwater[8]) used for human consumption could result in the health of less than 10 people being affected[9]. |
| General environmental harm | Location such that:<br>a) Contaminants may be released to areas of MNES, MSES or HEV waters that are not already authorised to be disturbed to at least the same extent under other conditions of this authority subject to any applicable offset commitment (Significant Values); and<br>b) Adverse effects[11] on Significant Values are likely; and<br>c) The adverse effects[10] are likely to cause at least one of the following:<br>i) loss or damage or remedial costs greater than $50,000,000; or<br>ii) remediation of damage is likely to take 3 years or more; or<br>iii) permanent alteration to existing ecosystems; or<br>iv) the area of damage (including downstream effects) is likely to be at least 5 km². | Location such that contaminants may be released so that adverse effects[10] (that are not already authorised to be disturbed to at least the same extent under other conditions of the authority subject to any applicable offset commitment) either:<br><br>a) Would be likely to be caused to Significant Values but those adverse effects[10] would not be likely to meet the thresholds for the High Consequence Category and instead would be likely to cause at least one of the following:<br>i) loss or damage or remedial costs greater than $10,000,000 but less than $50,000,000; or<br>ii) remediation of damage is likely to take more than 6 months but less than 3 years; or<br>iii) significant alteration to existing ecosystems; or<br>iv) the area of damage (including downstream effects) is likely to be at least 1 km² but less than 5 km².<br>or<br>b) Would be likely to be caused to environmental values classed as slightly or moderately disturbed waters[12], wetland of general ecological significance[13], riverine areas, springs or lakes and associated flora and fauna (Moderate Values), and the adverse effects[10] are likely to cause at least one of the following:<br>i) loss or damage or remedial costs greater than $20,000,000; or<br>ii) remediation of damage is likely to take more than 1 year; or<br>iii) significant alteration to existing ecosystems; or<br>the area of damage (including downstream effects) is likely to be at least 2 km². | Location such that either:<br>a) Contaminants are unlikely to be released to areas of Significant Values or Moderate Values; or<br>b) Contaminants are likely to be released to those areas, but would be unlikely to meet any of the minimum thresholds specified for the Significant Consequence Category for adverse effects[10] |
| General economic loss or property damage | Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require $10 million or greater in rehabilitation, compensation, repair or rectification costs[14]. | Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require $1 million and greater but less than $10 million in rehabilitation, compensation, repair or rectification costs[13]. | Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require less than $1 million in rehabilitation, compensation, repair or rectification costs[13] . |

7 To be used for all failure event scenarios

8.'People routinely present in the failure path' could be considered to be people who occupy buildings or other places of occupation that lie within the failure impact zone. For the purposes of this Manual, this should refer to people other than site personnel engaged by the resource operation and located on the tenements and tenure associated with the resource operation; for other ERAs, it would be the 'premises referred to in the authority'. It should be noted that while this is appropriate for the assessment of consequence categories in accordance with this Manual, adherence to the requirements of this Manual does not limit, amend, or change in any way, any other requirements to be complied with under relevant health and safety acts or legislation that requires the safety of site personnel to be considered.

9 When considering potential impacts on groundwater, it is not envisaged that a full hydrogeological assessment will be required in all cases. Any consideration of potential impacts on groundwater systems should consider the water quality of the potential receiving aquifer as well as the quality of fluid stored in the regulated dam. Existing groundwater drawdown in areas surrounding resource operations (e.g. drawdown as a result of mine pit or underground mine dewatering) can also be considered when assessing the consequence of dam seepage on groundwater systems.

10 'An adverse effect on human health means a physiological effect on human health and does not include an impact on the quality of downstream water that merely negatively affects taste and which is unlikely to cause persons to become physically ill.

11 Adverse effects includes chronic and acute effects where an acute effect is on living organism/s which results in severe symptoms that develop rapidly, and a chronic effect is an adverse effect on a living organism/s which develops slowly. In some instances, it may be necessary to carry out or reference existing ecological/toxicological studies to assess the impacts of contaminants on living organisms.

12 See Water EPP for definitions

13 Wetland of general ecological significance' means a wetland shown on a map of referable wetland as a 'general ecologically significant wetland' or 'wetland of other environmental value'.

14 This does not include the holder's own mine or gas production, on-site industrial or commercial assets, the holder's workers' accommodation, agricultural facilities on the holder's land such as a farm shed or farm dam or infrastructure solely for servicing the holder.

### 7.2.2 Consequence Category Assessment – Water Storage Dam

Assessments against the failure scenarios in the Manual for the Water Storage Dam under operational site conditions were undertaken. This assessment is contained in **Table 27**.

### 7.2.3 Consequence Category Assessment – Sediment Ponds

Assessments against the failure scenarios in the Manual for the sediment ponds under operational site conditions were undertaken. This assessment is contained in **Table 28**.

**TABLE 27: CONSEQUENCE CATEGORY ASSESSMENT – WATER STORAGE DAM**

| Environmental Harm | Consequence Category | | |
|---|---|---|---|
| | **Failure to Contain - Seepage** | **Failure to Contain - Overtopping** | **Failure to Contain - Dam Break** |
| Harm to Humans | All bores identified are understood to be associated with landowner activities.<br><br>In the event of a seepage failure of the WSD, the impact of humans is expected to impact less than 10 people as there are no bores registered for human consumption located on Agate Creek.<br><br>The WSD shall be lined, and as such a seepage failure is considered unlikely.<br><br>**Consequence Category is assessed as Low.** | Impounded waters and material within the WSD consist of pumped transfers from the Pits and sediment ponds. Waters may contain elevated levels of pH, electrical conductivity (EC) and other chemical properties.<br><br>Water quality sampling indicated that the site water quality is not likely to meet the threshold for a 'Significant' consequence category<br><br>In the event of overtopping of the WSD, spills are expected to flow east towards Agate Creek.<br><br>Overtopping of the WSD is considered unlikely as it filled via pump transfer or direct rainfall from a small catchment area.<br><br>**Consequence Category is assessed as Low.** | In the event of a dam break failure of the WSD, impounded waters will flow east towards, and enter Agate Creek.<br><br>In a dam break scenario, a maximum of 250 ML may be released.<br><br>Approximately 3 km to the south, along the southern boundary of the mine lease, Rungulla Road (an unsealed road) provides access to local landowners and to the site. Due to the upstream location of the Rungulla Road to WSD, dam break flows and inundation to the road is considered unlikely.<br><br>Non site personnel may be present (but not likely) in the failure path during a dam break failure.<br><br>**Consequence Category is assessed as Low** |
| General environmental harm | In the event of a seepage failure, the 'Regulated vegetation – intersecting a watercourse' to the east within Agate Creek and its unnamed tributaries may be impacted.<br><br>Water quality sampling indicated that the site water quality is not likely to meet the threshold for a 'Significant' consequence category.<br><br>The WSD shall be lined, and as such a seepage failure is considered unlikely.<br><br>**Consequence Category is assessed as Low.** | Impounded waters and material within the WSD consist of pumped transfers from the Pits and sediment ponds. Waters may contain elevated levels of pH, EC, and other chemical properties. Sampling of waters contained in the WSD should be undertaken upon construction and commissioning. Overtopping would only occur in extreme rainfall events and therefore runoff would be significantly diluted with natural surface flows and the Agate Creek watercourse.<br><br>In the event of an overtopping failure, the 'Regulated vegetation – intersecting a watercourse' to the east within Agate Creek and its unnamed tributaries may be impacted; however, it is considered a Low consequence.<br><br>**Consequence Category is assessed as Low.** | In the event of a dam break failure, the 'Regulated vegetation – intersecting a watercourse' within Agate Creek and its unnamed tributaries is likely to be impacted.<br><br>**Consequence Category is assessed as Significant.** |
| General economic loss or property damage | Approximately 3 km to the south of the subject site and along the southern boundary of the mine lease, Rungulla Road (an unsealed road) provides access to local landowners and to the site.<br><br>In the event of a seepage failure, the remediation/repair costs associated with repairing this road are expected to be less than $1 million.<br><br>**Consequence Category is assessed as Low.** | Approximately 3 km to the south of the subject site and along the southern boundary of the mine lease, Rungulla Road (an unsealed road) provides access to local landowners and to the site.<br><br>In the event of an overtopping failure, the remediation costs associated with repairing this road are expected to be less than $1 million.<br><br>**Consequence Category assessed as Low.** | Approximately 3 km to the south of the subject site and along the southern boundary of the mine lease, Rungulla Road (an unsealed road) provides access to local landowners and to the site.<br><br>In the event of a dam break failure, the remediation/repair costs associated with repairing this road are expected to be less than $1 million.<br><br>**Consequence Category is assessed as Low.** |
| Overall Consequence Category | **LOW** | **LOW** | **SIGNIFICANT** |

## TABLE 28: CONSEQUENCE CATEGORY ASSESSMENT – SEDIMENT PONDS

| Environmental Harm | Consequence Category | | |
|---|---|---|---|
| | **Failure to Contain - Seepage** | **Failure to Contain - Overtopping** | **Failure to Contain - Dam Break** |
| Harm to Humans | All bores identified are understood to be associated with landowner activities.<br><br>In the event of a seepage failure of the WSD, the impact of humans is expected to impact less than 10 people as there are no bores registered for human consumption located on Agate Creek.<br><br>**Consequence Category is assessed as Low.** | Impounded waters within the sediment ponds consist of runoff from the WRDs.<br><br>Water quality sampling indicated that the site water quality is not likely to meet the threshold for a 'Significant' consequence category<br><br>In the event of overtopping of the sediment ponds, spills are expected to flow towards Agate Creek or its unnamed tributaries to the east of the site. Overtopping would only occur in large rainfall events and therefore runoff would be diluted with natural surface flows and the Agate Creek watercourse.<br><br>**Consequence Category is assessed as Low.** | In the event of a dam break failure of the sediment ponds, impounded waters will flow east towards, and enter Agate Creek.<br><br>Approximately 3 km to the south, along the southern boundary of the mine lease, Rungulla Road (an unsealed road) provides access to local landowners and to the site. Due to the upstream location of the Rungulla Road to WSD, dam break flows and inundation to the road is considered unlikely.<br><br>Non site personnel may be present (but not likely) in the failure path during a dam break failure<br><br>**Consequence Category is assessed as Low.** |
| General environmental harm | In the event of a seepage failure, the 'Regulated vegetation – intersecting a watercourse' to the east within Agate Creek and its unnamed tributaries may be impacted.<br><br>Water quality sampling indicated that the site water quality is not likely to meet the threshold for a 'Significant' consequence category.<br><br>**Consequence Category is assessed as Low.** | Impounded waters within the sediment ponds consist of runoff from the WRDs. This water is dirty water that is assumed to be predominately sediment laden.<br><br>In the event of overtopping of the sediment ponds, spills are expected to flow towards Agate Creek or its unnamed tributaries to the east of the site.<br><br>**Consequence Category is assessed as Low.** | In the event of a dam break failure of the sediment ponds, the 'Regulated vegetation – intersecting a watercourse' within Agate Creek and its unnamed tributaries is likely to be impacted.<br><br>Water quality in the Sediment Ponds is proposed to be predominantly sediment laden and therefore of Low consequence if released.<br><br>**Consequence Category is assessed as Low.** |
| General economic loss or property damage | Approximately 3 km to the south of the subject site and along the southern boundary of the mine lease, Rungulla Road (an unsealed road) provides access to local landowners and to the site.<br><br>In the event of a seepage failure, the remediation/repair costs associated with repairing this road are expected to be less than $1 million.<br><br>**Consequence Category is assessed as Low.** | Approximately 3 km to the south of the subject site and along the southern boundary of the mine lease, Rungulla Road (an unsealed road) provides access to local landowners and to the site.<br><br>In the event of a seepage failure, the remediation/repair costs associated with repairing this road are expected to be less than $1 million.<br><br>**Consequence Category is assessed as Low.** | Due to the upstream location of the Rungulla Road to the sediment ponds, dam break flows and damage to the road is considered unlikely.<br><br>**Consequence Category is assessed as Low.** |
| Overall Consequence Category | **LOW** | **LOW** | **LOW** |

## 7.3 Summary and Hydraulic Performance Criteria

The consequence category assessment outcomes are summarised in **Table 29.**

**TABLE 29: CONSEQUENCE CATEGORY ASSESSMENT SUMMARY**

| Failure Scenario | Water Storage Dam | Sediment Ponds |
|---|---|---|
| Failure to Contain – Seepage | Low | Low |
| Failure to Contain – Overtopping | Low | Low |
| Failure to Contain - Dam Break | Significant | Low |
| Overall | Significant | Low |
| Regulated Structure, as defined in the Manual (Y/N) | Yes | No |

As shown in **Table 29**, the Water Storage Dam has a consequence category of 'Significant'. All other structures have a consequence category of Low. Details of the hydraulic performance criteria for the Water Storage Dam are detailed in **Section 4.4.2**.

# 8 WATER QUALITY MONITORING AND REVIEW

Water quality monitoring is required in accordance with regulatory requirements to identify any potential influence or threat to receiving waters. Proposed monitoring requirements in relation to both clean (diverted) water and the site water management system is provided in the followings actions.

## 8.1 Surface and Stored Water Quality Monitoring

### 8.1.1 Monitoring Parameters

Water quality monitoring is to occur within each water storage on site, with the data being reviewed against the containment limits nominally provided below. Monitoring of storages is proposed to be undertaken on a monthly basis at a minimum, and daily during release events. Surface water sampled in watercourses should be collected during flow events.

- pH (in-situ)
- Electrical Conductivity (in-situ)
- Dissolved Oxygen (in-situ)
- Turbidity (in-situ)
- Sulphate
- Bicarbonate
- Magnesium
- Sodium
- Potassium
- Calcium
- Chloride
- Nitrate
- Cadmium
- Chromium
- Cobalt
- Copper
- TOC
- Ammonia
- Total Phosphorus
- Manganese
- Zinc
- Iron
- Nitrite
- Alkalinity
- Aluminium
- Arsenic
- Boron
- Fluoride
- Lead
- Mercury
- Molybdenum
- Nickel
- Selenium
- Silver
- Petroleum Hydrocarbons
- Uranium
- Vanadium

The list of parameters will be reduced based on the initial surface water quality results.

### 8.1.2 Monitoring Analyses

Surface water quality results will be assessed against exceedance and trigger value limits identified in the Environmental Authority once it is approved, as well as the Water Quality Objectives.

## 8.2 Groundwater Quality Monitoring Approach

Groundwater quality monitoring within and around the project site must be undertaken to examine groundwater levels and water quality at the site. Groundwater monitoring should be undertaken on a quarterly (3-monthly) basis during mine operations and annually post-closure.

### 8.2.1 Monitoring Locations

Groundwater monitoring locations shall be constructed to identify any groundwater impacts occurring as a result of mining activities.

### 8.2.2 Groundwater Level Monitoring

Groundwater level monitoring should be undertaken prior to sampling for groundwater quality data. The purpose of groundwater level monitoring would be to confirm the groundwater flow direction.

### 8.2.3 Monitoring Parameters

Initial groundwater quality monitoring should be undertaken for a full suite of parameters as follows:

- pH (in-situ)
- Electrical Conductivity (in-situ)
- Dissolved Oxygen (in-situ)
- Turbidity (in-situ)
- Nitrate
- TOC
- Sulphate
- Chloride
- Bicarbonate
- Ammonia
- Mercury
- Molybdenum
- Nickel
- Selenium
- Silver
- Petroleum Hydrocarbons
- Uranium
- Vanadium
- Total Phosphorus
- Magnesium
- Sodium
- Potassium
- Calcium
- Manganese
- Zinc
- Iron
- Nitrite
- Alkalinity
- Aluminium
- Arsenic
- Boron
- Cadmium
- Chromium
- Cobalt
- Copper
- Fluoride
- Lead

The list of parameters may be reduced, based on the initial groundwater quality results against the values of the EA when it is issued.

### 8.2.4 Monitoring Analyses

Water quality results are to be assessed against exceedance and trigger value limits identified in the Environmental Authority, as well as the Water Quality Objectives.

## 8.3 Stormwater Management Performance

### 8.3.1 Performance Indicators

The performance indicators that will be used to identify the effective implementation of the Site Water Management Plan include the following procedures.

- The water management actions are in place and are operating as set out in the Site Water Management Plan.
- There is ongoing management and maintenance of the water storages or drainage structures, for example, erosion or scouring of any stormwater drainage pathway or disturbed surface.
- There is no evidence/observations of uncontrolled releases of water from containment structures, unless the release has been authorised to achieve the water quality objectives.

An Environment Officer or equivalent is to carry out the relevant assessment of the performance indicators.

### 8.3.2 Performance Inspection

Periodic third-party performance audits are necessary to demonstrate that the performance indicators are being effectively achieved. As a minimum, the performance audits to be carried out are to include both monthly and annual inspections, as set out below.

(i) Monthly Inspections

The purposes of the monthly inspections are:

- to confirm the integrity of the clean water and site runoff water management infrastructure; and,
- to identify evidence of uncontrolled releases of mine affected water that have discharged off-site.

(ii) Annual Inspections

- An annual inspection of all regulated structures is required each year, by a suitable, qualified person.
- The objective of the annual inspection is to assess dam safety against its structural, geotechnical and hydraulic performance criteria.
- Inspections of clean water and site water management drains, and proposed upgrade works will be required prior to each wet season.

### 8.3.3 Corrective Actions

If any issues or shortcomings are identified with respect to the stormwater management system, the following corrective actions shall be included, as a minimum.

- Sediment and other debris must be removed to maintain the required storage at water management dams and the integrity of the erosion and sediment control measures.
- Promptly undertake works, as required, to remediate areas subject to disturbance.
- Reinstate clean water diversion drains, as required, to maintain the separation of clean and mine impacted water.

## 8.4 Ongoing Water Management Plan Review

In conjunction with annual dam safety inspections, the hydraulic performance requirements for each structure are to be reviewed and updated to identify possible shortcomings. This inspection is to be completed by 1 November each year.

There is no formal frequency for review of the entire site Water Management Plan. Notwithstanding, a review should be undertaken, as deemed necessary, to ensure measures, practices and procedures are carried out effectively to minimise the risk of environmental harm. This may occur in the case of changes to the mining schedule, operations or other relevant aspects that could potentially impact the effectiveness of the Water Management Plan.

# 9 EMERGENCY AND CONTINGENCY PLAN

The following scenarios have been identified as potential events or incidents that would fall under this emergency and contingency management plan.

## 9.1 Extreme/Prolonged Rainfall

Extreme rainfall events or prolonged rainfall conditions could cause an emergency incident to occur. Very wet conditions may exceed the design rainfall intensity and duration used in designing the water management structures proposed in this report.

In the event of an exceedance of the rainfall intensity and duration adopted to design the water management structures, the critical or 'worst case' scenario would involve failure to contain water within the regulated structure.

Under these conditions, failure and/or overtopping of water management structures may result in flooding of downstream areas within the flow path, as well as the release of contaminants to the receiving environment. In this event, a risk to any personnel working within the area would also be present. Any structures at risk of flooding would need to be evacuated and vital equipment removed from the area.

Further water management may be required to limit uncontrolled releases from the site.

## 9.2 Incidents Causing Environmental Harm

### 9.2.1 Spills or Leaks

Spills or leaks may occur from tanks, pipes or other mine infrastructure and instrumentation during any weather conditions, particularly under strong winds or destructive conditions, where tanks can be moved and above ground pipes can burst. The impacts from the release of hydrocarbons are of particular concern to the receiving environment.

In the event of an incident, the assessment of potential environmental impacts stemming from spills, leaks and their associated effects is to be made, irrespective of the volume of the spill occurring. Notification of the incident to downstream stakeholders must occur for any degree of off-lease environmental impact. Notification and consultation with environmental authorities and specialists is an inbuilt feature of standard operating directives for spill incidents.

### 9.2.2 Erosion or Damage to Site Infrastructure

Water management infrastructure such as dams, embankments and drains may be subject to erosion, particularly during storm events or overtopping. Regular inspections are required to ensure infrastructure is operable and free of damage, with immediate remedial actions required should any damage be found. Where appropriate, sacrificial erosion measures are to be incorporated into spillway design to allow for controlled failure during extreme rainfall events.

### 9.2.3 Pumps

Back-up pumps and generators are to be made available in case of pump failure during extreme events. The additional pumps and generators are to be available while the failed pumps are being repaired. It is proposed that a contingency storage area with bunds or levy banks is provided within close proximity of the failure, to contain effluent until pump repairs are complete.

### 9.2.4 Inability to Access Control and Monitoring Points

Four-wheel drives (4WD) vehicles are to be retained on site for the purpose of accessing control and monitoring points during and after storm events.

## 9.3 Responsibilities and Reporting

It is the responsibility of the Site General Manager to ensure all elements of the water management plan are implemented. This includes ensuring all ongoing monitoring of the water management infrastructure is completed as required, and all inspections, reviews and reporting are undertaken and submitted to DES as specified and within the appropriate timeframes.

# 11 CONCLUSIONS AND RECOMMENDATIONS

This Water Management Plan was undertaken to meet the requirements of DES **[17]** and to assist in the application for an Environmental Authority amendment to allow operations at the site to commence.

The site requires a complex water management strategy to transfer water from several dirty water Sediment Ponds to a large centralised Water Storage Dam. Water Balance Modelling indicated that the Water Storage Dam has a spill risk of <1% each year and the Sediment Ponds are designed to have a spill risk less than 20%. The Water Storage Dam has been conservatively sized as there is limited information regarding the expected water quality in the pits and from the WRDs. Finalised results and details from the waste rock characterisation assessment are needed and this WMP should be updated when this information is made available.

It should be made clear that this WMP considers a 'worst-case' scenario in that all WRDs and Pits are disturbed catchments from the start of operations. This was assumed due to the limited information available regarding the mine development and existing site characteristics. There are efficiencies that could therefore be achieved with the water management strategy to reduce the on-site storages and transfer requirements by sequencing/staging the works and progressively rehabilitating areas to convert them to clean water catchments. It is recommended that this is conducted by developing a detailed staging plan in conjunction with a progressive rehabilitation plan as part of additional studies, prior to the detailed design phase of the project.

Overall, it is expected that the site will generate a significant amount of dirty water from disturbed areas. Under wet climate conditions, there be a surplus of water due to the multiple catchments from the WRDs and Pits, combined with low (dust suppression only) site water demands. The proposed Water Storage Dam has a consequence category of 'Significant', and as such, must ensure it has sufficient DSA before 1 November every year, and a MRL applies. The Sediment Ponds are not considered to be regulated structures.

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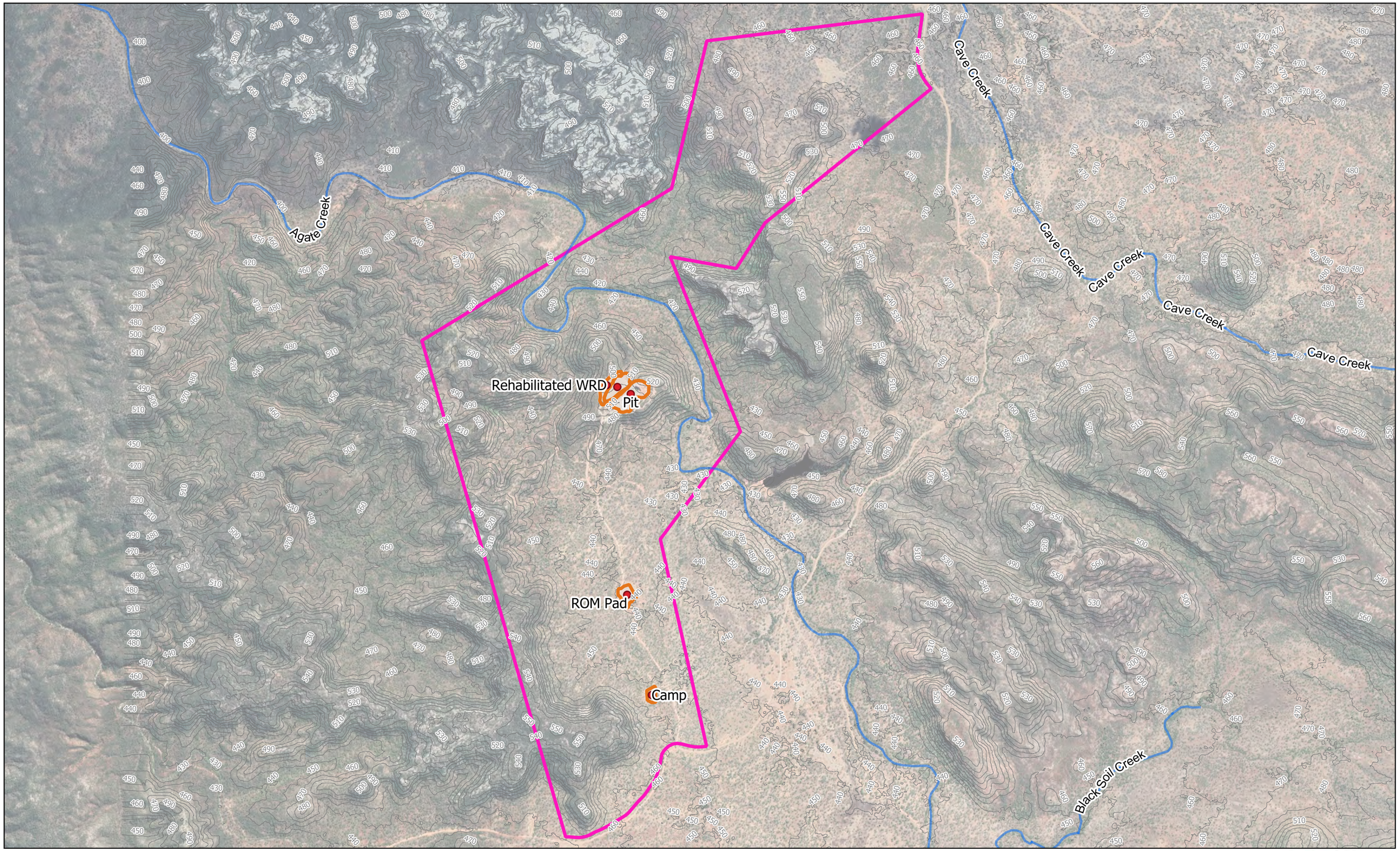
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# APPENDICES

# APPENDIX A – ATCW CONCEPT FIGURES




- LABLES
- MINE LEASE
- EXISTING FEATURES
- EXISTING CONTOURS 10m
- MAJOR WATERCOURSES

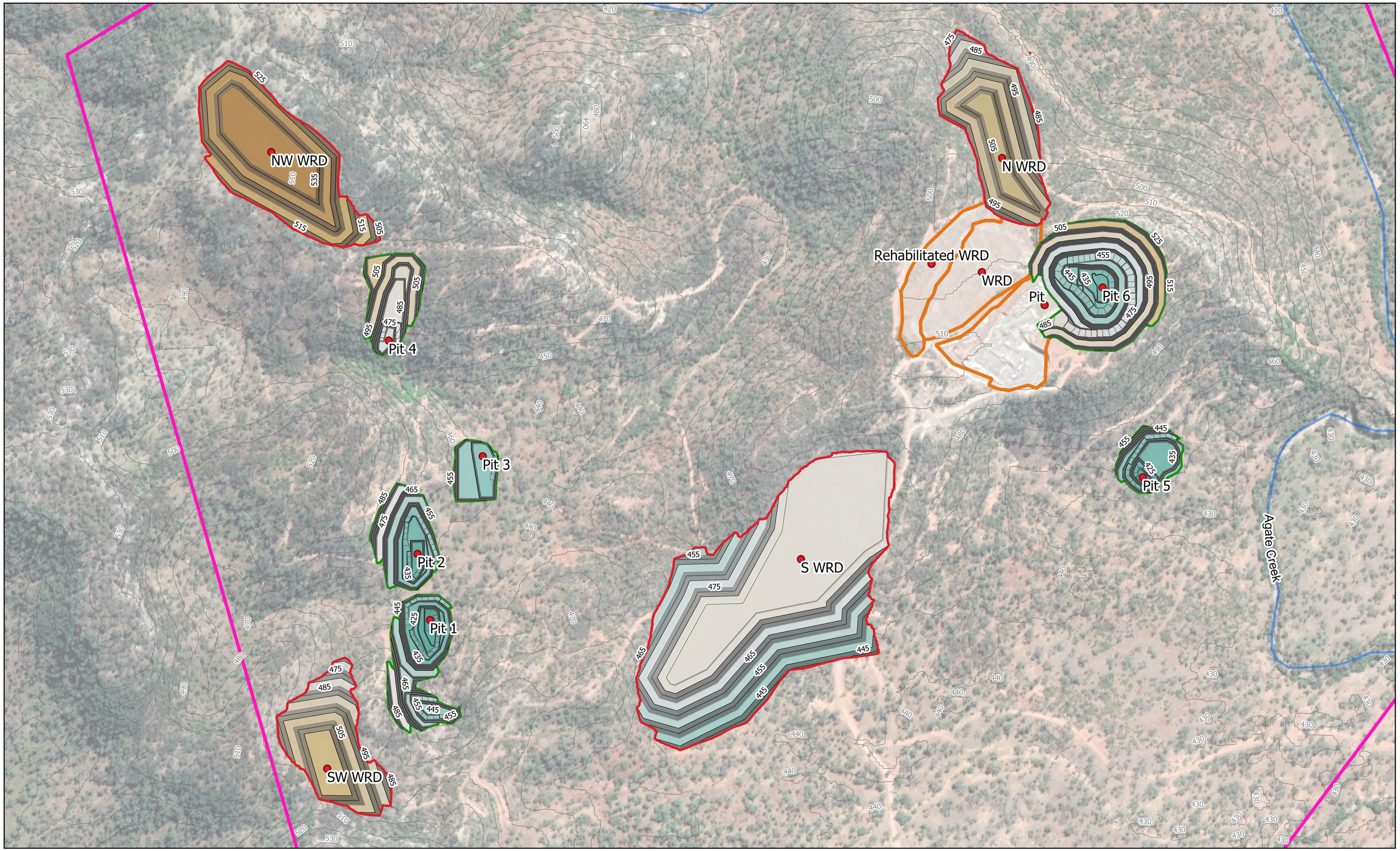
FIGURE 001
EXISTING FEATURES
AGATE CREEK GOLD MINE

N

0 500 1,000 1,500 m

REF: 116091.17 DATE: 2022-07-27

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- LABLES
- MINE LEASE
- EXISTING FEATURES
- WRD FOOTPRINTS
- PIT FOOTPRINTS
- EXISTING CONTOURS 10m
- AGATE CREEK

WRD & PIT DESIGN

- 400.00
- 437.50
- 475.00
- 512.50
- 550.00

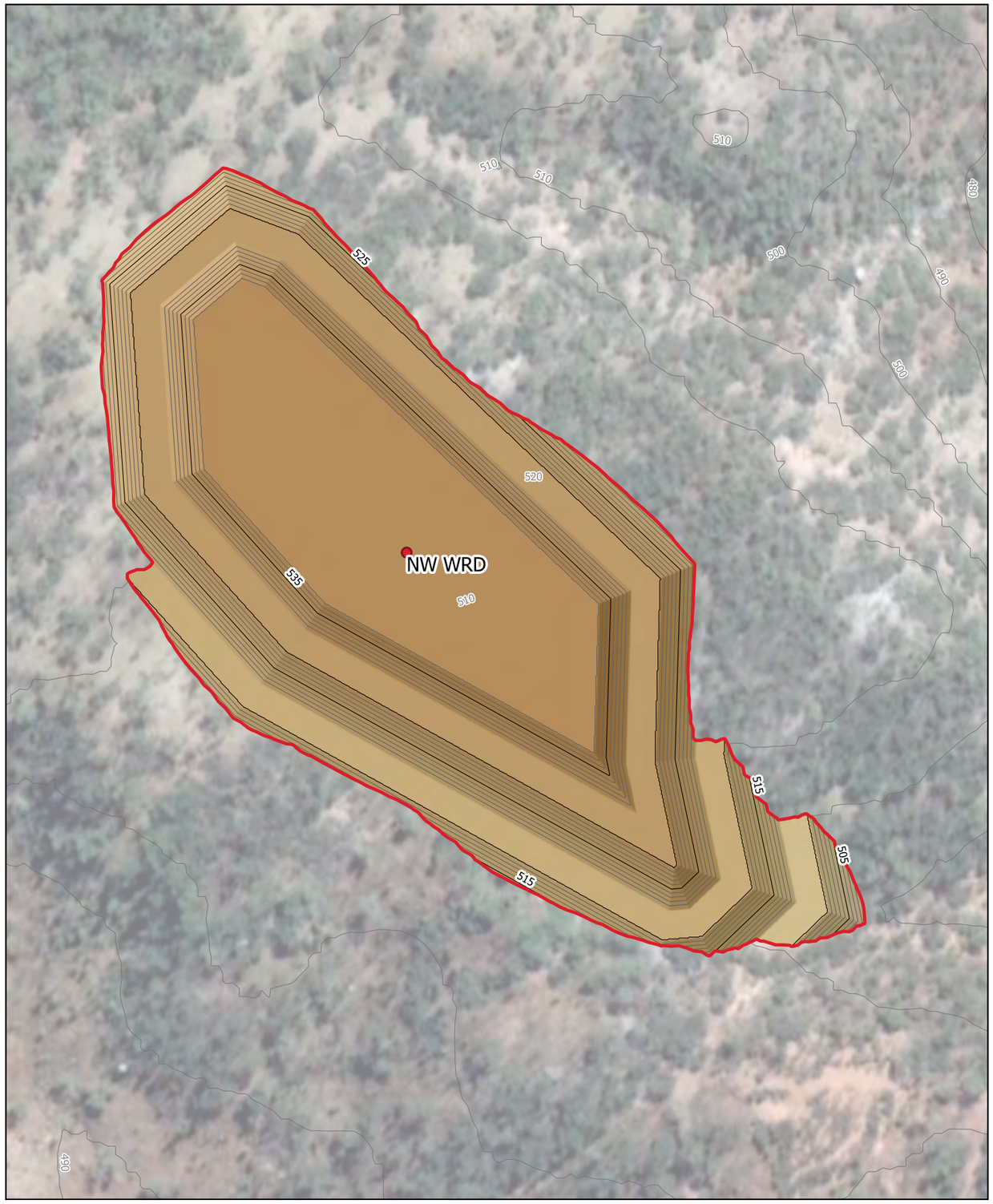
FIGURE 002
PROPOSED LAYOUT
AGATE CREEK GOLD MINE

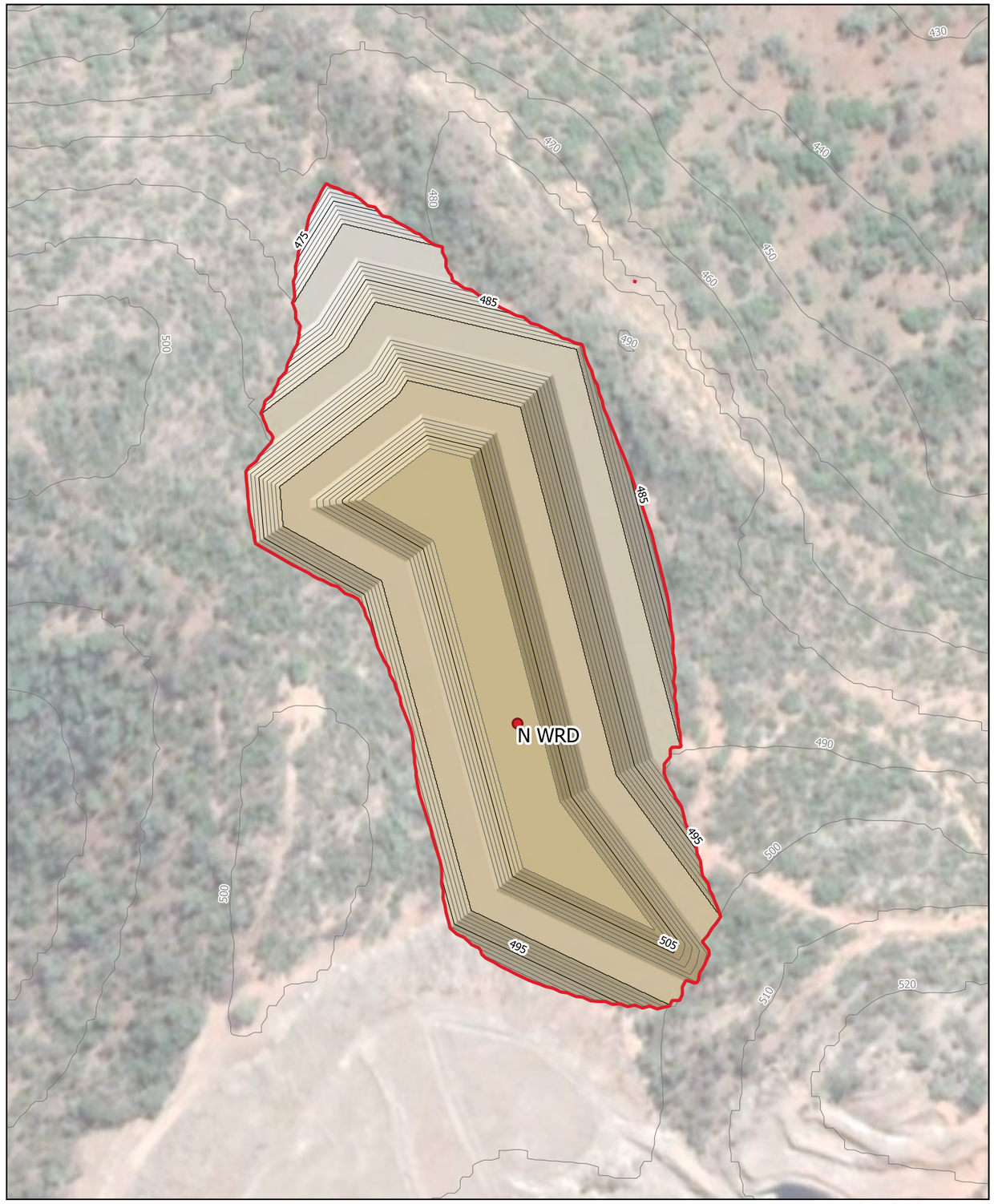
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0 100 200 300 m

REF: 116091.17 DATE: 2022-07-27

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LABLES
MINE LEASE
WRD FOOTPRINTS
EXISTING CONTOURS 10m

WRD DESIGN
400.00
437.50
475.00
512.50
550.00

FIGURE 003
PROPOSED NORTH-WEST & NORTH WASTE ROCK DUMP
AGATE CREEK GOLD MINE

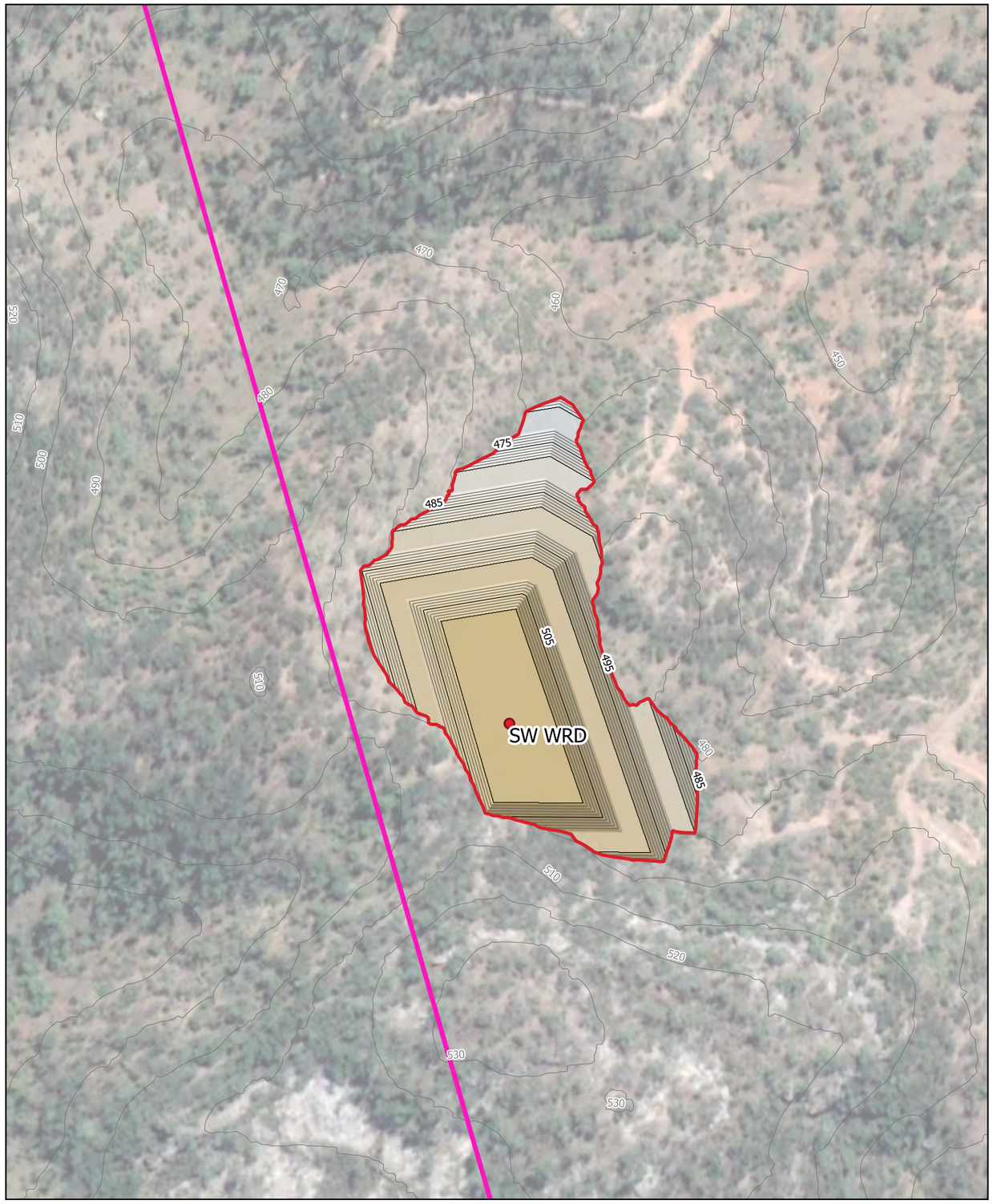
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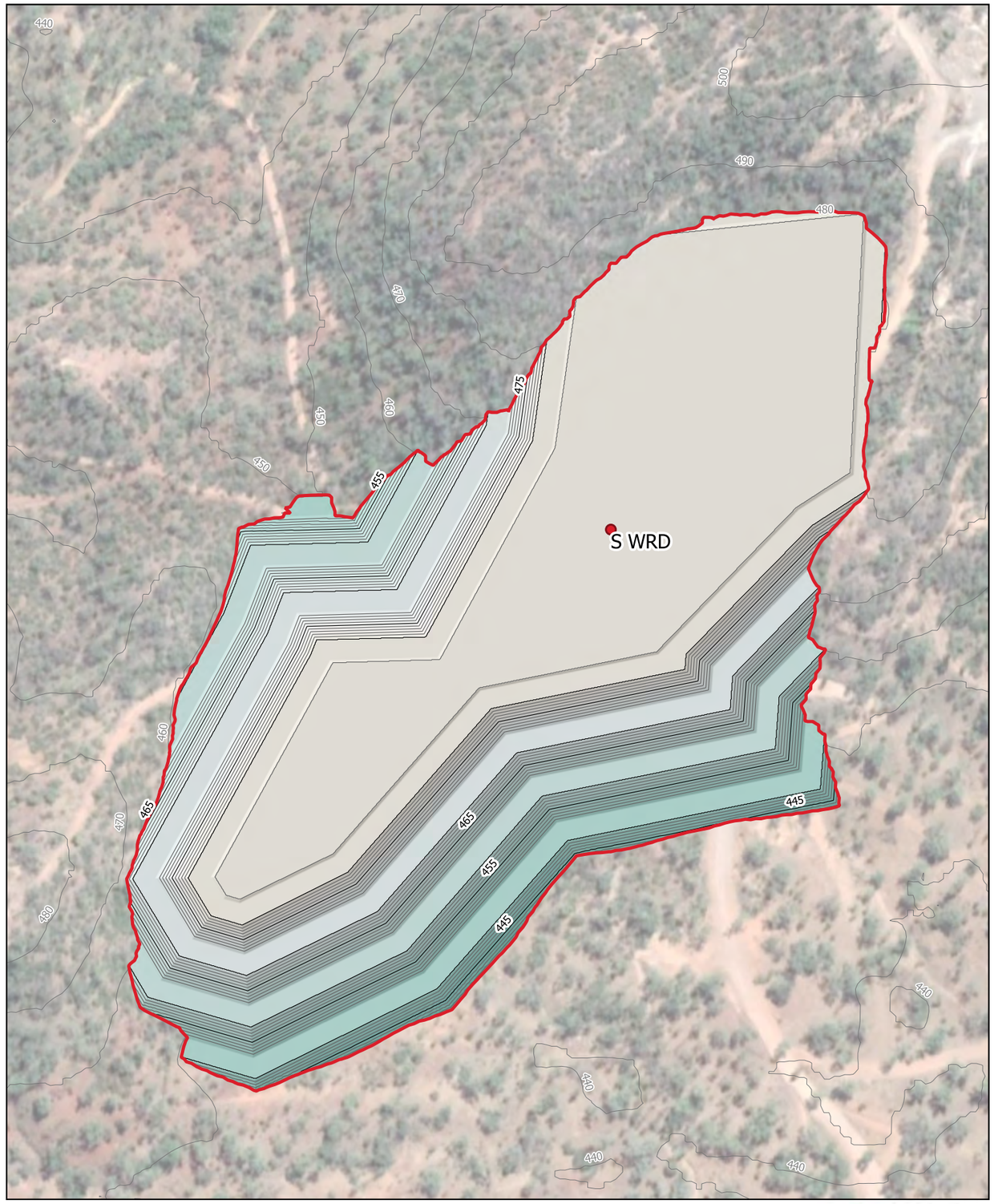
0 50 100 150 m

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- LABLES
- MINE LEASE
- WRD FOOTPRINTS
- EXISTING CONTOURS 10m

WRD DESIGN
- 400.00
- 437.50
- 475.00
- 512.50
- 550.00

FIGURE 004
PROPOSED SOUTH-WEST & SOUTH WASTE ROCK DUMP
AGATE CREEK GOLD MINE

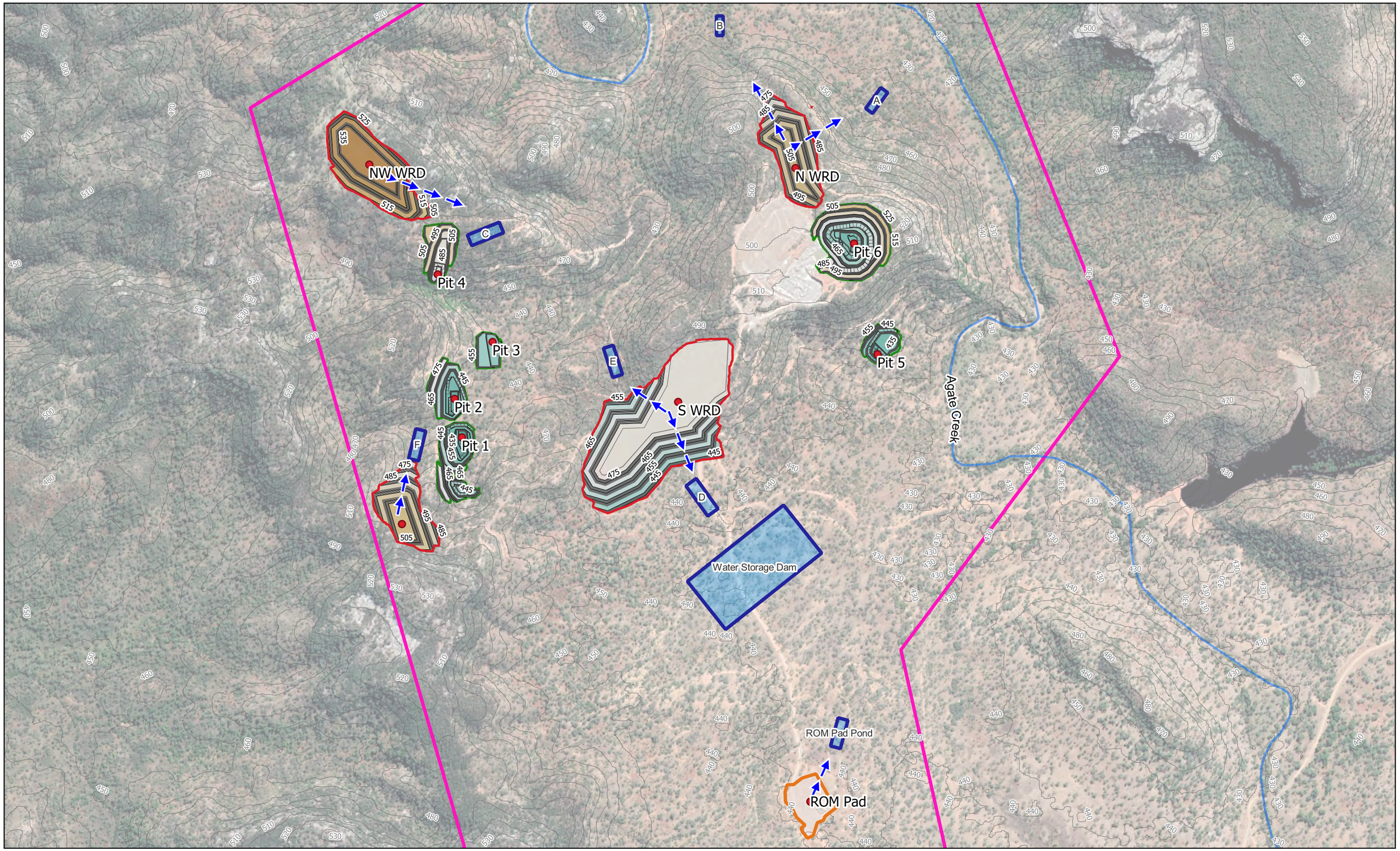
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0 50 100 150 m

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- LABLES
- MINE LEASE
- EXISTING FEATURES
- WRD FOOTPRINTS
- PIT FOOTPRINTS
- EXISTING CONTOURS 10m
- AGATE CREEK
- FLOW PATH
- SEDIMENT PONDS / WATER SRORAGE

WRD & PIT DESIGN

- 400.00
- 437.50
- 475.00
- 512.50
- 550.00

FIGURE 005
PROPOSED WATER MANAGEMENT PLAN
AGATE CREEK GOLD MINE

N

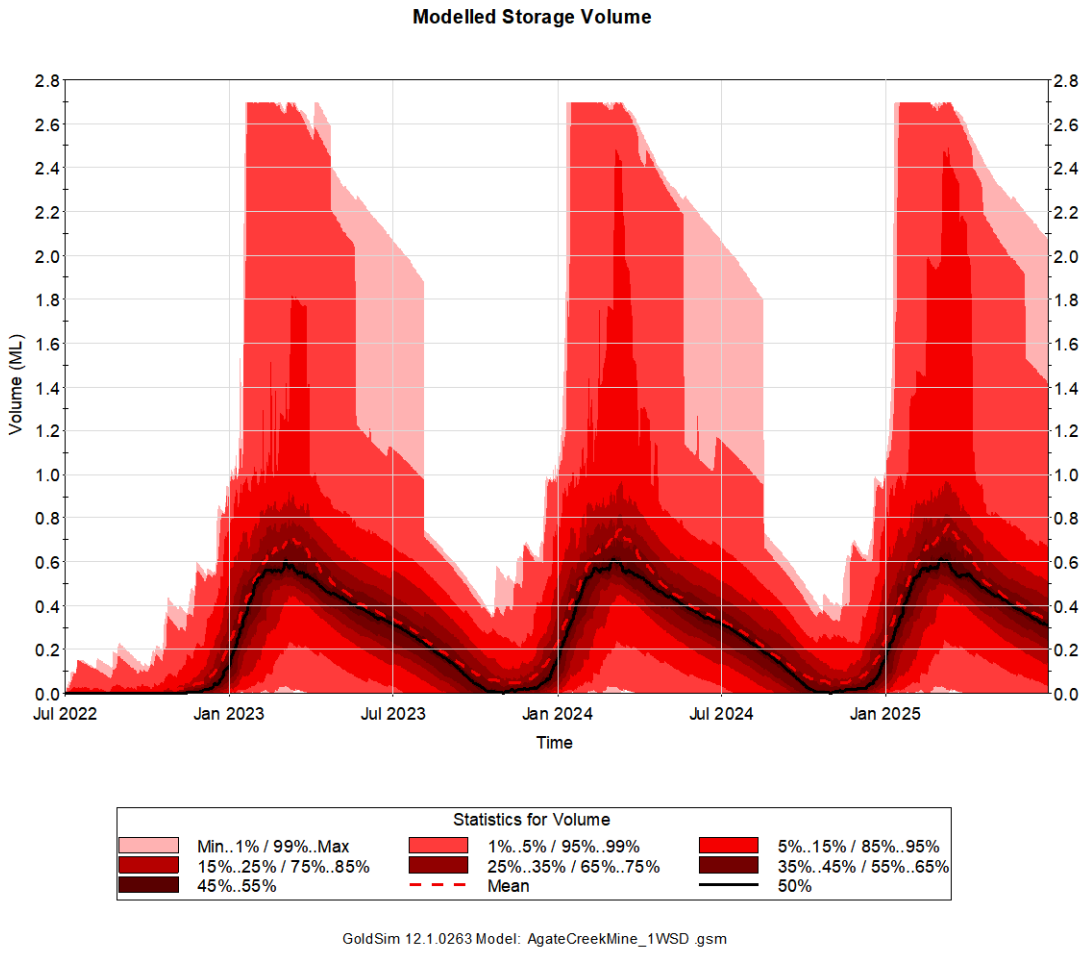
0 200 400 600 m

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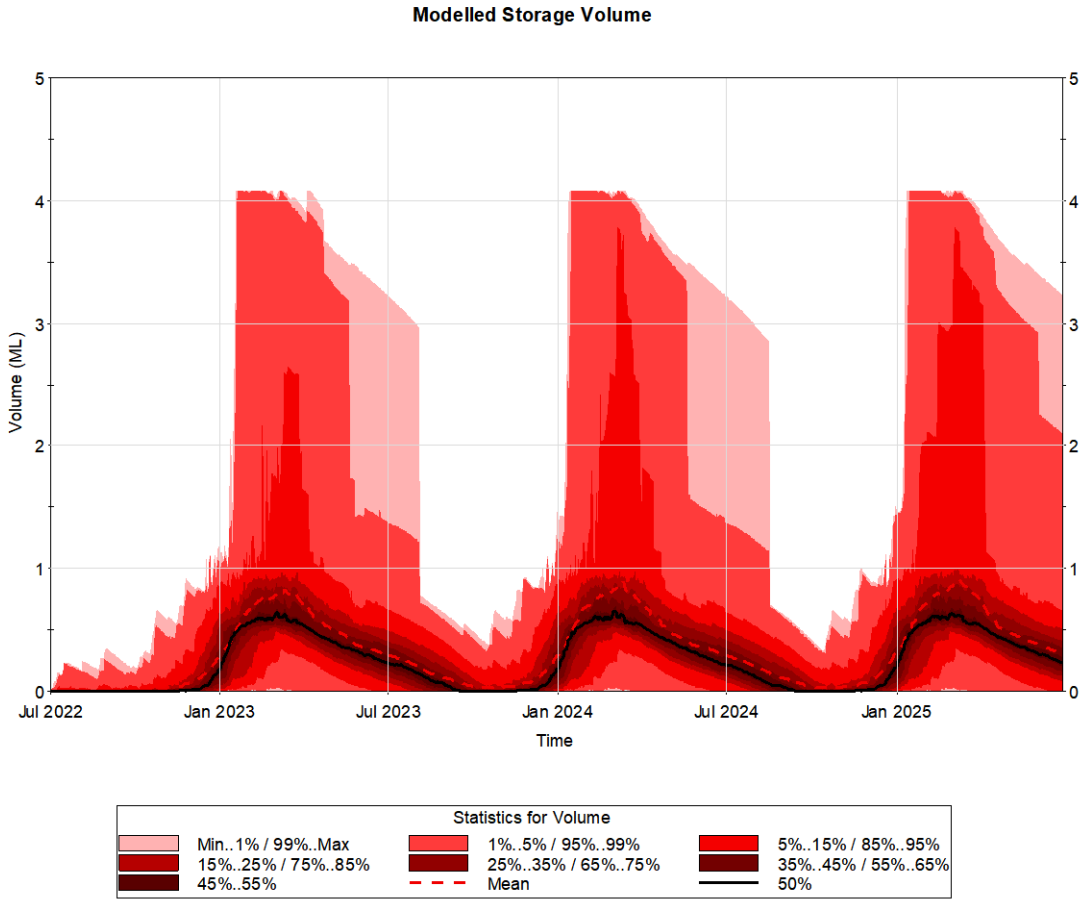
# APPENDIX B – OPERATIONAL WATER BALANCE RESULTS

## Diagram B.1 – Sediment Pond A Modelled Storage Volume

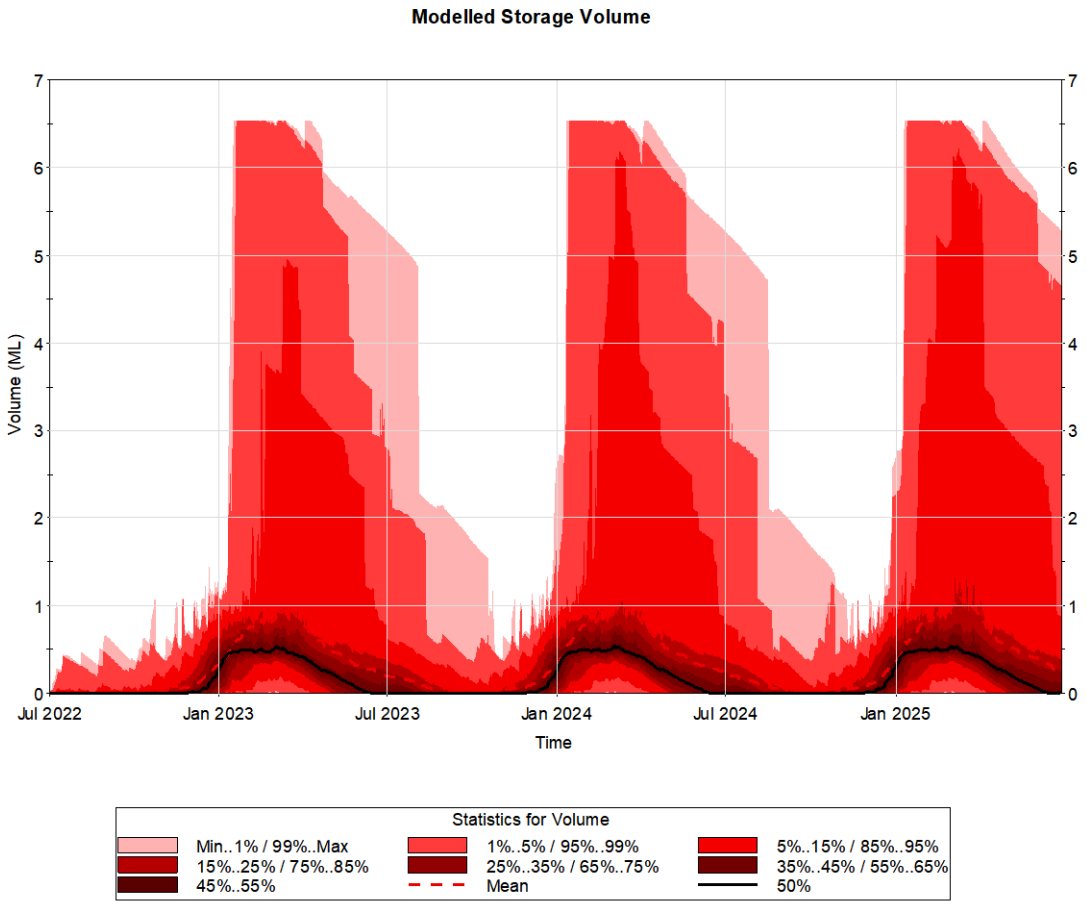



GoldSim 12.1.0263 Model: AgateCreekMine_1WSD .gsm

## Diagram B.2 – Sediment Pond B Modelled Storage Volume

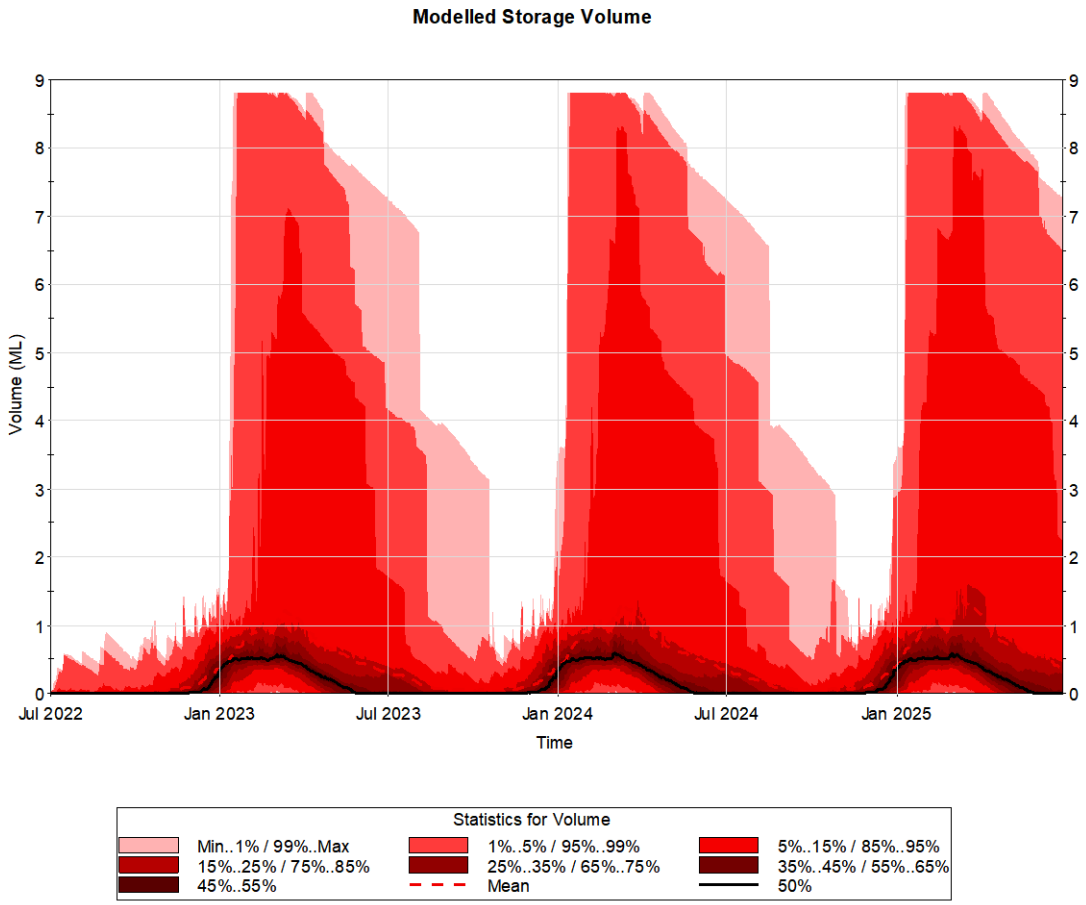


## Diagram B.3 – Sediment Pond C Water Storage



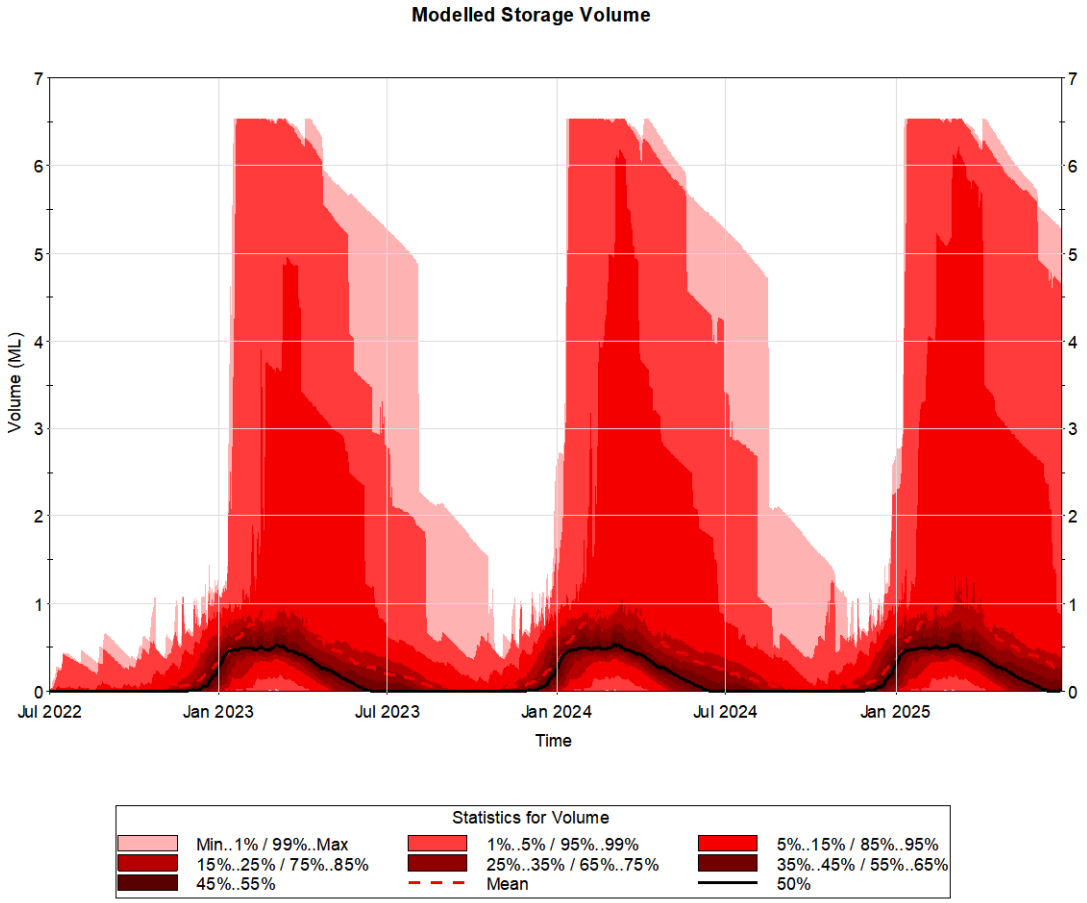

GoldSim 12.1.0263 Model: AgateCreekMine_1WSD .gsm

## Diagram B.4 – Sediment Pond D Modelled Storage Volume




GoldSim 12.1.0263 Model: AgateCreekMine_1WSD .gsm

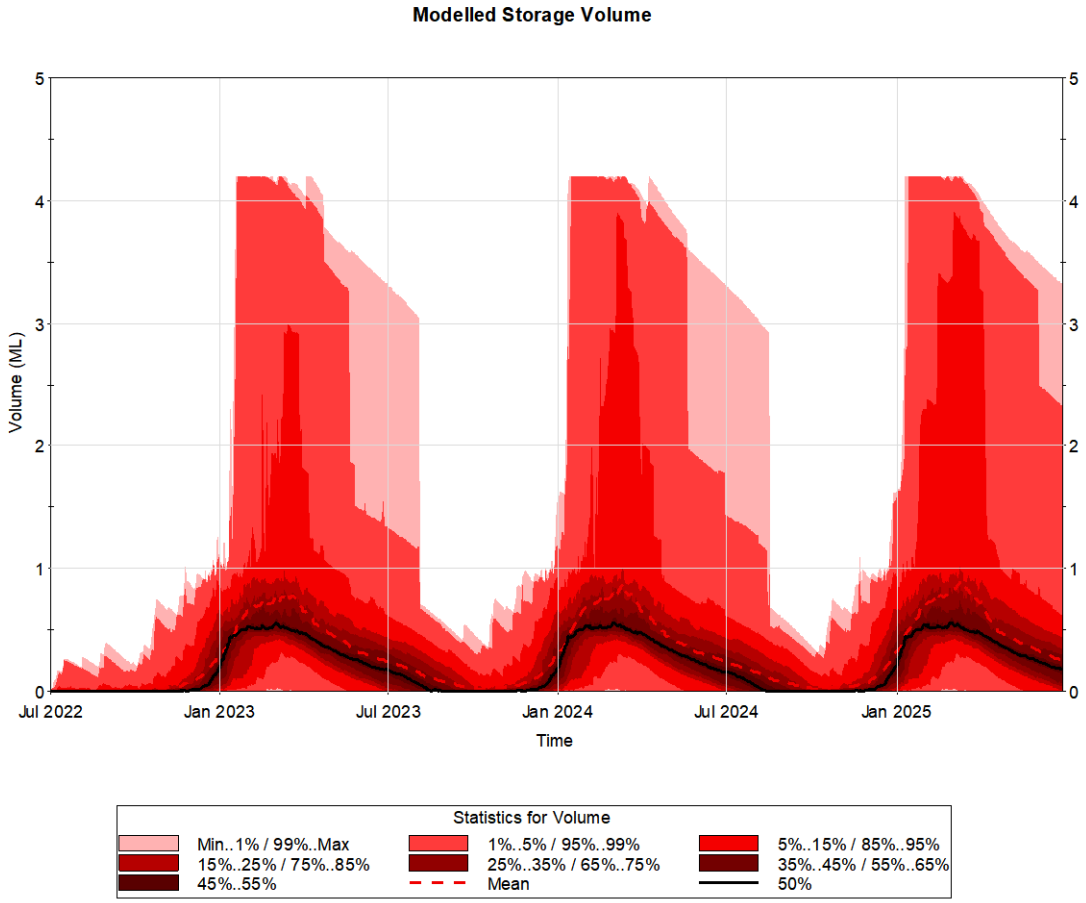
## Diagram B.5 – Sediment Pond E Modelled Storage Volume



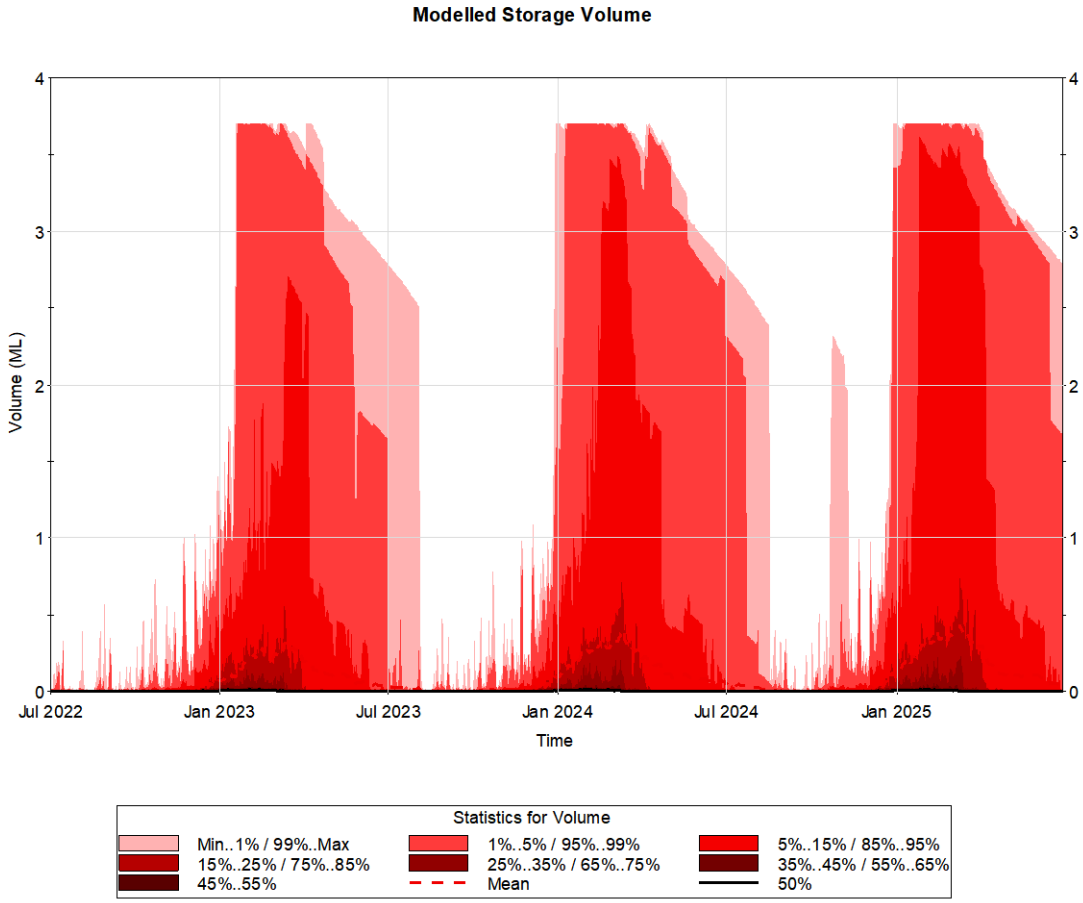

GoldSim 12.1.0263 Model: AgateCreekMine_1WSD .gsm

TAILINGS.WATER.WASTE.

## Diagram B.6 – Sediment Pond F Modelled Storage Volume



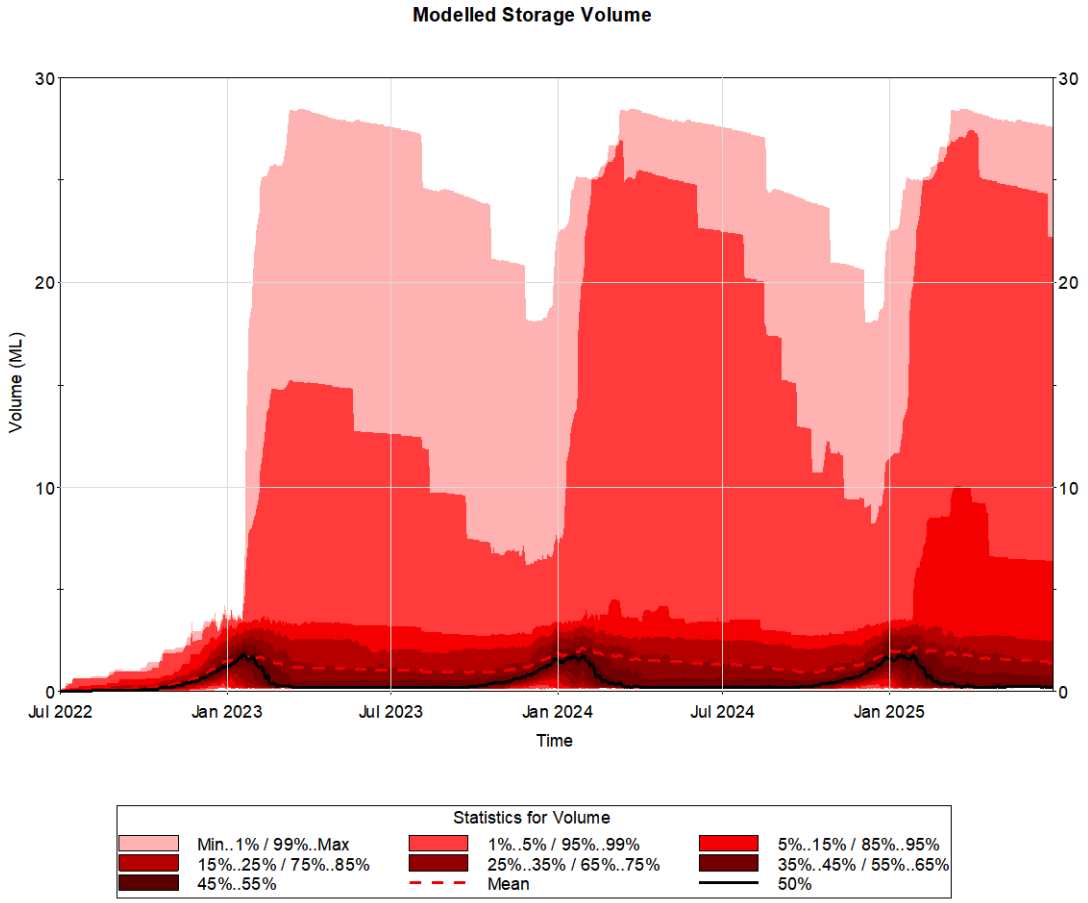
## Diagram B.7 – ROM Pad Sediment Pond Modelled Storage Volume




GoldSim 12.1.0263 Model: AgateCreekMine_1WSD .gsm

TAILINGS.WATER.WASTE.

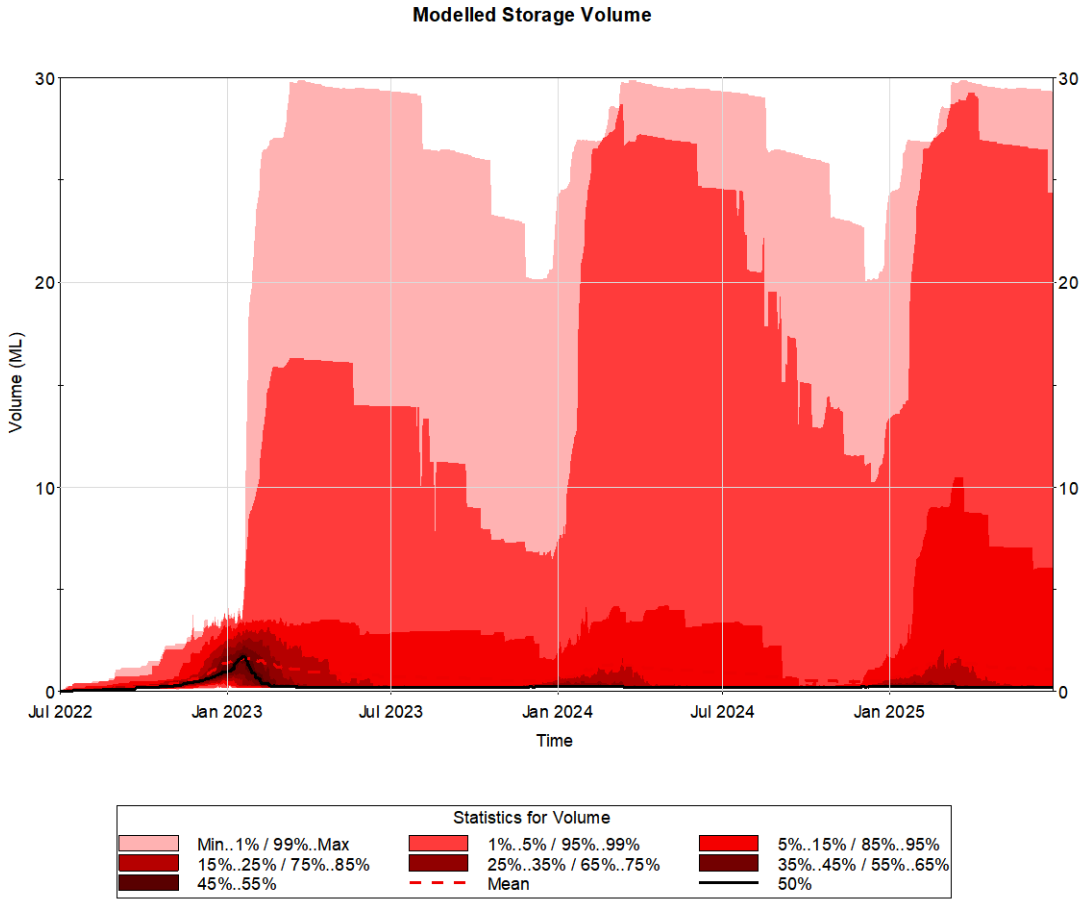
## Diagram B.8 – Pit 1 Modelled Storage Volume




GoldSim 12.1.0263 Model: AgateCreekMine_1WSD .gsm

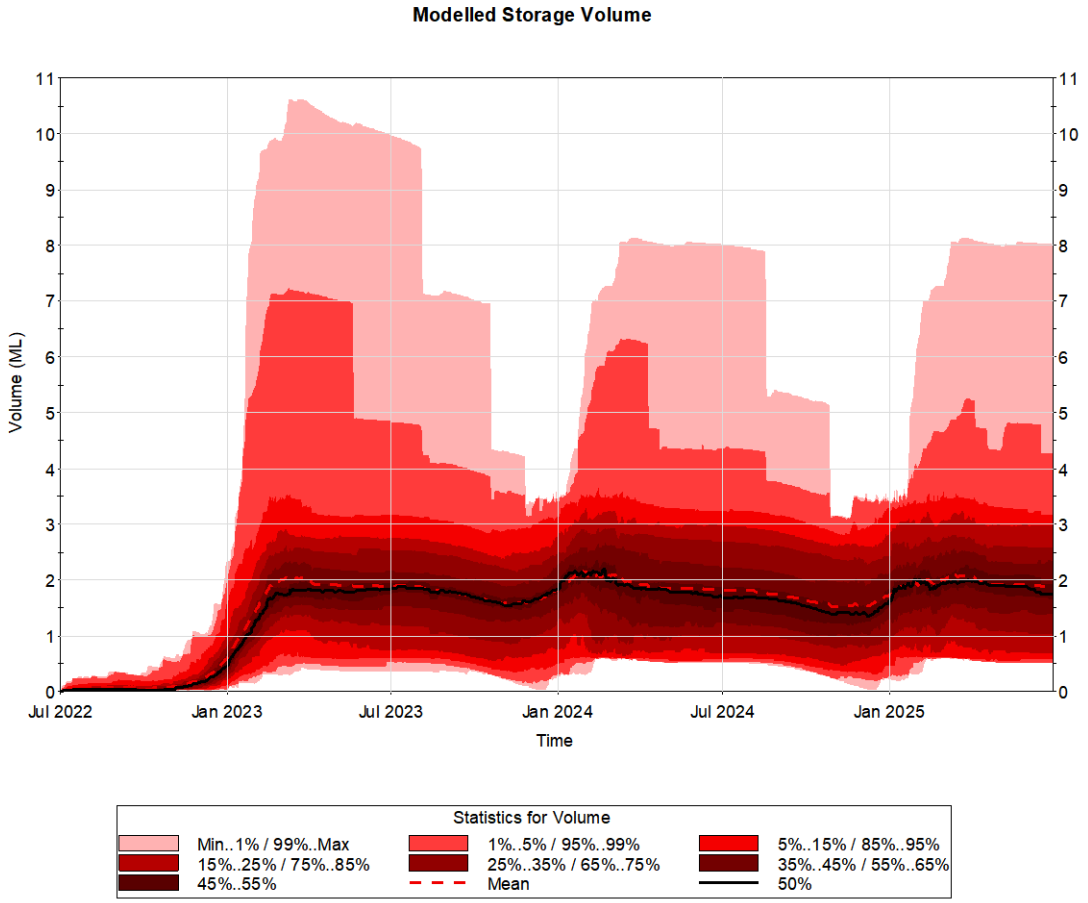
TAILINGS.WATER.WASTE.

## Diagram B.9 – Pit 2 Modelled Storage Volume



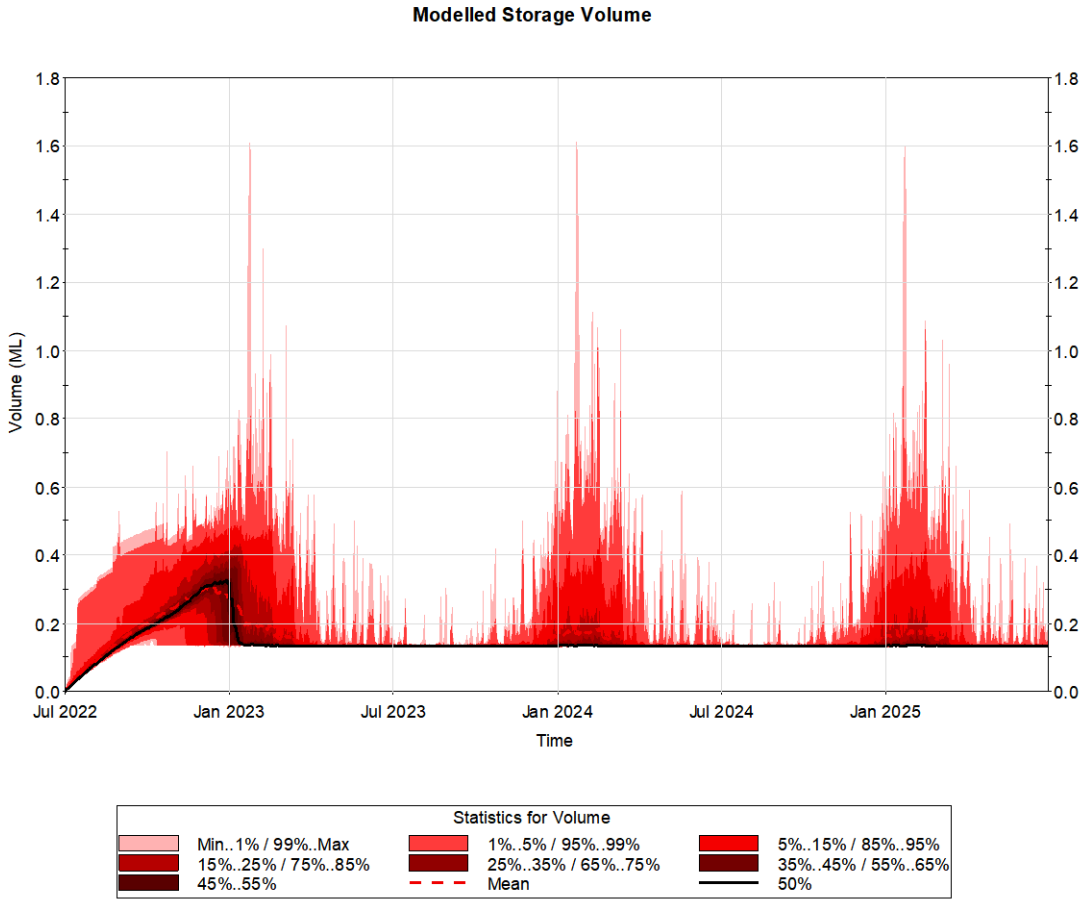

GoldSim 12.1.0263 Model: AgateCreekMine_1WSD .gsm

## Diagram B.10 – Pit 3 Modelled Storage Volume




GoldSim 12.1.0263 Model: AgateCreekMine_1WSD .gsm

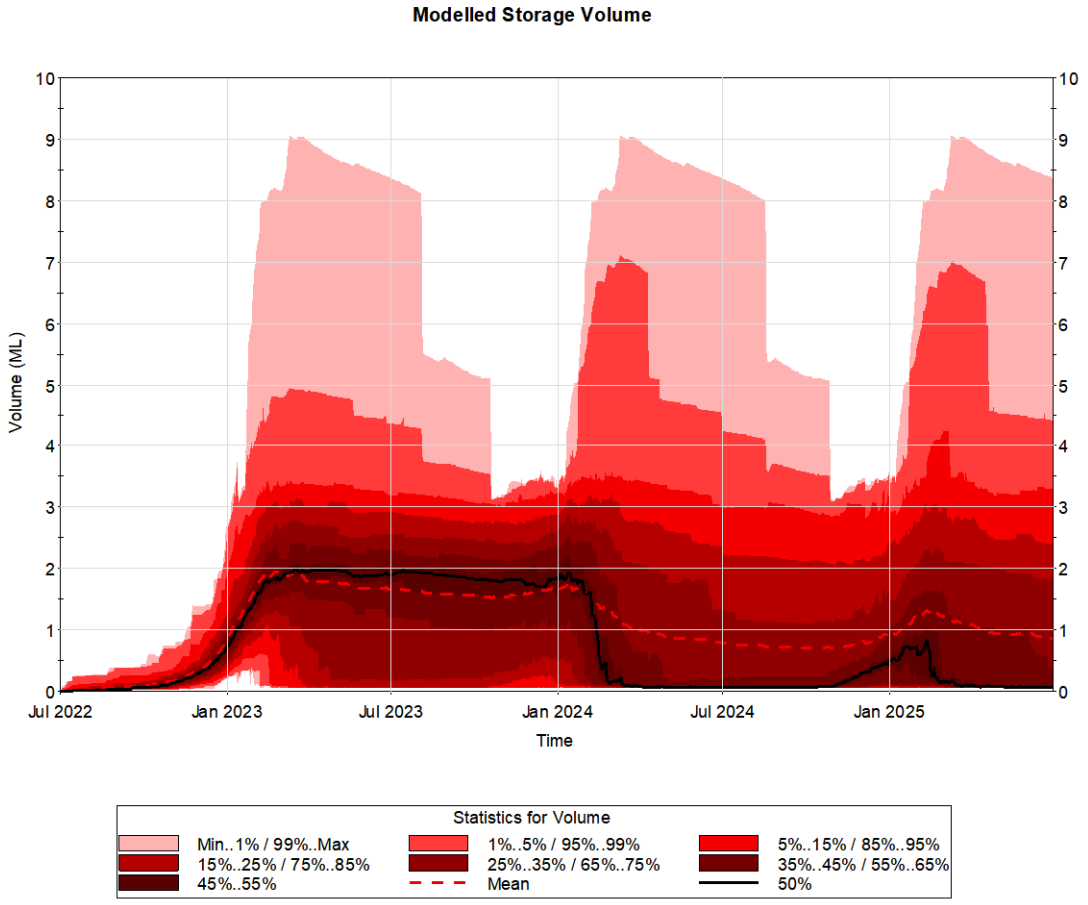
## Diagram B.11 – Pit 4 Modelled Storage Volume




GoldSim 12.1.0263 Model: AgateCreekMine_1WSD .gsm

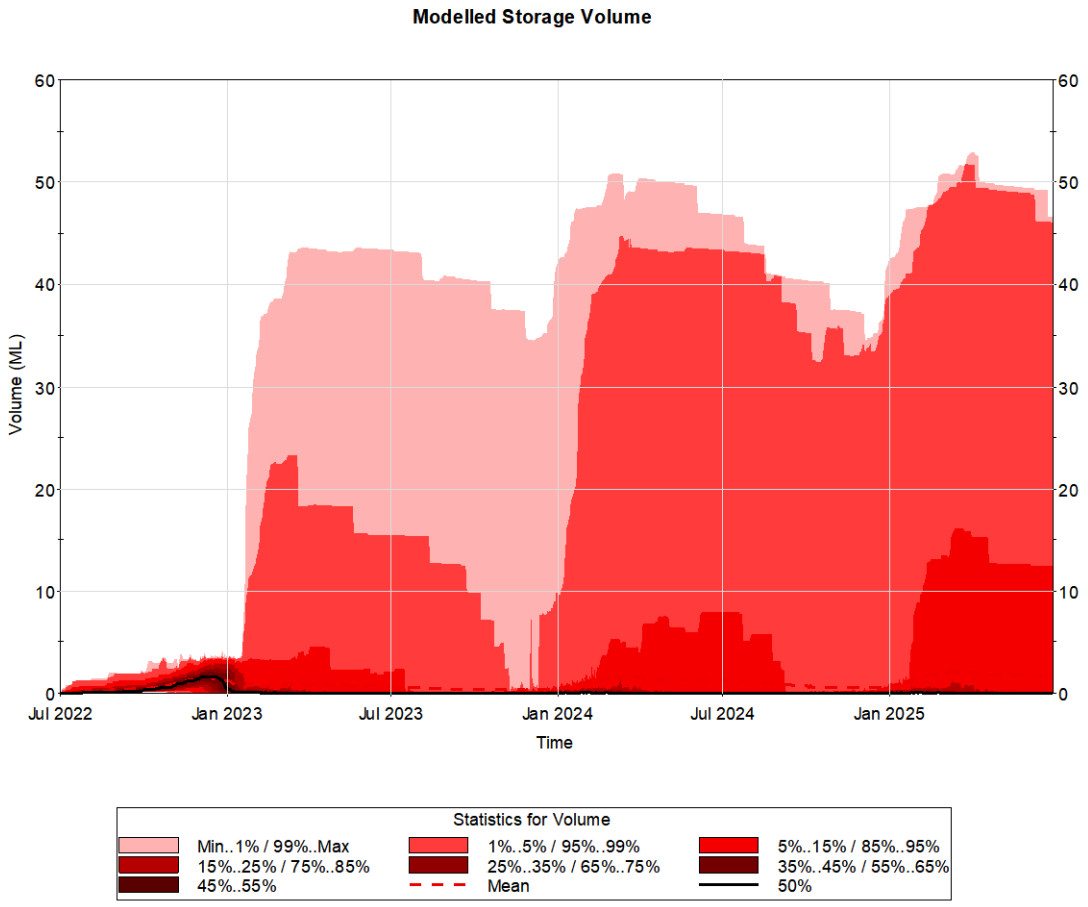
TAILINGS.WATER.WASTE.

## Diagram B.12 – Pit 5 Modelled Storage Volume



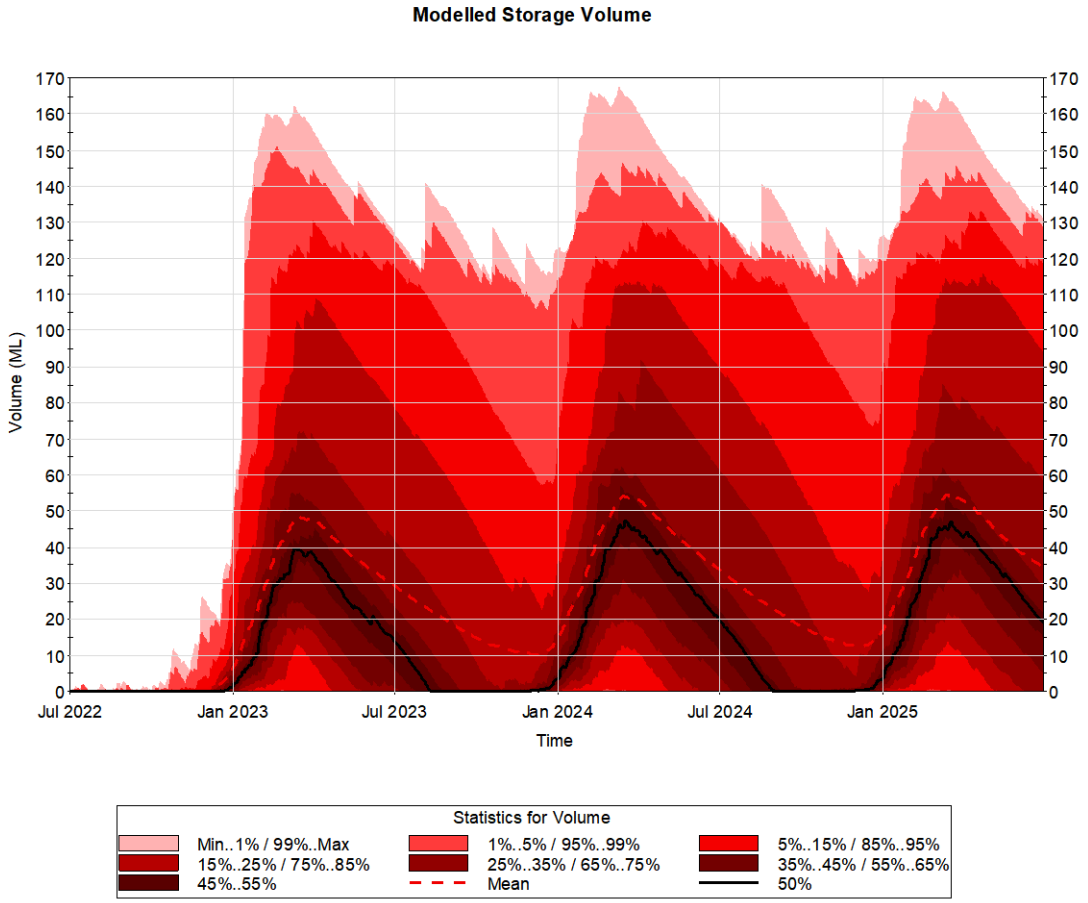

GoldSim 12.1.0263 Model: AgateCreekMine_1WSD .gsm

## Diagram B.13 – Pit 6 Modelled Storage Volume




GoldSim 12.1.0263 Model: AgateCreekMine_1WSD .gsm

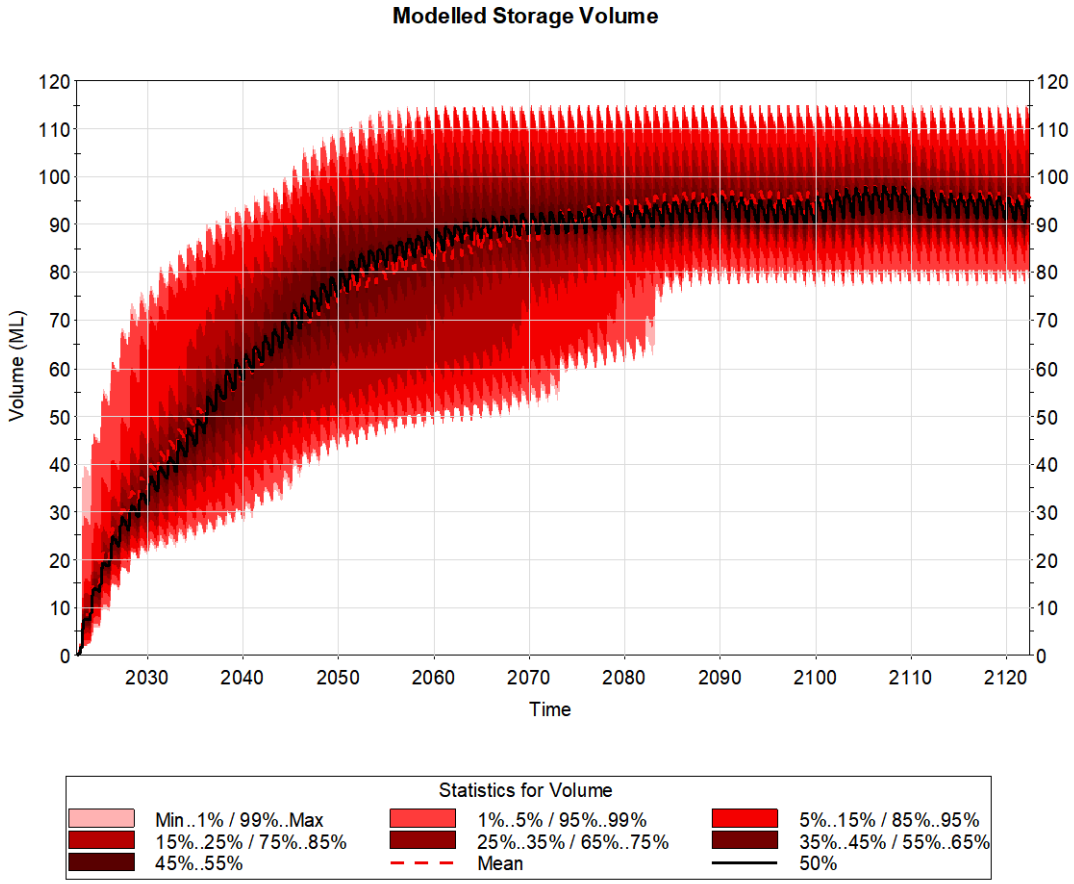
## Diagram B.14 – Water Storage Dam Modelled Storage Volume




GoldSim 12.1.0263 Model: AgateCreekMine_1WSD .gsm

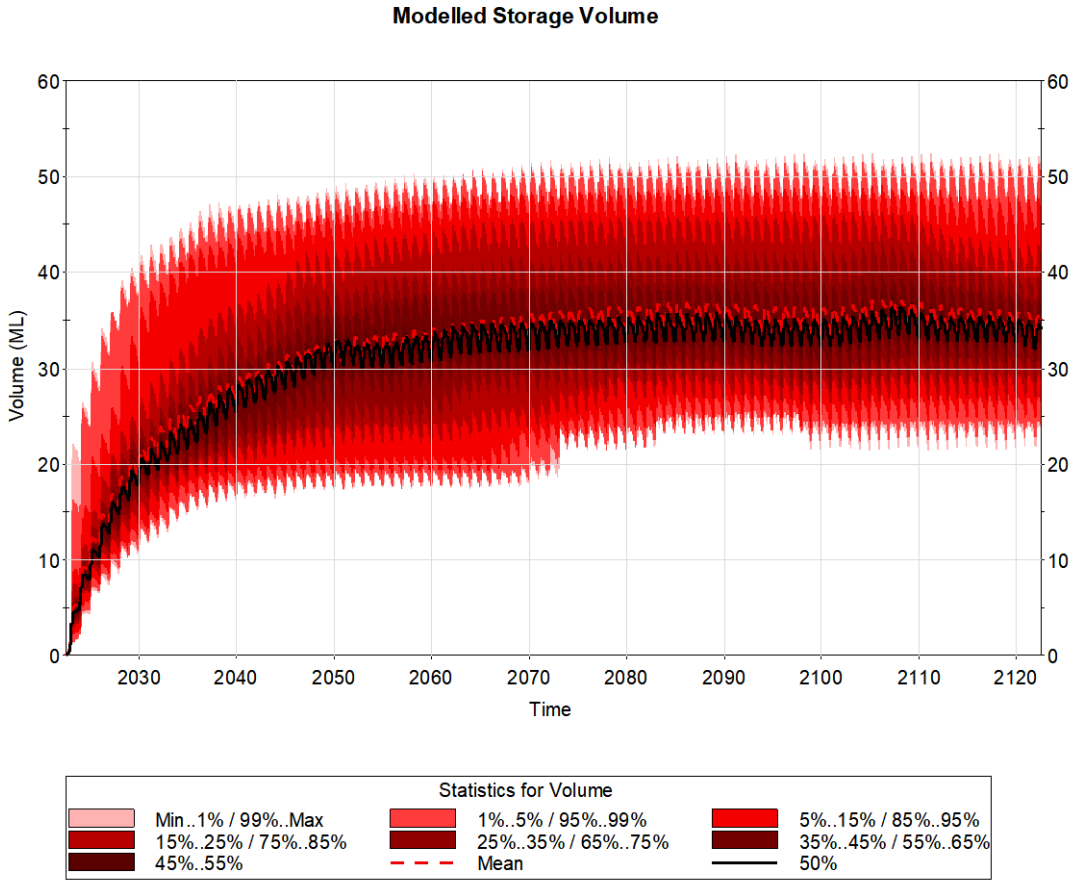
# APPENDIX C – POST-CLOSURE WATER BALANCE RESULTS

**Diagram C.1 – Pit 1 Modelled Storage Volume**



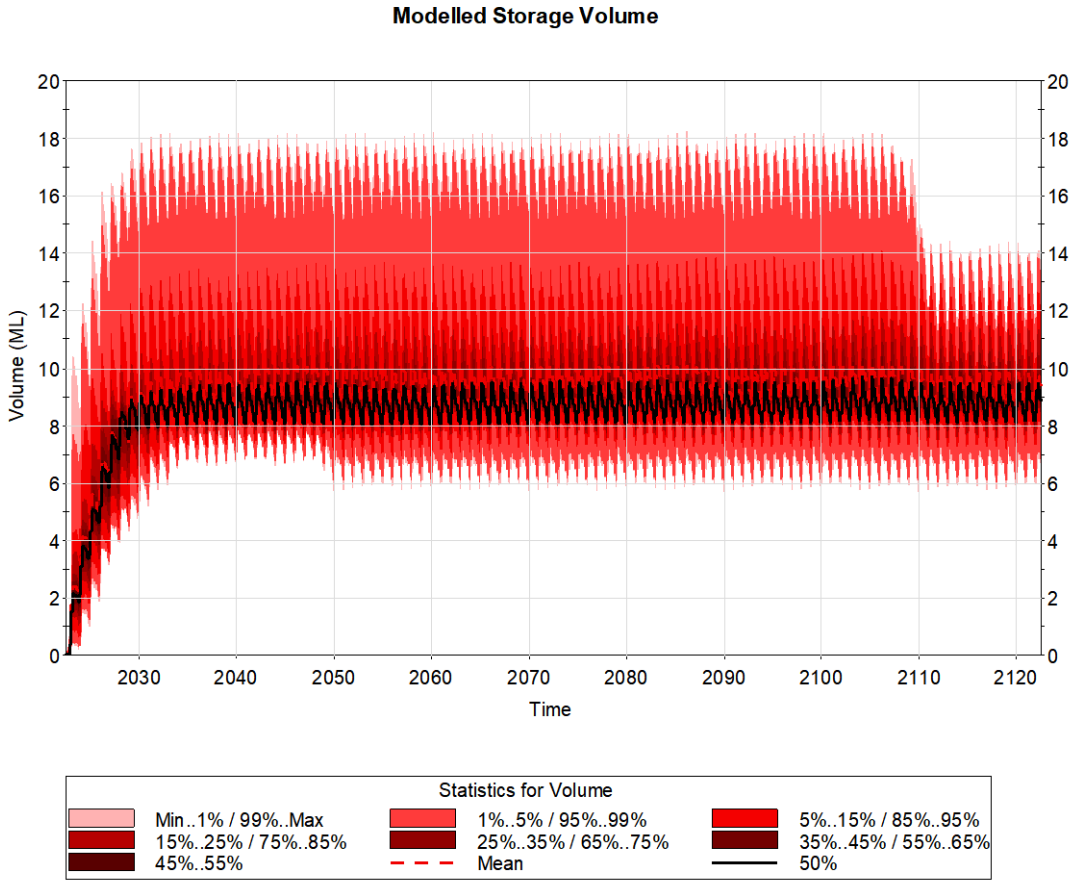

GoldSim 12.1.0263 Model: AgateCreekMine_Post_Closure.gsm

## Diagram C.2 – Pit 2 Modelled Storage Volume



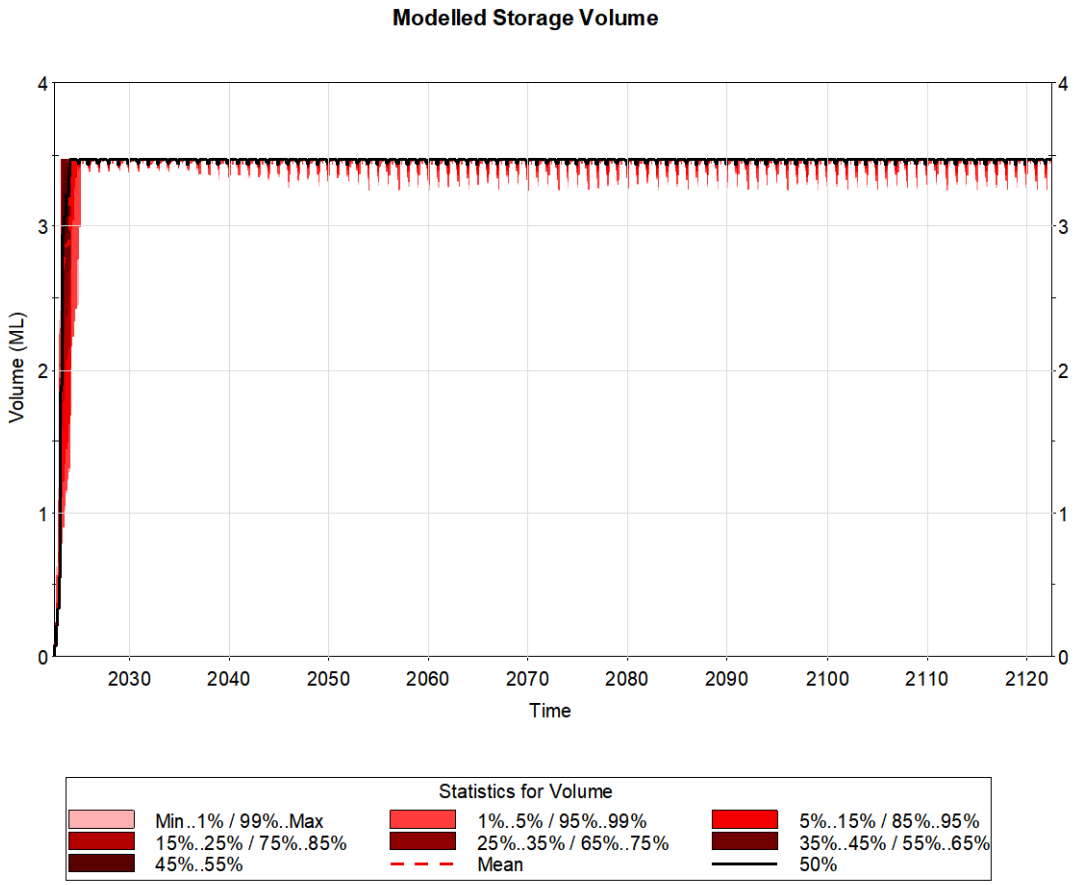

GoldSim 12.1.0263 Model: AgateCreekMine_Post_Closure.gsm

## Diagram C.3 – Pit 3 Modelled Storage Volume




GoldSim 12.1.0263 Model: AgateCreekMine_Post_Closure.gsm

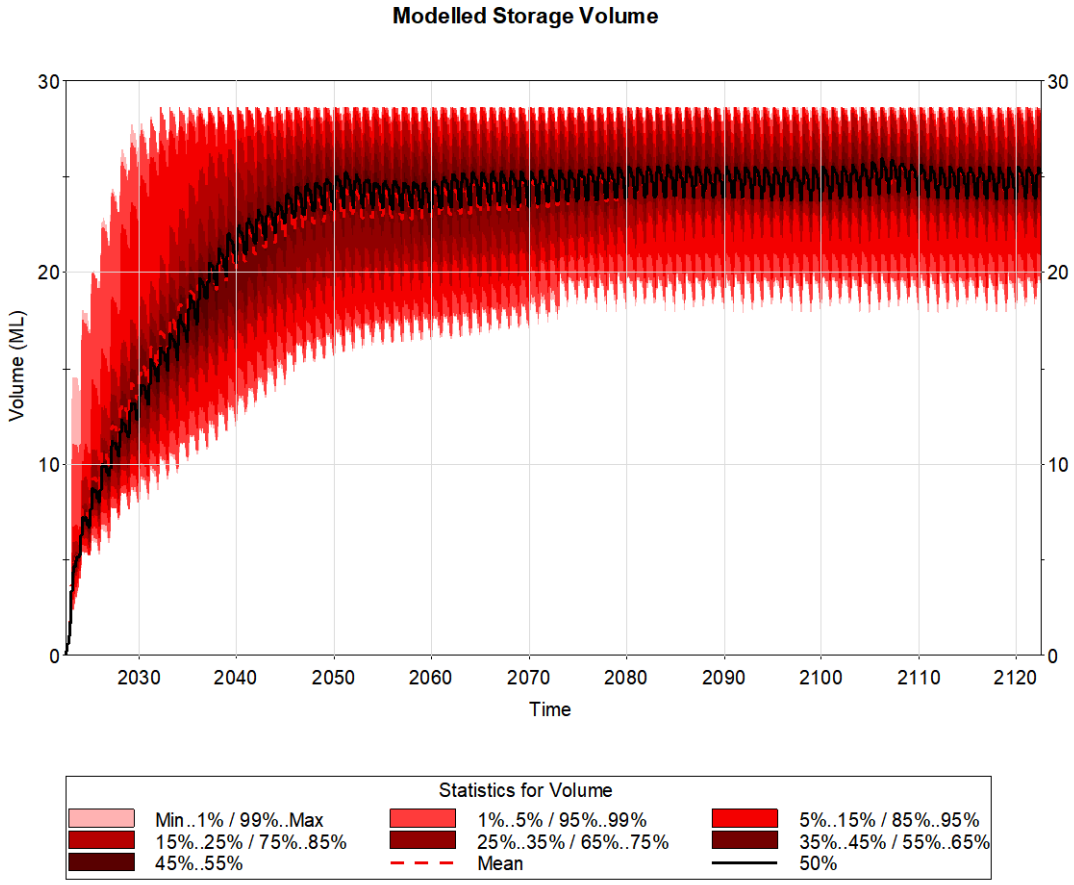
## Diagram C.4 – Pit 4 Modelled Storage Volume




GoldSim 12.1.0263 Model: AgateCreekMine_Post_Closure.gsm

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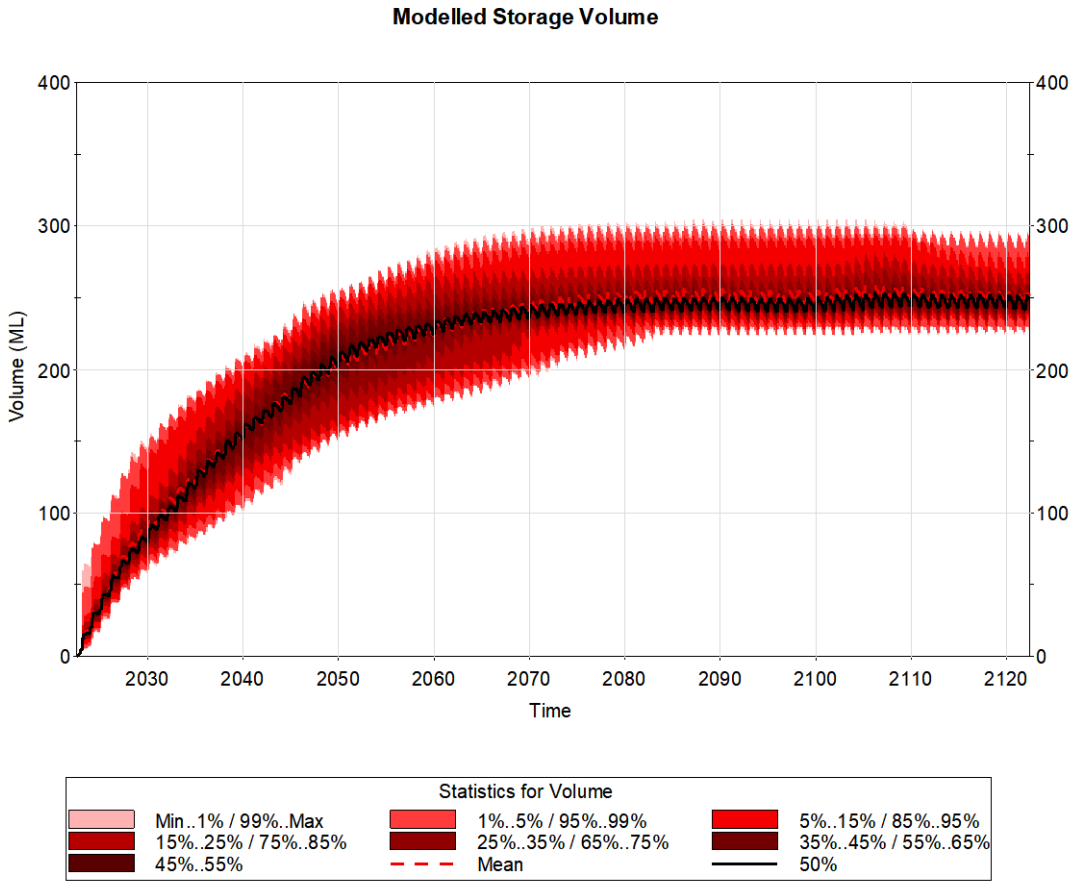
## Diagram C.5 – Pit 5 Modelled Storage Volume




GoldSim 12.1.0263 Model: AgateCreekMine_Post_Closure.gsm

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## Diagram C.6 – Pit 6 Modelled Storage Volume




GoldSim 12.1.0263 Model: AgateCreekMine_Post_Closure.gsm

# APPENDIX D – MSES MAPPING

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Queensland Government

**Department of Environment and Science**

Environmental Reports

# Matters of State Environmental Significance

For the selected area of interest
Longitude: 143.548 Latitude: -18.99474 with 2 kilometre radius

# Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: Planning.Support@des.qld.gov.au

# Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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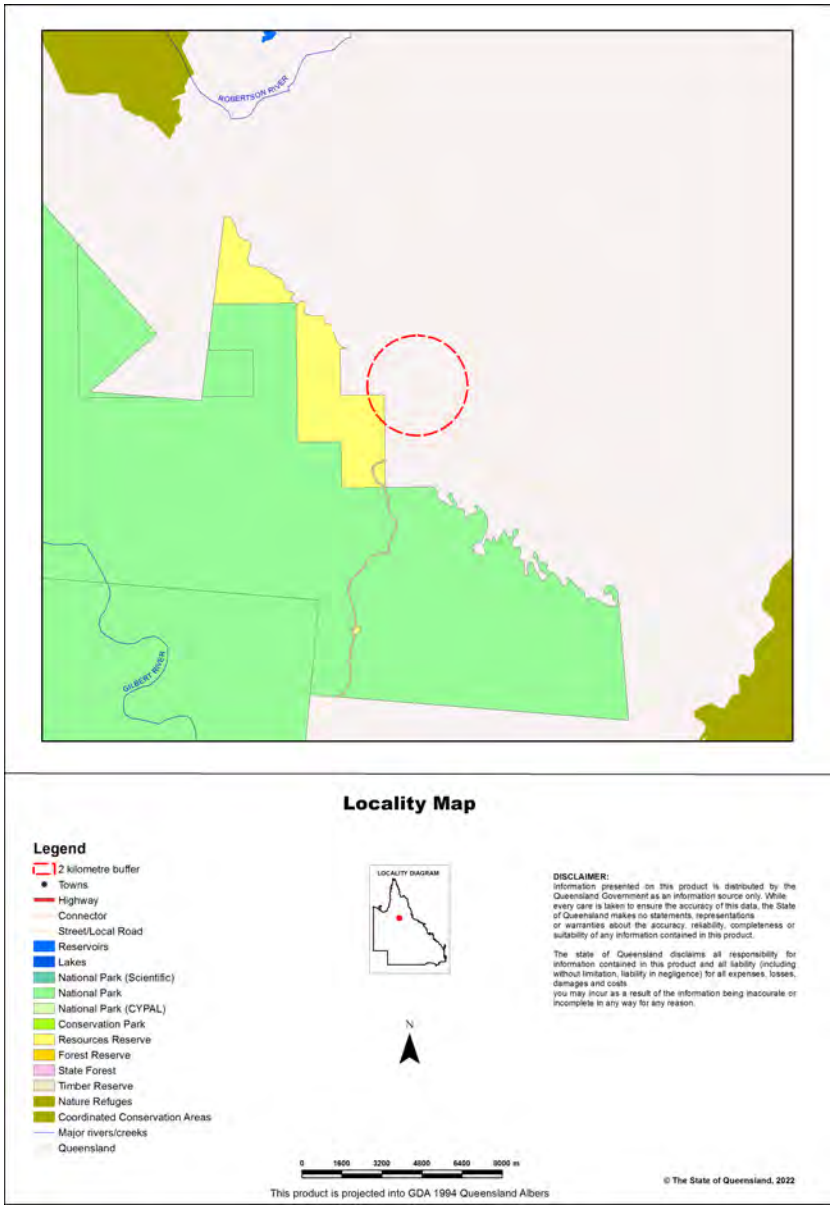
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# Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

**Table 1: Summary table, details for AOI Longitude: 143.548 Latitude: -18.99474**

| | |
|---|---|
| Size (ha) | 1,256.55 |
| Local Government(s) | Etheridge Shire |
| Bioregion(s) | Gulf Plains, Einasleigh Uplands |
| Subregion(s) | Gilberton Plateau, Kidston |
| Catchment(s) | Gilbert |



# Matters of State Environmental Significance (MSES)

## MSES Categories

Queensland's State Planning Policy (SPP) includes a biodiversity State interest that states:

'The sustainable, long-term conservation of biodiversity is supported. Significant impacts on matters of national or state environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised and residual impacts offset.'

The MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the *Nature Conservation Act 1992* ;

- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the *Marine Parks Act 2004* ;

- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;

- Threatened wildlife under the *Nature Conservation Act 1992* and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;

- Regulated vegetation under the *Vegetation Management Act 1999* that is:

    • Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;

    • Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;

    • Category R areas on the regulated vegetation management map;

    • Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;

    • Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;

- Strategic Environmental Areas under the *Regional Planning Interests Act 2014* ;

- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Queensland Wetland Environmental Values under the Environment Protection Regulation 2019;

- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;

- Legally secured offset areas.

## MSES Values Present

The MSES values that are present in the area of interest are summarised in the table below:

**Table 2: Summary of MSES present within the AOI**

| | | |
|---|---|---|
| 1a Protected Areas- estates | 46.99 ha | 3.7% |
| 1b Protected Areas- nature refuges | 0.0 ha | 0.0 % |
| 1c Protected Areas- special wildlife reserves | 0.0 ha | 0.0 % |
| 2 State Marine Parks- highly protected zones | 0.0 ha | 0.0 % |
| 3 Fish habitat areas (A and B areas) | 0.0 ha | 0.0 % |
| 4 Strategic Environmental Areas (SEA) | 0.0 ha | 0.0 % |
| 5 High Ecological Significance wetlands on the map of Referable Wetlands | 0.0 ha | 0.0 % |
| 6a High Ecological Value (HEV) wetlands | 0.0 ha | 0.0 % |
| 6b High Ecological Value (HEV) waterways ** | 0.0 km | Not applicable |
| 7a Threatened (endangered or vulnerable) wildlife | 0.0 ha | 0.0 % |
| 7b Special least concern animals | 0.0 ha | 0.0 % |
| 7c i Koala habitat area - core (SEQ) | 0.0 ha | 0.0 % |
| 7c ii Koala habitat area - locally refined (SEQ) | 0.0 ha | 0.0 % |
| 8a Regulated Vegetation - Endangered/Of concern in Category B (remnant) | 0.0 ha | 0.0 % |
| 8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth) | 0.0 ha | 0.0 % |
| 8c Regulated Vegetation - Category R (GBR riverine regrowth) | 0.0 ha | 0.0 % |
| 8d Regulated Vegetation - Essential habitat | 0.0 ha | 0.0 % |
| 8e Regulated Vegetation - intersecting a watercourse ** | 22.8 km | Not applicable |
| 8f Regulated Vegetation - within 100m of a Vegetation Management Wetland | 0.0 ha | 0.0 % |
| 9a Legally secured offset areas- offset register areas | 0.0 ha | 0.0 % |
| 9b Legally secured offset areas- vegetation offsets through a Property Map of Assessable Vegetation | 0.0 ha | 0.0 % |

# Additional Information with Respect to MSES Values Present

## MSES - State Conservation Areas

### 1a. Protected Areas - estates

| Estate name |
| --- |
| Rungulla Resources Reserve |

### 1b. Protected Areas - nature refuges

(no results)

### 1c. Protected Areas - special wildlife reserves

(no results)

### 2. State Marine Parks - highly protected zones

(no results)

### 3. Fish habitat areas (A and B areas)

(no results)

Refer to **Map 1 - MSES - State Conservation Areas** for an overview of the relevant MSES.

## MSES - Wetlands and Waterways

### 4. Strategic Environmental Areas (SEA)

(no results)

### 5. High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values

(no results)

### 6a. Wetlands in High Ecological Value (HEV) waters

(no results)

### 6b. Waterways in High Ecological Value (HEV) waters

(no results)

Refer to **Map 2 - MSES - Wetlands and Waterways** for an overview of the relevant MSES.

## MSES - Species

### 7a. Threatened (endangered or vulnerable) wildlife

Not applicable

**7b. Special least concern animals**

Not applicable

**7c i. Koala habitat area - core (SEQ)**

Not applicable

**7c ii. Koala habitat area - locally refined (SEQ)**

Not applicable

**Threatened (endangered or vulnerable) wildlife habitat suitability models**

| Species | Common name | NCA status | Presence |
|---|---|---|---|
| *Boronia keysii* | | V | None |
| *Calyptorhynchus lathami* | Glossy black cockatoo | V | None |
| *Casuarius casuarius johnsonii* | Sthn population cassowary | E | None |
| *Crinia tinnula* | Wallum froglet | V | None |
| *Denisonia maculata* | Ornamental snake | V | None |
| *Litoria freycineti* | Wallum rocketfrog | V | None |
| *Litoria olongburensis* | Wallum sedgefrog | V | None |
| *Melaleuca irbyana* | | E | None |
| *Petaurus gracilis* | Mahogany Glider | E | None |
| *Petrogale persephone* | Proserpine rock-wallaby | E | None |
| *Phascolarctos cinereus* | Koala - outside SEQ* | V | None |
| *Pezoporus wallicus wallicus* | Eastern ground parrot | V | None |
| *Taudactylus pleione* | Kroombit tinkerfrog | E | None |
| *Xeromys myoides* | Water Mouse | V | None |

**For koala model, this includes areas outside SEQ. Check 7c SEQ koala habitat for presence/absence.*

**Threatened (endangered or vulnerable) wildlife species records**

(no results)

**Special least concern animal species records**

(no results)

**Nature Conservation Act 1992 (NCA) Status- Endangered (E), Vulnerable (V) or Special Least Concern Animal (SL). Environment Protection and Biodiversity Conservation Act 1999 (EPBC) status: Critically Endangered (CE) Endangered (E), Vulnerable (V)*

*Migratory status (M) - China and Australia Migratory Bird Agreement (C), Japan and Australia Migratory Bird Agreement (J), Republic of Korea and Australia Migratory Bird Agreement (R), Bonn Migratory Convention (B), Eastern Flyway (E)*

To request a species list for an area, or search for a species profile, access Wildlife Online at:

https://www.qld.gov.au/environment/plants-animals/species-list/

Refer to **Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals** and **Map 3b - MSES - Species - Koala habitat area (SEQ)** for an overview of the relevant MSES.

## MSES - Regulated Vegetation

For further information relating to regional ecosystems in general, go to:
https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/
For a more detailed description of a particular regional ecosystem, access the regional ecosystem search page at:
https://environment.ehp.qld.gov.au/regional-ecosystems/

**8a. Regulated Vegetation - Endangered/Of concern in Category B (remnant)**

Not applicable

**8b. Regulated Vegetation - Endangered/Of concern in Category C (regrowth)**

Not applicable

**8c. Regulated Vegetation - Category R (GBR riverine regrowth)**

Not applicable

**8d. Regulated Vegetation - Essential habitat**

Not applicable

**8e. Regulated Vegetation - intersecting a watercourse****

A vegetation management watercourse is mapped as present

**8f. Regulated Vegetation - within 100m of a Vegetation Management wetland**

Not applicable

Refer to **Map 4 - MSES - Regulated Vegetation** for an overview of the relevant MSES.

**MSES - Offsets**

**9a. Legally secured offset areas - offset register areas**

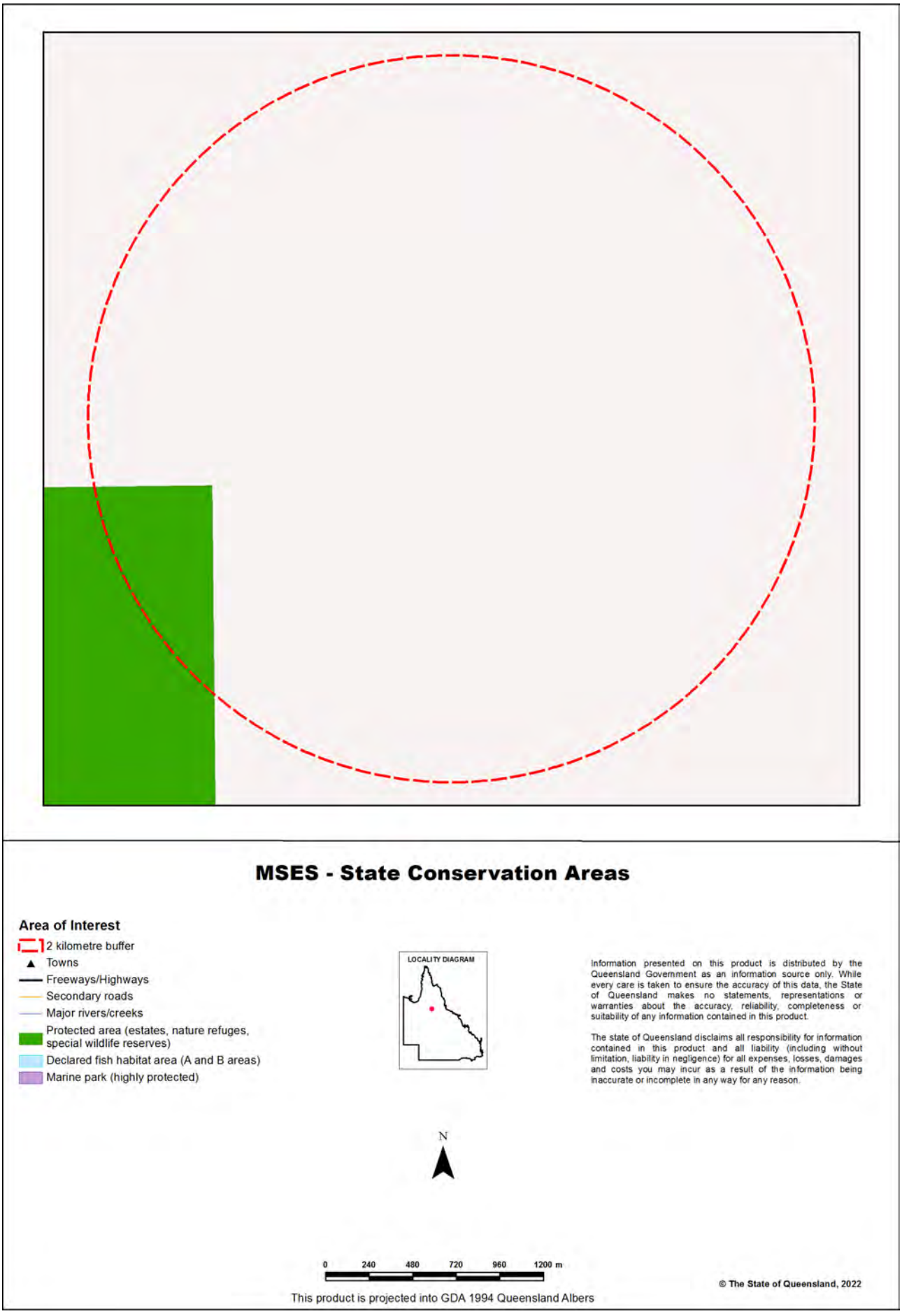
(no results)

**9b. Legally secured offset areas - vegetation offsets through a Property Map of Assessable Vegetation**

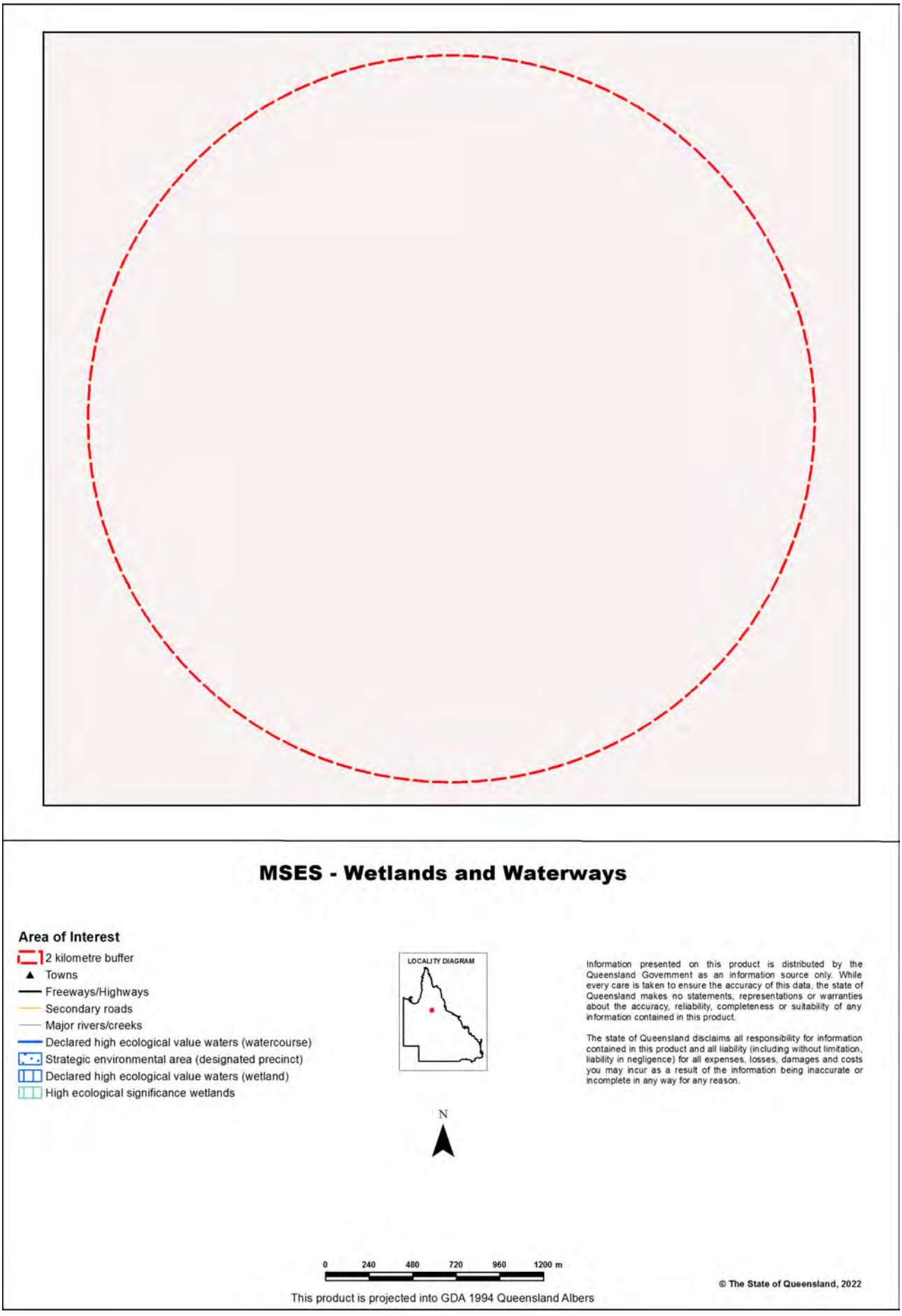
(no results)

Refer to **Map 5 - MSES - Offset Areas** for an overview of the relevant MSES.

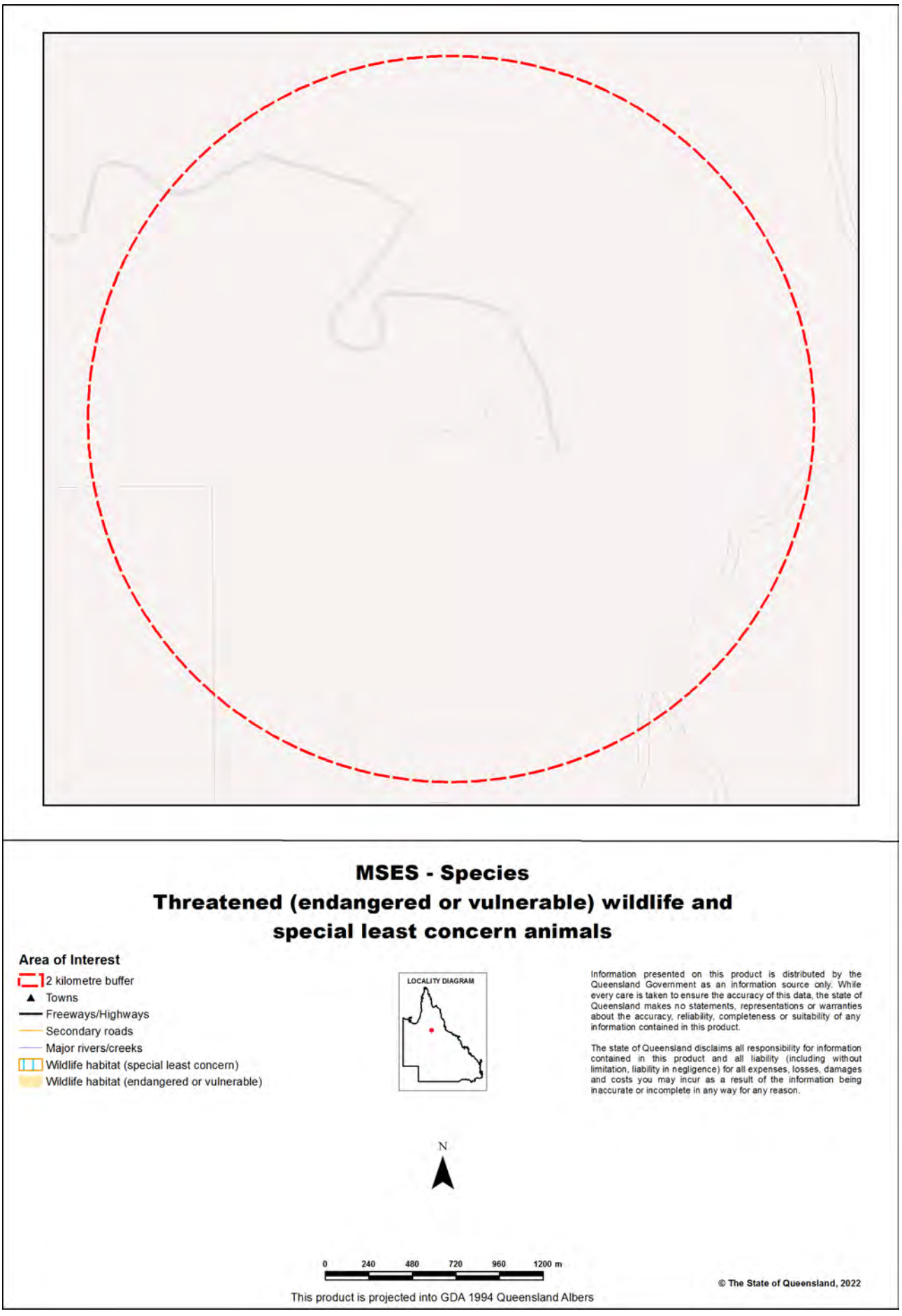
## Map 1 - MSES - State Conservation Areas



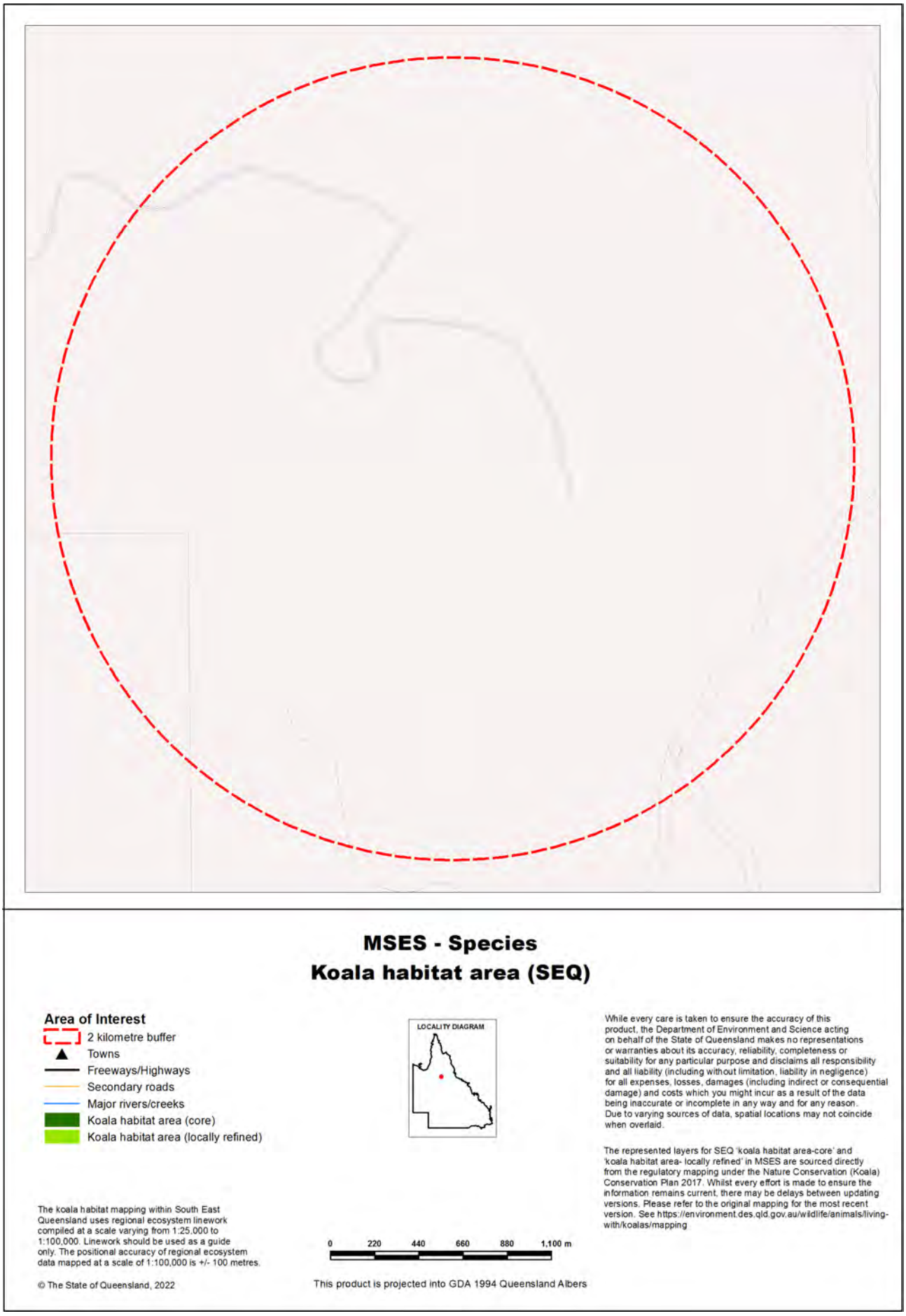
## Map 2 - MSES - Wetlands and Waterways



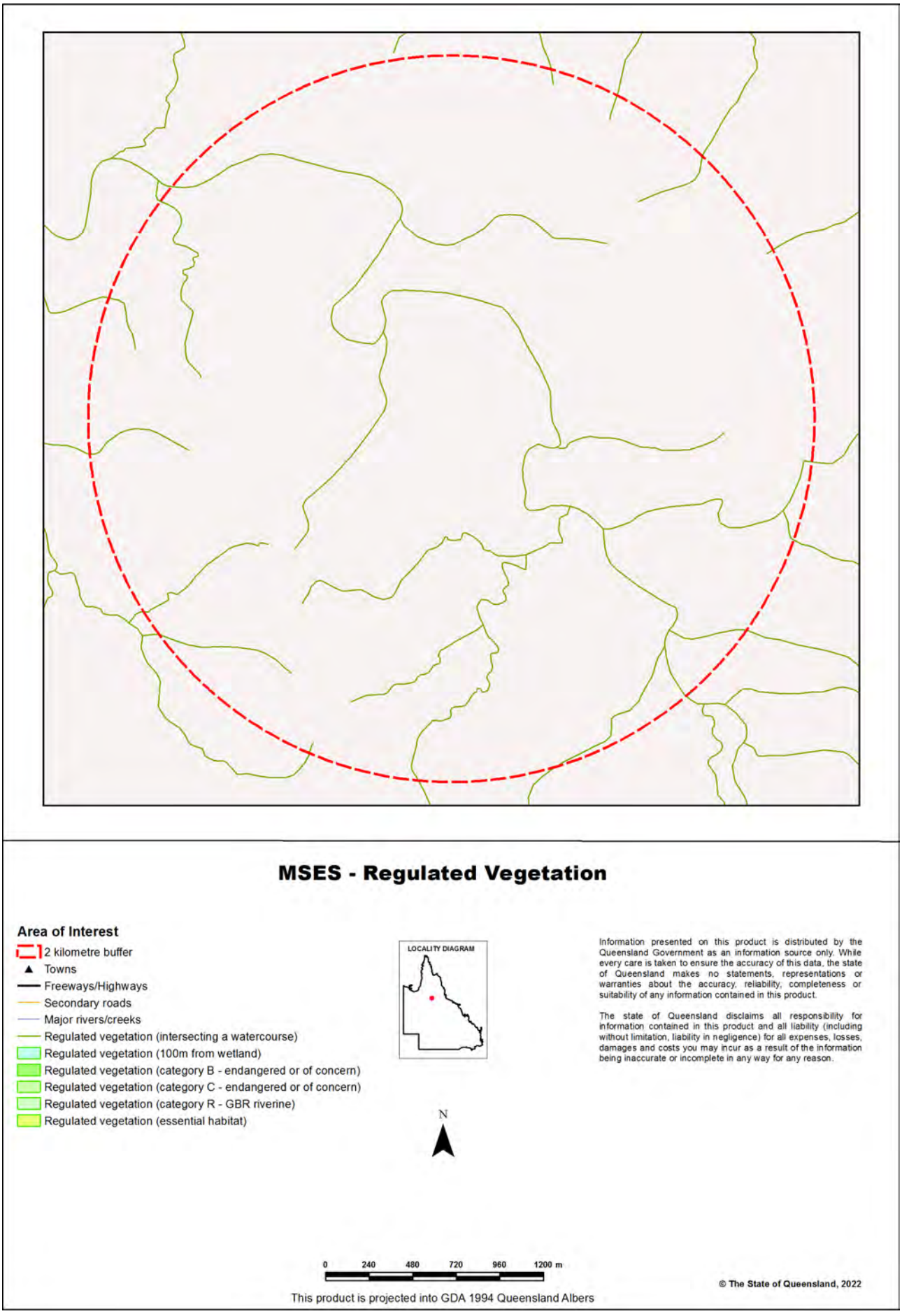
## Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals



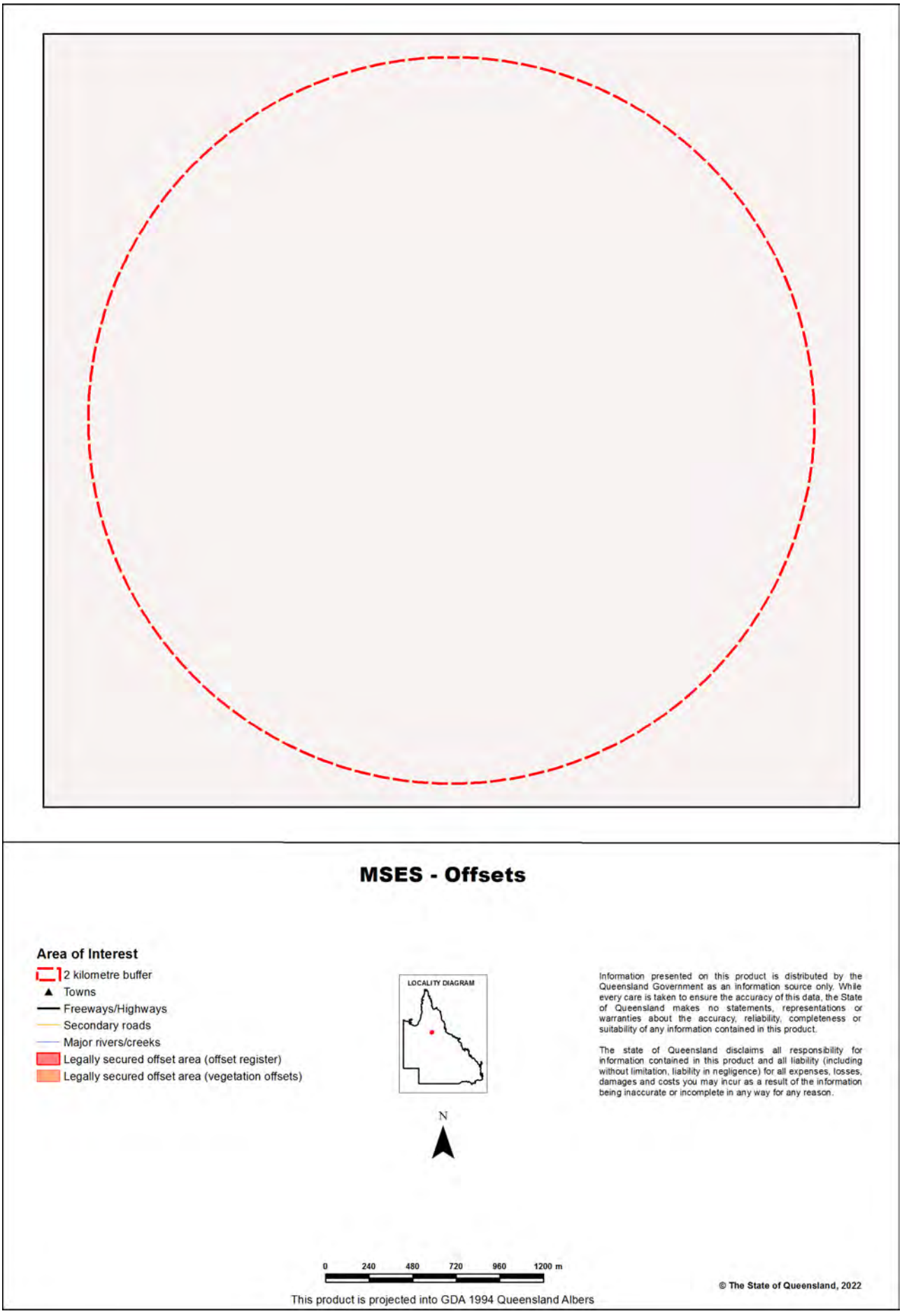
# Map 3b - MSES - Species - Koala habitat area (SEQ)



## Map 4 - MSES - Regulated Vegetation



## Map 5 - MSES - Offset Areas



# Appendices

## Appendix 1 - Matters of State Environmental Significance (MSES) methodology

MSES mapping is a regional-scale representation of the definition for MSES under the State Planning Policy (SPP). The compiled MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The Queensland Government's "Method for mapping - matters of state environmental significance for use in land use planning and development assessment" can be downloaded from:

http://www.ehp.qld.gov.au/land/natural-resource/method-mapping-mses.html .

## Appendix 2 - Source Data

**The datasets listed below are available on request from:**

http://qldspatial.information.qld.gov.au/catalogue/custom/index.page

- Matters of State environmental significance

Note: MSES mapping is not based on new or unique data. The primary mapping product draws data from a number of underlying environment databases and geo-referenced information sources. MSES mapping is a versioned product that is updated generally on a twice-yearly basis to incorporate the changes to underlying data sources. Several components of MSES mapping made for the current version may differ from the current underlying data sources. To ensure accuracy, or proper representation of MSES values, it is strongly recommended that users refer to the underlying data sources and review the current definition of MSES in the State Planning Policy, before applying the MSES mapping.

Individual MSES layers can be attributed to the following source data available at QSpatial:

| **MSES layers** | **current QSpatial data (http://qspatial.information.qld.gov.au)** |
|---|---|
| Protected Areas-Estates, Nature Refuges, Special Wildlife Reserves | - Protected areas of Queensland<br>- Nature Refuges - Queensland<br>- Special Wildlife Reserves- Queensland |
| Marine Park-Highly Protected Zones | Moreton Bay marine park zoning 2008 |
| Fish Habitat Areas | Queensland fish habitat areas |
| Strategic Environmental Areas-designated | Regional Planning Interests Act - Strategic Environmental Areas |
| HES wetlands | Map of Queensland Wetland Environmental Values |
| Wetlands in HEV waters | HEV waters:<br>- EPP Water intent for waters<br>Source Wetlands:<br>- Queensland Wetland Mapping (Current version 5)<br>Source Watercourses:<br>- Vegetation management watercourse and drainage feature map (1:100000 and 1:250000) |
| Wildlife habitat (threatened and special least concern) | -WildNet database species records<br>- habitat suitability models (various)<br>- SEQ koala habitat areas under the Koala Conservation Plan 2019 |
| VMA regulated regional ecosystems | Vegetation management regional ecosystem and remnant map |
| VMA Essential Habitat | Vegetation management - essential habitat map |
| VMA Wetlands | Vegetation management wetlands map |
| Legally secured offsets | Vegetation Management Act property maps of assessable vegetation.<br>For offset register data-contact DES |
| Regulated Vegetation Map | Vegetation management - regulated vegetation management map |

## Appendix 3 - Acronyms and Abbreviations

| | |
|---|---|
| AOI | - Area of Interest |
| DES | - Department of Environment and Science |
| EP Act | - *Environmental Protection Act 1994* |
| EPP | - Environmental Protection Policy |
| GDA94 | - Geocentric Datum of Australia 1994 |
| GEM | - General Environmental Matters |
| GIS | - Geographic Information System |
| MSES | - Matters of State Environmental Significance |
| NCA | - *Nature Conservation Act 1992* |
| RE | - Regional Ecosystem |
| SPP | - State Planning Policy |
| VMA | - *Vegetation Management Act 1999* |

# APPENDIX E – MNES PROTECTED MATTERS

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Australian Government
Department of Agriculture, Water and the Environment

# EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 09-Jun-2022


Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

# Summary

## Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

| | |
|---|---|
| World Heritage Properties: | None |
| National Heritage Places: | None |
| Wetlands of International Importance (Ramsar | None |
| Great Barrier Reef Marine Park: | None |
| Commonwealth Marine Area: | None |
| Listed Threatened Ecological Communities: | None |
| Listed Threatened Species: | 13 |
| Listed Migratory Species: | 10 |

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

| | |
|---|---|
| Commonwealth Lands: | None |
| Commonwealth Heritage Places: | None |
| Listed Marine Species: | 16 |
| Whales and Other Cetaceans: | None |
| Critical Habitats: | None |
| Commonwealth Reserves Terrestrial: | None |
| Australian Marine Parks: | None |
| Habitat Critical to the Survival of Marine Turtles: | None |

## Extra Information

This part of the report provides information that may also be relevant to the area you have

| | |
|---|---|
| State and Territory Reserves: | 2 |
| Regional Forest Agreements: | None |
| Nationally Important Wetlands: | None |
| EPBC Act Referrals: | 1 |
| Key Ecological Features (Marine): | None |
| Biologically Important Areas: | None |
| Bioregional Assessments: | None |
| Geological and Bioregional Assessments: | None |

# Details

## Matters of National Environmental Significance

| Listed Threatened Species | | | [ Resource Information ] |
|---|---|---|---|
| Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.<br>Number is the current name ID. | | | |
| Scientific Name | Threatened Category | Presence Text | Buffer Status |
| BIRD | | | |
| Calidris ferruginea<br>Curlew Sandpiper [856] | Critically Endangered | Species or species habitat may occur within area | In feature area |
| Erythrotriorchis radiatus<br>Red Goshawk [942] | Vulnerable | Species or species habitat likely to occur within area | In feature area |
| Erythrura gouldiae<br>Gouldian Finch [413] | Endangered | Species or species habitat likely to occur within area | In feature area |
| Falco hypoleucos<br>Grey Falcon [929] | Vulnerable | Species or species habitat likely to occur within area | In feature area |
| Rostratula australis<br>Australian Painted Snipe [77037] | Endangered | Species or species habitat may occur within area | In feature area |
| Tyto novaehollandiae kimberli<br>Masked Owl (northern) [26048] | Vulnerable | Species or species habitat may occur within area | In feature area |
| MAMMAL | | | |
| Dasyurus hallucatus<br>Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331] | Endangered | Species or species habitat may occur within area | In feature area |
| Macroderma gigas<br>Ghost Bat [174] | Vulnerable | Species or species habitat likely to occur within area | In feature area |

| Scientific Name | Threatened Category | Presence Text | Buffer Status |
|---|---|---|---|
| Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) | | | |
| Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104] | Endangered | Species or species habitat may occur within area | In buffer area only |
| Rhinolophus robertsi | | | |
| Large-eared Horseshoe Bat, Greater Large-eared Horseshoe Bat [87639] | Vulnerable | Species or species habitat may occur within area | In feature area |
| Saccolaimus saccolaimus nudicluniatus | | | |
| Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889] | Vulnerable | Species or species habitat may occur within area | In feature area |
| PLANT | | | |
| Cycas platyphylla | | | |
| a cycad [55796] | Vulnerable | Species or species habitat may occur within area | In buffer area only |
| Dichanthium setosum | | | |
| bluegrass [14159] | Vulnerable | Species or species habitat likely to occur within area | In feature area |

| Listed Migratory Species | | | [ Resource Information ] |
|---|---|---|---|
| Scientific Name | Threatened Category | Presence Text | Buffer Status |
| Migratory Marine Birds | | | |
| Apus pacificus | | | |
| Fork-tailed Swift [678] | | Species or species habitat likely to occur within area | In feature area |
| Migratory Terrestrial Species | | | |
| Cuculus optatus | | | |
| Oriental Cuckoo, Horsfield's Cuckoo [86651] | | Species or species habitat may occur within area | In feature area |
| Hirundo rustica | | | |
| Barn Swallow [662] | | Species or species habitat may occur within area | In feature area |
| Motacilla cinerea | | | |
| Grey Wagtail [642] | | Species or species habitat may occur within area | In feature area |
| Motacilla flava | | | |
| Yellow Wagtail [644] | | Species or species habitat may occur within area | In feature area |
| Migratory Wetlands Species | | | |

| Scientific Name | Threatened Category | Presence Text | Buffer Status |
|---|---|---|---|
| Actitis hypoleucos<br>Common Sandpiper [59309] | | Species or species habitat may occur within area | In feature area |
| Calidris acuminata<br>Sharp-tailed Sandpiper [874] | | Species or species habitat may occur within area | In feature area |
| Calidris ferruginea<br>Curlew Sandpiper [856] | Critically Endangered | Species or species habitat may occur within area | In feature area |
| Calidris melanotos<br>Pectoral Sandpiper [858] | | Species or species habitat may occur within area | In feature area |
| Gallinago hardwickii<br>Latham's Snipe, Japanese Snipe [863] | | Species or species habitat may occur within area | In feature area |

## Other Matters Protected by the EPBC Act

| Listed Marine Species | | | [ Resource Information ] |
|---|---|---|---|
| Scientific Name | Threatened Category | Presence Text | Buffer Status |
| Bird | | | |
| Actitis hypoleucos<br>Common Sandpiper [59309] | | Species or species habitat may occur within area | In feature area |
| Anseranas semipalmata<br>Magpie Goose [978] | | Species or species habitat may occur within area overfly marine area | In feature area |
| Apus pacificus<br>Fork-tailed Swift [678] | | Species or species habitat likely to occur within area overfly marine area | In feature area |
| Bubulcus ibis as Ardea ibis<br>Cattle Egret [66521] | | Species or species habitat may occur within area overfly marine area | In feature area |

| Scientific Name | Threatened Category | Presence Text | Buffer Status |
|---|---|---|---|
| [Calidris acuminata](#)<br>Sharp-tailed Sandpiper [874] | | Species or species habitat may occur within area | In feature area |
| [Calidris ferruginea](#)<br>Curlew Sandpiper [856] | Critically Endangered | Species or species habitat may occur within area overfly marine area | In feature area |
| [Calidris melanotos](#)<br>Pectoral Sandpiper [858] | | Species or species habitat may occur within area overfly marine area | In feature area |
| [Chalcites osculans as Chrysococcyx osculans](#)<br>Black-eared Cuckoo [83425] | | Species or species habitat may occur within area overfly marine area | In feature area |
| [Gallinago hardwickii](#)<br>Latham's Snipe, Japanese Snipe [863] | | Species or species habitat may occur within area overfly marine area | In feature area |
| [Haliaeetus leucogaster](#)<br>White-bellied Sea-Eagle [943] | | Species or species habitat may occur within area | In feature area |
| [Hirundo rustica](#)<br>Barn Swallow [662] | | Species or species habitat may occur within area overfly marine area | In feature area |
| [Merops ornatus](#)<br>Rainbow Bee-eater [670] | | Species or species habitat may occur within area overfly marine area | In feature area |
| [Motacilla cinerea](#)<br>Grey Wagtail [642] | | Species or species habitat may occur within area overfly marine area | In feature area |
| [Motacilla flava](#)<br>Yellow Wagtail [644] | | Species or species habitat may occur within area overfly marine area | In feature area |

| Scientific Name | Threatened Category | Presence Text | Buffer Status |
|---|---|---|---|
| Rostratula australis as Rostratula benghalensis (sensu lato) | | | |
| Australian Painted Snipe [77037] | Endangered | Species or species habitat may occur within area overfly marine area | In feature area |
| Reptile | | | |
| Crocodylus johnstoni | | | |
| Freshwater Crocodile, Johnston's Crocodile, Johnstone's Crocodile [1773] | | Species or species habitat may occur within area | In feature area |

## Extra Information

| State and Territory Reserves | | | [ Resource Information ] |
|---|---|---|---|
| Protected Area Name | Reserve Type | State | Buffer Status |
| Rungulla | Resources Reserve | QLD | In feature area |
| Rungulla | National Park | QLD | In feature area |

| EPBC Act Referrals | | | | [ Resource Information ] |
|---|---|---|---|---|
| Title of referral | Reference | Referral Outcome | Assessment Status | Buffer Status |
| Not controlled action | | | | |
| Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia | 2015/7522 | Not Controlled Action | Completed | In feature area |

# Caveat

## 1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

## 2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

## 3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

## 4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

# Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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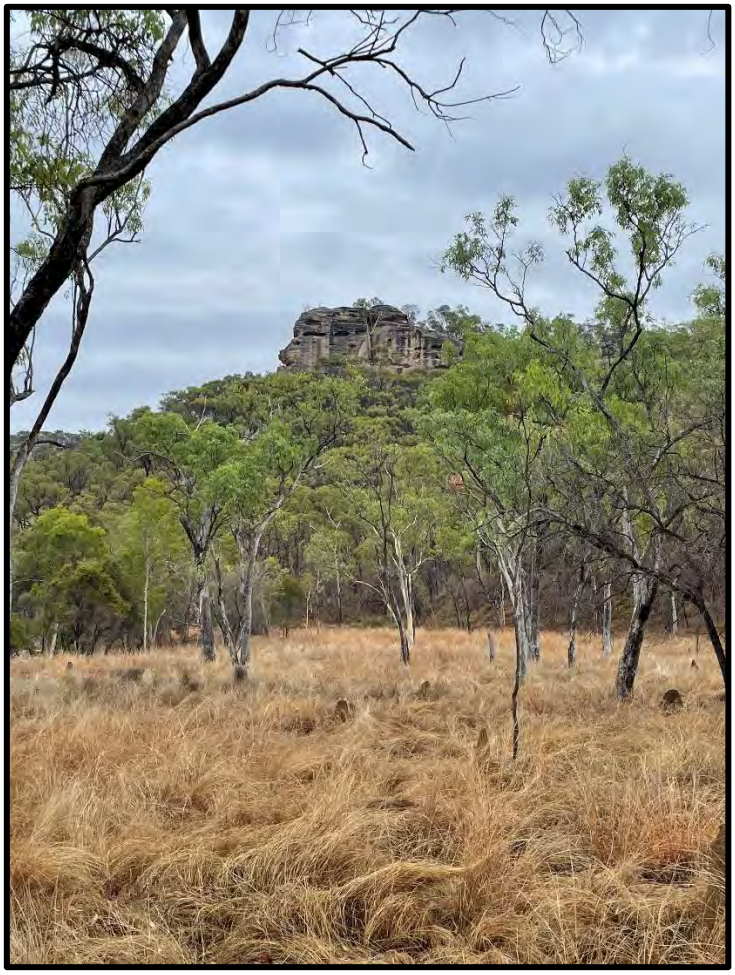
# Appendix G: Agate Creek Gold Mine Hydrogeology Assessment (C&R Consulting, 2022)

C&R CONSULTING
Geochemical & Hydrobiological Solutions Pty Ltd
ABN 72 077 518 784

Underground Coal Gasification / Coal Seam Gas Investigations
Mineralogical, Geological, Petrographic and Soils Services
Hydrogeomorphic and Palaeogeomorphic Evaluations
Terrestrial and Aquatic Fauna and Flora Surveys
Climate History and Extreme Events Analysis
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# AGATE CREEK GOLD MINE



## Stage 2 Major EA Amendment – Hydrogeology

Report Prepared for:

WULGURU TECHNICAL SERVICES

Date: May 2022

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DRAFT

| | |
|---|---|
| _____ | _____ |
| Dr Chris Cuff | Dr Cecily Rasmussen |
| Director | Director |
| _____ | _____ |
| Date | Date |

# IMPORTANT INFORMATION

1. This report is prepared and written in the context of the proposals stated in the introduction to this report and its contents should not be used out of context. Furthermore, new information, developing practices and changes in legislation may necessitate revised interpretation of the report after its original submission.
2. The copyright in the written materials shall remain the property of C&R Consulting but with a royalty-free perpetual licence to the client deemed to be granted on payment in full to C&R Consulting by the client of the outstanding amounts.
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5. This report contains only available factual data obtained for the site/s from the sources described in the text. These data were related to the site/s on the basis of the location information made available to C&R Consulting by the client.
6. The assessment of the site/s is based on information supplied by the client, and on-site inspections by C&R Consulting.
7. The report reflects both the information provided to C&R Consulting in documents made available for review and the results of observations and consultations by C&R Consulting staff.

DRAFT

# SUMMARY OF RELEVANT INFORMATION

| | |
|---|---|
| Project Title | Agate Creek Major EA Amendment – Hydrology Assessment |
| Property Location | Agate Creek Gold Mine |
| Property Description | Open-cut gold mine |
| Project Purpose | Complete an assessment of the hydrogeological systems that may potentially be impacted by the advancement of the stage 2 Agate Creek Gold Mine. |
| Project Number | 21108 |
| Client's Details | |
| Nominated Representative | Scott Hayes Stanley |
| Title/Position | Director |
| Company | Wulguru Technical Services |
| Telephone | 0437 799 193 |
| Email | scott@wulgurutechservices.com.au |
| Author's Details | |
| Primary Author | Sian Kennare |
| Qualifications | Graduate Diploma of Science (Groundwater), Master of Environmental Management. Bachelor of Environmental Science. |
| Experience | 10 years in the resource sector |
| Affiliations | International Association of Hydrogeologists. Environmental Institute of Australia and New Zealand. |

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**DOCUMENT CONTROL**

| Version | Compiled by | Date issued | Reviewer(s) | Date returned |
|---|---|---|---|---|
| Draft 1 | S. Kennare | 13/05/2022 | Dr J. Jaffrés | 18/05/2022 |
| Draft 2 | | | | |
| FINAL | | | - | - |

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# EXECUTIVE SUMMARY

The Agate Creek is an open-cut gold mining operation proposal for a stage 2 expansion of mining activities which are to involve six different open-cut pits. The proposed expansion has been assessed for the level of impact on the surrounding aquifer systems.

The groundwater monitoring network consists of ten monitoring bores within an area of approximately 1.5 $km^2$ that incorporates all six proposed voids. The network targets a section of the regional-scale Robertson Fault Zone and the northwest end of the Agate Creek Volcanic Complex. Specifically, all bores are screened within metamorphic rocks that have been intruded by Siluro-Devonian-age Robin Hood Granodiorite – and by early Permian rhyolitic and andesitic dykes and stocks that are related to the Agate Creek Volcanic Complex.

The geological lithologies present (granite, rhyolite, andesite, metasediment and veins) – and the data provided in numerous sources (including Brassington, 1988) – indicate that the hydraulic conductivities of the lithologies at Agate Creek are in the very low to low range. This was later confirmed – with pump tests completed on each monitoring bore, whereby hydraulic conductivities ranged between 6.57 x $10^{-8}$ m/sec and 5.06 x $10^{-7}$ m/sec.

The potentiometric surface suggests that the groundwater flow direction follows the surface topography whereby water moves from high elevation on the western boundary (CCWB519) to low elevation beside Agate Creek (CCWB521). The elevation difference between the bed of Agate Creek and CCWB521 supports the understanding that the groundwater systems present within the mining lease do not impact or interact with flow in Agate Creek.

Excluding the designated Agate Creek monitoring bores, no groundwater bores were identified within a 5 km buffer from the mining lease boundary. Further, the closest groundwater-dependent ecosystem is associated with the sandstone aquifer approximately 10 km away. Two springs were identified by helicopter and therefore little to no information is known about dynamics of the individual systems – although both springs are considered permanently active.

The groundwater across the bore network represents good quality water, with most bores reporting properties below guideline values for drinking water and livestock drinking water, except for fluoride.

The groundwater assessment for the Agate Creek mine expansion found that the risk to groundwater systems was low, with poor hydraulic conductivities restricting the zone of influence to within the mining lease boundary for several decades.

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# 1. INTRODUCTION

C&R Consulting Pty Ltd (C&R) have been engaged to complete the hydrogeological study of the Agate Creek Gold Mine (Agate Creek) stage 2 expansion, on behalf of Wulguru Technical Services (WTS). This study will form part of a major environmental authority (EA) amendment and progressive rehabilitation and closure plan (PRCP) that WTS are currently preparing on behalf of Agate Creek's current owners, Laneway Resources (Laneway). Laneway intends to progress Agate Creek into the stage 2 expansion phase, requiring approval to mine in excess of 200,000 tonnes of ore and a major EA amendment.

Agate Creek is located in north Queensland, approximately 340 km (520 km by road) west of Townsville and 78 km (175 km by road) south of the township of Georgetown (Figure 1). Alluvial gold was reported at Agate Creek in the early 20th century and was followed by various prospecting activities – including panning, shallow digs and regional exploration.

In February 2015, Laneway lodged a mining lease application for the Agate Creek prospect following a successful 5,000 tonne bulk trial pit. Mining lease (ML) 100030 was granted to Laneway on 7 February 2019, allowing Laneway to mine up to 200,000 tonnes of ore at Agate Creek under EA EPSL03068015 (dated 6 September 2021).

Agate Creek is required to assess the level of impact to surrounding groundwater systems due to mining activities. C&R performed the Agate Creek hydrogeological impact assessment in conjunction with the underground water impact report (UWIR). The UWIR is a requirement of the groundwater management framework legislated under Chapter 3 of the Queensland *Water Act 2000* (Water Act).

## 1.1 UWIR SCOPE AND STRUCTURE

The UWIR is a requirement of the groundwater management framework legislated under Chapter 3 of the Water Act. The main purpose of the UWIR is to describe the groundwater take due to mining (and any associated impacts) over a three-year period (the UWIR period). The UWIR has been prepared in accordance with Section 376 of the Water Act and the Department of Environment and Science (DES) guideline (the UWIR guideline), where relevant. The specific scope of the UWIR includes:

- A review of relevant groundwater, project development, geological and environmental reports from the mine site to develop an appreciation of the hydrogeological setting of the project;
- An updated review of hydrogeological data held on the Department of Natural Resources, Mines and Energy (DNRME) groundwater database to identify water supply bores;
- An updated census of water supply bores to confirm the extent of groundwater use in the area and collect relevant groundwater monitoring data;
- Confirmation of the conceptual model of the groundwater regime of the mine site and its surrounds, based on all available data;
- Refinement of the existing numerical groundwater model to allow the mining effects on groundwater levels to be presented for the first three years of mining;
- Confirmation of the groundwater impacts over the first three years of mining;
- Confirmation of the existing, approved EA groundwater monitoring programme and management measures.

The UWIR includes:

- An introduction to the UWIR (Section 1);

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- Relevant regulatory UWIR requirements (Section 2);
- Site description (Section 3);
- Assessment methods (Section 4);
- Groundwater regime and sensitive environmental features (Section 5);
- Groundwater impact assessment (Section 6);
- Groundwater monitoring programme (Section 7);
- Directions for reviewing and updating the UWIR (Section 7.3); and
- Conclusions (Section 8).

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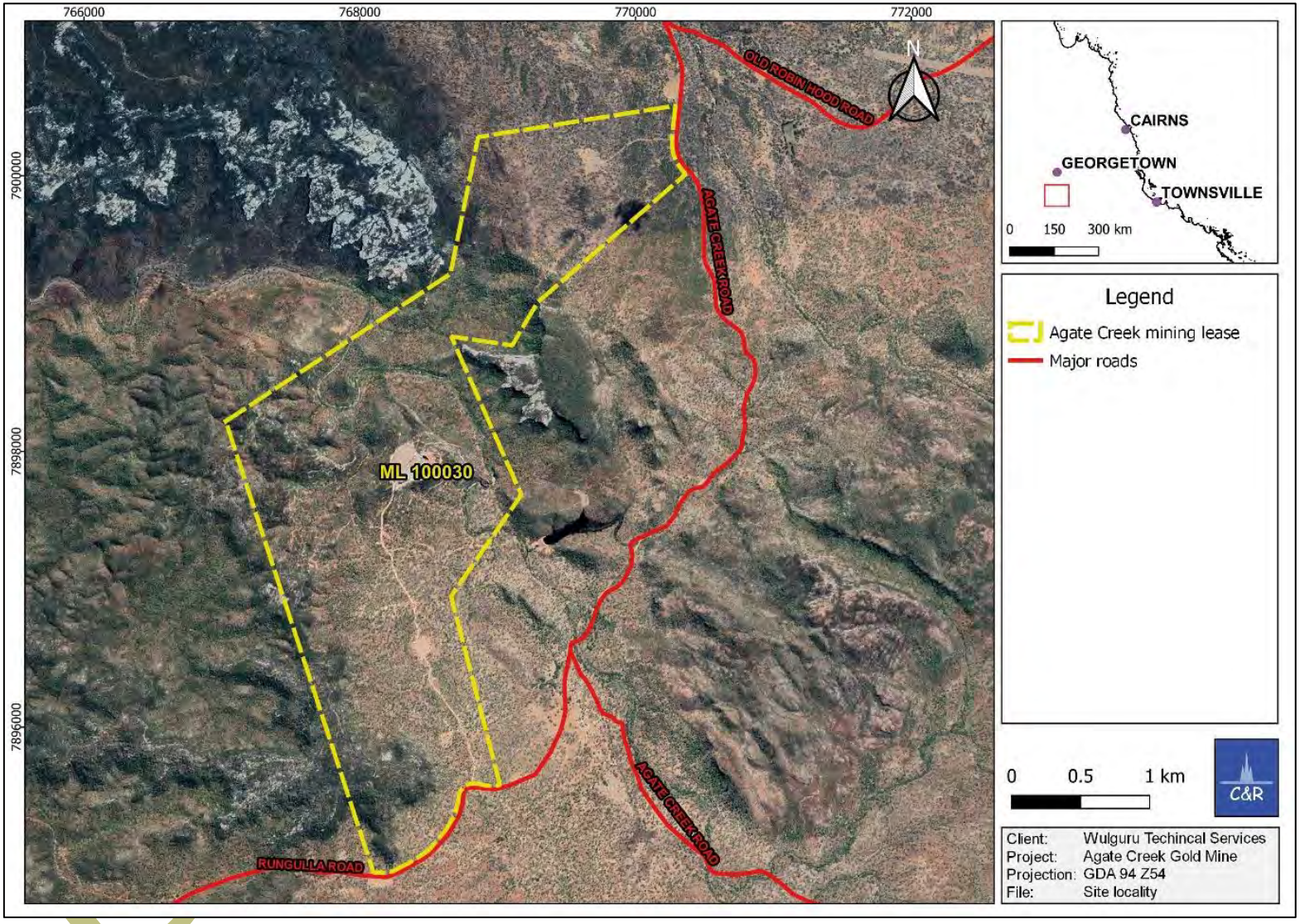



**Figure 1: Agate Creek locality.**

# 2. LEGISLATIVE REQUIREMENTS

The activities proposed under the project are regulated by the Water Act and the EP Act. The specific requirements under these regulations are the submission of an UWIR, which is required under The Water Act and a major EA amendment (required under the Queensland *Environmental Protection Act 1994* [EP Act]).

This report addresses the UWIR content requirements for both acts (see Table 1).

### 2.1.1 ENVIRONMENTAL PROTECTION ACT 1994 (QLD)

The EP Act provides a regulatory framework for the protection and management of the Queensland environment. Under the EP Act, environmentally relevant activities (ERAs) – such as mining – are licensed under EAs, which prescribe specific conditions for conducting ERAs. The objective of the EP Act is to protect Queensland's environment while allowing for sustainable development.

For the purposes of the EP Act, underground water rights refer to the statutory right afforded under the *Mineral Resources Act 1989* of a mining lease holder to "*take or interfere with underground water in the area of the tenure if the taking or interference with that water is necessarily and unavoidably obtained in the process of extracting the resource*" (Department of Environment Heritage Protection [DEHP], 2016).

A guideline from the Department of Environment and Science (DES, formerly DEHP) outlines the groundwater information required for an EA amendment application that involves the exercise of underground water rights under sections 126A and 227AA of the EP Act (DEHP, 2016). Section 126A of the EP Act requires specific information from applicants for a site-specific EA application (a new EA). Section 227AA requires that – if a change in mining activities necessitates changes to the exercise of underground water rights – a major EA amendment application must also fulfil the requirements of section 126A. Thus, the supporting information for Laneway's application to amend EA EPSL03068015 falls under section 227AA of the EP Act (and must therefore also comply with section 126A of the EP Act).

### 2.1.2 WATER ACT 2000 (QLD)

The Water Act was established primarily to provide a legal framework for the sustainable management of water and the management of impacts on underground water. Section 376 of the Water Act outlines the content of a UWIR. The requirements under section 376 of the Water Act are similar, but not identical, to those from sections 126A and 227AA of the EP Act (see Section 2.1.1).

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**Table 1: UWIR content requirements.**

| Water Act section no. | Water Act section content | UWIR cross-reference |
|---|---|---|
| 376(1)(a) | An underground water impact report must include each of the following— for the area to which the report relates—<br>(i) the quantity of water produced or taken from the area because of the exercise of any previous relevant underground water rights; and<br>(ii) an estimate of the quantity of water to be produced or taken because of the exercise of the relevant underground water rights for a 3-year period starting on the consultation day for the report. | (i) No groundwater has been produced or taken from the mine site due to the exercise of underground water rights to date.<br>(ii) Section 6.1 describes the estimated groundwater take over the UWIR period. |
| 376(1)(b) | For each aquifer affected, or likely to be affected, by the exercise of the relevant underground water rights—<br>(i) a description of the aquifer; and<br>(ii) an analysis of the movement of underground water to and from the aquifer, including how the aquifer interacts with other aquifers; and<br>(iii) an analysis of the trends in water level change for the aquifer because of the exercise of the rights mentioned in paragraph (a)(i); and<br>(iv) a map showing the area of the aquifer where the water level is predicted to decline, because of the taking of the quantities of water mentioned in paragraph (a), by more than the bore trigger threshold within 3 years after the consultation day for the report; and<br>(v) a map showing the area of the aquifer where the water level is predicted to decline, because of the exercise of relevant underground water rights, by more than the bore trigger threshold at any time. | (i) and (ii) Section 5.1 describes the groundwater regime in the relevant aquifers.<br>(iii) There has been no previous exercise of underground water rights.<br>(iv) Figure 11 shows the areas where depressurisation due to mining is predicted to exceed the bore trigger threshold during the UWIR period.<br>(v) Figure 11 shows the areas where depressurisation due to mining is predicted to exceed the bore trigger threshold during the life of the mine. |

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| Water Act section no. | Water Act section content | UWIR cross-reference |
|---|---|---|
| 376(1)(c) | A description of the methods and techniques used to obtain the information and predictions under paragraph (b). | Section 4 describes the UWIR methodology. |
| 376(1)(d) | A summary of information about all water bores in the area shown on a map mentioned in paragraph (b)(iv), including the number of bores, and the location and authorised use or purpose of each bore. | Sections 5.5, 6.1 and 6.2.2 describe the water bore census undertaken for the UWIR and confirms that there are no water bores within the area of predicted depressurisation. |
| 376(1)(da) | A description of the impacts on environmental values that have occurred, or are likely to occur, because of any previous exercise of underground water rights. | There have been no previous exercise of underground water rights and, hence, no previous groundwater impacts due to groundwater take. |
| 376(1)(db) | An assessment of the likely impacts on environmental values that will occur, or are likely to occur, because of the exercise of underground water rights—<br>(i) during the period mentioned in paragraph (a)(ii); and<br>(ii) (ii) over the projected life of the resource tenure. | Section 6 presents an assessment of potential groundwater impacts due to groundwater take. |
| | A program for—<br>(i) conducting an annual review of the accuracy of each map prepared under paragraph (b)(iv) and (v); and<br>(ii) giving the chief executive a summary of the outcome of each review, including a statement of whether there has been a material change in the information or predictions used to prepare the maps. | Section 7 describes the UWIR review and reporting process for the affected aquifers. |
| 376(1)(f) | A water monitoring strategy. | Section 7 describes the groundwater monitoring programme. |
| 376(1)(g) | A spring impact management strategy. | There are no springs within the mine site or its surrounds. Hence, a strategy for spring management is not justified. |
| 376(1)(h | If the responsible entity is the office—<br>(i) a proposed responsible tenure holder for each report obligation mentioned in the report; and | Not applicable. |

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| Water Act section no. | Water Act section content | UWIR cross-reference |
|---|---|---|
| | (ii) for each immediately affected area—the proposed responsible tenure holder or holders who must comply with any make good obligations for water bores within the immediately affected area. | |
| 376(1)(i) | The information or matters prescribed under a regulation. | No other relevant information or matters have been prescribed under a regulation. |
| 376(2) | However, if the underground water impact report does not show any predicted water level decline in any area of an affected aquifer by more than the bore trigger threshold during the period mentioned in subsection (1)(b)(iv) or at any time as mentioned in subsection (1)(b)(v), the report does not have to include the program mentioned in subsection (1)(e). | Section 7 describes the UWIR review and reporting process for the affected aquifers. |

Section 378 of the Water Act lists the content requirements for the water monitoring strategy. Table 2 lists the specific content requirements and provides an explanation of where each requirement is addressed in this UWIR.

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**Table 2: UWIR water monitoring strategy content requirements.**

| Water Act section no. | Water Act section content | UWIR cross reference |
|---|---|---|
| 378(1) | A responsible entity's water monitoring strategy must include the following for each immediately affected area and long-term affected area identified in its underground water impact report or final report—<br>(a) a strategy for monitoring—<br>(i) the quantity of water produced or taken from the area because of the exercise of relevant underground water rights; and<br>(ii) changes in the water level of, and the quality of water in, aquifers in the area because of the exercise of the rights;<br>(b) the rationale for the strategy;<br>(c) a timetable for implementing the strategy;<br>(d) a program for reporting to the office about the implementation of the strategy. | Section 7 describes the groundwater monitoring programme. |
| 378(2) | The strategy for monitoring mentioned in subsection (1)(a) must include—<br>(a) the parameters to be measured; and<br>(b) the locations for taking the measurements; and<br>(c) the frequency of the measurements. | Section 7 describes the groundwater monitoring programme. |
| 378(3) | If the strategy is prepared for an underground water impact report, the strategy must also include a program for the responsible tenure holder or holders under the report to undertake a baseline assessment for each water bore that is—<br>(a) outside the area of a resource tenure; but<br>(b) within the area shown on the map prepared under section 376(b)(v). | Not applicable. Sections 5.5, 6.1 and 6.2.2 describe the water bore census undertaken for the UWIR and confirm that there are no water bores within the area of predicted depressurisation. |
| 378(4 | If the strategy is prepared for a final report, the strategy must also include a statement about any matters under a previous strategy that have not yet been complied with. | Not applicable. |

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### 2.1.3 WATER PLANS

The project area falls within two water planning areas: the Gulf Water Plan (2007) and the Great Artesian Basin and other regional aquifers water plan (2017). The Gulf Water Plan is only relevant to the project for any proposed surface water take. The Great Artesian Basin and other regional aquifers water plan (2017) and the associated management protocol are relevant to the project.

**Table 3: Water plans and other documentation relevant to the project.**

| Water Plan | Subordinate documents | Groundwater management area | Groundwater management unit | Groundwater sub-area |
|---|---|---|---|---|
| Gulf Water Plan (2007) | N/A | N/A | N/A | N/A |
| Great Artesian Basin and other regional aquifers (2017) | Great Artesian Basin and other regional aquifers management protocol (2017) | Great Artesian Basin Groundwater Management Area | Springbok Walloon | Adori Injune Creek |

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# 3. SITE DESCRIPTION

Agate Creek is an open-cut gold mining operation located within the Etheridge Shire in north Queensland, approximately 78 km south of the township of Georgetown (Figure 1). Trial mining commenced at Agate Creek in 2013, with a transition to full-scale production in 2019. All mining activities undertaken at Agate Creek are permitted under the current EA EPSL03068015 (dated 6 September 2021).

The stage 2 expansion of the Agate Creek mine involves mining six different open-cut pits. The mine is presently working Pit 6 under the current EA that allows up to 200,000 tonnes of material to be extracted. However, further approval is required to mine Pit 6 deeper – exceeding the 200,000 tonnes limit – as well mining an additional five satellite pits. This proposed Agate Creek stage 2 expansion comprises 3,774,081 tonnes of waste rock material.

## 3.1 CLIMATE

Agate Creek is located within the seasonally arid tropics, with the area dominated by intense rainfall events throughout the summer months. These rainfall events are often highly variable in their spatial and temporal distribution, with the majority of the rain falling in distinct, spatially separated cells across the landscape. Rainfall throughout the remainder of the year is generally limited to an occasional shower in June or July and evaporation tends to exceed rainfall for almost all days of the year, with the exception of periods with intense rainfall events.

Climate statistics for Agate Creek have been compiled from the SILO (Scientific Information for Land Owners) database (grid point 19.0°S, 143.55°E; Jeffrey et al., 2001). Figure 2 displays annual rainfall, along with the 10-year rolling average and the long-term median (667.4 mm). A rising trend (in the 10-year rolling average) indicates a change towards wetter conditions, whilst a falling slope indicates a trend towards reduced rainfall. The rainfall pattern for Agate Creek shows an oscillating trend over time, with a steady decline currently observed for the 10-year rolling average.

Based on SILO data, the median annual rainfall experienced in the region is 667.4 mm, with approximately 93.4% of the rain falling between November and April each year (Figure 3). Conversely, the long-term median annual pan evaporation is 2,300.6 mm. Typical of climatic conditions within northwestern Queensland, evaporation significantly exceeds rainfall throughout most of the year. Furthermore, such conditions govern the flow regimes of the receiving environments surrounding Agate Creek, where creeks and rivers express intermittent flow conditions.

Historical temperatures based on SILO data at Agate Creek show marginal variation throughout the year, generally increasing in September and October each year with the 'build-up' to the monsoonal wet season, easing after the seasonal rainfall begins (Figure 4).

The closest data from the Bureau of Meteorology (BoM) is the Georgetown airport weather station (30124; BoM, 2022), which is approximately 98 km northwest of the Agate Creek mining lease.

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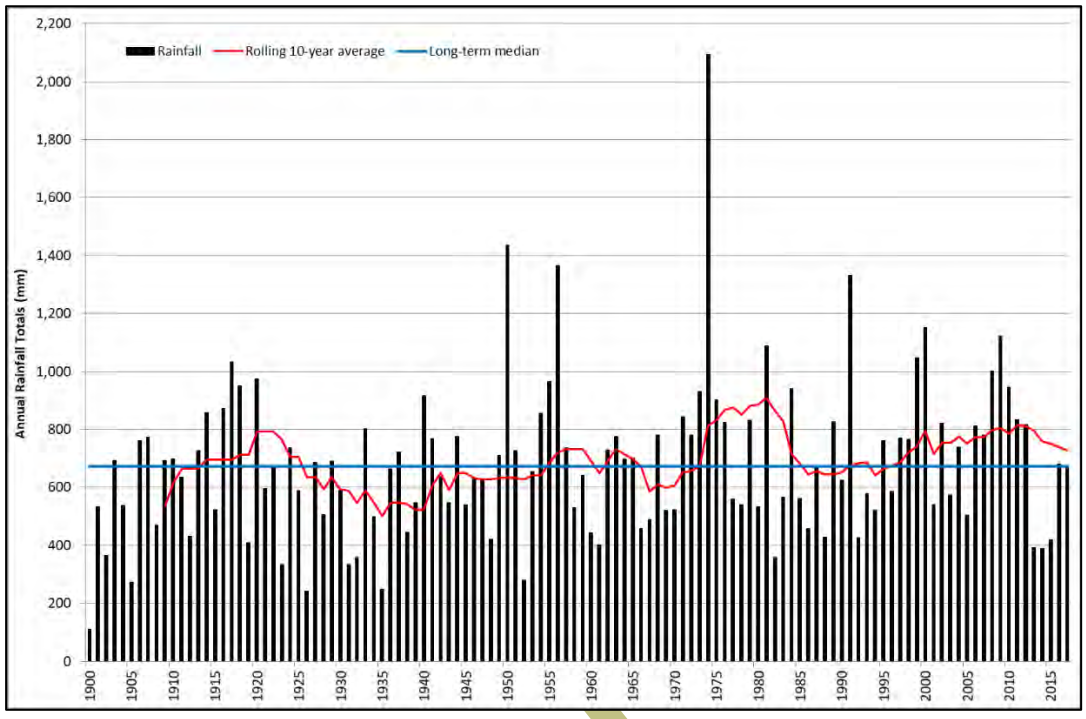



**Figure 2: Historical rainfall for Agate Creek derived from SILO.**

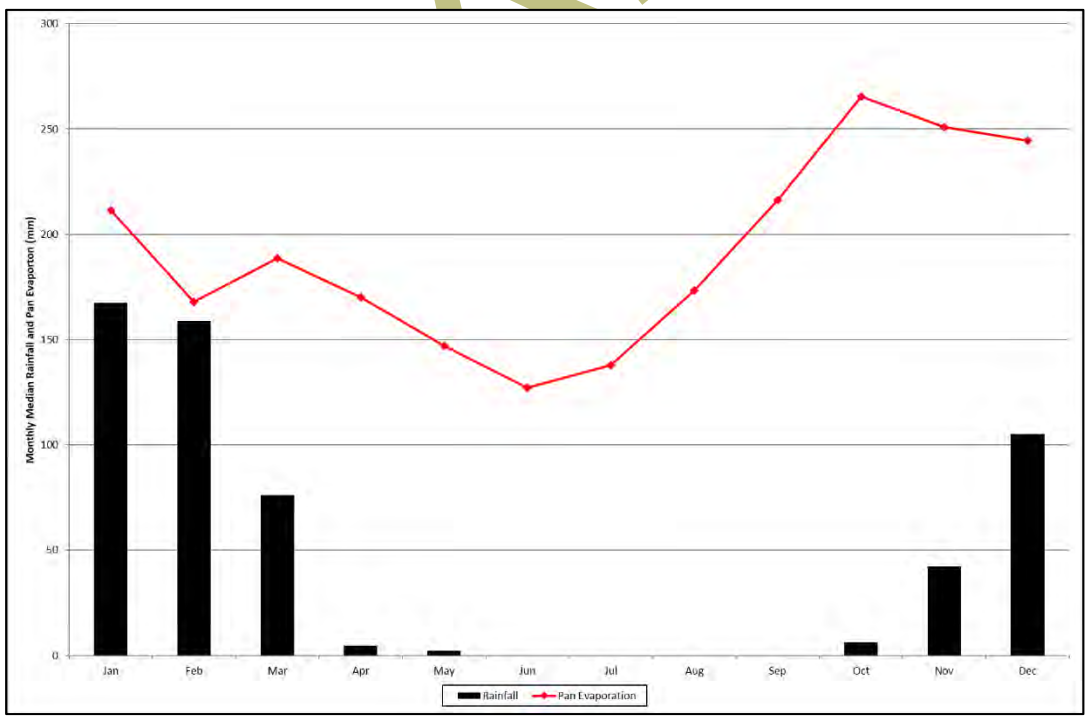



**Figure 3: Agate Creek long-term median monthly rainfall and pan evaporation totals (SILO).**

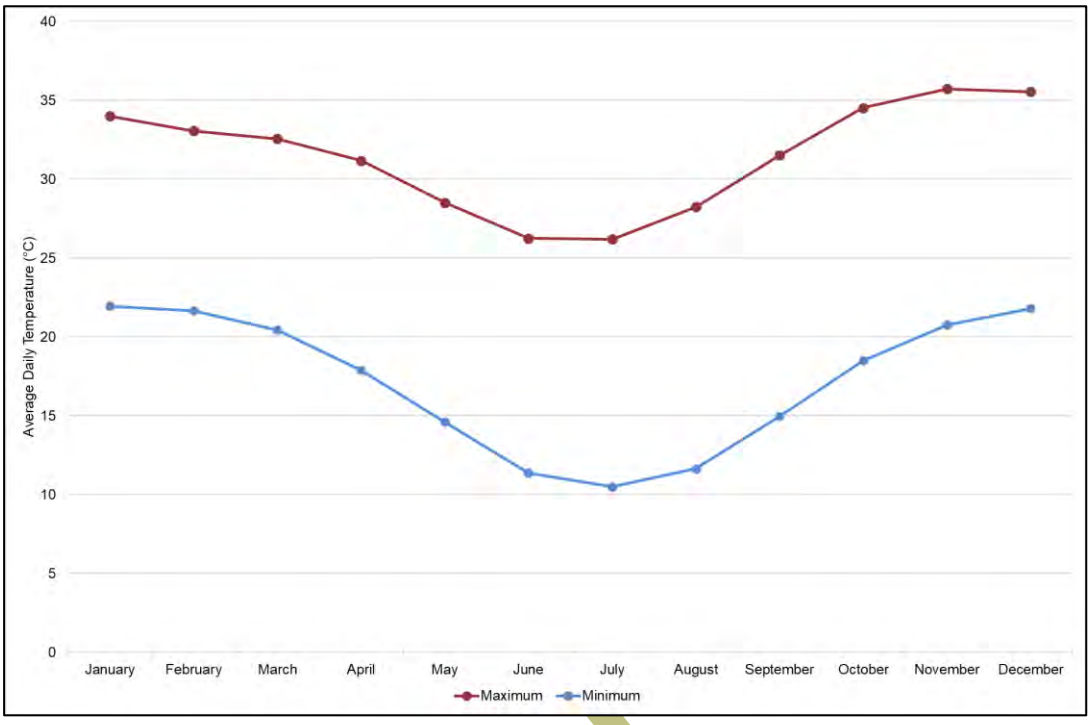



**Figure 4: Mean monthly temperature variation typically experienced throughout the year (SILO).**

## 3.2 LOCAL SOILS

The *Atlas of Australian Soils* (https://www.asris.csiro.au/themes/Atlas.html) – compiled by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) – provides a baseline description for regional soils found in and around the Agate Creek mining lease. The primary soil type found around the mine is a tenosol, specifically LL8 (Figure 5), characterised by low-hilly to hilly lands with abundant schistose rock outcrop. Occasional areas of shallow, stony sands also occur. In addition, loamy, red duplex soils with quartz-rich, gravelly A horizons are common on some slopes. Conversely, red friable earths are found on small basic intrusions.

Two other major soil units border the eastern boundary of the mining lease. Ta11 lies within the soil class chromosol. Within the chromosol class, soils typically display strong contextual contrast between the A and B horizons, whereby the B horizon is found to be neither acidic or sodic. Ta11 are typically found in undulating to moderately undulating lands – with long slopes and occasional steep rises with granite outcrop. They are generally associated with moderately deep, sandy duplex soils and often with gravel in the surface. These areas are also linked to red duplex soils and moderately deep, coarse sands. Shallow, coarse sands occur on steeper rises and near granite outcrop.

Fu20 represents the tenosol class. This soil type has typically a skeletal soil profile, with weak pedological organisation. Tenosols are found in low-hilly to hilly ranges, mostly with rounded crests. Massive rock outcrops are very common. Characteristically, all soils are very shallow and usually stony. Bleached loams are dominant but other shallow loams also occur with – less commonly – shallow bleached sands.

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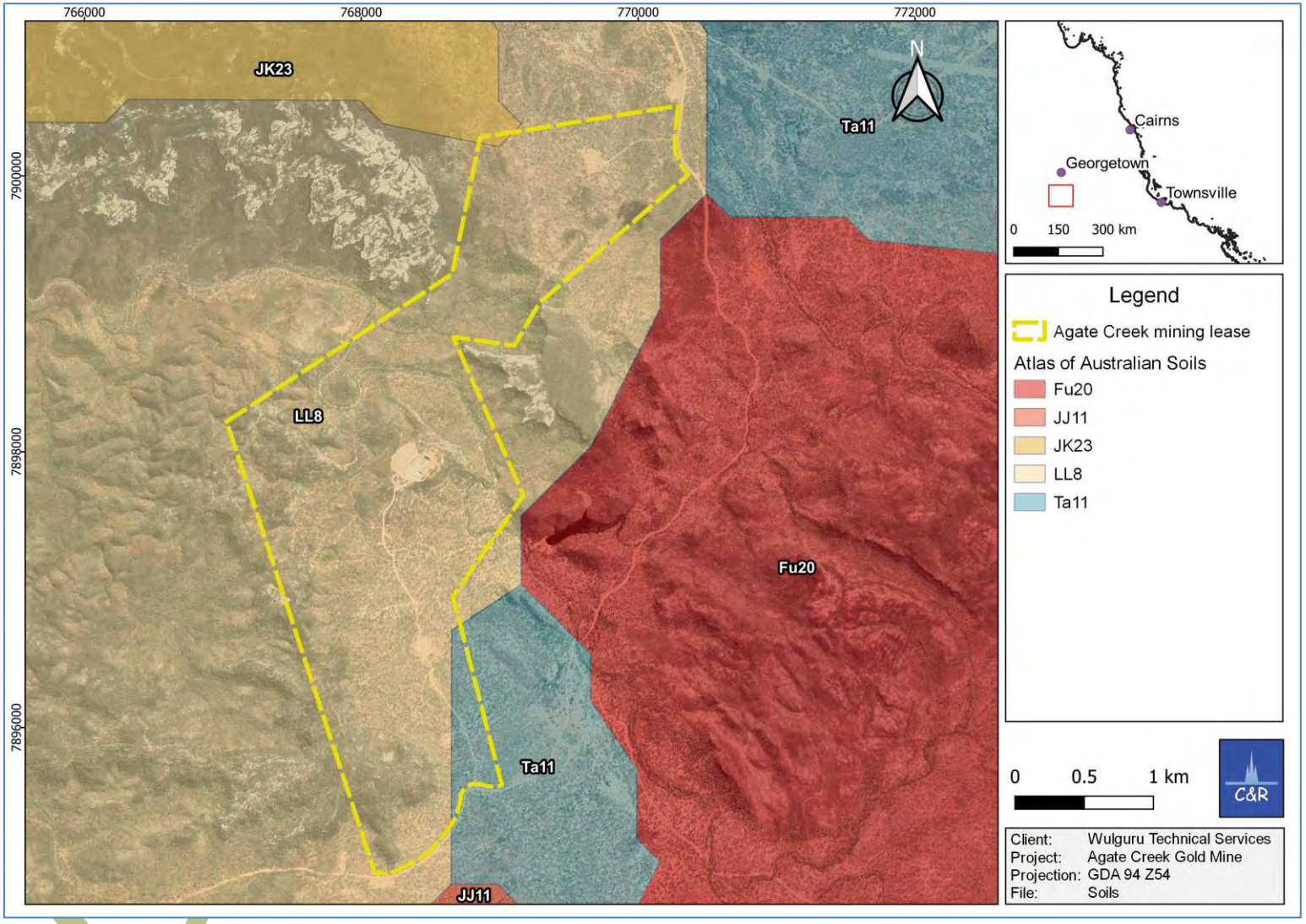



**Figure 5: Local soils profile based on the CSIRO *Atlas of Australian Soils*.**

## 3.3 GEOLOGY

The Agate Creek deposit is located in the central portion of the Proterozoic Etheridge Province. The primary identified deposit is known as Sherwood.

The Agate Creek mining lease includes a section of the regional-scale Robertson Fault Zone and the northwest end of the Agate Creek Volcanic Complex. The basement rocks are Proterozoic metasediment, composed of mudstone, sandstone, phyllite, quartzite and meta-basalt (Morrison et al., 2019). The metamorphic rocks have been intruded by Siluro-Devonian-age Robin Hood Granodiorite and by early Permian rhyolitic and andesitic dykes and stocks that are related to the Agate Creek Volcanic Complex. The volcanic complex is largely fault-bound and consists of andesitic lavas, rhyolitic tuff and ignimbrite. Jurassic Hampstead Sandstone consisting of basal conglomerate and quartzose sandstone forms plateau-like outliers capping the older rocks (Morrison et al., 2019).

These Proterozoic Etheridge metamorphic rocks were extensively intruded by Silurian to Early Devonian granitoid batholiths, and dominantly felsic Carboniferous to Early Permian magmatic complexes (Morrison et al., 2019). The mineralisation at Agate Creek is related to the emplacement of Permo-Carboniferous porphyritic rhyolite and andesite extrusives and intrusives, commonly referred to as the Agate Creek Volcanic Group.

The mineralisation at the main Sherwood deposit is best developed in breccias and vein networks hosted in shallow-dipping rhyolite dykes that occupy shallow, southeast-dipping thrust faults in the granodiorite. Thrust faults also separate the granodiorite from the metamorphic rocks throughout the prospect area and there are series of north- and northwest-trending, steep, normal faults that bound and disrupt the mineralised zones

The Sherwood gold mineralisation at Agate Creek is hosted by a low sulphidation epithermal system consisting of quartz-chalcedony veining, stockwork and breccia. Host rock lithology is predominantly porphyritic rhyolite or andesite that occupy shallow, southeast-dipping thrust faults in Silurian granodiorite (Morrison et al., 2019). This host rock is principally volcanic in origin.

A series of complex hydrothermal alteration assemblages surround the Agate Creek ore body. These assemblages range from a distal ubiquitous propylitic zone (chlorite +/- carbonate-epidote-pyrite-haematite) grading inwards to a more proximal variably argillic to sericitic zone (clay +/- quartz-sericite-pyrite) and locally phyllic zone (silica +/- pyrite or iron oxide) (Morrison et al., 2019). The hydrothermal alteration in the Agate Creek expansion area is predominantly clay +/- silica, sericite and/or pyrite (now weathered to iron oxide).

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**Table 4: Agate Creek site geology.**

| Group / Sub-group | Formation | Age | Description | Lithology Summary | Map Symbol |
|---|---|---|---|---|---|
| Qa-QLD | | Quaternary | Alluvium | Clay, silt, sand and gravel, flood plain alluvium | Qa |
| Eulo Queen Group | Hamstead Sandstone | Middle to Late Jurassic | Sandstone | Clayey, commonly pebbly, quartzose sandstone and conglomerate | Jh |
| Agate Creek Volcanic Group | Black soil andesite | Early Permian | Stratified unit – mafite (lavas, clastics and high-level intrusives) | Greyish-green, locally sparsely porphyritic augite-hypersthene-basaltic andesite with agate-filled amygdales; probably includes intrusive equivalents | Pvab |
| | Kennedy Province intrusive | Late Carboniferous – Early Permian | Intrusive – felsite (lavas, clastics and high level intrusives) | Mainly buff, pale grey to dark grey or brown, aphyric to highly porphyritic, intrusive rhyolite; commonly flow-banded; locally grades into microgranite | CPir |
| White Springs Supersuite | Robin Hood Granodiorite | Silurian | Intrusive - granitoid | Pink to grey hornblende-biotite granodiorite with quartz phenocrysts | Sgr |
| | Pama Province | Silurian | Intrusive - granitoid | Mainly I-type, biotite granite to hornblende-biotite granodiorite and tonalite; some biotite-hornblende and pyroxene-bearing tonalite to diorite and gabbro | Sg |
| Etheridge Group Robertson River sub-group | Dead Horse meta-basalt | Paleoproterozoic | Stratified unit – mafite (lavas, clastics and high-level intrusives) | Meta-basalt, locally pilled, hyaloclastic and/or amygdaloidal; minor metadolerite and metagabbro (unmapped) and interbedded siltstone | PLd |
| | Daniel Creek Formation | Paleoproterozoic | Stratified unit (including volcanic and metamorphic) – arenite-mudrock | Mudstone, siltstone, and fine subfeldspathic sandstone, locally calcareous and/or dolomitic. Grades into mica schist, quartzite and minor calc-silicate rocks | PLa |
| | Corbett Formation | Paleoproterozoic | Pelite – stratified volcanic and metamorphic | Greenish-grey mudstone (+/- chloritoid); grades into mica schist, with metamorphic sequence of staurolite, andalusite, sillimanite, garnet | PLco |

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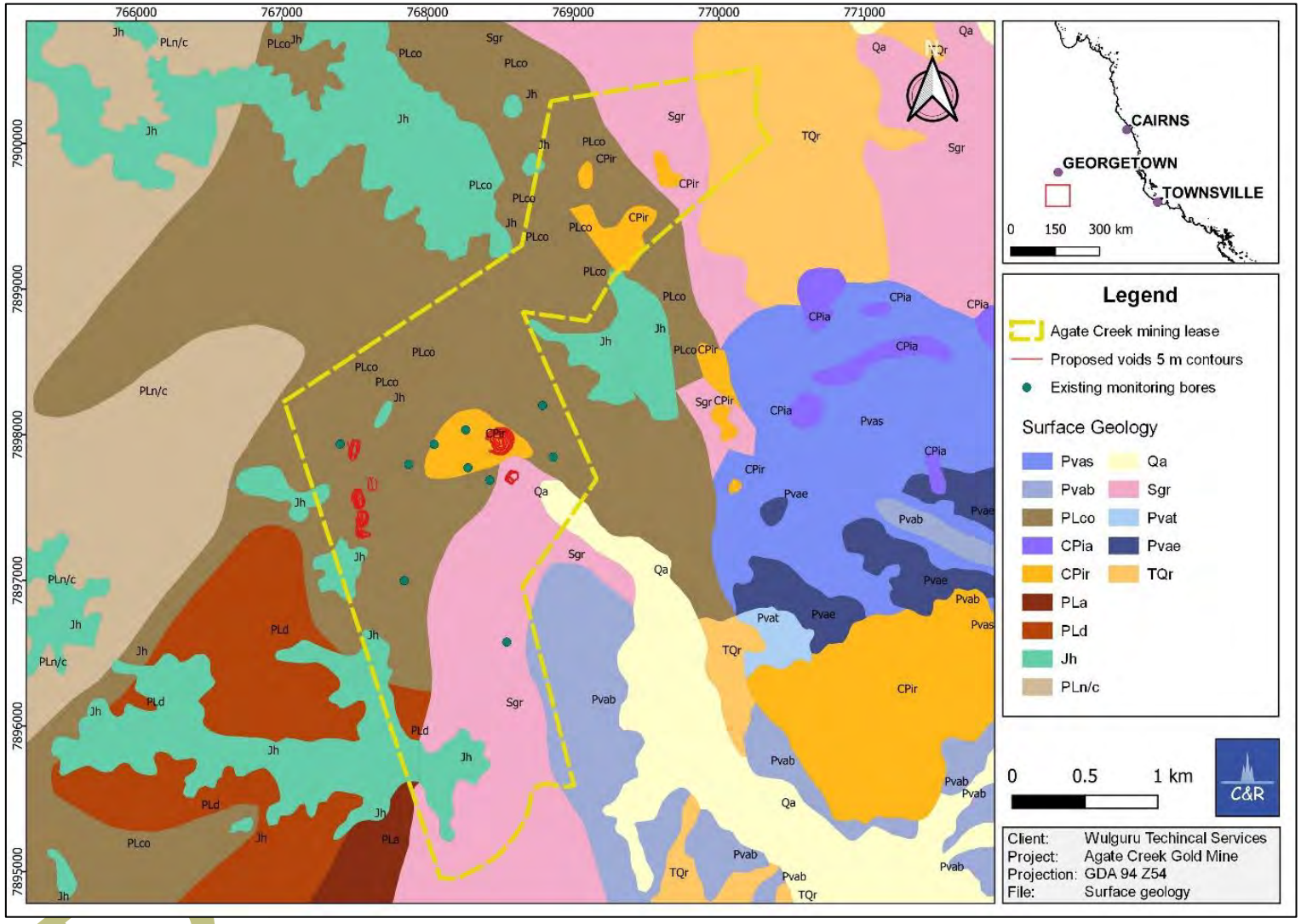



**Figure 6: Detailed surface geology.**

## 3.4 RECEIVING ENVIRONMENTS

The mining lease covers an area of approximately 688.86 ha and cuts directly through Agate Creek – a tributary of the Robertson River which flows into the Gilbert River before entering the Gulf of Carpentaria. The mining lease also encompasses several smaller drainage lines branching into Agate Creek (Figure 7) – and north into Cave Creek. Cave Creek joins Agate Creek upstream of the confluence with the Robertson River.

The watercourses throughout the project site are intermittent streams, only flowing for short periods after substantial rainfall events. Although small, semi-permanent pools are known to exist upstream of the project site, there are no naturally occurring, large, permanent waterbodies known within the Agate Creek catchment area upstream of the project site.

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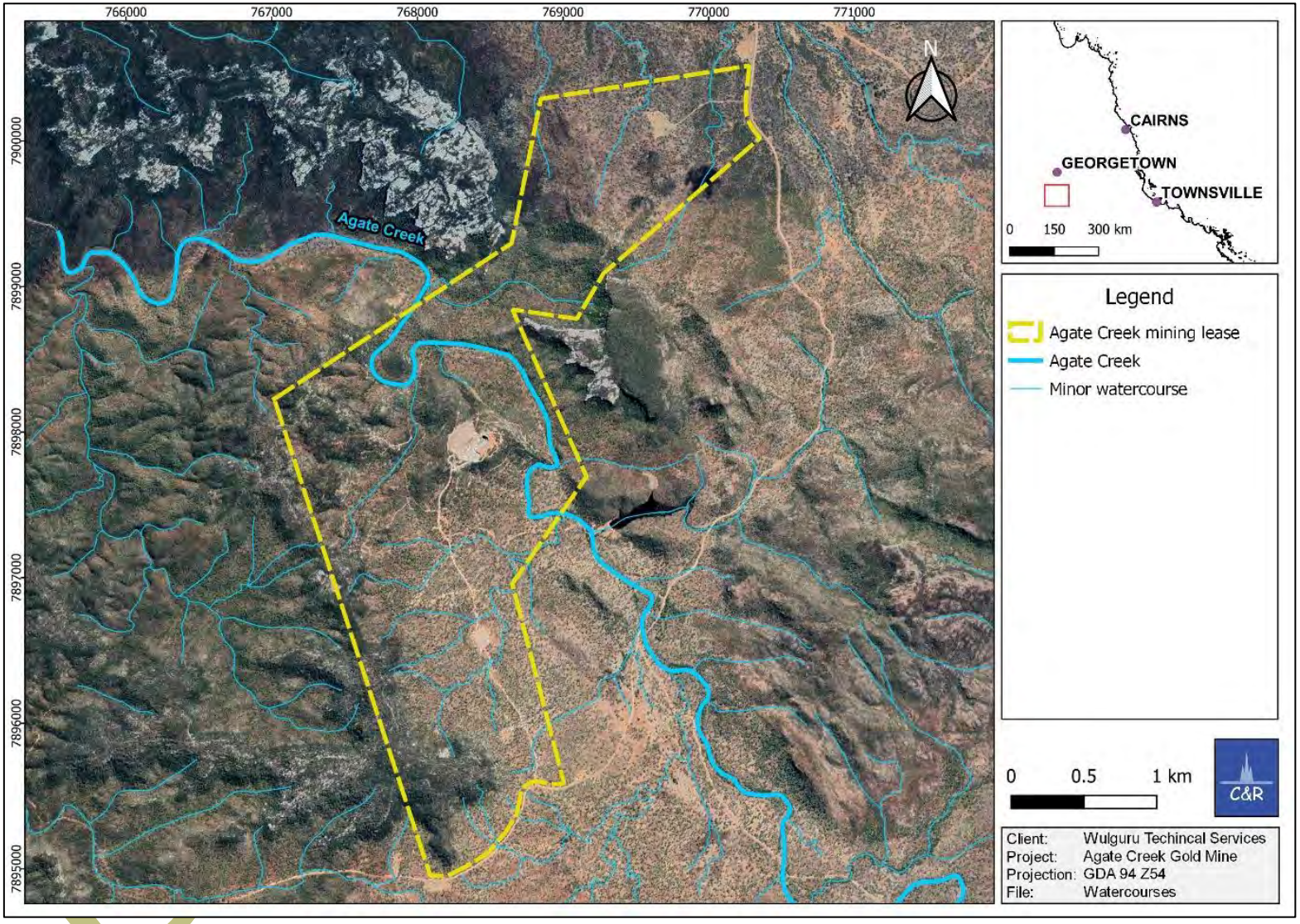



**Figure 7: Primary receiving environment of Agate Creek and minor tributaries.**

# 4. ASSESSMENT METHODS

This section describes the methods which have been adopted for the collection of hydrogeological data to inform the Agate Creek UWIR.

## 4.1 DATABASE SEARCHES FOR GROUNDWATER BORES

A search of relevant Queensland databases was undertaken to identify the presence of current water bores within and surrounding the mine. A water bore is a groundwater supply bore.

The following databases and mapping were searched:

- The DNRME groundwater database of registered water bore data from private water bores and Queensland Government groundwater investigation and monitoring bores: Accessed data include bore location, groundwater levels, construction details, stratigraphic logs, hydrogeological testing and groundwater quality.
- The Queensland Spatial Catalogue (QSpatial), via Queensland Globe: Records of petroleum and coal seam gas (CSG) exploration, production and monitoring wells are contained within this database.

Excluding the 24 groundwater bores installed by Laneway in 2020 and 2021, these searches did not identify any registered bores within 5 km of the project mining area.

## 4.2 DATABASE SEARCHES FOR SENSITIVE ENVIRONMENTAL FEATURES

The potential for groundwater-dependent ecosystems (GDEs) to be present within the project site was reviewed, with the review consisting of:

- Queensland Springs Database (via Queensland Globe);
- BoM's GDE Atlas; and
- Field investigations.

The Queensland Springs database and BoM GDE Atlas indicated that no springs are located within the project site. However, two springs (SPR1411 and SR1412) were identified within the 10 km buffer from the mining lease centroid. The two springs were identified by helicopter and therefore little to no information is known about dynamics of the individual systems – although both springs are considered permanently active (based on the BoM GDE Atlas and Queensland Springs Database). No field studies have been completed on either spring within the 10 km buffer from the Agate Creek mining lease.

## 4.3 PREVIOUS GROUNDWATER STUDIES

The hydrogeology of Agate Creek was initially assessed by Rob Lait and Associates Pty Ltd (Lait) in 2020 to provide advice and complete a preliminary assessment of the hydrogeological regime (Lait, 2020). This assessment included the provision of ten groundwater monitoring bore locations and construction, hydraulic conductivity testing and the preliminary assessment of the groundwater regime at Agate Creek.

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## 4.4 GROUNDWATER MONITORING DATA

All relevant data were collated and analysed to develop a conceptual understanding of the groundwater regime. Groundwater data collected from the mine monitoring bores have been used to inform this groundwater conceptualisation.

## 4.5 GROUNDWATER MONITORING NETWORK

In June 2020, ten groundwater monitoring bores were drilled and constructed to improve the understanding of the hydrogeological regime at the Agate Creek mine. The locations and construction designs were provided by Lait, whereas all geological descriptions for the individual bores were supplied by Laneway.

The ten monitoring bores were drilled and constructed in June 2020, with water level and water quality monitoring commencing on a monthly basis from October 2020 onwards. Spatially distributed groundwater level data were used to characterise groundwater flow directions, gradients and velocities. In addition, temporal variations in groundwater level were used to interpret the rate and distribution of recharge/discharge, influence from mining, and variability in groundwater level.

Groundwater quality data provide useful information on the hydrogeological regime because they are influenced by interaction with the aquifer matrix, and groundwater recharge/discharge processes.

Twelve additional monitoring bores were installed across the mining lease in December 2021, in preparation for the expansion of mining activities. A further two production bores have also been constructed to provide water for operational activities and camp facilities. However, due to reporting constraints, the limited data from these fourteen bores have not been included within this assessment.

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**Table 5: Groundwater monitoring bore network constructed in 2020 (MGA: Map Grid of Australia).**

| Bore ID | RN[1] | Installation date | Easting | Northing | Ground level | Casing above ground | Total depth | Screened interval | Geology unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | MGA zone 54 | | m AHD | m | m BGL | | |
| CCWB517 | 193026 | 7/06/2020 | 768399.5 | 7896463 | 435.6 | 0.6 | 55 | 49 – 55 | Robin Hood Granodiorite |
| CCWB518 | 193029 | 9/06/2020 | 767768.1 | 7897706 | 431.4 | 0.6 | 73 | 67 – 73 | Andesite/Rhyolite |
| CCWB519 | 193030 | 9/06/2020 | 767302 | 7897863 | 517.18 | 0.62 | 85 | 79 – 85 | Corbett Formation Metasediments |
| CCWB520 | 193031 | 10/06/2020 | 767947.2 | 7897838 | 434.96 | 0.59 | 73 | 67 – 73 | Andesite |
| CCWB521 | 193027 | 12/06/2020 | 768700.6 | 7898079 | 420.94 | 0.6 | 73 | 67 – 73 | Corbett Formation Metasediments |
| CCWB522 | 193032 | 13/06/2020 | 768761.9 | 7897724 | 434.2 | 0.6 | 73 | 67 – 73 | Corbett Formation Metadolerite |
| CCWB523 | 193033 | 14/06/2020 | 768321.3 | 7897579 | 449.6 | 0.61 | 73 | 67 – 73 | Robin Hood Granodiorite |
| CCWB524 | 193034 | 15/06/2020 | 768173.6 | 7897670 | 496.06 | 0.64 | 91 | 85 – 91 | Robin Hood Granodiorite |
| CCWB525 | 193035 | 16/06/2020 | 768166.9 | 7897930 | 498.77 | 0.62 | 103 | 97 – 103 | Corbett Formation Metasediments |
| CCWB526 | 193028 | 17/06/2020 | 767709.7 | 7896909 | 449.4 | 0.66 | 73 | 67 – 73 | Corbett Formation Metasediments |

[1]Registered Number

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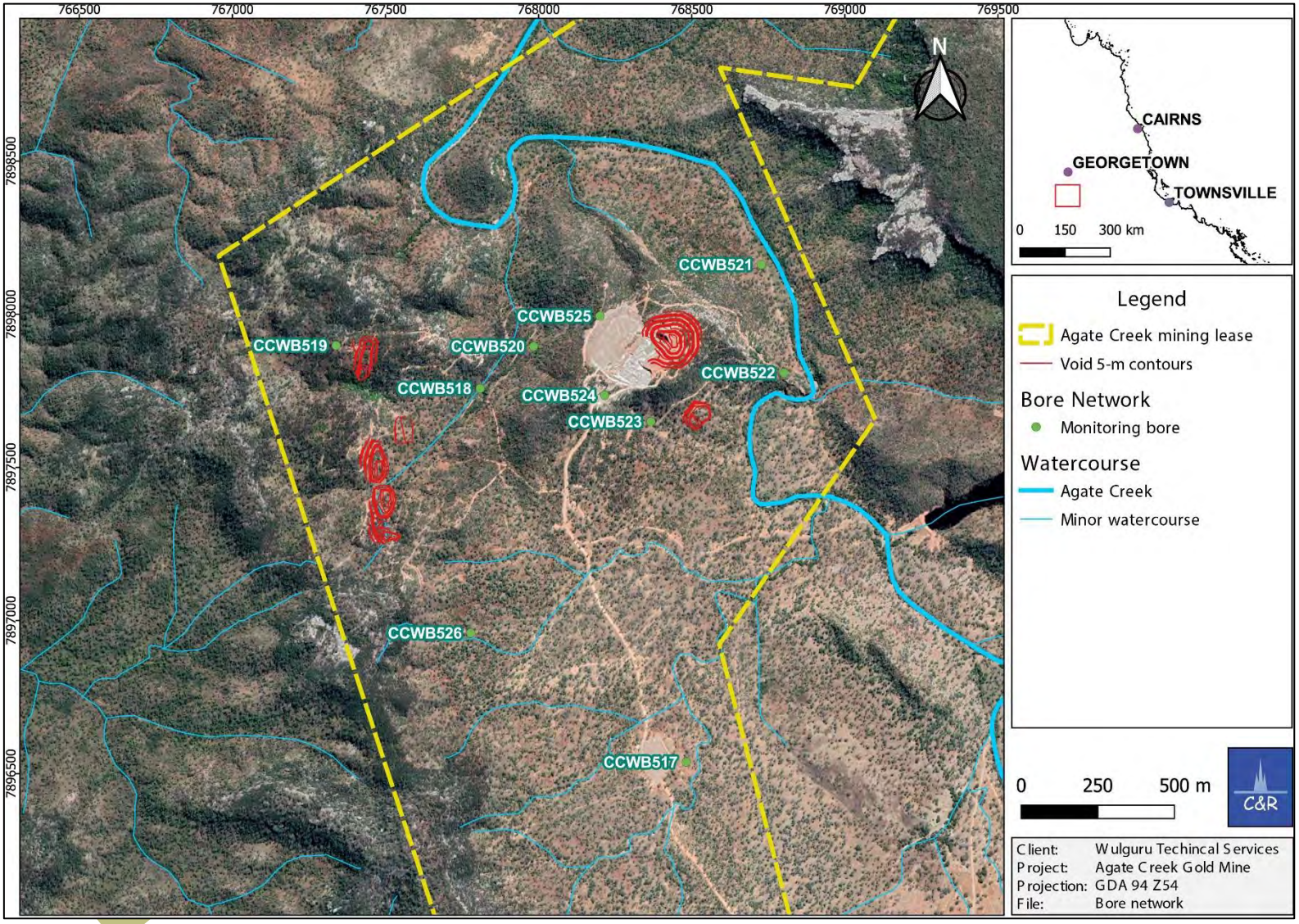



**Figure 8: Agate Creek groundwater monitoring bore network and proposed void outlines.**

# 5. GROUNDWATER REGIME

Mapping of aquifers – using the Australian Groundwater Explorer (http://www.bom.gov.au/water/groundwater/explorer/map.shtml) – identified the presence of three aquifers in the area, including an upper, middle and lower aquifer.

- The upper aquifer is associated with Quaternary alluvium that is present on the northeastern section of the ML, linked to Cave Creek, and just off the ML to the south on Agate Creek.
- The middle aquifer is associated with the Mesozoic sandstones. Mesozoic aquifers in this area form part of the Great Artesian Basin groundwater system. Although minor sandstone is represented in the lower part of the ML, mapping indicates that the middle aquifer is absent on the ML.
- The lower aquifer is associated with the weathered and fractured zones of the Palaeozoic and Palaeoproterozoic rocks.

Recent drilling and construction of monitoring bores in 2020 indicate very low hydraulic conductivity of the lower aquifer fractured rock formations. Construction logs for these bores indicate that screens were not set against intervals where groundwater was intersected – but rather at the bottom of the hole (Lait, 2020).

## 5.1 DISTRIBUTION

Project-scale mapping has identified structural complexity – associated with faulting and zones of brecciation along structures – across the site. The key faults on site include the Agate Creek Fault Zone, Zig Zag Fault and Sherwood West Fault. The primary source of groundwater within the Agate Creek mining lease is held within the fractured and weathered, igneous and metasedimentary rocks. Exploration drilling has reported that groundwater interception most commonly occurs within the zone of oxidation.

During the December 2021 drilling programme, several bores were installed within the alluvial aquifer, although no water was intersected at the time of drilling.

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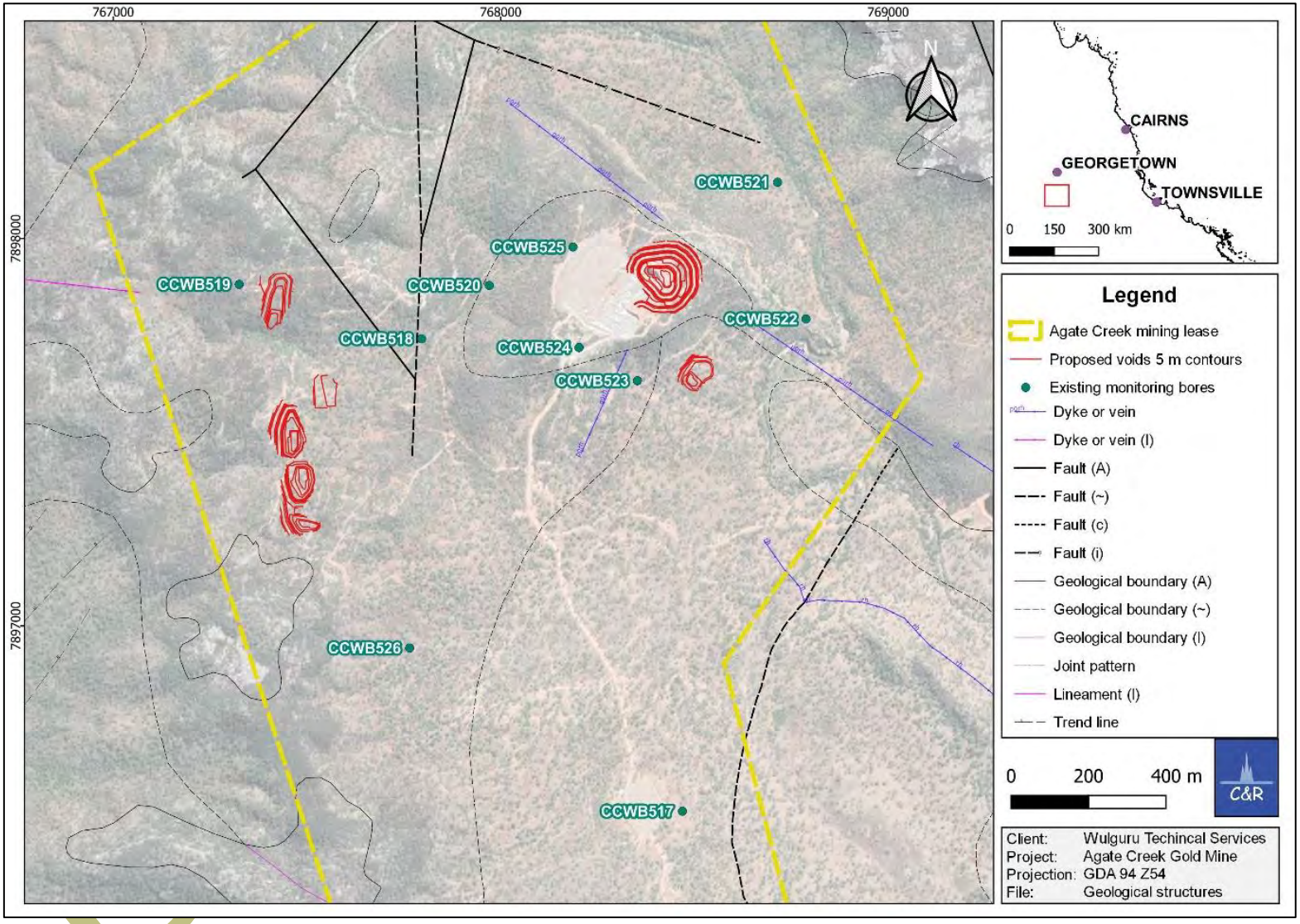



**Figure 9: Complex geological structures influencing the Agate Creek deposit and hydrogeological systems.**

## 5.2 HYDRAULIC PARAMETERS

The geological lithologies present (granite, rhyolite, andesite, metasediment and veins) – and the data provided in numerous sources (including Brassington, 1988) – indicate that the hydraulic conductivities of the lithologies at Agate Creek are in the very low to low range.

The prime data for this investigation were taken from Lait (2020) – on slug tests on boreholes CCWB517 to CCWB526 in the Agate Creek ML. In addition, the methodology of Marinelli and Niccoli (2000) was used for the estimation of groundwater inflow to the pits on the mine site.

Based on Lait (2020), hydraulic conductivities range from:

- $6.57 \times 10^{-8}$ m/sec for CCWB523 to
- $5.06 \times 10^{-7}$ m/sec for CCWB518.

Distances from individual bores to the main pit range from:

- 50 m to 173 m for CCWB524;
- 150 m for CCWB525;
- 1068 m for CCWB526; and
- 1275 m for CCWB517.

From assessing the range in the hydraulic conductivities (5 orders of magnitude), both linear and logarithmic solutions for inflow rates were obtained for the methodology of Marinelli and Niccoli (2000).

**Table 6: Inferred linear and logarithmic inflow rates based on hydraulic tests completed in 2020.**

| Bore CCWB | Linear Inflow Rate $m^3$/sec | Log Inflow Rate $m^3$/sec |
|---|---|---|
| CCWB517 | $4.464 \times 10^{-5}$ | $2.795 \times 10^{-5}$ |
| CCWB518 | $4.825 \times 10^{-5}$ | $3.037 \times 10^{-5}$ |
| CCWB519 | $3.707 \times 10^{-5}$ | $2.348 \times 10^{-5}$ |
| CCWB520 | – | – |
| CCWB521 | $1.756 \times 10^{-5}$ | $1.498 \times 10^{-5}$ |
| CCWB522 | $1.306 \times 10^{-5}$ | $1.351 \times 10^{-5}$ |
| CCWB523 | $1.040 \times 10^{-5}$ | $1.271 \times 10^{-5}$ |
| CCWB524 | $3.570 \times 10^{-5}$ | $2.275 \times 10^{-5}$ |
| CCWB525 | $4.390 \times 10^{-5}$ | $2.735 \times 10^{-5}$ |
| CCWB526 | $1.954 \times 10^{-5}$ | $1.568 \times 10^{-5}$ |

It should be noted that the bore hole design and construction suggest that the screened interval has been placed at the bottom of the hole instead of at water-making beds. Additionally, the aquifers at Agate Creek are believed to be primarily contained within fractured and weathered igneous and metasedimentary rocks – and groundwater was intercepted at depths ranging from 8 m to 68 m below ground level (BGL). Therefore, the indicated, very low conductivity values presented in Table 6 would only be representative of the solid rock formation.

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## 5.3 POTENTIOMETRIC SURFACE, RECHARGE, FLOW AND DISCHARGE

Following the drilling and construction of the ten groundwater monitoring bores at Agate Creek in June 2020, groundwater levels were measured in July 2020 before monthly levels were captured in September and monthly thereafter. No site-specific rainfall data were available for the monitoring period. Therefore, rainfall data from BoM station 30124 (Georgetown airport) has been used to provide an insight into the potential totals recorded on site. However, it should be noted that the spatially heterogeneous nature of rainfall events in the tropics can result in large variations in rainfall totals from one area to the next.

Between December 2020 and February 2021, 765.4 mm of rain fell (Figure 10), comparable to the median annual value (753.2 mm) for the same BoM station between 2005 and 2019. All bores within the Agate Creek network reported a positive change in groundwater elevation, which in most cases represents a recharging of the aquifer. However, the large degree of variability is doubtful. If all values are assumed to be accurate, CCWB517 recorded the smallest positive change (0.6 m), whereas CCWB524 reported a change of 18.9 m. The uncertainty (in data accuracy) is further complicated by the absence of manual depth measurements during the potential recharging period. CCWB519, CCWB524 and CCWB525 were not measured in December 2020 and January 2021.

Conversely, if the difference in groundwater elevations is compared to changes which occurred between November 2020 and April 2021 (wet season), the values appear more plausible. Screened in the Robin Hood Granodiorite and located in the southern reaches of the mining lease, CCWB526 (Figure 8) reported no change in groundwater elevation over the 2020/2021 wet season (Figure 10). Conversely, the greatest variation was recorded in CCWB521 (3.80 m) which is the bore located closest to Agate Creek and screened in the Corbett Formation Metasediments (Figure 8 and Figure 10).

The 12-month period between October 2020 and October 2021 was assessed to determine if any overall trends are occurring within the Agate Creek groundwater monitoring network. Excluding CCWB526, all bores recorded increases, which ranged between 0.17 m (CCWB517) and 3.71 m (CCWB521). An overall average increase of 1.38 m was observed across the entire network. The recorded increases across the network are likely a result of the extremely low hydraulic conductivities, representing a system which is continuing to reach equilibrium. However, it should be noted that groundwater elevations have the potential to be significantly impacted by the bore design and construction. Each bore in the Agate Creek network is screened at the bottom of the whole, with the bentonite seal placed at the bottom of the surface casing. Consequently, water may enter the screened interval from any point below the bentonite seal, therefore skewing the calculated groundwater elevations.

Furthermore, due to the network construction design, a level of uncertainty remains in terms of groundwater elevations and the direct relationship to the screened lithology. A potentiometric surface of groundwater elevations has been created utilising all groundwater monitoring bores within the network – using the median value calculated between July 2020 and October 2021. The water quality assessment undertaken as part of this report suggest that there is some degree of hydraulic continuity across the Agate Creek mining lease. The potentiometric surface shows that groundwater flows follow a similar pathway to the surface topography, with groundwater moving from areas of high elevation (CCWB519 – 454 m AHD) towards Agate Creek (CCWB521 – 414 m AHD) (Figure 11).

The three bores located within the closest proximity to Agate Creek and a smaller tributary (CCWB520, CCWB521 and CCWB522) reflect the areas of lowest groundwater elevations – ranging between 414 and 426 m AHD. Based on 1-m digital elevation models for the region, the banks and bed of Agate Creek are approximately 430 m AHD and 425 m AHD, respectively. The elevation difference between the bed of Agate Creek and CCWB521 supports the understanding that the groundwater systems present within the mining lease do not impact or interact with flow in Agate Creek.

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Due to aforementioned factors with issues relating to measurements of groundwater elevation, it is difficult to ascertain an accurate value for recharge during the reporting period. Furthermore, field notes suggest that monitoring methods have a significant impact on several bores, which are consequently failing to reach equilibrium between monitoring rounds. Further monitoring and a change of monitoring methodology is required to allow for an accurate assessment of recharge values for individual bores.

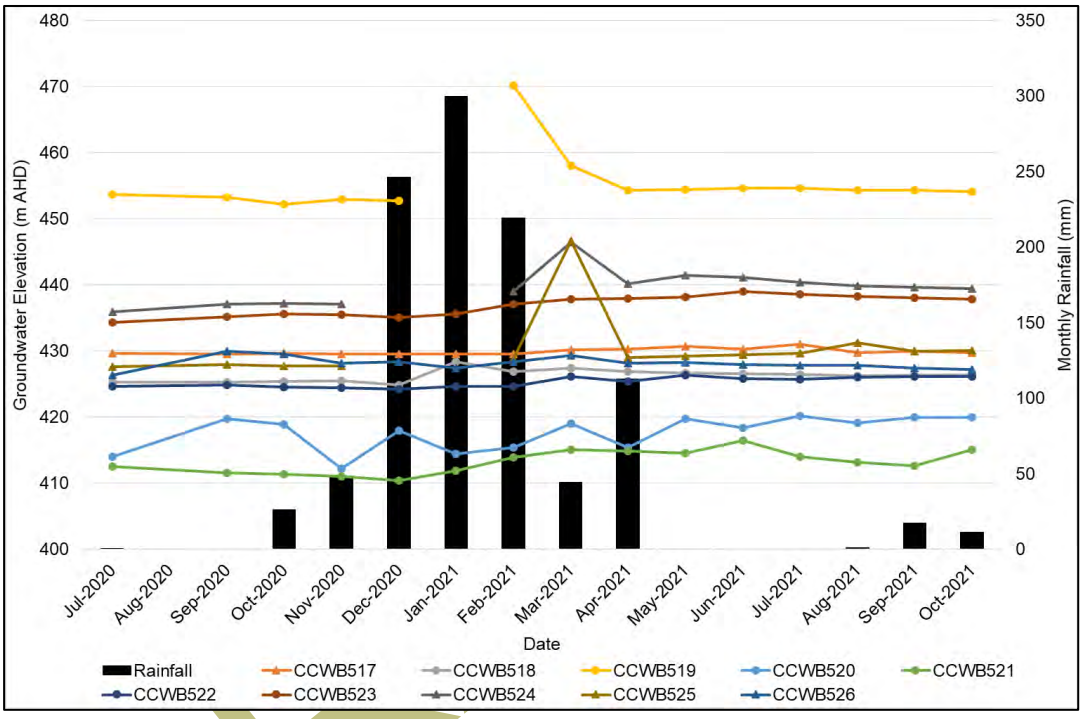



**Figure 10: Changes in groundwater elevations in response to rainfall at Agate Creek.**

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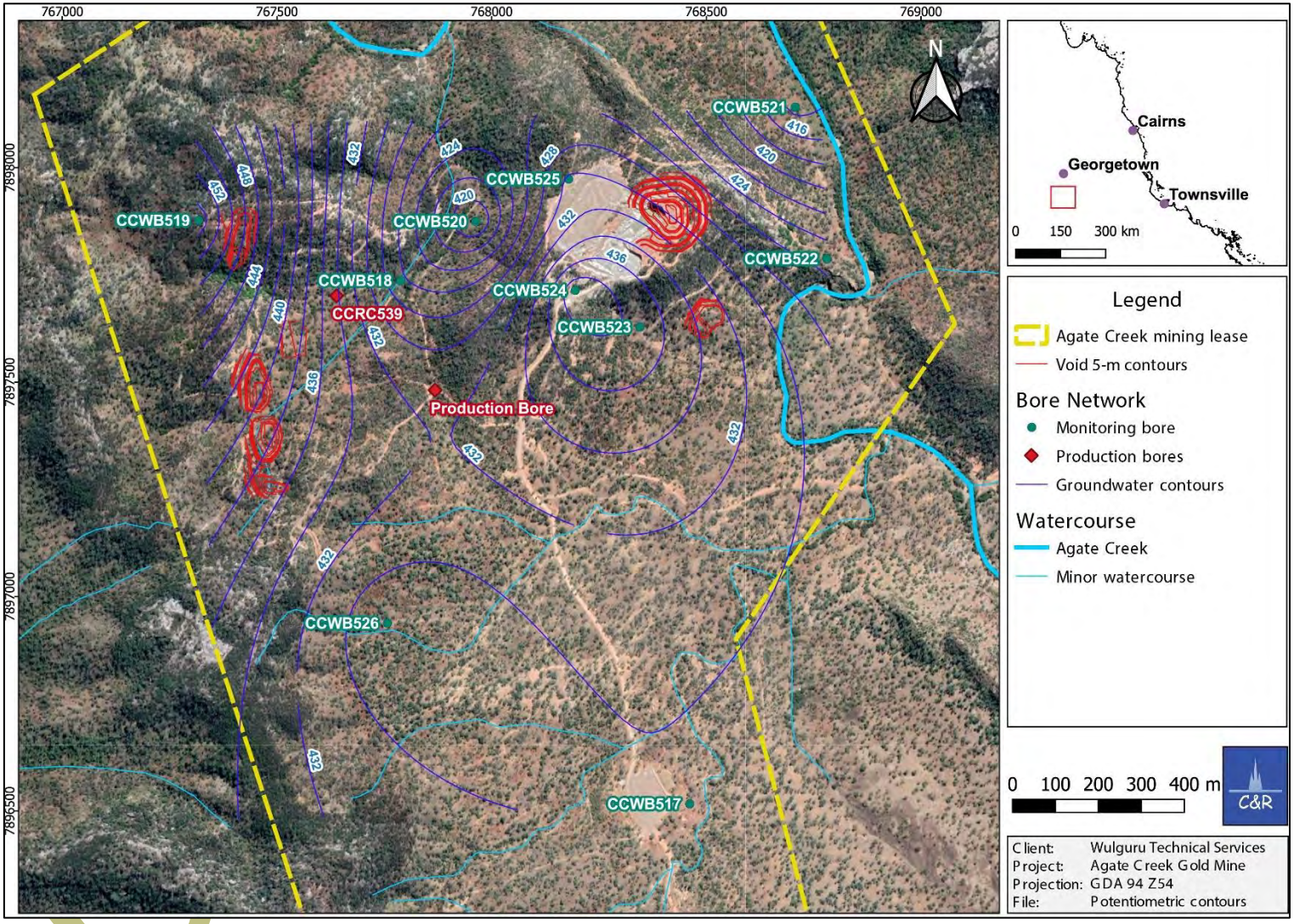



**Figure 11: Potentiometric surface contours developed from the median groundwater elevations over the 16-month monitoring period.**

## 5.4 GROUNDWATER QUALITY

Most bores within the Agate Creek groundwater monitoring network reflect mildly alkaline conditions, although – throughout the monitoring period – several bores have trended towards slightly acidic conditions (Figure 12). Screened in the Corbett Formation Metasediment, CCWB521 reflects stable alkaline waters ranging from 8.26 to 8.53, whereas bore CCWB523 – screened in the Robin Hood Granodiorite – reflects acidic conditions, with a median value of 6.5.

Most notably, CCWB525 reported the greatest pH range (6.39 – 7.73). With pH levels of CCWB525 steadily trending downwards over the monitoring period, the September 2021 value of 7.73 appears inconsistent. Although CCWB519 displays a range of 0.82, this value is skewed by the initial reading of 7.24 recorded in July 2020, whereas all remaining pH values range between 6.42 and 6.88.

The changes in pH between July 2020 and October 2021 are likely to reflect the low hydraulic conductivity reported, whereby each bore is gradually reaching equilibrium over the monitoring period. From the current data available, there does not appear to be any correlation with rainfall, with no discernible trend identified for the period between December 2020 and February 2021. All pH values are within ranges reflective of the rock type encountered across the groundwater network.

All pH values across the Agate Creek network remain within the Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) guidelines for livestock drinking water (5 – 9; ANZECC and ARMCANZ, 2000).

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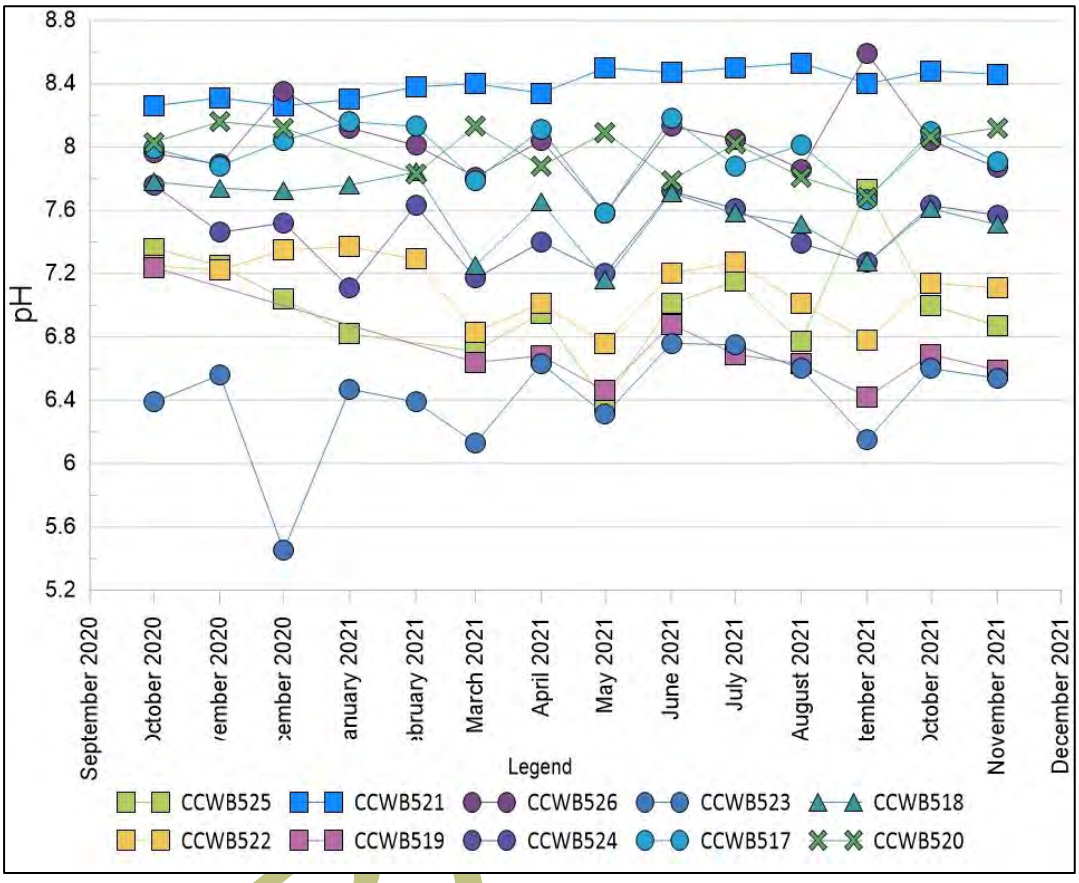



**Figure 12: pH values within the Agate Creek groundwater monitoring network.**

Excluding CCWB517 and CCWB526, all bores have fresh water quality (<1,560 µS/cm). CCWB517 and to a lesser extent CCWB526 are considered brackish (1,560 – 4,680 µS/cm). All screened formations reflect stable conditions throughout the monitoring period, with small fluctuations detected in CCWB517 following the significant wet season rainfall events between December 2020 and February 2021.

The CCWB517 construction log shows that the bore has been predominantly drilled through differing states of weathered granite within the Robin Hood Granodiorite, whereas CCWB526 is said to be screened in the metasediments within the Corbett Formation. However, from the stratigraphy described within the construction log, CCWB526 appears to drill through the same weathered granite sequence depicted in CCWB517. Due to the absence of bentonite seals above the bores' screened interval, it is considered highly likely the water quality in CCWB526 reflects a mixture of waters. The elevated salinity is attributed to the water present within the weathered granite.

Total dissolved solids (TDS) are a measure of all inorganic salt dissolved in water and is a guide to water quality. Electrical conductivity can be used to approximately calculate the concentration of TDS using the conversion of

*Electrical conductivity (µS/cm) x 0.67 = TDS (mg/L)*

In accordance with the formula above, all bores excluding CCWB517 and CCWB526 are below the Australian drinking water guideline value of 600 mg/L for TDS. Whereas the water of CCWB526 is regarded as poor quality (900 – 1200 mg/L), CCWB517 is considered to be unacceptable (> 1200 mg/L). However, all bores meet the livestock drinking water guideline value for TDS of 4000 mg/L.

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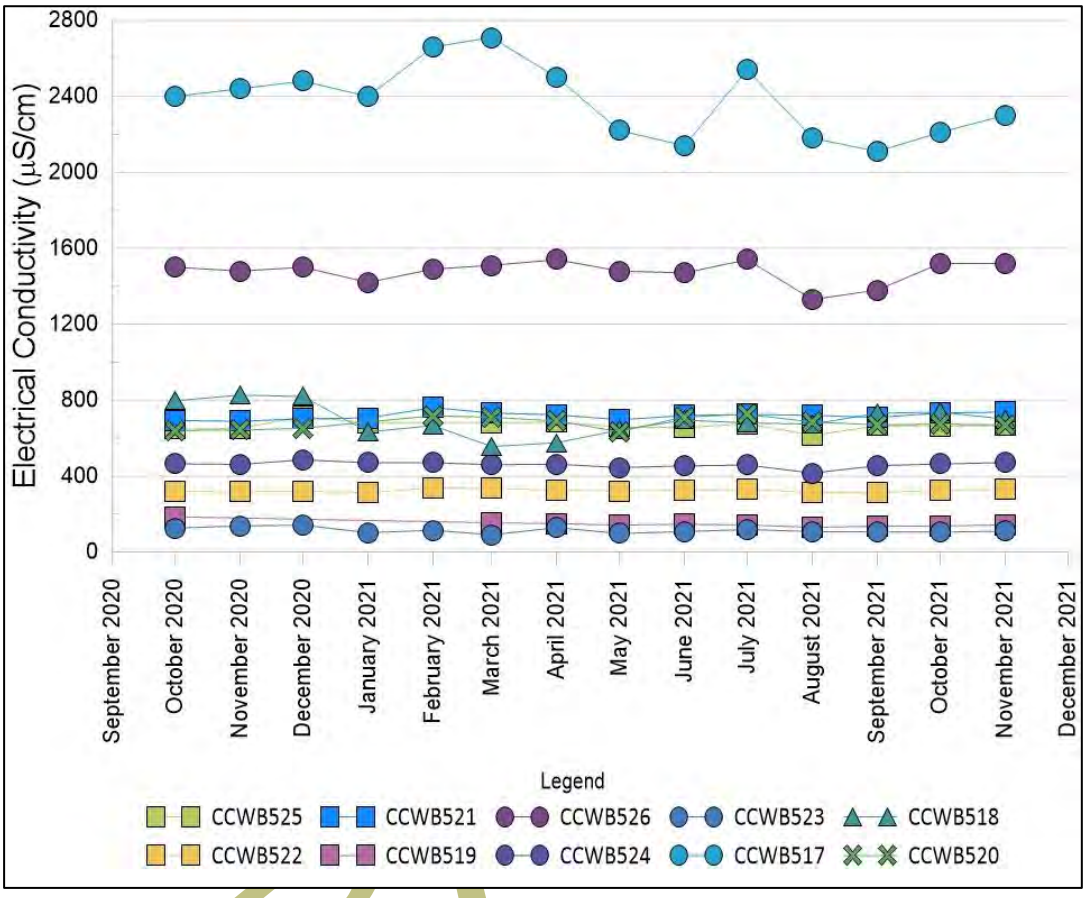



**Figure 13: Electrical conductivity values within the Agate Creek groundwater monitoring network.**

Table 7 and Figure 14 display the ionic composition of each bore sampled between October 2020 and November 2021. Table 7 expresses the median values calculated from the sixteen monitoring points whereby it has been determined that seven different water types exist within the Agate Creek bore network. The differing water types present are evident in the Piper diagram (Figure 14), with most bores forming individual clusters spatially excluded from one another. The dominant cation for most bores is sodium, whereas bicarbonate is the primary anion in eight of ten bores. CCWB518 and CCWB525 are distinguishably different due to calcium being the primary cation. The dominance of bicarbonate anions also explains the slightly alkaline pH values.

The variation in Figure 14 also visibly expresses the lack of similarities between bores screened within the same lithology. This further supports the understanding that – due to the design and construction of each borehole allowing water to enter from any depth – the expressed water types are mixtures of the various target aquifers present at Agate Creek.

**Table 7: Ionic composition percentage based on median value and specified water types.**

| Bore ID | Calcium | Magnesium | Sodium | Potassium | Carbonate | Bicarbonate | Chloride | Sulphate | Fluoride | Water Type |
|---|---|---|---|---|---|---|---|---|---|---|
| CCWB517 | 7% | 15% | 77% | 0% | 0% | 84% | 14% | 2% | 1% | Na – $CaCO_3$ |
| CCWB518 | 57% | 13% | 28% | 2% | 0% | 56% | 12% | 31% | 1% | Ca – $CaCO_3$ |
| CCWB519 | 22% | 34% | 36% | 7% | 1% | 59% | 23% | 16% | 1% | Na – Mg – $CaCO_3$ |
| CCWB520 | 33% | 10% | 52% | 4% | 0% | 57% | 19% | 24% | 1% | Na – $CaCO_3$ |
| CCWB521 | 5% | 2% | 92% | 1% | 1% | 45% | 24% | 22% | 6% | Na – $CaCO_3$ - Cl |
| CCWB522 | 19% | 5% | 70% | 6% | 0% | 64% | 14% | 17% | 4% | Na – $CaCO_3$ |
| CCWB523 | 21% | 12% | 41% | 25% | 1% | 61% | 24% | 14% | 1% | Na – Ca - $CaCO_3$ |
| CCWB524 | 34% | 20% | 34% | 11% | 0% | 59% | 7% | 33% | 1% | Na – Ca – $CaCO_3$ |
| CCWB525 | 41% | 28% | 23% | 8% | 0% | 22% | 38% | 40% | 0% | Ca – Mg – $SO_4$ – Cl |
| CCWB526 | 16% | 10% | 73% | 1% | 0% | 73% | 15% | 12% | 0% | Na – $CaCO_3$ |

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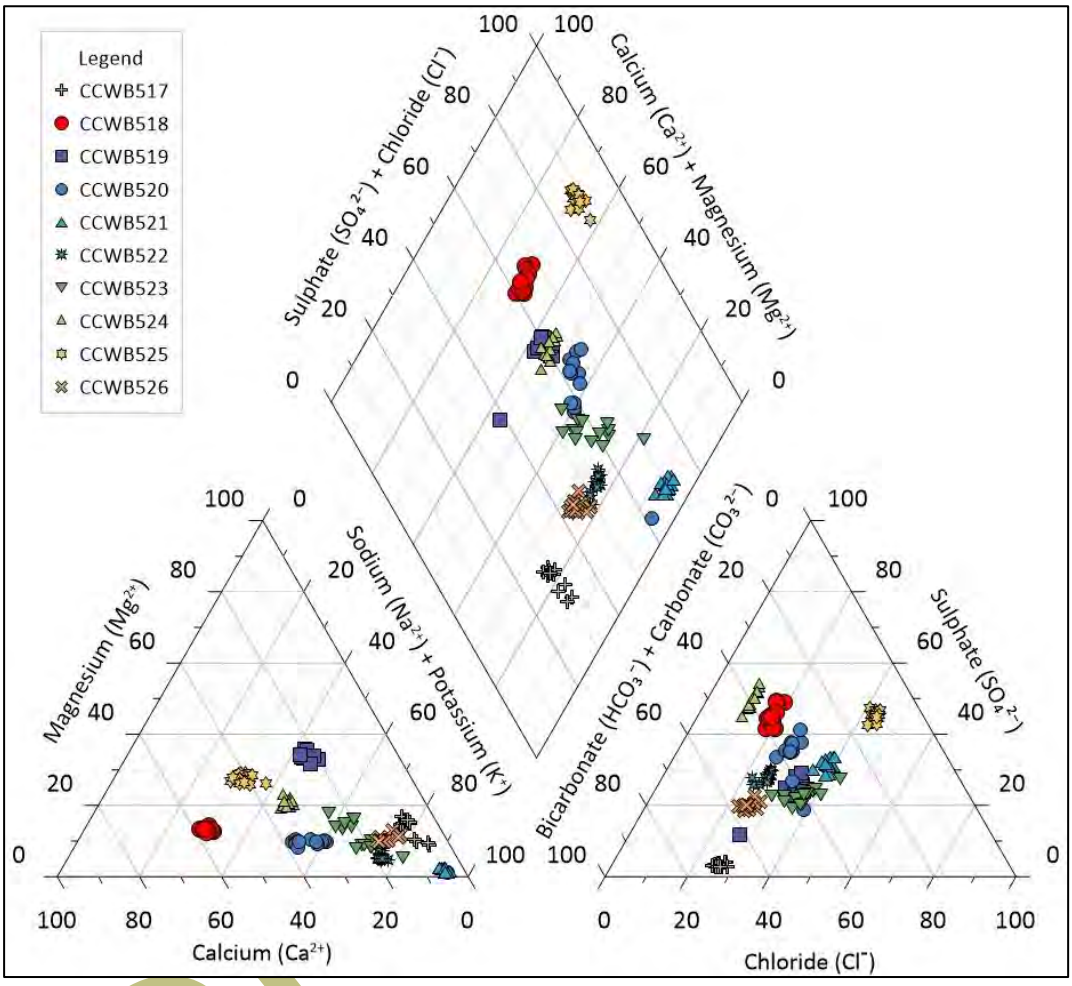



**Figure 14: Ionic composition of all groundwater samples collected from the Agate Creek bore network.**

ANZECC and ARMCANZ (2000) recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value. Where groundwaters are in good condition, the intent is to maintain existing water quality. Where groundwaters interact with surface waters, groundwater quality should not compromise identified environmental values and water quality guidelines for those waters. Due to the good nature of the groundwaters found in Agate Creek, excluding CCWB517 and CCWB526, analytes have been compared against the Australian guidelines for drinking water and ANZECC and ARMCANZ (2000) guidelines for livestock drinking water quality. For the dissolved metals and metalloids, the Australian drinking water guideline values are assessed, whereas total metals and metalloids are compared against guideline values presented in the livestock drinking water guidelines. The mean value calculated from the fourteen rounds of monitoring has been compared against the respective guideline values.

All bores excluding CCWB517 and CCWB526 are below the Australian drinking water guideline value of 600 mg/L for TDS. Whereas the water of CCWB526 is regarded as poor quality (900 – 1200 mg/L), CCWB517 is considered to be unacceptable (> 1200 mg/L). However, all bores meet the livestock drinking water guideline value for TDS of 4000 mg/L.

The guideline limits for fluoride are 1.5 mg/L and 2 mg/L for drinking water and livestock drinking water, respectively. Consequently, only four of the Agate Creek groundwater network report mean values below the human drinking limit, whereas six meet the livestock drinking water limit. Screened in the Corbett Formation Metasediments and positioned within close proximity to Agate Creek, CCWB521 fluoride concentrations are double that of any

other bore in the groundwater network (Figure 15). CCWB521 also displays the greatest level of variation over the 18-month moitoring period, ranging between 12.1 mg/L and 16.6 mg/L. Conversely, the southern-most bore (CCWB517) initially reported stable concentrations between October 2020 and February 2021. However, levels appear to have risen during the wet season, with concentrations increasing from 4.4 mg/L to 7 mg/L between February and April 2021. For the remainder of the monitoring period, concentrations have flucuated between 6 mg/L and 8 mg/L. Elevated levels of fluoride are consistent with crystalline rocks (i.e granite) which often contain fluorine-rich minerals that are encountered in most bores at Agate Creek. CCWB518, CCWB520, CCWB522 and CCWB524 also exceeded both drinking water guideline values, although all concentrations remained stable throughout the monitoring period. All fluoride concentrations at Agate Creek are deemed to be naturally occurring.

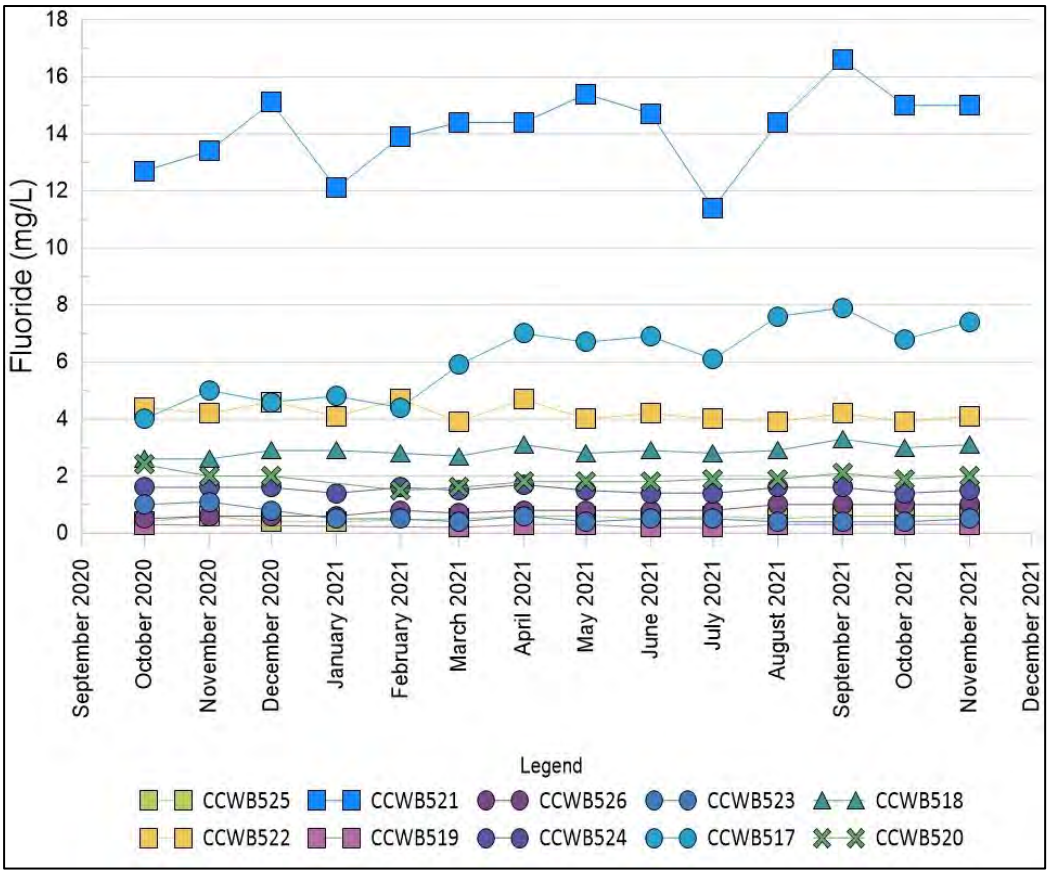



**Figure 15: Varying concentrations of fluoride over the monitoring period.**

The mean dissolved and total aluminium concentrations (0.1 mg/L and 5 mg/L, respectively) both exceeded the guideline values in CCWB519, CCWB520, CCWB521 and CCWB522, whereas only the mean dissolved aluminium values exceeded the guideline level in CCWB517 and CCWB523. Figure 16 displays the large degree of variation captured in total aluminium concentrations throughout the groundwater network over the monitoring period. No specific explanation has been provided, although it is most likely that the elevated levels are attributable to the sampling techniques and poor recharge. High-flow purging relies on sufficient recharge to remove three casement volumes from each bore prior to sampling. However, from the limited field data provided, it appears as though most bores at Agate Creek do not meet this criterion as per the Australia water sampling guidelines, with poor recharge limiting the purges to a single casement volume. Elevated colloids are often correlated with turbulent conditions or elevated levels of disturbances within the water column, possibly from sampling techniques implemented, which is associated with the large fluctuations in total aluminium (Figure 16).

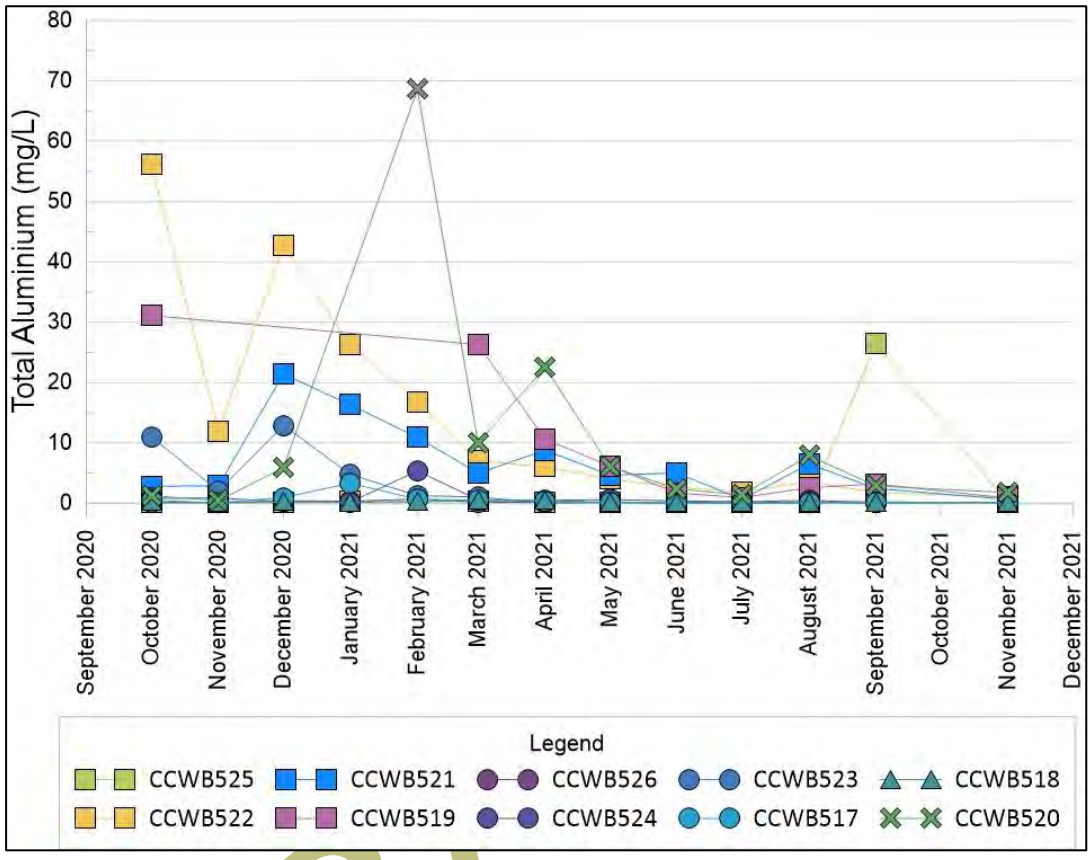



**Figure 16: Varying concentrations of total aluminium over the monitoring period.**

The mean dissolved arsenic concentrations of three bores (CCWB518, CCWB520 and CCWB521) exceeded the Australian drinking water guideline of 0.001 mg/L, with values ranging between 0.016 mg/L and 0.037 mg/L. CCWB518 is clearly distinguishable in Figure 17, with significantly elevated concentrations above any other bores in the network. Elevated levels of arsenic are attributed to the heavily altered geology intersected by CCWB518, drilling through multiple layers of veins, rhyolite and andesite. Dissolved arsenic concentrations in CCWB518 appear to show that the bore is requiring several months to stabilise following the drilling process, with levels fluctuating between 0.026mg/L and 0.071 mg/L over the initial four monitoring rounds and generally displaying a downward trend. Although elevated, CCWB520 and CCWB521 remained relatively stable through the monitoring period. Conversely, all mean values remained below the livestock drinking water guideline value for total arsenic of 0.5 mg/L.

The drinking water guideline limit for dissolved manganese is 0.5 mg/L. Although most bores do not exceed this limit, three bores have consistently recorded concentrations above that threshold. CCWB519 and CCWB522 had marginally elevated mean values of 0.72 mg/L and 0.55 mg/L, respectively, whereas CCWB525 reported a markedly higher mean value of 3.83 mg/L.

The only other metal or metalloid to exceed either the drinking water guideline or stock drinking water guideline is CCWB525 for dissolved nickel. The drinking water guideline for dissolved nickel is 0.02 mg/L, in comparison to the calculated mean for CCWB525 which equals 0.31 mg/L. The elevated dissolved nickel in CCWB525 correlates with the raised dissolved manganese concentrations. Dissolved manganese has a high adsorption capacity to available metals within the respective system. These naturally elevated levels are consistent with the weathered granite lithology encountered in CCWB525.

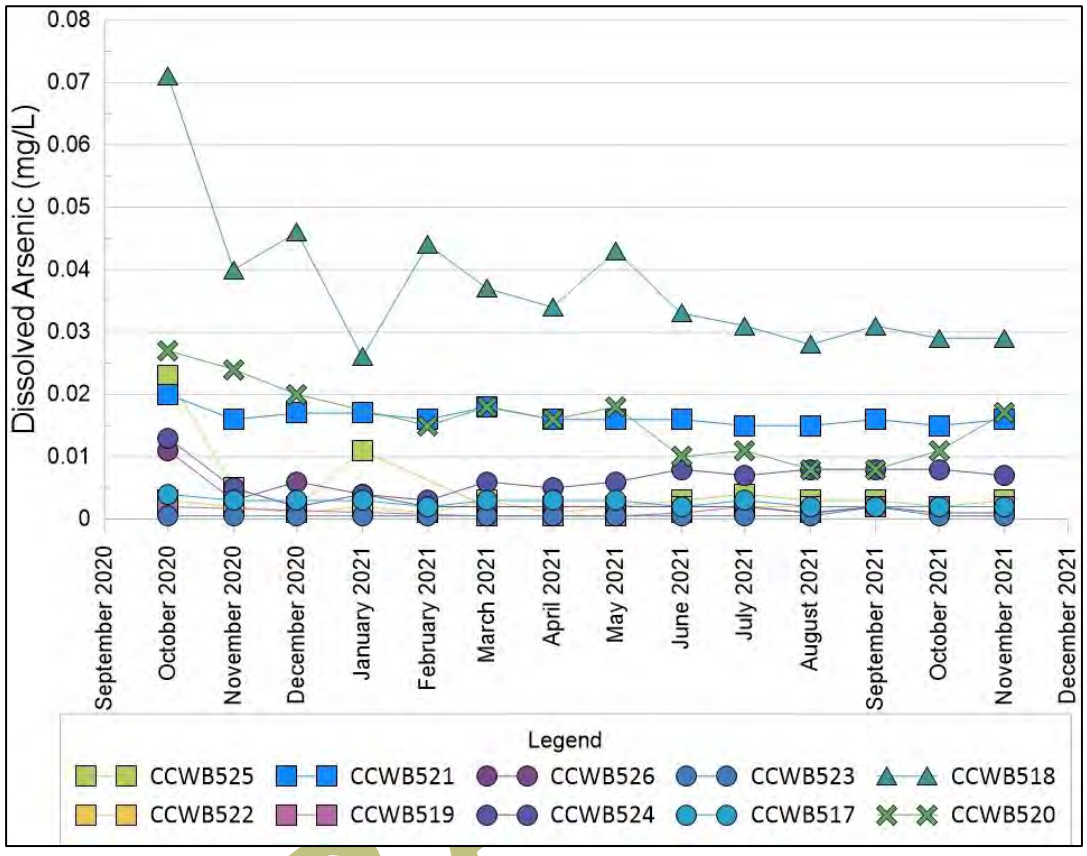



**Figure 17: Time series of dissolved arsenic across the groundwater monitoring network.**

All analytical times series can be reviewed within Appendix A.

## 5.5 YIELD AND USES

Exploration drilling data captured groundwater intersection depths and indicative airlift yields. Many of the drilled exploration holes intersected very low-yielding water. A number of exploration bores were drilled in the area between Sherwood West Fault and Zig Zag Fault – and areas where no groundwater monitoring bores were drilled. A number of these exploration holes – drilled along an east-west ridge line – indicate yields of 1 L/s to 10 L/s, aligning with a ridge line. Two of these exploration holes provide the production water supply and the camp supply (Figure 11). No further information has been provided regarding the bore holes which supply water for the site's production and camp facilities.

The assessment method for possible impacts from mining operations at Agate Creek included a bore network search whereby no other groundwater users were identified within a 5 km buffer. Therefore, it is concluded that the number of groundwater uses in the vicinity of Agate Creek is minimal.

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# 6. GROUNDWATER IMPACT ASSESSMENT

## 6.1 GROUNDWATER TAKE

Distances of the individual bores to the main mine pit were measured. This measurement was generally straightforward – with the exception of CCWB524 where ambiguity existed owing to the presence of a haul road. Furthermore, CCWB519 was assessed in relation to the main pit and proposed pit located within close proximity to the bore.

The inflow rates outlined in Table 6 have been utilised to calculate the relationship between groundwater flows and the main pit, whereby the rate of $m^3$/sec is converted to $m^3$/year (by multiplication by 86,400 and 365.25). Assuming all groundwater flows are directed towards the main pit, then:

(a) For the linear case, an inflow of 8,521.31 $m^3$/year may be predicted (16.20 L/min); and

(b) For the logarithmic case, an inflow of 5,958.51 $m^3$/year may be predicted (11.329 L/min).

Groundwater flows of CCWB519 into the small pit on the western flank are predicted to impact the void at a rate of 1.410 L/min.

It should be noted that these values must be considered worst-case scenarios.

From the flow rates and distances from the main pit, the individual flows from bores CCWB518, CCWB524 and CCWB525 are those most likely to impact the main pit (Figure 11). Flows from the three bores may all combine to give a flow of 7.686 L/min on a linear model and 4.828 L/min on a logarithmic model. These are considered relatively low flows and are reasonable estimates of likely inflows.

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## 6.2 ENVIRONMENTAL IMPACTS

The stage 2 expansion of the Agate Creek mine involves mining six different open-cut pits. The mine is currently working Pit 6 under the current EA that allows up to 200,000 tonnes of material to be extracted. However, further approval is required to mine Pit 6 deeper – exceeding the 200,000 tonnes limit – as well mining an additional five satellite pits.

### 6.2.1 GROUNDWATER RESOURCES

Hydraulic conductivities of all rocks within the Agate Creek site are very low to low ($10^{-8}$ to $10^{-7}$ m/sec) which implies that inflows into the main pit will also be low – 11,329 L/min to 16,201 L/min on a worst-case scenario or 4.828 to 7.686 L/min on a more likely scenario.

Impact on/from flows from CCWB524, CCWB525 and CCWB518 may occur on the main pit over a 4- to 31.5-year time span. However, it is more likely that this time span will be closer to 10 to 31.5 years. A low-flow impact (1.410 L/min) may occur on a 10-year time span from CCWB519 on the minor pit – and 125 m to the west of this bore. The two distant bores, CCWB517 and CCWB526, may experience an impact over at least an 80-year time span.

Any impacts are predicted to be minor and will remain on the mine lease over at least an 80-year time span. Considering all aforementioned factors, the overall risk to the sampled aquifers – and from the relatively small inflows into both the main pit and the minor pit to the west of CCWB519 – is very low to low.

### 6.2.2 GROUNDWATER USERS

The groundwater census completed within the 10 km buffer from Agate Creek found no registered groundwater bores. Accordingly, the impact to other groundwater users withing close proximity to Agate Creek is considered to be negligible.

### 6.2.3 GROUNDWATER-DEPENDENT ECOSYSTEMS

There are no formally identified groundwater-dependant ecosystems or springs within the mining extent. The nearest mapped groundwater-dependent ecosystem is a subterranean aquifer associated with the Hamstead Sandstone aquifer at Cobbold Gorge, downstream of the Agate Creek and Cave Creek confluence. The southern edge of this groundwater-dependent ecosystem is approximately 15 km northwest of the ML boundary. Considering the poor hydraulic conductivity measured and that the modelled minor drawdown will not surpass the mining lease boundary for several decades, it is unlikely that the activities at Agate Creek will interact with the associated groundwater-dependent ecosystems. Additionally, the potentiometric contours and associated difference between the bed of Agate Creek and CCWB521 support the understanding that the groundwater systems present within the mining lease do not impact or interact with flow in Agate Creek.

### 6.2.4 GROUNDWATER QUALITY

In general, the Agate Creek groundwater monitoring network currently expresses good quality water, with most bores meeting drinking water quality guidelines for both human and livestock consumption, excluding fluoride. The potential risk to groundwater from the mining operations at Agate Creek relate to the storage and interaction with waste rock. As part of this EA amendment application, Laneway and C&R have completed a waste rock characterisation assessment to determine the environmental implications of producing up to 200,000 tonnes of waste rock. Currently, only the intermediate results are available and will require further assessment dependent on the risk evaluation completed under the waste rock characterisation assessment.

However, initial results suggest that most waste rock contains benign lithology, which predominantly consists of felsic volcanics. The analysed pH values are impacted by the testing method (i.e. fluid extracted from crushed samples, with a very high surface area to solution ratio), it is expected that both the low and high pH results in the waste rock are a worst-case scenario. Therefore, it is envisaged that the pH of runoff from the proposed open-cut pits waste rock will not be as low or high as that reflected in the waste rock sample test results. Also, in order for significant runoff to occur at Agate Creek, the rainfall dilution factor should be greater than the 1:5 (sample:water) ratio used in the extract solutions. This, in turn, would counteract the resulting acidity or alkalinity. In general, most waste rock samples are in the slightly acidic range (Figure 18), indicative of the waste rock lithology (felsic volcanics).

The electrical conductivity of the Agate Creek waste rock samples ranges from 8 µS/cm to 4,860 µS/cm and has a low median value of 204 µS/cm. Most Agate Creek waste rock samples have low electrical conductivity values (<300 µS/cm) and, apart from the tailings dam samples, all waste rock samples have electrical conductivities below 1,000 µS/cm (Figure 19). The relatively low electrical conductivity recorded in most waste rock samples correlates with the good quality reported in the groundwater, whereby the highest electrical conductivity is approximately 2,400 µS/cm. It is therefore unlikely that seepage and infiltrations from the waste rock dumps into the groundwater system would cause detrimental effects to the water quality at Agate Creek.

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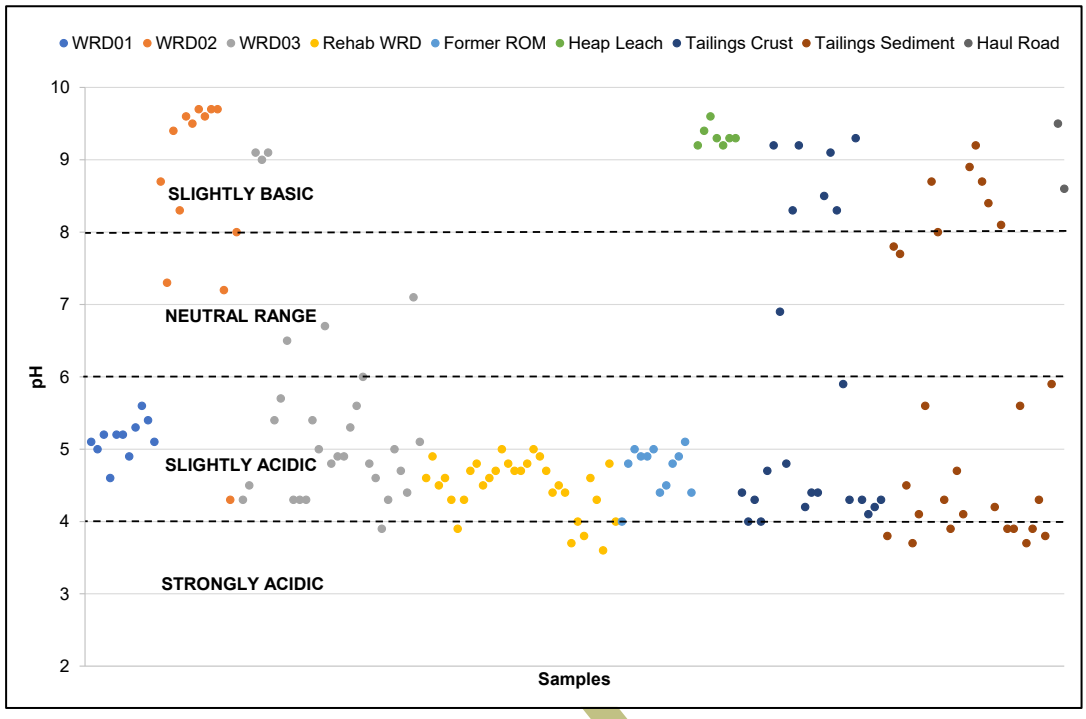



**Figure 18: pH values for Agate Creek waste rock samples.**

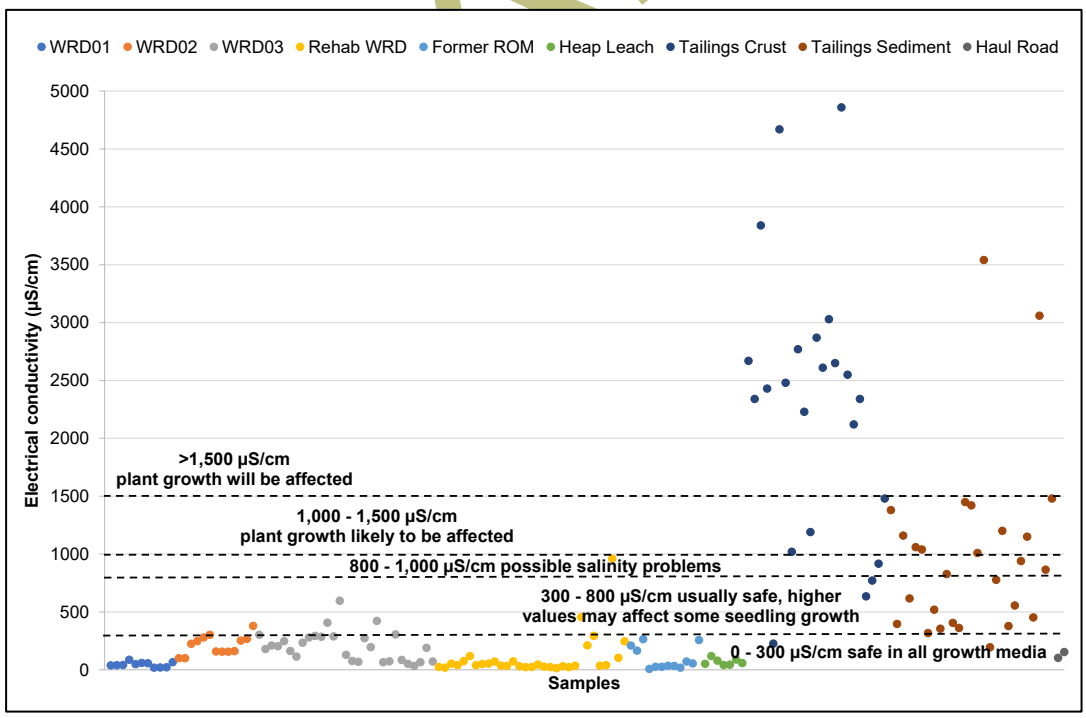



**Figure 19: Electrical conductivity for Agate Creek waste rock samples.**

The net acid generation (NAG) test is used to directly measure the net amount of acid produced by a waste rock sample.

Figure 20 demonstrates that most Agate Creek waste rock samples have a NAG(pH) greater than 4.5 and a NAPP value below 0. Therefore, they are not acid generating. In contrast, two samples have a NAG(pH) greater than 4.5 and a net acid production potential (NAPP) value above 0 (these are classified as uncertain PAF [potentially acid-forming]), whereas

one sample is certainly PAF, having a NAG(pH) less than 4.5 and a positive NAPP value (Figure 20).

A summary of the NAG(pH) versus total sulphur geochemical classification criteria for the waste rock samples is presented in Table 8.

**Table 8: Geochemical classification criteria for Agate Creek waste rock samples.**

| Geochemical Classification | Total Sulphur (%) | $NAG_{(pH)}$ | Pit 1 | Pit 2 | Pit 3 | Pit 4 | Pit 5 | Pit 6 |
|---|---|---|---|---|---|---|---|---|
| NAF (barren) | ≤0.1 | - | 11 | 10 | 15 | 30 | 11 | 7 |
| NAF (very low sulphur) | >0.1 to ≤0.55 | ≥ 4.5 | 0 | 3 | 11 | 0 | 1 | 0 |
| NAF (low sulphur) | 0.55 to 1.5 | ≥ 4.5 | 0 | 0 | 0 | 0 | 0 | 0 |
| PAF (very low sulphur) | 0.1 to ≤0.55 | < 4.5 | 0 | 0 | 1 | 1 | 0 | 0 |
| PAF (low sulphur) | 0.55 to 1.5 | < 4.5 | 0 | 0 | 1 | 0 | 0 | 0 |
| Percentage of NAF samples | | | 100% | 100% | 93% | 97% | 100% | 100% |
| Percentage of very low sulphur PAF samples | | | 0% | 0% | 3.5% | 3% | 0% | 0% |
| Percentage of low sulphur PAF samples | | | 0% | 0% | 3.5% | 0% | 0% | 0% |

Applying the NAG(pH) and total sulphur geochemical classification criteria (Table 8), it can be shown that most waste characterisation samples are non-acid forming (NAF; Figure 21).

Of the 225 Agate Creek waste rock samples, there are only three samples that could be categorised as PAF when the NAG(pH) and total sulphur values are considered:

- Two samples on WRD03, both of which occur in the same hole; and
- One sample on the rehabilitated waste rock dump.

These samples make up less than 4% of the total sample size for their respective areas – and their sulphur values are still very low to low. It is therefore expected that these three samples will not present an acid drainage issue because the amount of produced acid will be negligible; and any acid produced by the samples will be buffered by the surrounding NAF rock that makes up more than 90% of the waste rock. Therefore, the environmental risk of waste rock seepage and potentially acid rock drainage impacting the groundwater aquifers at Agate Creek is deemed to be low.

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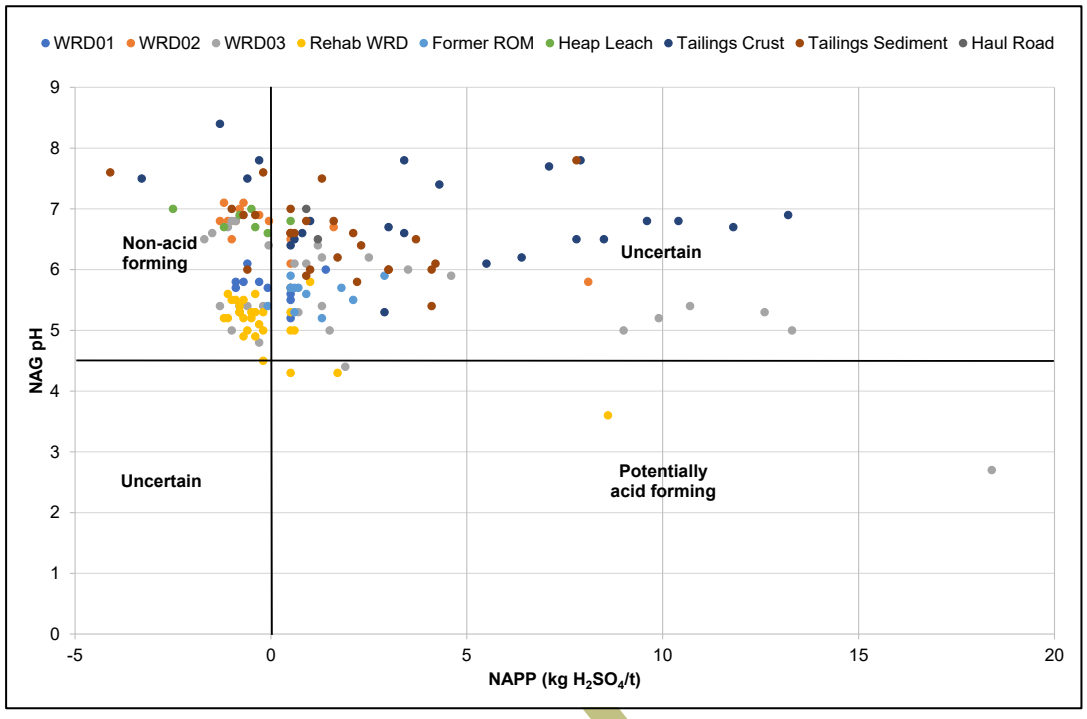



**Figure 20: $NAG_{(pH)}$ versus NAPP for Agate Creek waste rock samples.**

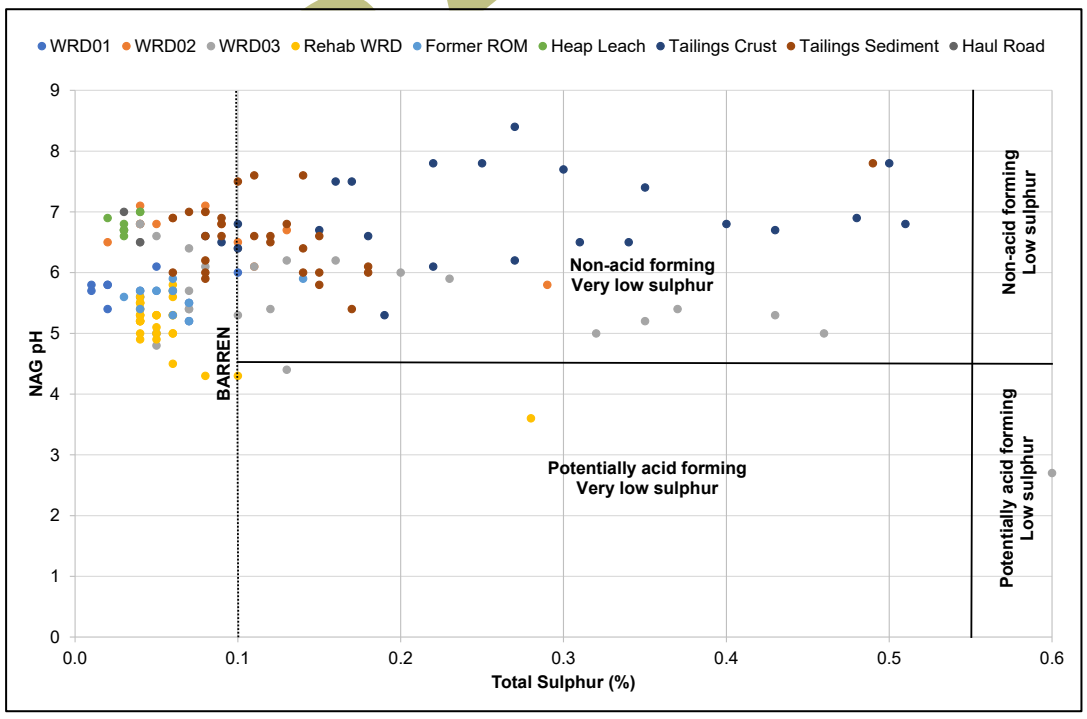



**Figure 21: $NAG_{(pH)}$ versus sulphur for Agate Creek waste rock samples.**

# 7. GROUNDWATER MONITORING PROGRAMME

The Agate Creek operations currently monitor an extensive groundwater bore network which comprises 21 monitoring bores located across the mining lease (Table 9). The purpose of the groundwater monitoring network is to monitor groundwater levels and quality in the primary aquifers potentially impacted by mining activities.

## 7.1 GROUNDWATER LEVEL AND QUALITY MONITORING

Groundwater levels will be measured and recorded on a monthly basis, which will enable the observation of natural groundwater level fluctuations – such as seasonal responses to rainfall. Standing water level monitoring must be able to distinguish the difference between natural fluctuations and potential mining activities.

Groundwater quality monitoring will be undertaken on a quarterly basis to enhance the existing baseline dataset available prior to commencement of the project. This will be used to detect any changes in groundwater quality during and post-mining. Water quality samples will be analysed for physico-chemical parameters – including pH, electrical conductivity, alkalinity, hardness, major ions (Ca, Mg, Na, K, Cl and $SO_4$) and dissolved and total metals and metalloids (Al, AS, B, Cd, Cr, Co, Fe, Pb, Mn, Hg, Mo, Ni, Se and Zn).

All samples for groundwater quality shall be collected after the bore is appropriately purged. Groundwater samples will be collected in accordance with the relevant guidelines and conventions specified in the *Monitoring and sampling manual* (DES, 2018), and in compliance with, for example, AS/NZS 5667:11 1998 (Australian/New Zealand standards, 2016). The samples will be preserved and forwarded to a National Association of Testing Authorities (NATA) accredited water laboratory for analysis.

The groundwater monitoring data will be reviewed annually, and the groundwater monitoring programme revised, as necessary. In the event that the monitoring programme identifies a significant departure from the prediction, an investigation will be undertaken to identify the cause and manage any unexpected impacts associated with the project.

## 7.2 NETWORK SUITABILITY

When assessing the suitability of the groundwater monitoring network, the construction issue – whereby no bentonite seal has been installed above the screens for all bores drilled in 2020 – must be addressed. Affected bores are identified with an asterisk in Table 9. These bores essentially represent open holes and therefore do not meet the minimum construction requirements for water bores in Australia. Accordingly, it is strongly recommended the monitoring bores drilled in 2020 are decommissioned and redrilled in accordance with the Australian guideline and implemented into the Agate Creek groundwater monitoring programme.

Additionally, minimal data have been provided for this assessment regarding the two extraction bores used on site for production and camp purposes. To ensure compliance with the UWIR, each extraction point must be fitted with a flow meter to accurately measure take volumes. This will provide additional scope for assessment when the annual groundwater reviews are completed to determine whether any impact has occurred to water levels and/or quality. Furthermore, specifics relating to the extraction points must be identified to ensure monitoring bores are screened within the same aquifers to accurately assess impacts of drawdown.

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**Table 9: Current groundwater monitoring programme (MGA: Map Grid of Australia; TBA: to be advised).**

| Bore ID | Easting | Northing | Ground level | Casing above ground (m) | Total depth | Screened interval |
|---|---|---|---|---|---|---|
| | MGA94 zone 54 | | m AHD | m | m BGL | |
| CCWB517* | 768400 | 7896463 | 435.6 | 0.6 | 55 | 49 – 55 |
| CCWB518* | 767768 | 7897706 | 431.4 | 0.6 | 73 | 67 – 73 |
| CCWB519* | 767302 | 7897863 | 517.18 | 0.62 | 85 | 79 – 85 |
| CCWB520* | 767947 | 7897838 | 434.96 | 0.59 | 73 | 67 – 73 |
| CCWB521* | 768701 | 7898079 | 420.94 | 0.6 | 73 | 67 – 73 |
| CCWB522* | 768762 | 7897724 | 434.2 | 0.6 | 73 | 67 – 73 |
| CCWB523* | 768321 | 7897579 | 449.6 | 0.61 | 73 | 67 – 73 |
| CCWB524* | 768174 | 7897670 | 496.06 | 0.64 | 91 | 85 – 91 |
| CCWB525* | 768167 | 7897930 | 498.77 | 0.62 | 103 | 97 – 103 |
| CCWB526* | 767710 | 7896909 | 449.4 | 0.66 | 73 | 67 –73 |
| CCWB527 | 767660 | 7897458 | 461.50 | TBA | 31 | 25 – 31 |
| CCWB528 | 767955 | 7898381 | 415.49 | TBA | 73 | 67 – 73 |
| CCWB529 | 770217 | 7900144 | 463.85 | TBA | 31 | 25 – 31 |
| CCWB530 | 767948 | 7898378 | 422.80 | TBA | 7 | 4 – 7 |
| CCWB531 | 767997 | 7898782 | 420.39 | TBA | 55 | 49 – 55 |
| CCWB532 | 770221 | 7900138 | 469.62 | TBA | 7 | 4 – 7 |
| CCWB533 | 769580 | 7900063 | 473.09 | TBA | 25 | 19 – 25 |
| CCWB534 | 768655 | 7895516 | 454.09 | TBA | 25 | 19 – 25 |
| CCWB535 | 768681 | 7897248 | 407.91 | TBA | 7 | 4 – 7 |
| CCWB536 | 768622 | 7897214 | 440.68 | TBA | 19 | 13 – 19 |
| CCWB537 | 768005 | 7898801 | 420.66 | TBA | 19 | 13 – 19 |
| CCWB538 | 768651 | 7895513 | 468.83 | TBA | 7 | 4 – 7 |

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## 7.3 UWIR Review

It is deemed the role and responsibility of Laneway to guarantee the implementation of the UWIR at Agate Creek. The UWIR is designed to align with the site's EA. Therefore, it is recommended that the monitoring programme stipulated in Section 7.1 forms part of the EA amendment for the expansion of mining at Agate Creek.

Furthermore, the recommendation to redrill all 2020 monitoring bores may significantly impact the water quality assessment completed as part of this report. Therefore, following the collection of 12 data points, all hydrochemistry data should be reassessed to ensure the identified environmental values remain applicable.

# 8. CONCLUSIONS

The Agate Creek is an open-cut gold mining operation proposal for a stage 2 expansion of mining activities which are to involve six different open-cut pits. The proposed expansion has been assessed for the level of impact on the surrounding aquifer systems.

The groundwater monitoring network consists of ten monitoring bores within an area of approximately 1.5 $km^2$ that incorporates all six proposed voids. The network targets a section of the regional-scale Robertson Fault Zone and the northwest end of the Agate Creek Volcanic Complex. Specifically, all bores are screened within metamorphic rocks that have been intruded by Siluro-Devonian-age Robin Hood Granodiorite – and by early Permian rhyolitic and andesitic dykes and stocks that are related to the Agate Creek Volcanic Complex.

However, the construction of the ten monitoring bores has impinged on the ability to accurately assess the potential impact of mining activities on the local groundwater aquifers. The omission of a bentonite seal above the screened interval has resulted in essentially open boreholes, where water can enter into the bore from any depth.

The geological lithologies present (granite, rhyolite, andesite, metasediment and veins) – and the data provided in numerous sources (including Brassington, 1988) – indicate that the hydraulic conductivities of the lithologies at Agate Creek are in the very low to low range. This was later confirmed – with pump tests completed on each monitoring bore, whereby hydraulic conductivities ranged between 6.57 x $10^{-8}$ m/sec and 5.06 x $10^{-7}$ m/sec. Although not ideal, the construction of the bores has not significantly impacted on these results because the calculated hydraulic conductivity represents the fastest of all aquifers present. Any impacts are predicted to be minor and will remain on the mine lease over at least an 80-year time span. Therefore, the expansion of mining activities at Agate Creek presents an overall very low to low risk to the aquifers sampled from the relatively small inflows into both the main pit and the minor pit to the west of CCWB519

Additionally, the impact to users is deemed to be negligible. Excluding the designated Agate Creek monitoring bores, no groundwater bores were identified within a 5 km buffer from the mining lease boundary. Further, the closest GDE is associated with the sandstone aquifer approximately 10 km away. Two springs were identified by helicopter and therefore little to no information is known about dynamics of the individual systems – although both springs are considered permanently active.

The potentiometric surface suggests that the groundwater flow direction follows the surface topography whereby water moves from high elevation on the western boundary (CCWB519) to low elevation beside Agate Creek (CCWB521). The elevation difference between the bed of Agate Creek and CCWB521 supports the understanding that the groundwater systems present within the mining lease do not impact or interact with flow in Agate Creek.

The groundwater across the bore network represents good quality water, with most bores reporting properties below guideline values for drinking water and livestock drinking water, except for. The greatest threat to water quality with the expansion of the Agate Creek mining operations comes from the increased volume of waste rock present on the surface. However, most waste rock samples returned pH, electrical conductivity and NAF properties which present low environmental risk to surrounding groundwaters. Typical of the surrounding geology, much of the waste rock is benign, with elevated levels attributed to samples collected from within the ore body.

Based on the available data, this groundwater assessment has determined that the expansion of the Agate Creek mining operations would present a low environmental risk to the hydrogeological systems present.

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# Appendix A – Analyte timeseries

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# Appendix H: Savannah Goldfields Limited Community Consultation Plan and Register



# SAVANNAH GOLDFIELDS COMMUNITY CONSULTATION PLAN AND REGISTER

## AGATE CREEK GOLD MINE AND GEORGETOWN GOLD PROJECT

Savannah Goldfields Limited

DECEMBER 2022

WULGURU TECHNICAL SERVICES

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**Document Control and History**

| Version | Date | Description | Prepared By | Reviewed By |
|---|---|---|---|---|
| 1.0 | 5/12/2022 | Final | Jessica Crabb | Madison Jackson |

**Citation**

Wulguru Technical Services, 2022, *Savannah Goldfields Limited – Community Consultation Plan*, Prepared by Wulguru Technical Services Pty Ltd for Savannah Goldfields Limited.

# 1. Introduction

Savannah Goldfields Limited (herein referred to as SVG) (formerly Laneway Resources Limited) owns and operates the Agate Creek Gold Mine (Agate Creek) and Georgetown Gold Project under Environmental Authorities EPSL03068015 and EPML00899813 respectively.

Wulguru Technical Services have developed this CCP for SVG in accordance with the Guideline for PRCPs and section 126C(1)(c)(iii) of the Environmental Protection Act 1994. This CCP has been designed to facilitate ongoing engagement with stakeholders, detail how ongoing consultation will continue, and keep a register of community consultation information.

Agate Creek and the Georgetown Gold Project are located within the Etheridge Shire Council in far north Queensland.

The Ewamian People are the traditional owners of land the country that occupies the Gulf of Carpentaria savannah lands in the upper Gilbert and Einasleigh River catchments (Ewamian Aboriginal Corporation, 2021). As of the 2016 Census 5.5% of Etheridge shire identifies as Aboriginal and/or Torres Strait Islander (ABS, 2016).

## 1.1. Agate Creek Gold Mine

Agate Creek is located off Rungulla Road, approximately 40km south-west of Forsayth. SVG commenced operations at Agate Creek during 2019 which consisted of the extraction of gold ore via open cut methods with ore exported offsite.

SVG have proposed an amendment to the EA to expand operations across the Sherwood and Sherwood West resource areas under ML100030, extracting up to 250,000 tpa of gold ore across six individual open cut pits. SVG are also transitioning to a Progressive Rehabilitation and Closure Plan (PRCP) which requires a Community Consultation Plan (CCP).

**Table 1. Agate Creek Real Property Description**

| | |
|---|---|
| **Company Name – ABN** | Laneway Resources Pty Ltd – 75 003 049 714 |
| **Lot on Plan** | Lot 2 on SP242983 and Lot 7 on SP275179 |
| **Mining Lease** | ML100030 |
| **Property Size** | 689.3 ha |
| **Local Government Area** | Etheridge Shire Council |
| **Zoning Information** | Rural |

## 1.2. Georgetown Gold Project

The Georgetown Gold Project is located across multiple Mining Leases (MLs), approximately 280 km southwest of Cairns, North Queensland. The Georgetown Gold Project includes the Georgetown Process Plant (the Plant) and satellite mining operations currently held in care and maintenance.

**Table 2. Georgetown Process Plant Real Property Description**

| | |
|---|---|
| **Company Name – ABN** | Laneway Resources Limited – 75 003 049 714 |
| **Lot on Plan** | 53 on SP242966 |
| **Mining Leases** | ML3591, ML3540, ML3409 |
| **Site Area** | 80.9 ha |
| **Local Government Area** | Etheridge Shire Council |
| **Zoning** | Rural |

**Table 3. Georgetown Gold Project Mining Lease(s)**

| Mining Lease | Location | Title |
|---|---|---|
| **ML3591, ML3540, and ML3490** | 5 km SW of Georgetown | Georgetown Process Plant |
| **ML3548** | 14 km NNE of Georgetown | Electric Light |
| **ML30203** | 43 km NNE of Georgetown | Red Dam |
| **ML3374** | 62.5 km SSE of Georgetown | Jubilee Plunger |
| **ML30192** | 31.9 km NNW of Georgetown | Philey's |
| **ML30193** | 32.8 km NNW of Georgetown | Rhyolite |
| **ML30195** | 22.3 km NNW of Georgetown | Tom's |
| **ML30196** | 25.9 km NNW of Georgetown | Sir William Alfred |

## 2. Objectives for Community Consultation

Social license is a valued element of SVG's operations. SVG aims to enhance social outcomes in the surrounding region in which they operate. This CCP has been prepared to enable and enhance targeted stakeholder engagement and community participation.

The objectives of the CCP are described in Table 4.

**Table 4. CCP Objectives**

| CCP Objective | Description |
|---|---|
| Identify stakeholders who have an interest in the projects. | Key stakeholders have been identified in Table 5. |
| Facilitate two-way engagement with stakeholders. | Existing communication channels, described in Section 3.2, will continue to be made available, such as face-to-face meetings and email. Additional communication methods will be implemented as and if required. |
| Provide accurate, timely and relevant information on the projects. | Communication with stakeholders will be undertaken in an appropriate format (Section 3.2) to ensure a common understanding of outcomes, objectives and any potential concerns or issues. |
| Identify any concerns or potential issues stakeholders may have with the projects. | Existing communication channels (Section 3.2) will be utilised to identify any concerns or potential issues stakeholders may have with the projects. If concerns are identified, SVG will respond promptly. |
| Explore areas of the projects with the potential to have a positive impact on the region. | SVG will continue to work with stakeholders to identify opportunities for supporting the local |

| | |
|---|---|
| | community and having a positive impact on the region (Section 3.6). |
| Develop appropriate strategies to mitigate any concerns. | Community concerns will be responded to promptly and with the correct information. All forms of feedback will be recorded within a register to identify any stakeholder engagement trends which can be appropriately responded to, managed and addressed (Section 3.6). |

# 3. Community Engagement

## 3.1. Stakeholders

Initial scoping has identified key stakeholders directly and/or indirectly affected by activities at Agate Creek or the Georgetown Gold Project. The stakeholders that may participate in the consultation process are summarised in Table 5.

**Table 5. Key Stakeholders**

| Community Stakeholder | Details | Interest |
|---|---|---|
| **Relevant Community Stakeholders** | | |
| Local Stations | Land within and surrounding Agate Creek and the Georgetown Project Mining Leases is used for grazing. Compensation Agreements are in place between SVG and landholders. | • Future access to land covered by the ML<br>• Rehabilitation outcomes<br>• Environmental impact and management<br>• Water access |
| Traditional owners | The Ewamian Limited are the traditional owners of the land on which Agate Creek and the Georgetown Gold Project is situated. Agreements between SVG and Ewamian Limited are in place. | • Cultural heritage impacts<br>• Environmental impact and management<br>• PMLU<br>• Impacts on Native Title |
| Utility owners<br>• Department of Transport and Main Roads<br>• Ergon Energy | Department of Transport and Main Roads, and Ergon Energy own assets within or adjacent to Agate Creek and the Georgetown Gold Project. SVG engage with utility owners on an as needs basis. The PRCP will not require an update to any agreements. | • Rehabilitation and impacts to assets<br>• Disruption of access to assets<br>• Impacts to asset value |
| Local Government | The projects are within the Etheridge Shire Council region. Agreements, including road maintenance, are in place between SVG and the Etheridge Shire Council. | • Local opportunities<br>• Economic and community sustainability<br>• Environmental impact and management<br>• Effects on Council assets<br>• Mine rehabilitation<br>• PMLU<br>• Compliance with the Etheridge Shire Council Planning Scheme |
| **Other stakeholders** | | |

| Community Stakeholder | Details | Interest |
|---|---|---|
| SVG employees and contractors | All SVG personnel and contractors are expected to be interested in closure planning where it may be thought to impact employment security. Other interests can include working conditions, training and employment, and economic benefit. | • Job retention<br>• Loss of jobs with closure<br>• Living conditions<br>• Working conditions<br>• Training and development<br>• Economic development and benefit |
| Community members and group | Affiliated communities' members and organisations of the Georgetown and Forsayth region. | • Job opportunities<br>• Job retention<br>• Loss of jobs with closure<br>• Environmental impact and management<br>• PMLU<br>• Rehabilitation |
| Queensland Government | Government organisations with invested interest in Agate Creek and the Georgetown Gold Project including:<br>• Department of Resources<br>• Department of Environment and Science<br>• Etheridge Shire Council<br>• Mayors and Councillors of the Etheridge Shire Council<br>• Electorate member for Traeger<br>• Minister for Natural Resources, Mines and Energy<br>• Minister for the Environment and the Great Barrier Reef and Minister for Science and Youth Affairs | • Resource development<br>• Job opportunities<br>• Job retention<br>• Environmental impacts and management<br>• Rehabilitation cost<br>• Environmental risk<br>• PMLU |
| Federal Government | Department of Agriculture Water and Environment (DAWE) | • Resource development<br>• Job opportunities<br>• Job retention<br>• Environmental impacts and management<br>• Rehabilitation cost<br>• Environmental risk<br>• PMLU |

## 3.2. Engagement

Consultation will be undertaken on an ad hoc basis, as requested by the relevant stakeholder.

SVG will continue to promote and maintain easily accessible lines of communication between residents, land holders, and other stakeholders reasonably expected to be affected by the activities to ensure that social, cultural heritage, and environmental impacts are identified and managed. Community engagement may include meetings (face to face or virtual), email or other written correspondence, phone, or facsimile. Contact channels are provided on the SVG website and are also provided in other

notices and communications. SVG have already established good relationships and agreements with various stakeholders including landholders, Ewamian Limited, and Etheridge Shire Council.

SVG consider local employment and spending a priority for promoting community engagement and sustainable development of the local workforce and business.

### 3.3. Approach

This CCP has been prepared in accordance with SVG values. The engagement process will aim to:

- Target the relevant communities and stakeholders;
- Provide meaningful, understandable, and sufficient information and resources to the community and stakeholders;
- Focus on relevant topics of the PRCP and other associated concerns;
- Remain supportive and encourage two-way exchange of engagement;
- Provide an inclusive, diverse, and culturally appropriate engagement events and discussions;
- Remain free of coercion; and
- Document information, discussions, and feedback.

### 3.4. Rehabilitation

The principal objective of rehabilitating the disturbance areas of Agate Creek and the Georgetown Gold Project is to return the land to a pre-mining state with a land use cohesive to the surrounds and local economy.

Community consultation will improve understanding of the community's and landholders wants and needs, in relation to post mining land uses. Some mining domains such as tracks or water storages may be retained for future use of the landholder(s) if agreeable and will assist in enhancing the capability of the land and region.

### 3.5. Information to be Provided

Information to be provided to the community and stakeholders may include;

- Post Mining Land Use areas;
- Non-Use Management Areas;
- Mining infrastructure with the potential to be retained for use after closure through agreement;
- PRCP document and supporting information; and
- PRCP audits.

Other relevant information may be provided by SVG to stakeholders upon request (i.e., environmental monitoring plans).

### 3.6. Community Feedback

Feedback from the community and stakeholder engagement is to be encouraged by SVG as it is considered to have the potential to provide helpful insights into how the projects and SVG may represent risks and opportunities in the community. This may also include providing helpful ideas and changes moving forward. Community feedback may also provide indication that some stakeholders may not desire to be further involved or consulted as community engagement participants.

Where able, the feedback captured from community engagement should be demonstrated in latter engagement events.

## 4. Community Consultation Register

In accordance with the Environmental Protection Act 1994 Section 126C(1)(c)(iv), a Community Consultation Register has been developed for the Agate Creek and Georgetown Gold Project (Table 6). It has been designed to record the necessary information from community engagement events. The community consultation register will be mainetained throughout the life of the project through to closure. The register will be regularly reviewed to identify trends and opportunities for improvement.

**Table 6. Community Consultation Register**

| Date of Consultation | Community Members Involved | Consultation Type (i.e., workshop, meetings, etc.) | Relevant Projects | Information provided to the community | Issues raised and discussed | How have the issues been considered? | Decisions and outcomes of the engagement | Commitments made by the applicant |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

# Appendix I: Agate Creek Rehabilitated Disturbance Areas (WTS, 2022)

# TECHNICAL MEMORANDUM

| | | | |
|---|---|---|---|
| **TO** | Scott Hayes-Stanley | **DEPT** | Approvals and Compliance |
| **FROM** | Delwyn Windridge | **OFFICE** | Wulguru Technical Services Pty Ltd, Townsville |
| **EMAIL** | delw@wulgurutechservices.com.au | **PHONE** | (07 4419 7484) |
| **PROJECT TITLE** | Agate Creek Gold Mine Expansion Project | | |
| **SUBJECT** | Agate Creek Rehabilitated Disturbance Areas | | |
| **DATE** | 14 November 2022 | **OUR REF** | 2022.09001_ Agate Creek Rehabilitated Disturbance Areas Technical Memo_20221103_V1.0 |

## 1. Introduction

Agate Creek Gold Mine (Agate Creek) is owned and operated by Savannah Goldfields Limited (SVG) (formerly Laneway Resources Limited). Mining activities commenced at Agate Creek in 2019 under Environmental Authority ESPL03068015. SVG are currently seeking to amend the EA to allow for the expansion of operations within the mining lease (ML100030).

The conditions of the existing EA state: The conditions of approval for this environmental authority are the standard conditions contained within *Code of environmental compliance for Mining Lease Projects – Version 1.1* and the following variation condition:

> V1: All exploration activities carried out on the mining leases must comply with each of the Standard Environmental Conditions contained in the *Eligibility criteria and standard conditions for exploration and mineral development projects* (standard conditions).

The follow conditions of the standard conditions relate to the rehabilitation of relevant disturbance areas:

> Condition B25: For all other areas (other than Riverine Areas as per condition B24) on the mining tenement, the holder of the environmental authority must complete the rehabilitation processes on all areas disturbed by mining activities, apart from those areas currently being utilised for mining activities, as soon as practical and at least within six months of the completion of works in those areas: and
>
> Condition B28: The holder of the environmental authority must rehabilitate areas disturbed by mining activities to a stable landform similar to that of surrounding undisturbed areas.

The rehabilitation of a number of historic exploration tracks and other disturbance areas has been undertaken over the course of the life of the project and it is likely that some of these areas can be removed from the total disturbance area applicable to the EA.

This technical memo provides a summary of the rehabilitated areas and the results of a preliminary assessment of vegetation within a sample of existing rehabilitation areas to support the removal of historic disturbance areas from the total disturbance area.

### 1.1. Site Description

Agate Creek is located in northwest Queensland, approximately 40 km southwest of Forsayth within the Etheridge Shire Council region on Lot 2 on SP242983 and Lot 7 on SP275179 (Table 1).

Agate Creek commenced production in 2019 with the establishment of the Sherwood open cut pit within the Sherwood Resource area. Mined ore is transported to the Run of Mine (ROM) pad prior to being exported offsite for processing. Associated mining domains include the Sherwood open cut waste rock dump, and other Mine Infrastructure Areas (MIA) including haul roads/access tracks, camp, administration facilities and core shed.

**Table 1 Property Description**

| | |
|---|---|
| **Company Name - ABN** | Laneway Resources Pty Ltd – 75 003 049 714 |
| **Lot on Plan** | Lot 2 on SP242983 and Lot 7 on SP275179 |
| **Mining Lease** | ML100030 |
| **Property Size** | 689.3 ha |
| **Local Government Area** | Etheridge Shire Council |
| **Zoning Information** | Rural |

ML100030 is situated on the boundary of two bioregions, Gulf Plains (GUP) and Einasleigh Uplands (EIU), with the boundary between the two being roughly located where the Corbett Formation meets the Hampstead Sandstones. As a result, the mapped Regional Ecosystems (RE) in the ML comprise both GU and EIU REs adding complexity to the potential REs present.

## 2. Desktop Assessment

There are several historical disturbance areas mapped within the mine lease that have been rehabilitated post use. Historical exploration tracks and more recently rehabilitated waste rock dumps (WRD) continue to contribute to the total disturbance area for the project.

### 2.1. Historical Exploration Disturbance Areas

Prior to the commencement of operations, extensive exploration activities were undertaken by interested parties and date back to 1997. Some of these exploration areas have been assumed into the existing mining operations and/ or have been designated for post mine use under a landholder agreement as per condition B30 of the standard conditions. The remaining exploration disturbance areas have been designated for rehabilitation and/ or rehabilitated and while the methodologies used are unavailable due to the extensive history of the site, the available data relating to the monitoring of rehabilitated areas (Database: Rehabilitation_Spreadsheet_Agate-

Master) indicates that both active and passive rehabilitation methods were used following completion of the drilling activities.

The rehabilitated track areas are currently mapped as Rehabilitated Exploration Track on the Agate Creek domain mapping. While there are no allocated Post Mine Land Use (PMLU) values allocated for disturbance areas under the existing EA, it is likely that these areas meet the condition B28 criteria given the linear footprint associated with the tracks of the drilling program and time elapsed since the completion of much of the exploration activity. In accordance with condition B28 of the standard conditions, the prescribed criteria for a disturbance area is a stable landform similar to that of surrounding undisturbed areas. Comments in the rehabilitation site monitoring data also indicate that the rehabilitation sites are meeting the prescribed criteria with respect to stability and vegetation establishment.

The rehabilitation areas associated with the exploration programs consist of 9.94 km of exploration track at a width of 2.8 m. The total rehabilitation area equals 2.783 ha (Figure 1).

Two Regional Ecosystems (REs) are associated with the rehabilitated exploration track areas. The mapped RE for the greater area of rehabilitation is currently mapped as comprising RE 2.11.1a: "*Eucalyptus crebra* woodland, occasionally with *Corymbia pocillum*. The ground layer is grasses, including *Aristida* spp., *Bothriochloa* sp. and *Triodia pungens*. Occurs on steep rugged Metamorphic hills, often with sandstone caps." Geological surveys of the area, however, indicate that the surface geology associated with the location is comprised of Robin Hood Granodiorite associated with the Corbett Formation and the area was subsequently ground-truthed by SLR in 2021 surveys as RE 9.12.11: *Eucalyptus crebra* and/or *E. whitei* +/- *Corymbia erythrophloia* open woodland on steep to rolling hills on igneous rocks.

The mapped RE for the lesser of the rehabilitation areas is currently mapped and ground-truthed as 2.10.5a: *Acacia shirleyi* woodland and *Triodia pungens* hummock grassland on scarps and stony ledges.

All rehabilitated exploration tracks are currently mapped as remnant vegetation. A summary of the rehabilitated exploration tracks is provided in Table 2.

## 2.2. Waste Rock Dump Area

A 0.93 Ha area of the existing waste rock dump was rehabilitated in 2019 (Figure 1). The seed mix used for rehabilitation was unavailable at the time of the writing. The pre-clearance regional ecosystem for the area is currently mapped as comprising RE 2.11.1a and, as above, was subsequently ground-truthed by SLR in 2021 surveys as RE 9.12.11: *Eucalyptus crebra* and/or *E. whitei* +/- *Corymbia erythrophloia* open woodland on steep to rolling hills on igneous rocks.

There is no allocated Post Mine Land Use (PMLU) allocated for disturbance areas under the existing EA with standard conditions. In accordance with condition B28 of the standard conditions, the acceptable criterion for disturbance areas is that of a stable landform similar to that of surrounding undisturbed areas.

**Figure 1 Site Location**

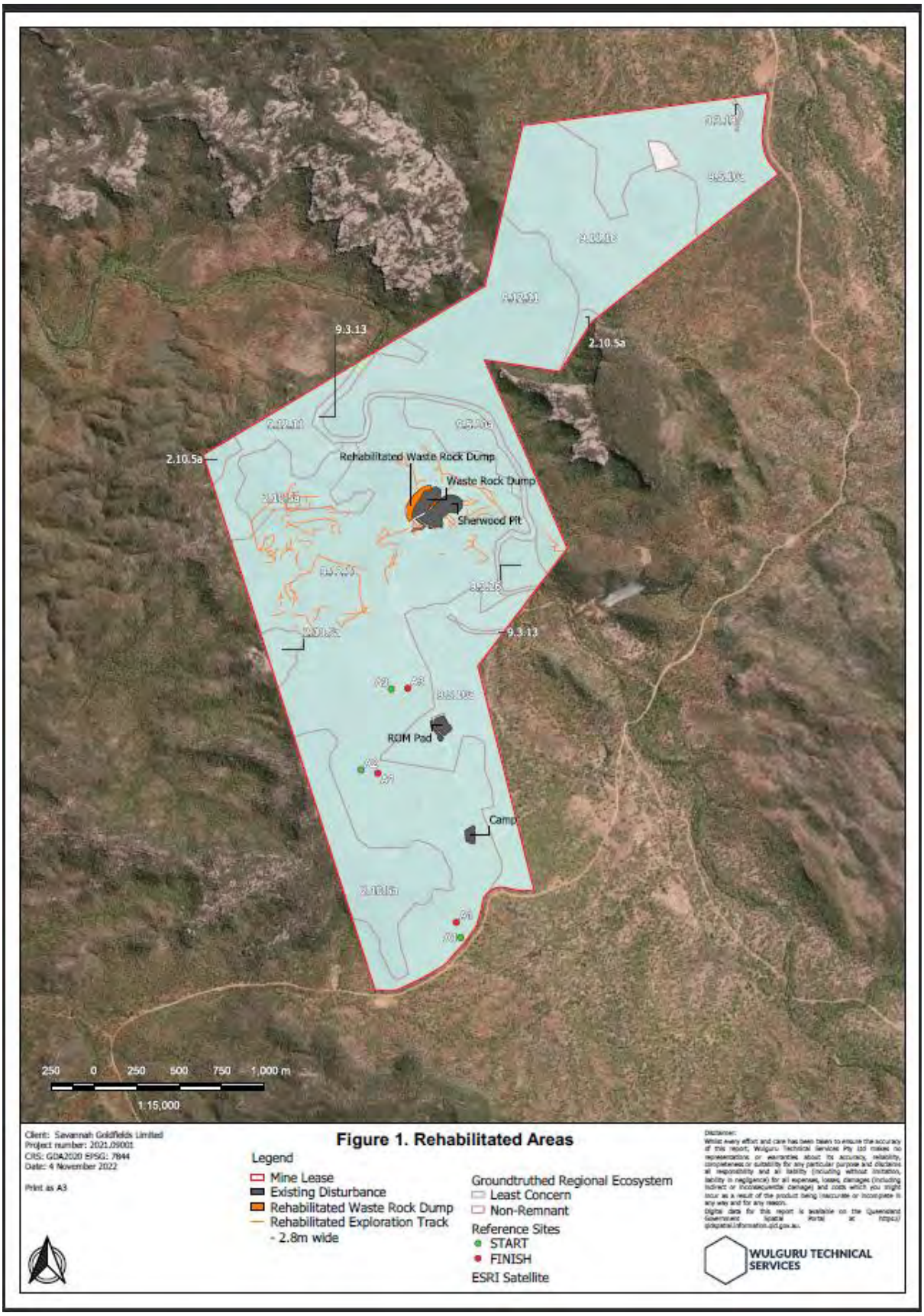


**Table 2 Summary table of rehabilitated disturbance areas**

| Rehabilitation Area | Domain | Area (ha) | Activity Date | Decomission Date | Rehabilitation Date (passive or active) | PMLU | Monitoring activities and comments | Surrounding undisturbed areas or Pre-clear RE# |
|---|---|---|---|---|---|---|---|---|
| ASH tracks (4.284 km) | Rehabilitated exploration tracks | 1.20 | 1996-2009 | No later than 2010 | No later than 2010 | Condition B28 | *Numerous locations monitored, comments include: no evidence of erosion, monitor only, regrowth, good regrowth, moderate vegetation and on track. | RE 9.12.11 |
| ASW tracks (4.945 km) | Rehabilitated exploration tracks | 1.38 | 1996-2010 | No later than 2010 | No later than 2010 | Condition B28 | *Numerous locations monitored, comments include: no evidence of erosion, monitor only, regrowth, good regrowth, and on track. Only two locations indicate the need for contouring. | RE 9.12.11 and 2.5.10a |
| Sherwood West (0.707 km) | Rehabilitated exploration tracks | 0.2 | 2014 | 2018 | No later than 2015 | Condition B28 | *Numerous locations monitored, comments include: no evidence of erosion, monitor only, good regrowth, good vegetation and on track.<br>Vegetation largely consistent with remnant vegetation in the surrounding area | RE 9.12.11 |
| Waste Rock Dump | Rehabilitated waste rock dump | 0.93 | 2019 | 2020 | 2020 | Condition B28 | Rehabilitation established and consistent with succession growth phases | RE 9.12.11 |

**Information from Database: Rehabilitation_Spreadsheet_Agate- Master.*
*#RE - Vegetation management pre-clear regional ecosystem map - version 12.02.*

# 3. Methodology

## 3.1. Reference Sites

Relevant reference sites were selected based on the pre-existing regional ecosystem (which may be the pre-clearance RE or that of a ground-truthing survey) and using the *Method for the Establishment and Survey of Reference Sites for BioCondition* guidelines[1] of best on offer sites. For the purposes of the rehabilitation sites relevant to this report the reference sites are located in RE 9.12.11.

As no BioCondition benchmarks for RE 9.12.11 were available at the time assessment the methodology for the monitoring of rehabilitation reference sites was based on the *Method for the Establishment and Survey of Reference Sites for BioCondition*[1] and includes the collection of additional data to assist in the development of benchmarks. Additional tree and shrub stem count data was also collected as these are relevant to the establishment of vegetation in a rehabilitation scenario.

## 3.2. Rehabilitation Sites

As the purpose of the rehabilitation site assessment to inform this technical note was to provide a sample of the current condition of existing rehabilitation, rather than to provide comprehensive ongoing seasonal data for monitoring, only two locations were assessed. While these sites do not provide sufficient data to perform statistical analysis data for each of the rehabilitation sites, they were selected to obtain best representation of the sites at the time of assessment.

The BioCondition assessment method[2] was used for the assessment of the sample rehabilitation sites and additional tree and shrub stem counts were also recorded.

## 3.3. Bench-mark Criteria

For the purposes of this technical memorandum, bench-mark criteria for site analysis were developed using the results of the rehabilitation reference site data for one dry season only. The standardised values listed in

[1] Eyre TJ, Kelly AL and Neldner VJ (2017). Method for the Establishment and Survey of Reference Sites for BioCondition. Version 3. Queensland Herbarium, Department of Science, Information Technology and Innovation, Brisbane.

[2] Eyre, T.J., Kelly, A.L, Neldner, V.J., Wilson, B.A., Ferguson, D.J., Laidlaw, M.J. and Franks, A.J. (2015). BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.2. Queensland Herbarium, Department of Science, Information Technology, Innovation and Arts, Brisbane.

Table 3 were used for completion criteria for rehabilitation and absolute completion criteria values are based on the mean results for all reference sites with respect to each of the relevant attributes and discussed in section 4.1.

**Table 3 Completion criteria standardised values**

| Criterion | Completion Score |
|---|---|
| Tree Canopy (EDL) Height | 70% of reference site |
| Subcanopy Height | 70% of reference site |
| Total Native Tree Species | 70% of reference site |
| Shrub Species Richness | 70% of reference site |
| Grass Species Richness | 70% of reference site |
| Forbs and Other Species Richness | 70% of reference site |
| Canopy Cover (%) | 50% of reference site |
| Subcanopy Cover (%) | 25% of reference site |
| Native Shrubs Cover (%) | 70% of reference site |
| Native Perennial Grass Cover (%) | 70% of reference site |
| Native Forbs and Other Species Cover (%) | 70% of reference site |
| Litter Cover (%) | 80% of reference site |
| Stems/hectare (tree) | 70% of reference site |
| Stems/hectare (shrub) | 70% of reference site |
| Non-native Plant Cover (%) | 70% of reference site |

# 4. Results and Discussion

## 4.1. Reference Site

Three reference sites (ACRefA1, ACRefA2 and ACRefA3) have been established to provide bench-mark data for the ongoing monitoring of Agate Creek rehabilitation areas located on RE 9.12.11. Only one baseline dry season assessment had been undertaken (August 2022) at the time of the report. Additional baseline monitoring will be undertaken during the wet and dry seasons during 2023 and 2024 to provide a bench-mark criteria with greater statistical rigour. Completion criteria will subsequently be updated where appropriate.

The following table provides the summary of absolute completion criteria for rehabilitation sites located on RE 9.12.11.

**Table 4 Absolute completion criteria for RE 9.12.11 based on one dry season survey data only.**

| Criterion | Mean attribute values for 3 RE 9.12.11 sites | Completion score | Absolute completion value |
|---|---|---|---|
| Tree Canopy (EDL) Height | 12.27 | 70% of reference site | 8.5 |
| Subcanopy Height | 3.60 | 70% of reference site | 2.5 |
| Total Native Tree Species | 4.67 | 70% of reference site | 3 |
| Shrub Species Richness | 5.67 | 70% of reference site | 4 |
| Grass Species Richness | 8.67 | 70% of reference site | 6 |
| Forbs and Other Species Richness | 7.67 | 70% of reference site | 5 |
| Canopy Cover (%) | 41.13 | 50% of reference site | 20.5 |
| Subcanopy Cover (%) | 6.63 | 25% of reference site | 1.65 |
| Native Shrub Cover (%) | 1.30 | 70% of reference site | 1 |
| Native Perennial Grass Cover (%) | 18.27 | 70% of reference site | 12.5 |
| Native Forbs and Other Species Cover (%) | 3.4 | 70% of reference site | 2 |
| Litter (%) | 29.07 | 80% of reference site | 23 |
| Stems/hectare (tree) | 333.33 | 70% of reference site | 230 |
| Stems/hectare (shrub) | 456.67 | 70% of reference site | 320 |
| Non-native Plant Cover (%) | 20.80 | <10% or <50% of reference site | <10% |

## 4.2. Rehabilitation Sites

For the purposes of this assessment the rehabilitation sites have been assessed against the mean of the site attributes for one dry season monitoring event only. The results of the rehabilitation sites have been compared to the completion criteria absolute values.

**Table 5 Rehabilitation results comparison table**

| Criterion | Average | Completion criteria | Completion Values | Rehab 1 | Rehab 2 |
|---|---|---|---|---|---|
| Tree Canopy (T1) Height | 12.27 | 70% | 8.5 | 9 | n/a |
| Subcanopy Height | 3.60 | 70% | 2.5 | 3.5 | 4 |
| Total Native Tree Species | 4.67 | 70% | 3 | 5 | 4 |
| Shrub Species Richness | 5.67 | 70% | 4 | 8 | 9 |
| Grass Species Richness | 8.67 | 70% | 6 | 10 | 6 |
| Forbs and Other Species Richness | 7.67 | 70% | 5 | 8 | 5 |
| Canopy Cover (%) | 41.13 | 50% | 20.5 | 36 | 23.4 |
| Subcanopy Cover (%) | 6.63 | 25% | 1.65 | 0 | 31 |
| Native Shrub Cover (%) | 1.30 | 70% | 1 | 8.3 | 5.7 |
| Native Perennial Grass Cover (%) | 18.27 | 70% | 12.5 | 18.6 | 16.2 |
| Native Forbs and Other Species Cover (%) | 3.40 | 70% | 2 | 2.2 | 1.4 |
| Litter (%) | 29.07 | 80% | 23 | 26.2 | 49 |
| Stems/hectare (tree) | 333.33 | 70% | 230 | 620 | 300 |
| Stems/hectare (shrub) | 456.67 | 70% | 320 | 900 | 500 |
| Non-native Plant Cover (%) | 20.80 | <10% | <10 | 0 | 0 |

### 4.2.1. Historical Rehabilitated Exploration Area – Rehab 1

The historical rehabilitated exploration area (Rehab 1) assessment site was a sample site, chosen as a proxy site for all rehabilitated exploration tracks. The site was located in the vicinity of the Sherwood West exploration tracks. Exploration in this area was undertaken in 2014 and rehabilitated in 2015, making it the youngest of all the locations. As exploration in other locations (ASH and ASW) predates the Sherwood West location and areas were rehabilitated earlier, it is expected that rehabilitation in these sites would be in later successional stages of regrowth than the assessment site.

Results of the assessment of the Rehab 1 site indicate that vegetation in the previously disturbed exploration area has recovered sufficient that it could now be considered remnant vegetation. It is worth noting that the area is also currently mapped as remnant vegetation in the *Vegetation management regional ecosystem map - version 12.02*. The following sections provide discussion regarding the condition of the Rehab 1 site and comparison with the measured attributes of the local reference sites.

#### *4.2.1.1. Tree heights*

While the median height of the ecologically dominant layer (EDL) of the Rehab 1 site (9 m) is less than the mean for reference sites (12.27 m), it exceeds the 70 % completion criteria value (8.5 m). Median subcanopy

height (3.5 m), however, is similar to the mean value of reference sites (3.6 m) exceeding that of the completion criteria value (2.5 m) (Figure 2a).

#### *4.2.1.2. Canopy cover*

Tree canopy cover of the Rehab 1 site (36 %) is well within the standard error of the mean for the reference sites (41.13 % +/- 11.18) and well above the 50 % completion criteria value (20.5 %). Unfortunately, subcanopy species were (in error) grouped into the shrub layer during the canopy cover assessment leading to an apparent lack of subcanopy cover. However, the results of the shrub cover assessment along with photos of the site (Figure 3) would indicate that this strata (8.3 %) is sufficient to exceed the 25 % completion criteria values for subcanopy cover(1.65 %) (Figure 2b).

#### *4.2.1.3. Ground cover*

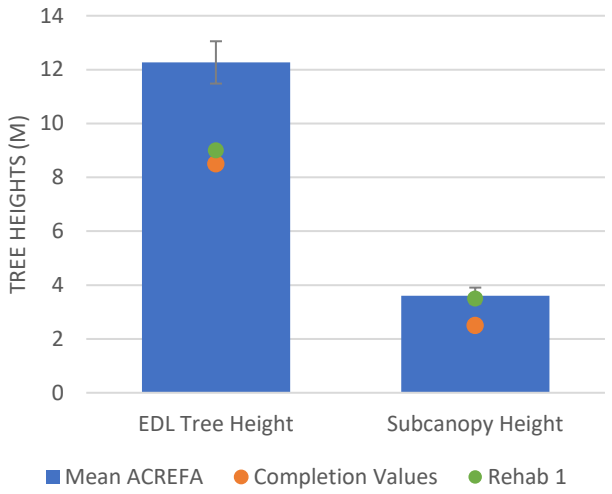
In all cases (perennial grass cover, native forbs and other cover, and litter cover) ground cover values were equal to or exceeded the completion criteria value for ground cover. Notably, perennial grass cover (18.6 %) exceeded the mean of the reference sites (18.27 %) (Figure 2c).

#### *4.2.1.4. Stem counts*

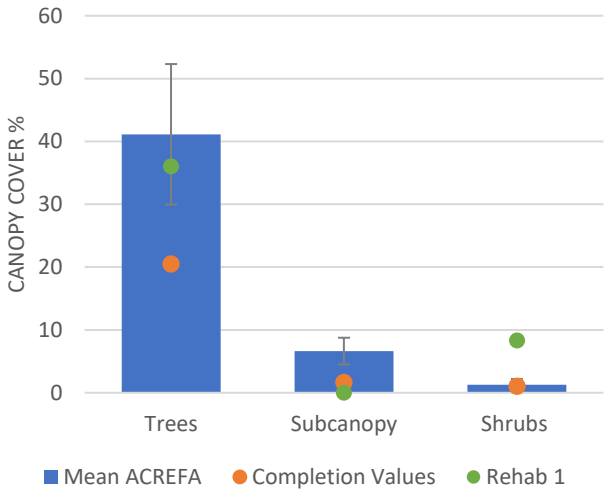
Both tree (620 stems/ha) and shrub (900 stems/ha) stem counts for Rehab 1 exceeded the mean reference site values and therefore the 70 % completion criteria values for stem counts per hectare (230 stems/ha and 320 stems/ha respectively) (Figure 2d).

#### *4.2.1.5. Species richness*

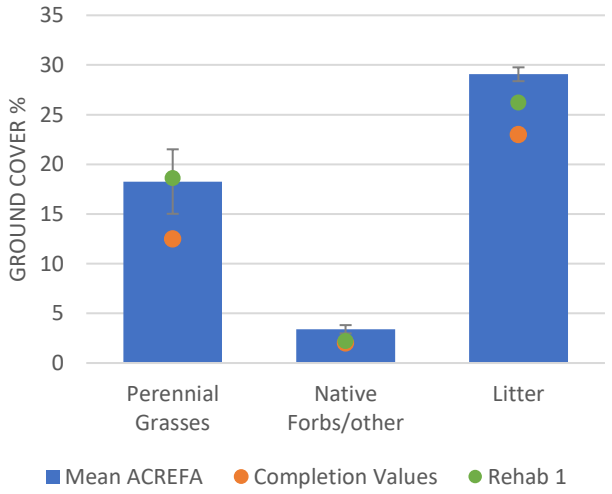
Species richness in all strata were higher in the Rehab 1 site than in the mean of the reference sites (Figure 2e).



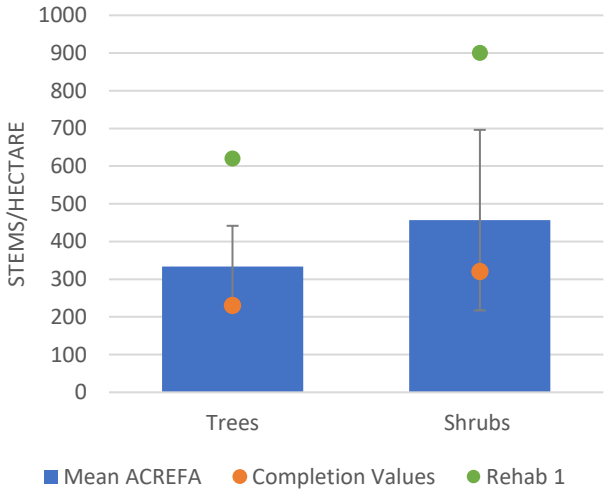

a.



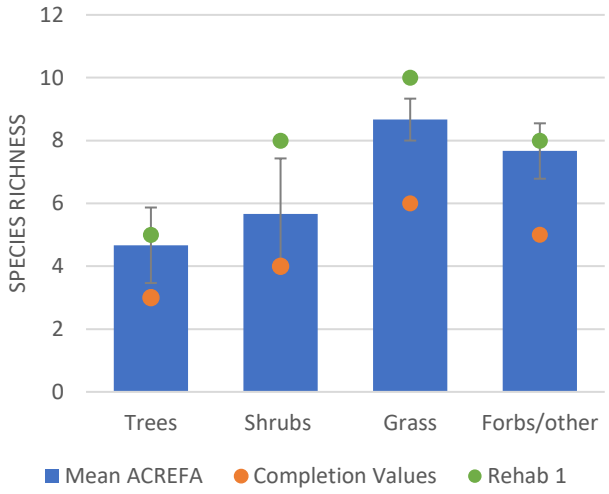

b.




c.




d.




e.

**Figure 2 Rehab 1 site attribute comparisons with mean reference sites and completion values for: a. Tree heights; b Canopy cover; c. Ground cover; d Stem counts; and e. Species richness. Error bars indicate deviation from the mean across three reference sites**





**Figure 3 Rehab 1 site images showing vegetation and condition similar to that of the surrounding area.**

### 4.2.2. Waste Rock Dump Area – Rehab 2

As the rehabilitation works of the waste rock dump area of the Rehab 2 site were undertaken in 2019, the vegetation strata have only undergone three years of growth. The vegetation present however, is well established and consistent with that of vegetation in the early stage of successional growth (S2: 0-5 years) as described by Grant in his paper on *State-and-Transition Successional Model for Bauxite Mining Rehabilitation* (Grant, 2006).

#### *4.2.2.1. Tree heights*

Due to the age of the Rehab 2 site there was no representative dominant canopy layer within the range of heights of the reference site mean EDL canopy height, and all species, irrespective of their expected climax strata, appeared in the subcanopy layer. In the subcanopy layer however, the median height (4 m) did exceed that of the mean of the reference sites (3.6 m) (Figure 4a).

#### *4.2.2.2. Canopy cover*

Tree canopy cover has not yet been established in the Rehab 2 site. As mentioned in section 4.2.2.1, the subcanopy is the dominant strata and this is reflected in an extremely high cover for subcanopy of 54.4 %. Shrub cover (5.7 %) is also higher than the mean of the reference sites (1.3 %) (Figure 4b). These cover values are typical of rehabilitation in the early stage of succession[3].

#### *4.2.2.3. Ground cover*

Native perennial grass (16.2 %) and litter (49 %) cover were both higher than the completion criteria value for these cover attributes (12.5 % and 23 % respectively) (Figure 4c). Native forb and other cover was low at 1.4 %, however this is not unexpected for a rehabilitation site in the early stages of succession as species in this strata are less typically included in rehabilitation seed mixes and are instead, naturally recruited over time.

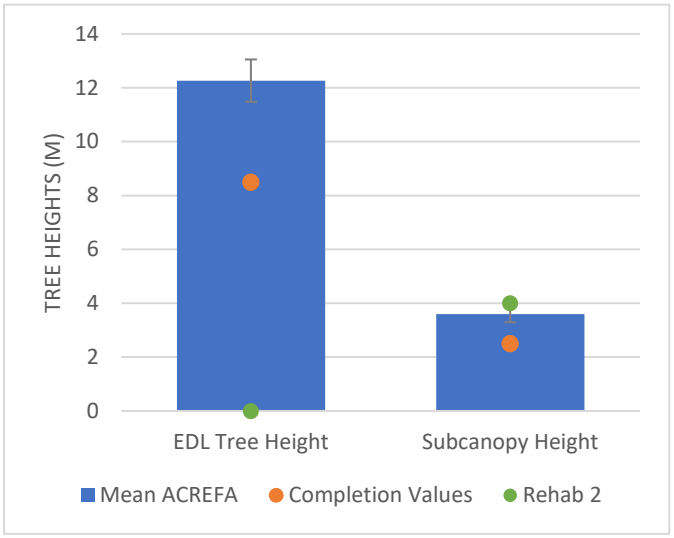
#### *4.2.2.4. Stem counts*

Tree stems in the subcanopy layer (300 stems/ ha) were within the standard error of the mean for reference sites (333 +/- 108 stems/ ha) and greater than that of the 70 % completion criteria values (230 stems/ ha). Shrub stems per hectare for the Rehab 2 site (500 stems/ ha) were higher than the mean for the reference sites (456 stems/ ha). Higher shrub counts are typically expected in the earlier successional stages of rehabilitation[3]

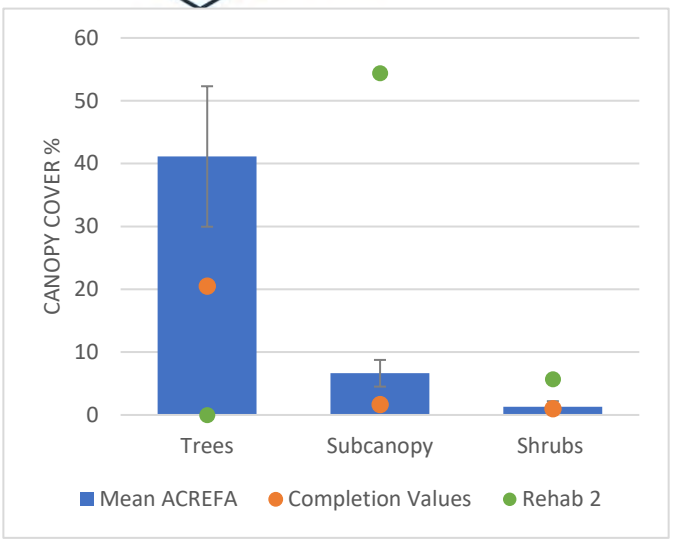
#### *4.2.2.5. Species richness*

Species richness in all strata within in the Rehab 2 site were equal to or higher than that of the mean of the reference sites (Figure 2e). The highest species richness (9 species) occurred in the shrub strata.

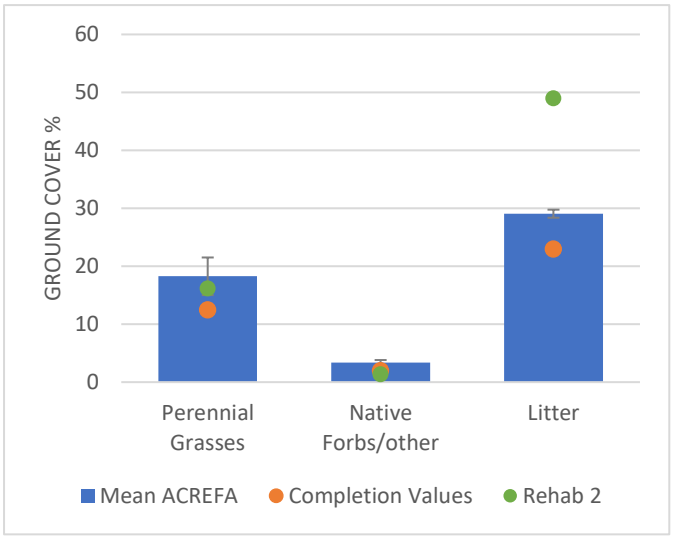
[3] Grant, CD (2006). 'State-and-transition successional model for bauxite mining rehabilitation in the jarrah forest of Western Australia', Restoration Ecology, 14(1):28–37.



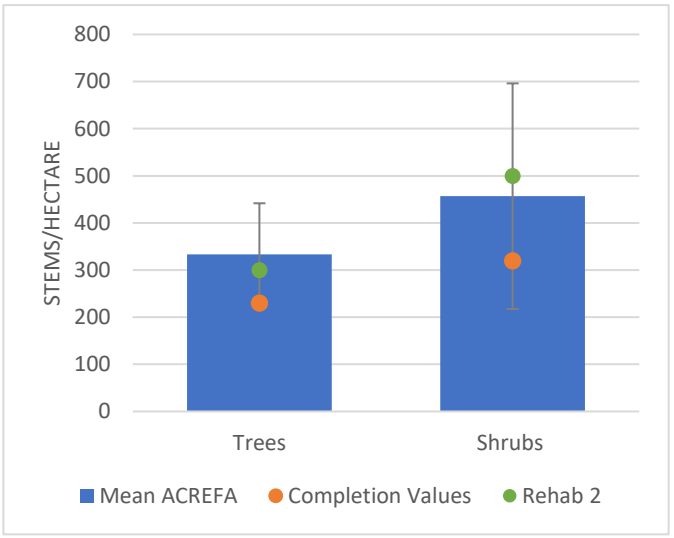

a.



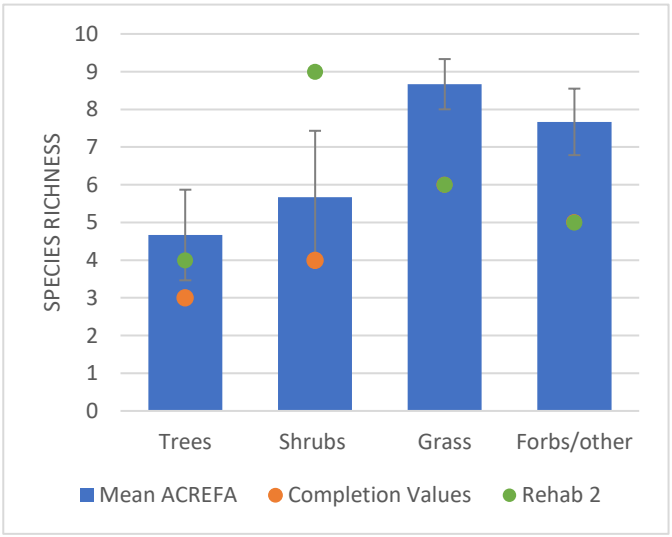

b.




c.




d.




e.

**Figure 4 Rehab 2 site attribute comparisons with mean reference sites and completion values for: a. Tree heights; b Canopy cover; c. Ground cover; d Stem counts; and e. Species richness. Error bars indicate deviation from the mean across three reference sites**



**Figure 5 Rehab 1 site images showing vegetation is well established and in early stages of successional growth**

# 5. Conclusion and Recommendations

The vegetation of the two rehabilitation areas assessed at Agate Creek (Rehab 1 and Rehab 2) is well established and either similar to or on a successional pathway towards the vegetation of the surrounding area.

The vegetation at Rehab 1 is consistent with that of the surrounding area and in accordance with the acceptable criteria for disturbance areas of condition B28 of the standard conditions the area contributes to a stable landform similar to that of surrounding undisturbed areas. While this assessment site was a sample site for the whole of the rehabilitated exploration areas, which includes 9.94 km of historical exploration tracks, all other areas (ASH and ASW) were disturbed and rehabilitated prior to the Sherwood West location. It is therefore expected that: the assessment location is suitably representative; and that rehabilitation in the older exploration sites would be in similar or more advanced stages of successional regrowth than the assessment site.

The vegetation of the Rehab 2 site is in the early stages of successional growth, though well established and comprised of pioneer species that are expected to provide a pathway to the successful establishment of secondary and climax species.

Ongoing monitoring and maintenance of established rehabilitation areas is recommended in line with an annual rehabilitation monitoring program for the Agate Creek mine. Key focus areas include maintenance of rehabilitation to minimise risk of weed and pest impacts.