Progressive Rehabilitation and Closure Plan

WARWICK LIMESTONE MINE

prepared by Ausrocks Resource Consultants
for Department of Environment and Science

AUQ00238A

AUSROCKS RESOURCE CONSULTANTS

TERREQUIP ENVIRONMENTAL PTY LTD

WARWICK LIMESTONE MINE – PROGRESSIVE REHABILITATION AND CLOSURE PLAN

16 APRIL 2024

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WARWICK LIMESTONE MINE PRC PLAN COVER PAGE

A Progressive Rehabilitation and Closure Plan (PRC plan) must contain a cover page and include the following information:

Table 1: Cover page requirements

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16/04/2024	Terrequip Environmental Pty Ltd; Department of Environment and Science

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This document has been reviewed and signed off by the undersigned:

Carl Morandy (RPEQ22981)

Managing Director, Ausrocks Pty Ltd

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Appendix 1 Warwick Limestone Environmental Authority (EMPL00136213) (5 April 2019)

Appendix 2 Horizon Soil Science and Engineering (16 September 2022): Report on the Soil Survey Leases of the Warwick Limestone Quarry Rev 1.0

Appendix 3 Epic Environmental Pty Ltd (17 November 2020): Environmental Management Plan – Warwick Limestone Mine

Appendix 4 Rocktest Rock Engineering Consultants (5 June 2019): Warwick Limestone Mine Geothechnical Risk Assessment and Management for Sibelco Version 1.0

Appendix 5 Epic Environmental Pty Ltd (20 November 2020): Water Management Plan – Warwick Limestone Mine

Appendix 6 Australian Laboratory Services Pty Ltd (19 May 2020): Material Testing Certificate of Analysis Ref BR20104442

Appendix 7 Landholder Agreements

Appendix 8 BAAM Ecological Consultants: Rehabilitation Plan for the Warwick Mining Leases Areas

Appendix 9 Plans and Maps

Terms & Abbreviations

ALC	Agricultural Land Classification
Ausrocks	Ausrocks Resource Consultants (Ausrocks Pty Ltd)
CEC	Cation Exchange Capacity
DA	Development Approval
DEHP	Department of Environment and Heritage Protection (merged into DES)
DES	Department of Environment and Science
DNRME	Department of Natural Resources, Mines & Energy (Now DOR))
DOR	Department of Resources
EA	Environmental Authority
EP Act	Environmental Protection Act 1994
ERA	Environmentally Relevant Activity
ESA	Environmentally Sensitive Area
ESP	Exchangeable Sodium Percentage
EV	Environmental Value(s)
GQAL	Good Quality Agricultural Land
ICMM	International Council on Mining and Metals
LGA	Local Government Authority
LOD	Land outcome document
MCU	Material Change of Use
MERFP Act	Mining and Energy Resources (Financial Provisioning) Act 2018
ML	Mining Lease
PMAV	Property Map of Assessable Vegetation
PMLU	Post-mine land use
PRC plan	Progressive Rehabilitation and Closure Plan
RC	Reverse Circulation
RPI Act	Regional Planning Interests Act 2014
RZS	Root Zone Salinity
SCA	Strategic Cropping Area
SDRC	Southern Downs Regional Council
Terrequip	Terrequip Environmental Pty Ltd
VM Act	Vegetation Management Act 1999
WQO	Water Quality Objective(s)

INTRODUCTION

This transitional Progressive Rehabilitation and Closure Plan (PRC plan) has been prepared for the Warwick Limestone Mine (Warwick Limestone) in accordance with the amendments promulgated by the *Mineral and Energy Resources (Financial Provisioning) Act 2018* (MERFP Act) to the *Environmental Protection Act 1994* (EP Act). This PRC plan has also been prepared to meet the requirements of the Progressive Rehabilitation and Closure Plan Guideline (PRCP Guideline)[1].

Environmental Authority Holder:	**EPML00136213**
Environmental Authority Number:	**Terrequip Environmental Pty Ltd**
Land description:	**ML50237, ML50239, ML50238, Lot 178/M34534, Lot 106/ML623, Lot 2/RP36822, Lot 1291/M34534, Lot 5/SP236094, Lot1219/M34519, ML50083, ML50146**

Environmentally relevant activities (ERA) at the Warwick Limestone are limited to resource activities under Schedule 2A, 21 and extraction and screening 2 under prescribed ERA 16 per conditions of the site's Environmental Authority (EA) EPML00136213[2] (**Appendix 1**). The EA is the land outcome document (LOD) for this transitional PRC plan.

Per PRCP Guideline requirements, this PRC plan comprises two parts:

- **Part A: Rehabilitation planning part** – provides information about the site, rehabilitation plans, and evidence and justification to support the development of the proposed PRCP schedule; and
- **Part B: PRCP schedule** – includes maps of rehabilitation and closure for the site and tables of time-based milestones.

Transitional provisions

Part 27, Chapter 13 of the EP Act outlines the transitional provisions following the commencement of the MERFP Act. Terrequip is the 'mining EA holder' for the purposes of the transitional provisions on the basis that, on commencement of the MERFP Act, Terrequip was "the holder of an environmental authority (EPML00136213) for a mining activity relating to a mining lease authorising operation" at Warwick Limestone (section 750, EP Act). Section 6 of the PRCP Guideline makes provision for "existing EA holders who must transition to the new PRC plan framework"[1]. The site has an approved EA therefore Warwick Limestone falls under the scope of the requirements of a transitional PRC plan.

[1] Queensland Department of Environment and Science (April 2023) Progressive Rehabilitation and Closure Plan Guideline
[2] Queensland Department of Environment and Science (April 2019) Environmental Authority (EPML00136213)

Per section 6 of the PRCP Guideline, the following are applicable to this PRC plan:

- A Transition Notice for Warwick Limestone was issued to Terrequip by the Administering Authority, dated 29 September 2020. This Transitional Notice required submission of the Warwick Limestone Mine PRC plan by 31 August 2021.
- The site's Transitional Notice was issued following a pre-notification meeting held between the Administering Authority, Terrequip, and Ausrocks consultants, on 9 August 2020.
- In accordance with transitional provisions (section 750, EP Act), the Warwick Limestone EA is an approved LOD.
- Prior to the submission of the PRC plan, the following meetings were held between the Administering Authority, Terrequip, and Ausrocks:
    - Initial pre-lodgement meeting
    - Additional pre-lodgement meetings held on 9 August 2021 and 28 October 2021; and
    - Meeting to discuss extension of PRCP Decision Stage.
- Following the Information Request period from the original submission, this document represents the updated and final version of the Warwick Limestone transitional PRC plan submitted for Administering Authority approval.

Consideration to the above and requirements of the PRCP Guideline, the following process for transitioning rehabilitation and closure outcomes from the Warwick Limestone EA into the site's PRCP schedule was followed:

Step 1. Identifying rehabilitation and closure outcomes in the LOD (EPML00136213);

Step 2. Identifying post-mine land uses (PMLUs) or non-use management areas (NUMAs; these are not planned for Warwick Limestone);

Step 3. Identify rehabilitation areas within PMLUs (improvement areas are not required as there are no NUMAs relevant);

Step 4. Identify milestones that deliver on SMART principles;

Step 5. Identify site-specific milestone criteria; and

Step 6. Identify when the first milestone must commence and completion dates for milestones.

PRCP amendment

The current EA allows for environmentally relevant activities (ERA) under Resource Activity, Schedule 2A, 21 (mining activity) and Prescribed ERA, ERA 16 (extraction and screening). If any changes are made or a decision is made to alter operations outside current approved ERAs, an EA amendment in additional to any associated PRCP amendment will be required. The rehabilitation activities described in this PRC plan relate solely to the mining and extraction and screening activities approved in the current EA.

Future exploration

There is potential for the development of quarry products within mining lease areas of exhausted limestone resource. At the time of preparation of this PRC plan, it is not planned to develop these quarry products, however, should this change in future, the holder of the environmental authority is appropriately authorised to carry out such activities under ERA 16(2)(c), 16(2)(b) and 16(3)(b).

No future exploration outside of mining leases is proposed for this PRC plan.

PART A: REHABILITATION PLANNING PART

1 Project Planning

Legislative Requirement

In accordance with section 126C(1)(b) and (c)(ii) of the EP Act, the rehabilitation planning part of the PRC plan must include a description of:

- each resource tenure, including the area of each tenure
- the relevant activities to which the application relates
- the likely duration of the relevant activities
- how and where the relevant activities are to be carried out, including maps.

PRCP Guideline

The following spatial information must be submitted as part of the PRC plan:

- the location and maximum extent of disturbance footprint for the mine life
- the PMLUs and NUMAs for the area within the resource tenures
- any sensitive receptors.

In addition to the list above, the PRC plan must include spatial information outlining the rehabilitation and improvement areas that correspond to the proposed PRCP schedule. The spatial information must show the locations of the rehabilitation and improvement areas for a 10-year period (minimum).

All spatial information must be prepared and submitted in accordance with the guideline 'Spatial Information Submission' (ESR/2018/4337).

1.1 Project Description

Warwick Limestone mine is located near the Queensland/New South Wales border within the Balone-Condamine basin and approximately 21km south east of Warwick. The site is accessible via O'Deas Road.

The EA holder is Terrequip Environmental Pty Ltd (Terrequip).

EA EMPL00136213 limits activity at Warwick Limestone to Environmentally Relevant Activities (ERA) 16(2)(c) extractive, 16(2)(b) extractive, 16(3)(b) screening, and Resource Activity Schedule 2A(21) mining activities.

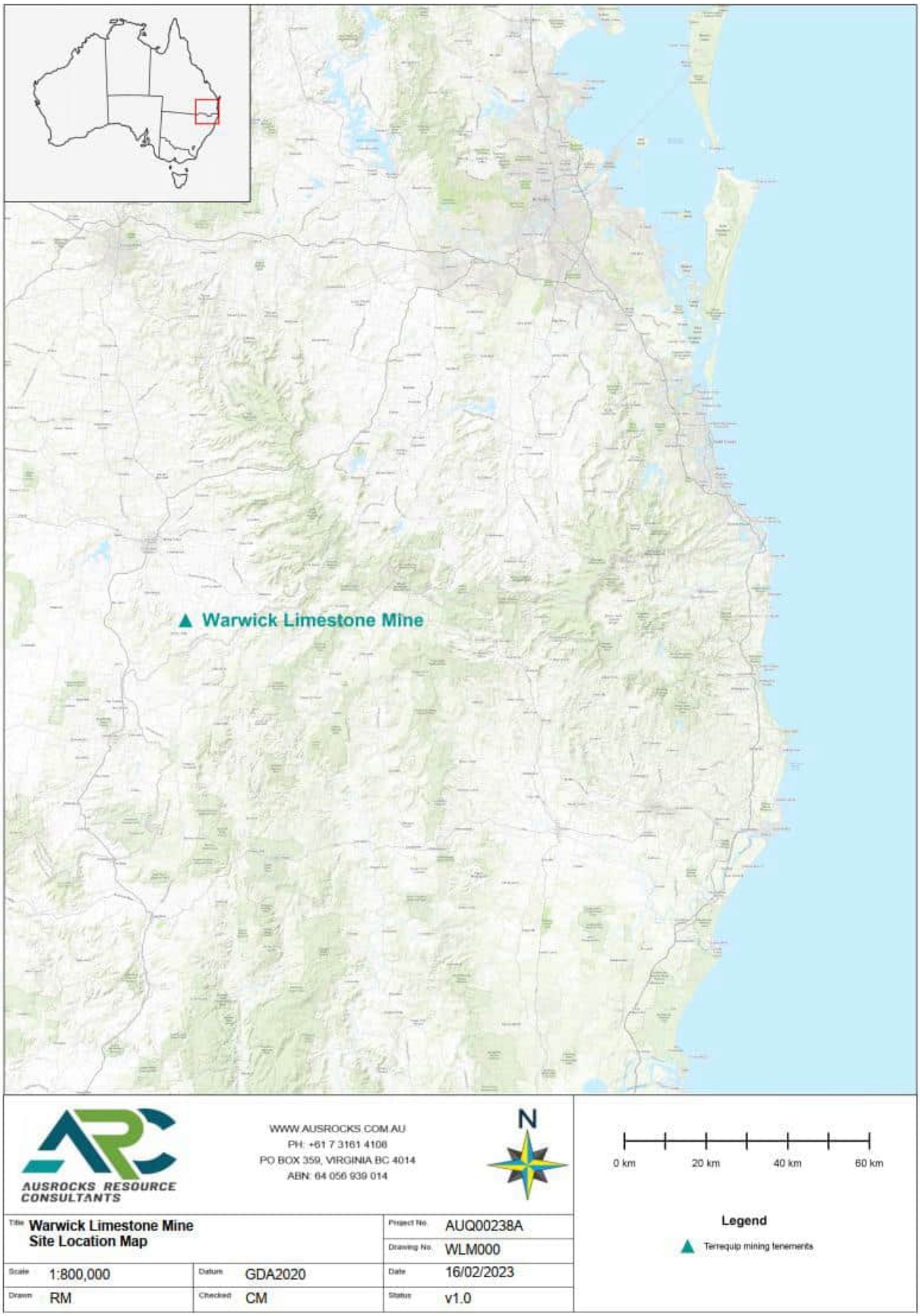

Figure 1: Warwick Limestone location map

1.1.1 Mining Tenements

Warwick Limestone operates the mining leases (MLs) provided in **Table 2**.

Table 2: Warwick Limestone mining tenements

Mining lease	Name	EA holder	Purpose	Area (ha)
ML 50083	O'DEA EXTENDED	Terrequip Environmental Pty Ltd	East-West Pit	22.9
ML 50146	WARWICK PLANT	Terrequip Environmental Pty Ltd	Aspinal Pit	50.78
ML 50236	AREA 1	Terrequip Environmental Pty Ltd	East-West Pit	1.85
ML 50237	AREA 2	Terrequip Environmental Pty Ltd	Phoenix Pit	71.31
ML 50238	AREA 4	Terrequip Environmental Pty Ltd	Phoenix Pit	11.2
ML 50239	AREA 3	Terrequip Environmental Pty Ltd	East-West Pit	13.52
			Total area	**171.56**

1.1.2 Primary Mine Features and Infrastructure

Warwick Limestone consists of three (3) operational areas each including an open-cut pit. The main features and infrastructure approved within the EA for Warwick Limestone are summarised in **Table 3** and illustrated in **Figure 2**, to **Figure 4.**

Table 3: Primary mine features and infrastructure

Mine domain	Mine feature name
Ancillary infrastructure	• Mining footprint • Mine infrastructure • Access tracks, ancillary roads and haul roads • Administration, office buildings, carparks and amenities • Laydown areas (including vehicle manoeuvring) • Material storage • Weighbridge • Processing and bagging plant (including building components and silos) • Workshop (including maintenance shed, hazardous chemical storage and transportable buildings)
Dams	• Onsite water storage(s) • Sediment controls
Combined stockpile areas	• Topsoil stockpiles • Waste rock dumps and overburden stockpiles • Product stockpiles / Storage pads
Non-mining areas	• Undisturbed land • Rehabilitation areas (complete and in progress)
Utilities / Services	• Septic sewage • Power lines • Communications

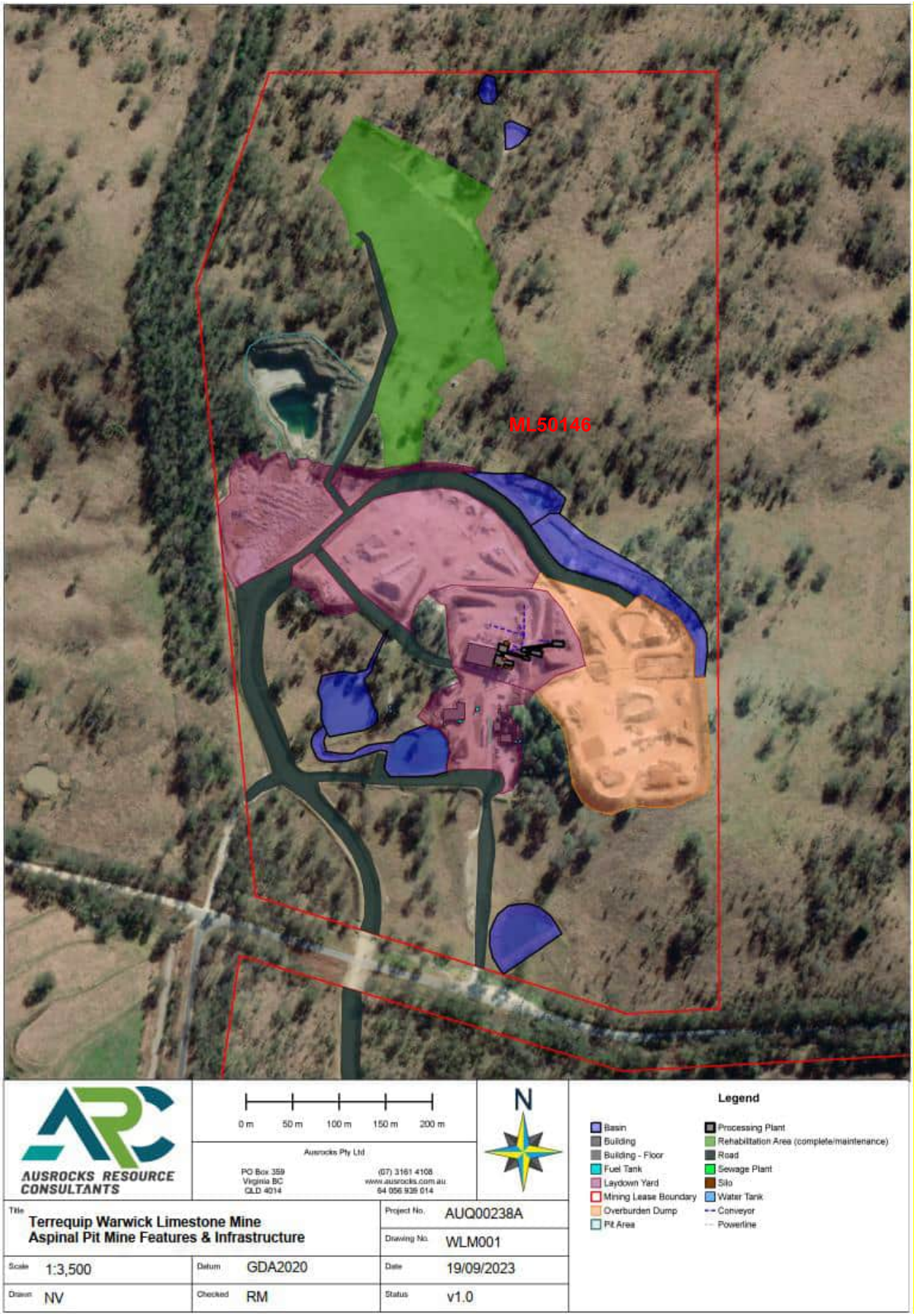

Figure 2: Aspinal pit mining tenements including primary mine features and infrastructure

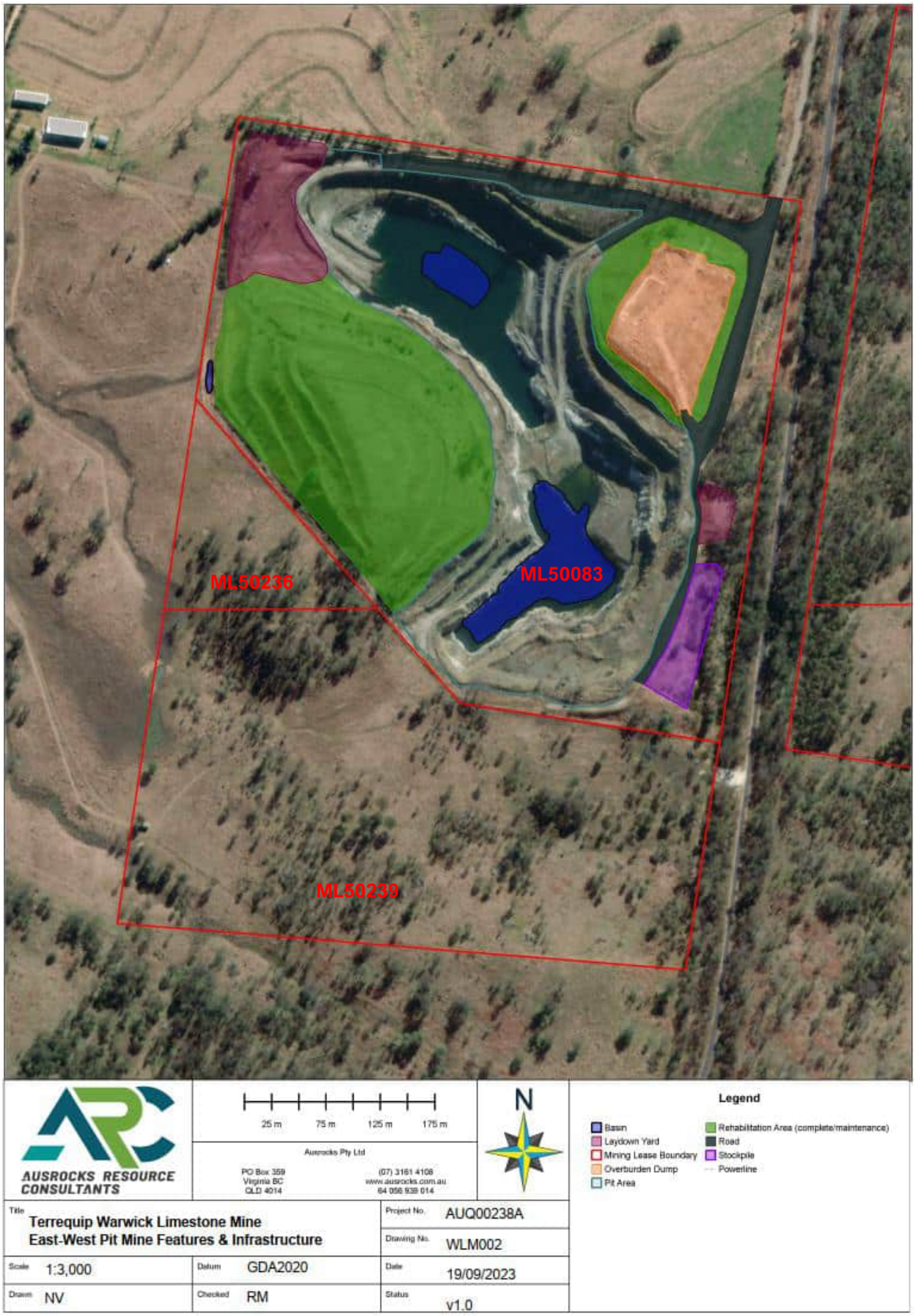

Figure 3: East-West pit mining tenements including primary mine features and infrastructure

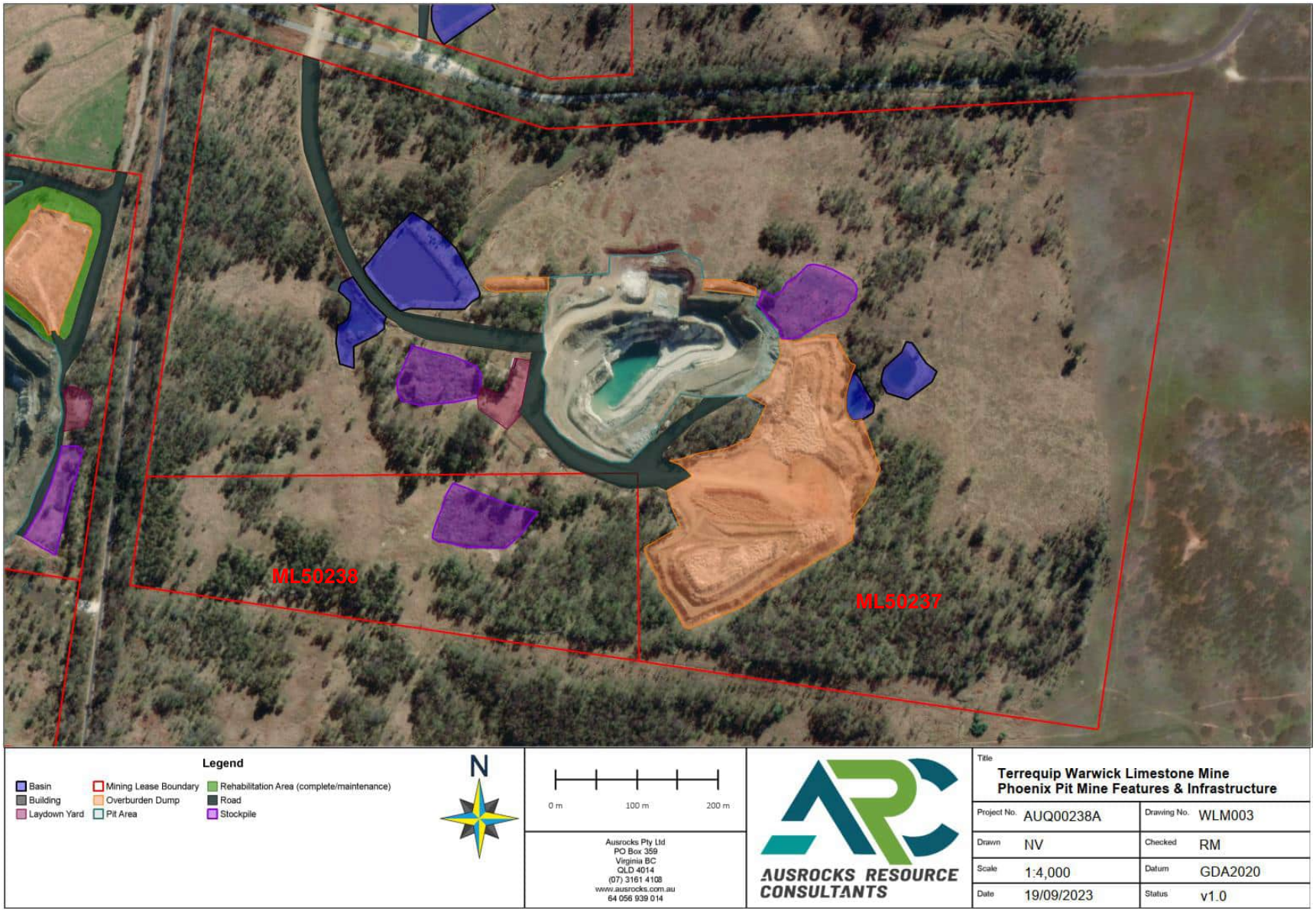

Figure 4: Phoenix pit mining tenements including primary mine features and infrastructure

1.1.3 Type of Mining Operation

Terrequip at the time of preparation of this PRC plan, is an active mining operation. The EA permits activities associated with extraction and screening ERA and resource mining activities:

- Extraction and Screening ERA s16(2)(c), 16(2)(b) and 16(3)(b); and
- Resource Activity Schedule 2A(21) mining activities.

At the time of preparation of this PRC plan, no extraction is occurring within ML50236, ML50238 or ML50239. There may be potential for future mining in these areas however none are proposed for this PRC plan. The majority of mining occurs within ML50237 (Phoenix pit). Resources have been depleted in ML50083 (East-West pit) and ML50146 (Aspinal pit).

Current mining methods include, but are not limited to:

- open-cut mining methods;
- drill and blast overburden dumps then transport via truck and shovel to waste dumps;
- drill and blast limestone resource then transport via truck and shovel to plant area;
- backfilling pit voids (with overburden); and
- progressive rehabilitation activities (e.g. topsoil, rip, contour, seed, revegetate).

1.1.3.1 Historical Mining Operation

Warwick Limestone has been in an operation and production phase since the 1990s, previously operated by Sibelco Australia Limited. Mining is conducted via open-cut pits. Historical mining methods are assumed to have included, but were not limited to:

- clearing of vegetation including removal and disposal by dozer;
- excavation and temporary stockpile of topsoil by dozer and/or excavator and/or articulated dump truck;
- removal of overburden via rip and push method by dozer;
- overburden re-used in pit backfill to final landform level and/or stockpiled; and
- mining and transport of limestone resource by excavator to road trucks via haul access road networks to designated stockpile and processing areas.

1.1.3.2 Quarrying

Limestone resource is exhausted in the Aspinal pit (ML50146) however, there is potential for future development of quarry products in this area. At the time of preparation of this PRC plan, there is no plan to further explore this option. Should this change in the future, the PRC plan and PRCP schedule and Environmental Authority will be amended as required.

1.1.4 Proposed Duration of the Operation

Current mining activities at Warwick Limestone are proposed to continue until the limestone resource is exhausted or up to, and including, the expiry dates of each granted mining lease tenement (year 2025 ML50083,

2028 ML50146, and 2032 ML50236, ML50237, ML50238, ML50239). It is anticipated an application to renew and/or extend the expiry dates of these mining leases will be required to align with the planned year of completion of mining and rehabilitation (year 2042). When an application is submitted to the administering authority, the PRC plan and PRCP schedule will be amended accordingly.

1.1.4.1 Estimated Remaining Resource

Majority of valuable resource exists within the Phoenix pit which is estimated to have 15-years of production remaining (estimate correct as of May 2022) therefore, active mining in this area will continue up to 2036. **Figure 5** illustrates an approximate staged extraction plan for the pit.

Limestone resource in the Aspinal and East-West pits are exhausted with only low-grade resource remaining. To support mining in the Phoenix pit, it is anticipated a renewal application for ML50146 (Aspinal pit) will be required. The Aspinal pit will be used to house processing and stockpiling activities until limestone resource in the Phoenix pit has been exhausted.

Undisturbed mining leases ML50236 and ML50239 are known to contain limestone resource, extending south from the East-West pit (ML50083). Future exploration works will be conducted to determine viability of these resources (**Figure 6**).

Figure 5: Phoenix pit staged extraction plan

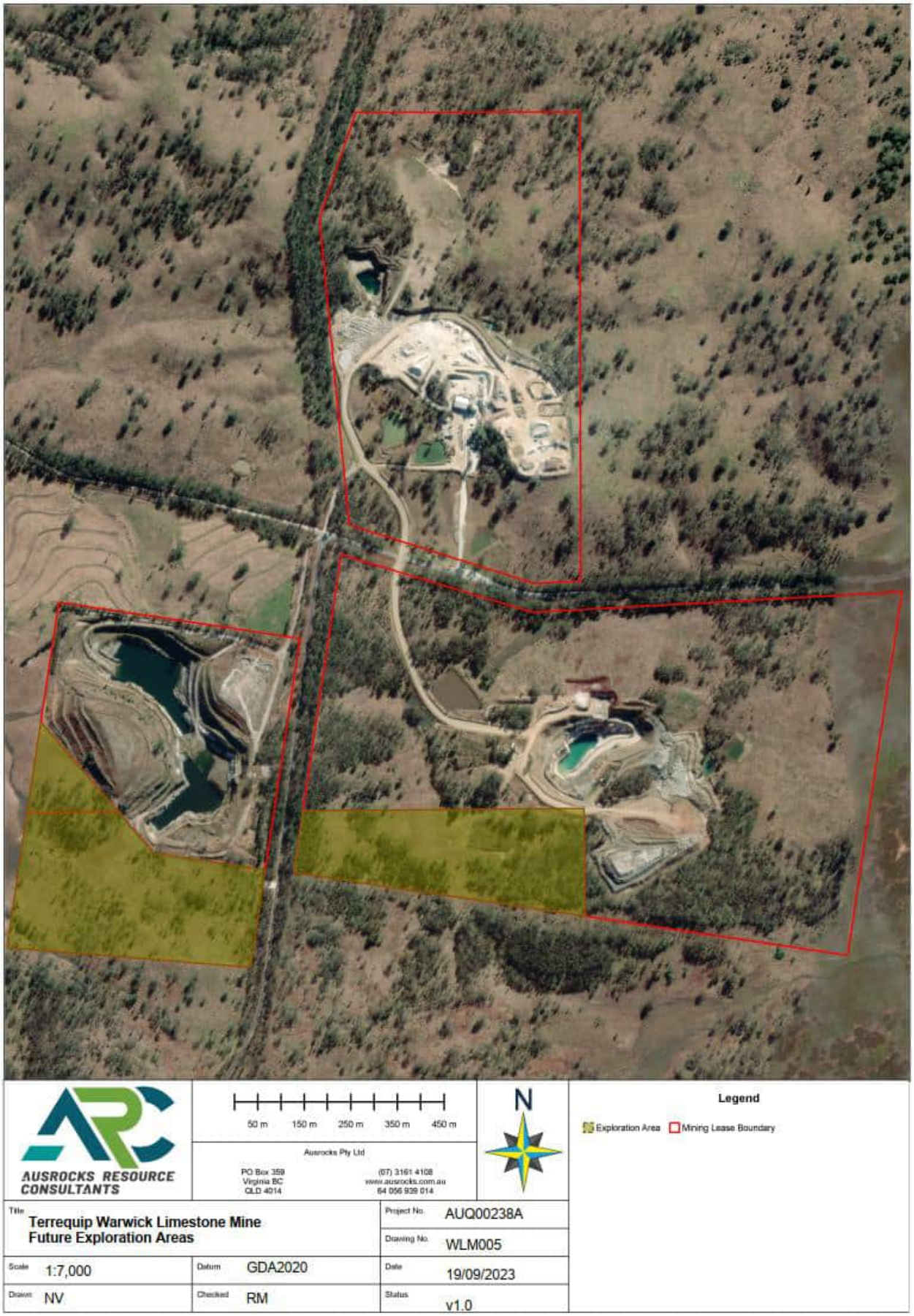

Figure 6: Resource exploration areas at Warwick Limestone

1.2 Baseline Information

PRCP Guideline (section 3.1)

In addition to the legislative requirements, the following information about the site, where relevant, is considered necessary by the administering authority (as per section 126C(1)9j) of the EP Act) to decide whether to approve the PRCP schedule:

- site topography (locally and regionally)
- climate (general and specific (rain, evaporation, temperature) including long-term projections
- geological setting
- site hydrology and fluvial networks
- groundwater levels and properties
- soil types, properties and productivity
- land stability (pre-existing land degradation/erosion and pre-disposition to ongoing stability issues)
- vegetation communities and ecological data (including existing regional ecosystem mapping)
- fauna presence and populations
- pre-mining land use
- identification of underlying landholders

Applicability to Transitional PRC plan

Transitional PRC plans must include any baseline information collected as part of an EIS process or original EA application. If this information is unavailable, the reasons should be explained in this section of the rehabilitation planning part. Transitional PRC plans are not required to demonstrate how aspects of the mine site have been designed for closure for existing or approved disturbance. However, any expansion to an existing site must demonstrate how it has been designed for closure. The rehabilitation/improvement planning must include data from when mining first commenced up until planned surrender. The transitional provisions of the EP Act include an exceptional circumstance for when land is available for rehabilitation.

Under section 126C(1)(j) of the EP Act, transitional PRC plans must also include the following details about any existing rehabilitation already completed at the time of submission of the proposed PRC plan:

- a description of the rehabilitation works previously carried out
- when the rehabilitation works commenced and were completed
- whether the rehabilitation has been applied for or approved as progressively certified under the EP Act

Spatial information outlining the location of all existing rehabilitation must also be submitted as part of the proposed PRC plan.

1.2.1 Site topography

The elevation of the site ranges between 530m to 580m AHD. The regional topography is characterised by low undulating hills comprising of open pastures and isolated patches of mid-high regrowth open forests on crests; the area is mostly cleared for grazing land uses with few large mature trees.

1.2.2 Climate

Warwick Limestone lies in the Darling Downs and Granite Belt weather district and is subject to a semi-arid to subtropical highland climate due to its elevated topography. Monitoring of weather data is not conducted onsite. Data has been collected from the Bureau of Meteorology (BoM) Killarney Post Office (Station no. 041056) and Elbow Valley TM (Station no. 041494). The following climate information is informed from data available from the BoM weather station and historical recorded data.

1.2.2.1 Temperature

Maximum temperatures range from 19ºC in July to 34ºC in December, and minimum temperatures from 14ºC in July to 25ºC in December-January[3].

1.2.2.2 Rainfall

Average annual rainfall during the wet season is approximately 90mm per month. Average annual rainfall is approximately 741.1mm.

Table 4: Killarney Post Office (Station no. 041056) monthly average rainfall

Month	Mean (mm)
January	95.0
February	87.2
March	79.6
April	45.1
May	44.6
June	44.5
July	43.5
August	32.1
September	39.3
October	64.6
November	74.6
December	93.6
Annual	**741.4**

1.2.2.3 Evaporation

Evaporation fluctuates throughout the year but is highest during the warming months and lowest during the cooler months. Average annual solar exposure of 18.8MJm^{-2}.

1.2.2.4 Wind

The prevailing wind direction is south to south-easterly.

[3] Accessed from the Bureau of Meteorology (1889 – 2013).

1.2.2.5 Long-term Climate Projections

Future climate conditions for the Warwick Limestone area are summarised by the 'Climate Change in the Eastern Downs Region'[4] report to include higher temperatures, hotter and more frequently occurring hot days, harsher fire weather, fewer frosts, less rainfall in winter and spring, and more intense downpours.

Storms

There is no defined storm season or period for when severe storms and severe weather events are most likely to occur in Queensland. It is, however, typical for the State to experience such weather events during warmer months between October to April, and during heatwave events.[5] It is also common for severe storms to cause significant damage to property and infrastructure by means of destructive and powerful wind gusts, flash flooding, lighting, and large hailstones <4cm diameter. [6]

Cyclones

Whilst the climate influence is predominantly from southeast and southwest air flow, the area may be indirectly impacted, albeit occasionally, by tropical cyclones passing nearby or crossing the coastline. Tropical cyclones are more likely to occur in Queensland between early November to late April.[6] The likelihood of a tropical cyclone travelling inland depends on a number of external factors and can be strongly influenced by the El Niño Southern Oscillation (ENSO). Historical data of the area shows that no cyclones have been known to occur in the vicinity of the Project.

Floods

The main watercourses around Warwick Limestone include Little John Creek (northwest) and the Condamine River (northeast). The Condamine River catchment to Warwick (20km north of site) covers an area of approximately 1300km2 where the headwaters of its main tributaries rise in the Dividing Ranges. The fan-like shape of the catchment makes the area susceptible to flooding during heavy rainfall events, particularly in agricultural areas adjacent to waterways and major flooding of residential and commercial areas in Killarney and Warwick.[6]

The Warwick area has a long history of flooding from the Condamine River with records dating back to 1887. The highest flood recorded occurred in February 1976 where waters rose to 9.1m on the Warwick flood gauge at the McCahon Bridge[7]. This flood event caused significant damage to residential homes, leaving many homeless. The most recent flood event recorded in Warwick was caused by a combination of heavy rainfall from Tropical Cyclone Tasha coinciding with the peak of a La Niña Modoki event. The flood occurred two weeks apart over December 2010 and January 2011. **Table 5** summarises historical flood levels of the Condamine River catchment to the most recent significant recent flood of the towns of Killarney, Elbow Valley, and Warwick. Due to its elevated topography, Warwick Limestone has no history of flooding.

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[4] Department of Environment and Science. (2019). Climate change in the Eastern Downs Region. Version 1.
[5] Queensland Fire and Emergency Services. (2017). QFES Incident Data.
[6] Bureau of Meteorology. (2017). Flood warning system for the Condamine River to Warwick.

Table 5: Historical flood records in the Killarney, Elbow Valley and Warwick area

Flood Event	Killarney	Elbow Valley	Warwick
Jun 1950	6.99	-	7.78
Jan 1974	5.61	5.40	7.01
Feb 1976	6.13	6.8	9.10
May 1983	3.45	4.23	6.25
Jul 1984	-	4.48	5.95
Apr 1989	4.90	5.32	5.45
May 1996	6.15	5.04	6.50
Jan 2008	6.60	6.24	6.04
Dec 2010	6.45*	6.13	7.90
Jan 2011	6.45*	-	8.35
Jan 2013	6.25	6.10	7.21
Mar 2017	6.15	4.61	6.21

**Estimated peak flood heights from flood marks and other information*

Bushfires

Bushfire risk is influenced by a combination of factors including increased temperature and wind, and low rainfall particularly in areas of woody vegetation. Southern Downs Regional Council Planning Scheme[7] provides a Bushfire Hazard Overlay Code to control development in bushfire prone areas minimising risk and danger to people, and damage to property. Warwick Limestone is located in the south-eastern most part of the Brigalow Belt bioregion, adjacent to the New England Tableland bioregion. Eucalypts species are common in both these fire regions and act as good fuel for bushfires.

Earthquakes

Queensland is considered a seismically active State – the highest hazard region lies along the eastern coast near offshore regions.[8] An average of 110 earthquakes have been recorded by the Queensland Seismic Network between 1977 and 2000. Geoscience Australia's Atlas of Seismic Hazard Maps Australia[9] places Warwick in a zone of low earthquake hazard. It indicates that a ground acceleration of 0.06g have a 10% probability of being exceeded in a 250-year period. This relationship corresponds to a 2500-year average recurrence interval for this intensity of movement. There is therefore a 10% probability that an acceleration (Ae) of less than 0.03g

[7] Southern Downs Regional Council. (2018, 27 June). Southern Downs Planning Scheme. Version 5.
[8] The University of Queensland. (2012). Earthquake Information for Queensland, Australia.
[9] Geoscience Australia. (2012). Atlas of Seismic Hazard Map of Australia, Commonwealth of Australia, Canberra.

(100/250ths of 0.06g) will be exceeded during a 100-year period. Large (wall) scale instabilities being triggered by earthquakes within any pit are rare; they are not expected to do so at this site.[10]

Drought

As of 23 August 2022, Southern Downs Regional Council area is not in a drought declared state.[11] Data from BOM indicates the Warwick Limestone area typically experiences low rainfall during cooler months between April and September. Furthermore, the southern downs region experiences drought conditions that vary in intensity and duration. The most recent period where the region was declared in drought was as recent as 2021. The QLD Drought Duration Report[14] indicates that since 1964, 30-40% of the time the site location is classified as 'drought declared'.

1.2.3 Geological Setting

There are seven specific geological formations within the operational area contained by the mining leases as shown in **Table 6** and displayed in **Figure 7** and **Figure 8**.

Table 6: Geological formations underlying the Warwick Limestone Mine

Rock Unit Name	Lithological Summary	Period	Map Symbol	Map Colour
Bald Hill Formation/b	Hypabyssal and extrusive metabasites	Early Devonian	Dlb/b	
Bald Hill Formation/f	Basaltic hyaloclastic debris flow deposits	Early Devonian	Dlb/f	
Bald Hill Formation/g	Medium to coarse-grained, hypabyssal metagabbro	Early Devonian	Dlb/g	
Bald Hill Formation/l	Limestone	Early Devonian	Dlb/l	
Bald Hill Formation/s	Thin to medium-bedded turbiditic, partly volcaniclastic arenite and mudstone together with some chert; sporadic deposits of slump melange locally containing large olistoliths of chert, volcanic rocks and limestone	Early Devonian	Dlb/s	
Bald Hill Formation/v	Mafic peperites and associated volcaniclastic sediments; metabasite	Early Devonian	Dlb/v	
Stanthorpe Granite	Pale pink to grey, mainly medium-grained, equigranular to porphyritic, leucocratic, biotite (+ rare hornblende) monzogranite to syenogranite; rapakivi texture common; scattered fine-grained saccharoidal leucogranite	Early Triassic	Rgst	

[10] Rocktest Consulting. (2019). Warwick Limestone Mine Geotechnical Risk Assessment and Management.
[11] https://www.longpaddock.qld.gov.au/drought/archive/ (accessed September 2022)

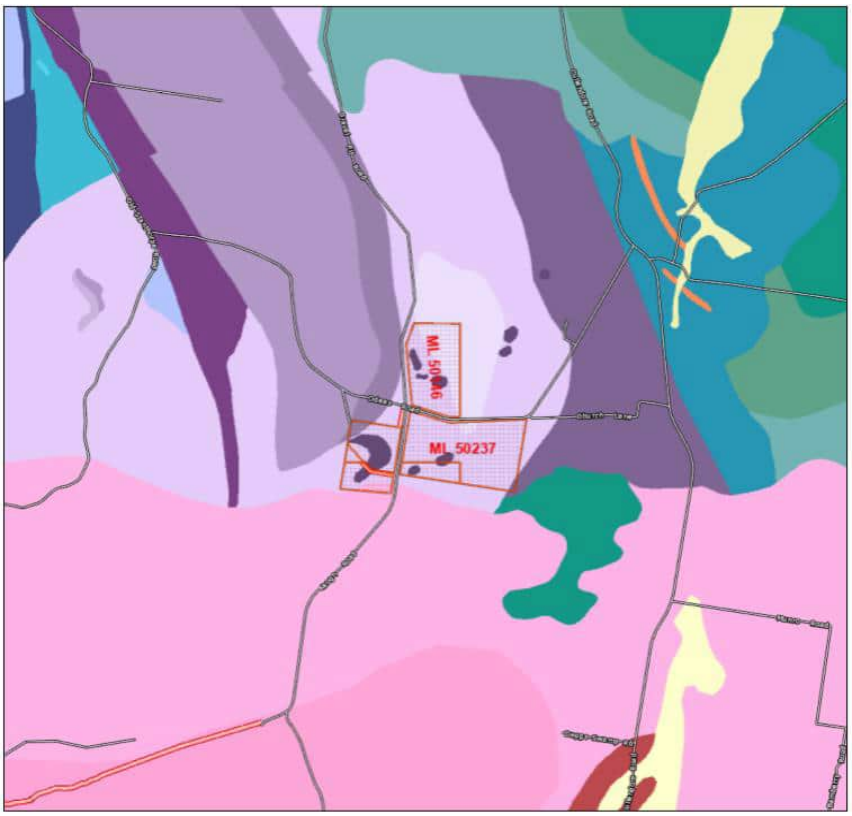

Figure 7: Regional geology[12]

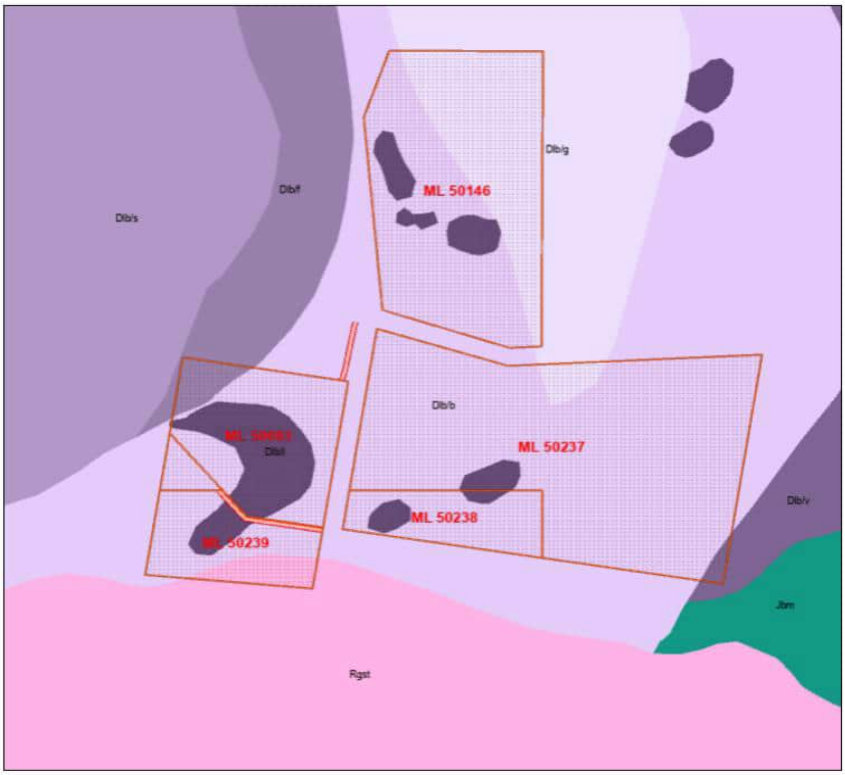

Figure 8: Site geology[12]

[12] https://qldglobe.information.qld.gov.au/ (accessed August 2022)

1.2.4 Site Hydrology and Fluvial Networks

1.2.4.1 Watercourses and Drainage Features

Limestones in the area have been metamorphosed and fault-dissected to form small, scattered, steeply dipping lenses of coarse-grained marbles. The marble is mostly near white and generally contains fractures coated with an iron oxide film. There are also large patches of grey marble and a streaky grey-white variety. The host Rosenthal Creek Formation consists of sandstones, siltstones, and volcanic rocks, intersected by green andesite dykes. The marbles are generally massive with no visible bedding as they are likely near vertical to steeply dipping. At places along the western side of ML50083, there is a steep dipping contact between the marbles and the dark greenish-grey shale that strikes roughly north-south. It appears that no limestone occurs beyond this contact. The depth of the marble has not been determined.

1.2.4.2 Regional Catchment Overview

The Project is located within the Condamine-Balonne River basin which spans a total area of 143,900km^2 comprising 14.4% of the Murray-Darling Basin[13] (**Figure 9**). The primary surface water resources include the Maranoa, Condamine, and Balonne rivers as well as numerous wetlands, natural lakes, and man-made reservoirs and dams. Minor waterways in the basin include the Cogoon River, Merivale River, Dogwood Creek, and Bungil Creek.

1.2.4.3 Local Catchment Overview

Warwick Limestone is located on the southern-most boundary of the Condamine-Balonne River basin (**Figure 9**). This results in the formation of headwaters for minor unmapped tributaries connecting to Little John Creek and the Condamine River.

1.2.4.4 Topography and Drainage

The general topography of the site is relatively flat with an approximate elevation of 530mAHD to 580mAHD. The unmapped tributaries on with the Project area drain towards the north to Little John Creek and the Condamine River.

[13] Thoms, M.C. & Parsons, M. (2003). Identifying spatial and temporal patterns in the hydrological character of the Condamine-Balonne River, Australia using multivariate statistics, *River Research Applications, 19*(5-6): 443-457. doi:10.1002/rra.737.

1.2.4.5 Floodplain assessment

Major floods occur in the Condamine-Balonne River, on average, every two-years[14]. Under the 'Guideline for Voids in Flood Plains'[15], a flood plain model of the Project area is not required as the watercourses on site are not mapped within the Level 1 Queensland Floodplain Assessment Overly (**Figure 10**).

Although the unnamed watercourses on site connect to the upper-most tributaries of the Condamine River, the area has no risk of significant flooding and no history of flooding on site.

The site topography is undulating and is predominantly on top of ridgelines, with no risk of 'floodplain' development as water moves across site. Due to the relatively small catchments associated with the site, the risk to final landform structures from floodwaters is considered very low. No constructed landforms have been placed in the path of concentrated stormwater runoff; the majority of waste dumps are located immediately downslope of the pit which limits the flow of stormwater to the waste dump's own surface area. Appropriately sized erosion and sediment controls have been designed to convey surface water away from the landform in a safe manner. Due to these factors, water movement across site is considered very low risk to the long-term stability of the final landforms designed on site.

[14] Australian Government. (2019, 9 January). *Surface Water Systems*, Australian Government Bioregional Assessments.
[15] Queensland Government. (2020, 11 March). Information Sheet: Voids in flood plains (ESR/2019/4966).

Figure 9: Catchment area and main watercourses

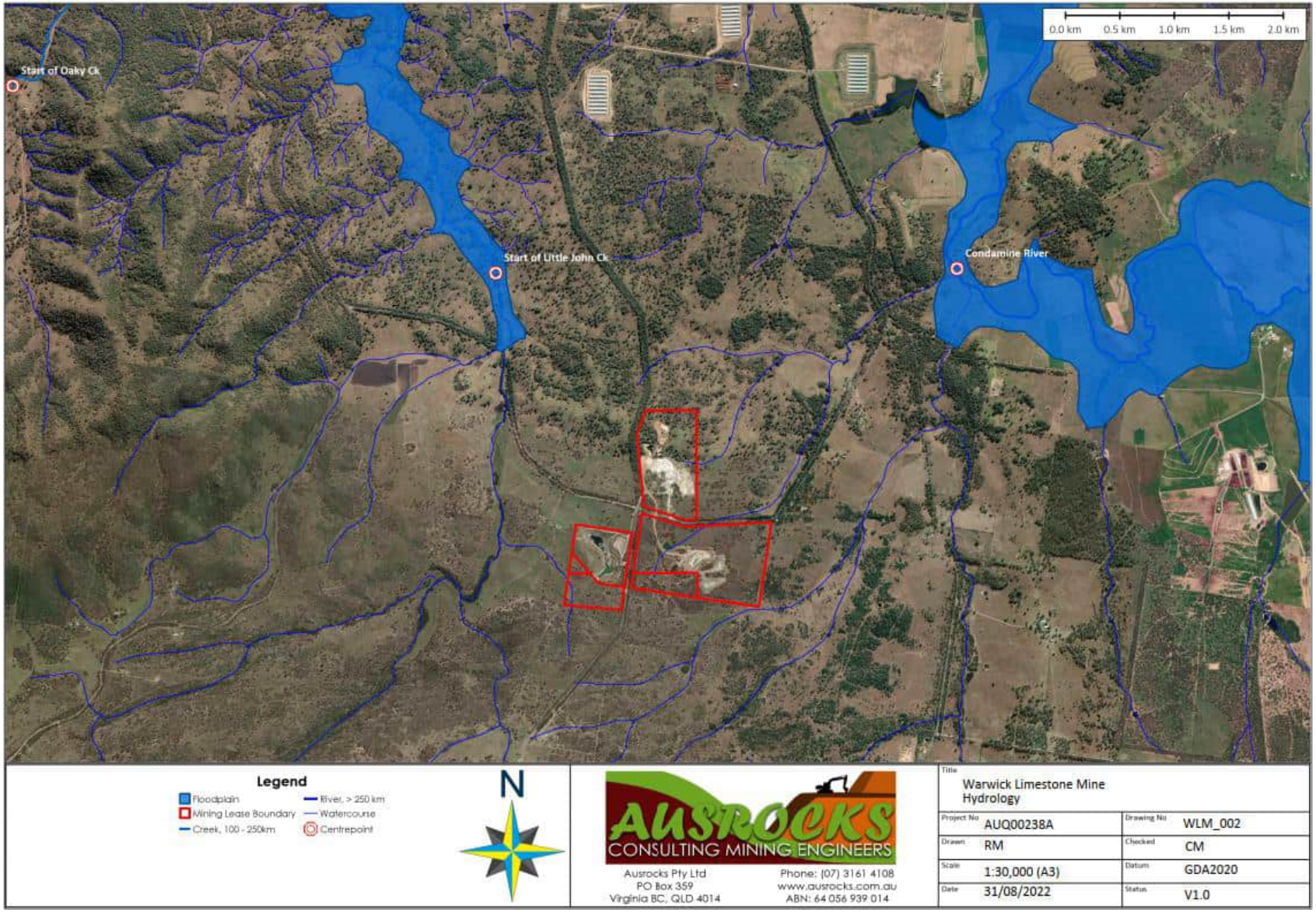

Figure 10: Hydrology and fluvial networks and flood extent

1.2.4.6 Groundwater

Warwick Limestone sits within the Condamine-Balonne Underground Water Management Area[16]. The site lies predominantly in an area of aquifer with the following lithologies:

- Acid to intermediate volcanics (e.g. andesite, rhyolite, tuff); and
- Sedimentary strata (e.g. sandstone, shale, conglomerate)

Historical site-specific groundwater modelling has not been undertaken, however local groundwater levels are around 20m to 25m depth below ground level as observed from drill logs and minor seepage in pits. Groundwater flow has been observed to be very slow from minor pit seepage. Rainfall run-off and slow percolation of subsurface drainage is the main source of water to the pits. Mining from the base of the pits suggests that, at shallow depths, groundwater yields may be variable, and that the aquifer system may be discontinuous. Groundwater resources in the vicinity of the project are suitable for most uses, although marginal for human consumption and low for salt-tolerant crops with a salinity range of 500mg/L to 1500 mg/L (total dissolved salts) and a bore yield <5L/sec.

There is no continuous groundwater body present in the limestone deposits in the East-West pit. It is likely that groundwater migrates into the more permeable substrata from a more consistent water body or recharge area hydraulically upgradient of the deposit. Groundwater recharge does not occur in this area. Where perched water or surface water enters the pits, they must be pumped out to allow mining operations to continue. The Aspinal pit is in an area of limited groundwater recharge, and while some infiltration occurs in this area, it is otherwise very slow and has significant surface water ponding after rainfall events.

A groundwater bore (Bore Licence WL86305T; 10ML maximum annual extraction) located on ML50083 has been inactive for several years. A <1L/sec yield has been estimated by site personnel. Groundwater levels are lower than 15m below the surface. Historical data suggests groundwater salinity range between 750EC to 2240EC. Minor groundwater seepage is observed in the Phoenix pit at approximately 20m below ground level.

Aquifer transmissivity in limestone is typically low, i.e. the impacts on other groundwater users in the area are considered negligible due to low transmissivity and proximity to potential mining influence. The nearest bore (Bore No. 86326) in the area is positioned approximately 1.6km to the east, at a surface elevation 40-50m below the site average and in a weathered granite and yields <0.5L/sec. Groundwater water quality is described as potable from a drill depth of 22m; pH 8.4 and 2191EC salinity. The project is surrounded by farmland primarily used for cattle grazing. Hence groundwater is mainly used for agricultural use and cattle drinking water. Considering surrounding boreholes in the area have been installed in varying formations (a result of the limestone deposits), it is unlikely that mining operations will have an impact to the water quality or quantity in these bores. It is therefore determined that further groundwater modelling for the purpose of this PRC Plan will not be necessary as mining operations will not impact on the local groundwater table.

[16] https://qldglobe.information.qld.gov.au/

1.2.5 Soil Types, Properties and Productivity

1.2.5.1 Identified Soils

The dominant soil type in the immediate area of the Project is mapped as yellow and yellow-grey duplex soils (Dy) on the Soil Map of Australia (Queensland) 5M. These soils are characterised by a sandy or loamy surface horizon with a sharp to clear boundary to a clay subsoil[17].

Terrequip commissioned Horizon Soil Scientists and Engineering (Horizon) to survey and produce a report on the soils present within the MLs of Warwick Limestone (**Appendix 2**)[18]. Report findings identified four soil types described by the Australian Soil Classification (ASC) system as Brown and Red Sodosols, Brown Tenosols, Brown Vertosols, and Red Dermosols (Isbell 2021). These are summarised in **Table 7**. Brown and Red Sodosols covered the greatest area of the Project (>80% coverage) **(Figure 11**).

Table 7: Soil types within the Warwick Limestone area

Australian Soil Classification	Mapped area (ha)
Brown and Red Sodosol	143.3
Brown Tenosol	10.4
Red Dermosol	5.1
Brown Vertosol	13.1

1.2.5.2 Strategic Cropping Area

Strategic Cropping Area is an area of regional interest comprised of Strategic Cropping Land (SCL) under the *Regional Planning Interests Act 2014* (RPI Act). This is land that is or is likely to be highly suitable for cropping based on the land's soil, climate, and landscape features.

It is an offence to carry out a development on SCL or potential SCL that has a permanent or temporary impact on the land with approval, under the RPI Act. Resource developments must therefore avoid and minimise to the maximum extent possible, any temporary or permanent impacts on identified SCL. Where this is not possible, mitigation of permanent impacts may be required.

There are no SCL located within the Project MLs or within the vicinity of the Project[19].

1.2.5.3 Good Quality Agricultural Land

Good Quality Agricultural Land (GQAL) is a system used to determine the ability of the land to sustain agricultural use without causing degradation to the land or to other natural resources. Agricultural Land Classification (ALC) Class A is accepted as GQAL in all areas, whereas ALC Class B and Class C have conditional GQAL.

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[17] Northcote, K. H. (1979). *A factual key for the recognition of Australian soils*, 4th ed., Rellim Technical Publications Pty Ltd., Adelaide.
[18] Horizon Soil Scientists and Engineers. (2022, 16 September). Report on the Soil Survey of Leases of the Warwick Limestone Quarry.
[19] Epic Environmental Pty Ltd. (2020, 17 November). Environmental Management Plan – Warwick Limestone Mine.

Local Government uses ALC to inform planning schemes and regional plans as required for agricultural provisions of the State Planning Policy. The implementation of this policy requires awareness of GQAL from Local and State Governments, as well as applicants.

Warwick Limestone GQAL was assessed a desktop study. It was determined that no GQAL is located within the mining leases or immediate surrounding areas of Warwick Limestone.[20]

1.2.5.4 Stockpile Material

Assessment of topsoil stockpiles was conducted by Horizon as part of their survey of the Warwick Limestone mining leases. Three (3) topsoil stockpiles were randomly sampled (0-100mm depth), and three (3) replicate samples were taken per stockpile.

Stockpiles no. 1 and 3 were found to be similar, with brown to reddish brown medium to heavy clay texture, a few brown mottle, and common medium gravel. Stockpile no. 2 was found to be a light yellowing brown silty sand. The physicochemical characteristics of the sampled stockpiles are summarised below:

Stockpile 1 and 3

- Neutral pH
- Non-saline
- Moderate to high organic carbon
- Moderate CEC, non-sodic with low Ca:Mg ratio
- EAT scores suggest slaking but non-dispersive soils

Stockpile 2

- Moderately acid
- Non-saline
- Moderate organic carbon
- Low CEC, non-sodic with balanced Ca:Mg ratio
- EAT scores suggest slaking but non-dispersive soils

Table 8 summarises the results of stockpile chemistry analysis.

Table 8: Analysis of stockpile chemistry

Stockpile	EC_{se}	pH	ESP %	CEC	Ca:Mg ratio	OC %	EAT
1	0.01	6.9	1.8	16.3	3.0	1.1	3
2	0.01	5.8	1.7	2.8	1.4	0.9	4
3	0.01	6.9	0.3	19.7	5.5	2.0	3

[20] Epic Environmental Pty Ltd. (2020, 17 November). Environmental Management Plan – Warwick Limestone Mine.

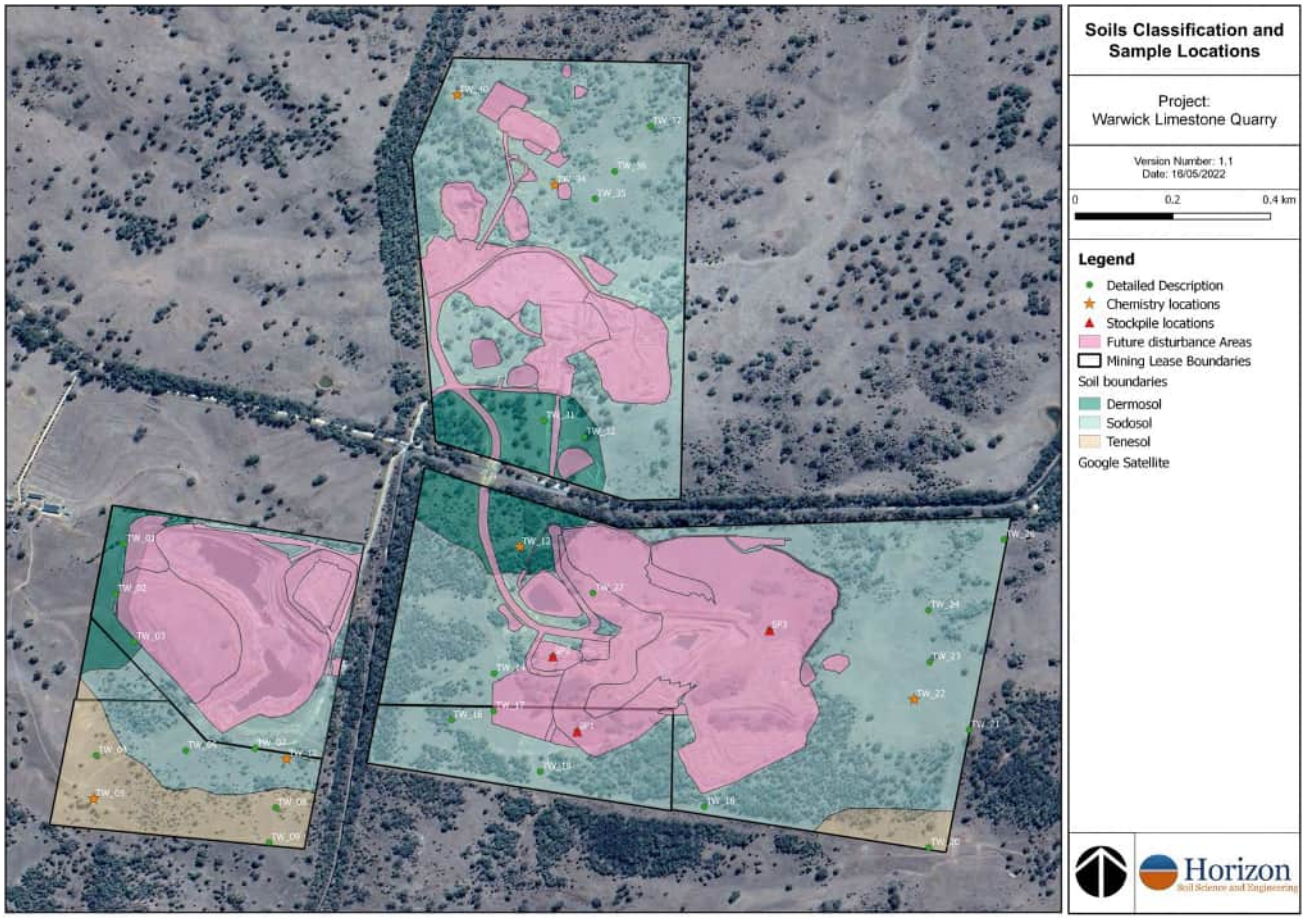


Figure 11: Mapped soil types and sample locations

1.2.6 Land Stability

Warwick Limestone sits on land that has been predominantly used as grazing land for many years prior to the operation of the mine in 1930. Native vegetation has been extensively cleared to allow for the cultivation of agricultural grass species for cattle; the primary stock kept on the land. Historical aerial imagery shows vegetation regrowth has occurred in the area, and particularly from the late 1970s onwards.

A few properties adjoining and surrounding Warwick Limestone have installed contour bunding in areas of hilly terrains to slow movement of surface water and direct flows into storage dams. The erosive effects of surface water flows over pastured areas has been generally mitigated in areas where this contour bunding is installed. There is also little evidence of natural land slips in the area, however stability issues are most likely to arise around the walls of remaining pit voids. The stability of these walls have been investigated and are reported in the site geotechnical report (**Appendix 4**).[21]

The EA defines final slope requirements for pit walls, waste dumps, and water storages in the Schedule F tables 1-7. These slope requirements will be used as completion criteria when executing final batters.

[21] Rocktest. (2019, June). Warwick Limestone Mine Geotechnical Risk Assessment and Management for Sibelco.

1.2.7 Vegetation Communities and Ecological Data

A desktop search was conducted to identify the presence and mapped distribution of vegetation communities at Warwick Limestone. The results of the search are provided in the following sub-sections.

The results of the desktop search are limited by the following factors:

- Lack of historical field-based ecological assessment to confirm accuracy of desktop search data; and
- Data available online I based on reported sightings across a large period of time, therefore reporting is inconsistent.

1.2.7.1 Vegetation Communities

Vegetation communities at Warwick Limestone consist of both remnant and non-remnant growth. These are summarised in **Table 9**.

Table 9: Vegetation communities within the Warwick Limestone area

Regional Ecosystem	Short description	Biodiversity status [1]	Condition
11.9.9	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks	No concern at present	Remnant
11.9.13	*Eucalyptus moluccana* or *E. microcarpa* open forest on fine grained sedimentary rocks	Of concern	Remnant
Non-remnant	None	None	Non-remnant

[1] *Vegetation Management Act 1999 (VM Act)*

1.2.7.2 Threatened Ecological Communities

The desktop search returned six (6) threatened ecological communities (TECs) listed as Matters of National Environmental Significance (MNES) under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act):

- Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions;
- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland;
- New England Peppermint (*Eucalyptus nova-anglica*) Grassy Woodlands;
- Poplar Box Grassy Woodland on Alluvial Plains;
- Weeping Myall Woodlands; and
- White Box-Yellow Box-Blakely's Road Gum Grassy Woodland and Derived Native Grassland.

There are no specific requirements in the Warwick Limestone EA for the inclusion of TECs in the rehabilitation planning.

The following summarises outcomes from the site Environmental Management Plan (**Appendix 3**).[22] Refer to **Figure 12** for mapped ecological features.

Aspinal pit

Previously, the vegetation located on the western side of Aspinal pit was mapped as RE 11.9.9/11.9.13. A ground-truthing vegetation survey was undertaken of the extant remnant vegetation community (under the *Vegetation Management Act 1999* (VM Act)) within the mapped Essential Habitat area on the west side of Aspinal Pit. This vegetation is described as tall grassy woodland whose canopy is dominated by gum-topped box *Eucalyptus moluccana* with associated occurrences of narrow-leaved ironbark *E. crebra*. The shrub layers of this community are very sparse to almost absent and the ground layer is dominated by a mixture of native grasses with very sparse occurrences of native forbs.

The occurrence of narrow-leaved ironbark throughout this community defines this Regional Ecosystem as the Least Concern (VM Act) RE 11.9.9.

RE 11.9.13 was not present within the area surveyed and was not observed within the neighbouring road reserve. Government based mapping will need to be updated to reflect this ground-truthed mapping change. As at time of writing, a Property Map of Assessable Vegetation (PMAV) Application has not been submitted to DNRME to undertake this change.

Phoenix pit

The grassland located north of the existing pit was considered to possibly be the Commonwealth Threatened Ecological Community (TEC) Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland[23]. Whilst the grassland meets several criteria; it is mapped as occurring on sandstone derived sediments (Land Zone 9) and is not associated with an alluvial area. Therefore, the grassland does not qualify as a TEC.

Historical aerial mapping of the site shows that the grassland area has been untouched for over 20 years and site assessment of species composition suggests that the grassland could be regarded as Remnant under the VM Act and in good condition. If mapped as a grassland it could only be RE 11.9.3, a Least Concern (VM Act) with a biodiversity status of “No Concern at present”. It is however more likely to be an open patch of grassland formed by historic clearing of the surrounding grassy woodland RE 11.9.9 and is therefore considered to be a “derived” grassland. Being Least Concern under the VM Act and having a No Concern at Present Biodiversity status, this grassland does not represent a development constraint at the State level.

There appears to be no statutory reason for the identification of habitat trees within the Project area. Review of the threatened species likely to occur on the site, either via online searches or by on-ground confirmation of

[22] Epic Environmental Pty Ltd. (2020, 17 November). Environmental Management Plan – Warwick Limestone Mine.
[23] BAAM Ecology. (2019). Targeted flora and terrestrial vertebrate fauna assessment.

habitat, suggest that the trees do not provide habitat for threatened species and therefore, do not present a constraint to development of the site.

East-West pit

No ecologically sensitive vegetation values are mapped within the East-West Leases.

1.2.7.3 Threatened Flora

Due to the age of the site, historical records of flora ecological assessments is not available. A desktop search was conducted to identify the presence of threatened flora at Warwick Limestone. The search returned ten (10) threatened species listed in the EPBC Act and/or *Nature Conservation Act 1992* (NC Act)[24]. These are summarised in **Table 10**.

There are no specific requirements in the Warwick Limestone EA for inclusion of threatened flora species in the rehabilitation planning.

Table 10: Threatened flora populations within the Warwick Limestone area

Class	Scientific name	Common name	Status [1, 2]	Likelihood of occurrence [3]
Plant	*Arthraxon hispidus*	Hairy-joint grass	V	L
	Cadellia pentastylis	Ooline	V	M
	Callistemon pungens	-	V	M
	Dicanthium setosum	Bluegrass	V	L
	Eucalyptus glaucina	Slaty Red Gum	V	M
	Eucalyptus nicholii	Narrow-leaved Peppermint, Narrow-leaved Black Peppermint	V	M
	Lepidium monoplocoides	Winged Pepper-cress	E	M
	Lepidium peregrinum	Wandering Pepper-cress	E	M
	Picris avae	Hawkweed	V	L
	Thesium austral	Austral Toadflax, Toadflax	V	I

[1] Status: Vulnerable (V); Critically Endangered (CE); Endangered (E), Special Least Concern (SL)
[2] Status: Restricted invasive (RI); Other Invasive (OI)
[3] Likelihood of occurrence: Species or species habitat known to occur within area (K); Species or species habitat likely to occur within area (L); Species or species habitat may occur within area (M); Species or species habitat known to occur within area; Foraging, feeding or related behaviour likely to occur within area (F); Pest species has potential to occur within area (P)

1.2.7.4 Protected Flora Triggers

The site does not have any mapped protected plants on the Protected Plants Flora Survey Trigger Map.

[24] https://pmst.awe.gov.au (accessed April 2023)

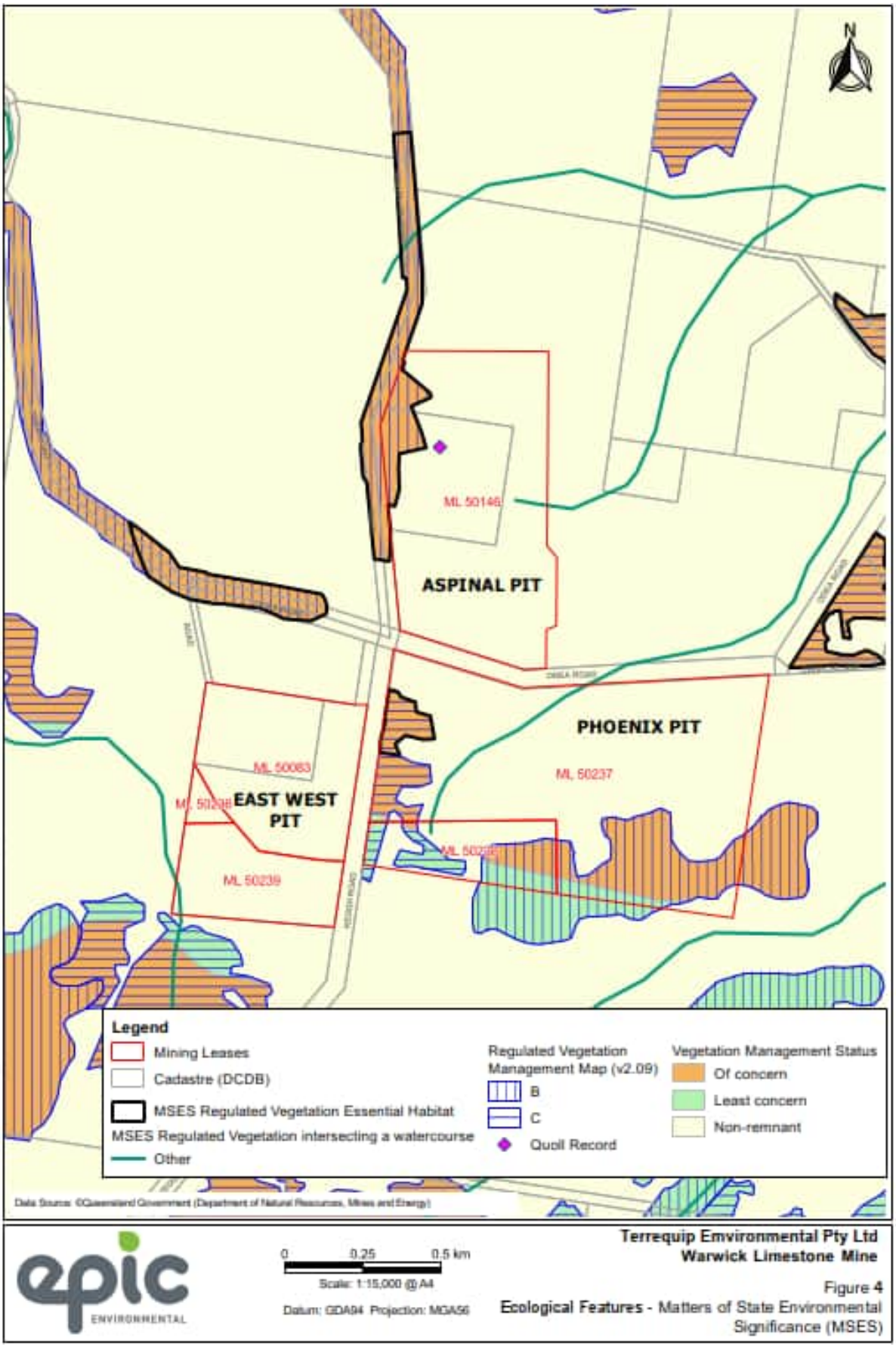


Figure 12: Mapped ecological feature

1.2.7.5 Weeds

According to the WildNet database, there are no listed weed species occurring on or near the Project area. The Queensland Government Weed Map[25] records the weed species in Table 8 as known to be present in the Elbow Valley area. The Project implements a Vegetation Management Plan to manage pest and weed infestation regarding the species listed in **Table 11**.

Table 11: Weed species known to occur in the Warwick Limestone area

Scientific Name	Common Name	State Declaration	Category[1]	Notifiable
Lycium ferocissimum	African Boxthorn	Restricted	3	No
Eragrostis curvula	African Lovegrass	Not declared	N/A	No
Ambrosia artemisiifolia	Annual ragweed	Restricted	3	No
Rubus anglocandicans, R. fruticosus agg.	Blackberry	Restricted	3	No
Ligustrum lucidum	Broad-leaf privet	Restricted	3	No
Celtis sinensis	Chinese celtis	Restricted	3	No
Ligustrum sinense	Chinese privet	Restricted	3	No
Pyracantha augustifolia, P. koidzumii	Firethorn	Restricted	N/A	No
Senecio madagascariensis	Fireweed	Restricted	3	No
Baccharis halimifolia	Groundsel bush	Restricted	3	No
Gleditsia triacanthos	Honey locust	Restricted	3	No
Lantana camara	Lantana	Restricted	3	No
Anredera cordifolia	Madeira vine	Restricted	3	No
Bryophyllum delagoense, B. x houghtonii	Mother-of-millions	Restricted	3	No
Opuntia tomentosa, O. stricta, O. monacantha, O. aurantiaca	Prickly pear	Restricted	3	No
Sporobolus natalensis, S. pyramidalis, S. jacquemontii, S. fertilis	Rat's tail grasses	Restricted	3	No

[1] *Biosecurity Act 2014*

1.2.8 Fauna Presence and Populations

A desktop search was undertaken to identify the potential presence of native and introduced fauna populations at Warwick Limestone. Due to the age of the mine, there are no historical records of field-based ecological assessments.

[25] Department of Agriculture and Fisheries. (2019). Online Weed Map Version 2. https://qgsp.maps.arcgis.com/apps/webappviewer/index.html?id=6d325b2e476d4113be6490225308428c

There were 31 threatened fauna species and 2 migratory species listed under the EPBC Act and/or the NC Act returned from the desktop search that may occur within the Warwick Limestone Area. Six (6) pest species were also identified. The likelihood and occurrence of each species is based on reported sightings and mapped habitats. This is summarised in **Table 12**. There are no specific requirements in the Warwick Limestone EA for inclusion of fauna habitat planning in the rehabilitation planning.

Table 12: Fauna populations within the Warwick Limestone area

Class	Scientific name	Common name	Status [1, 2]	Likelihood of occurrence [3]
Threatened species				
Bird	*Anthochaera phyrgia*	Regent Honeyeater	CE	F
	Aphelocephala leucopsis	Southern Whiteface	V	M
	Botaurus poisiloptilus	Australasian Bittern	E	M
	Calidris ferruginea	Curlew Sandpiper	CE	M
	Calyptorhynchus lathami lathami	South-Eastern Glossy Black-Cockatoo	CE	L
	Climacteric picumnus victoriae	Brown Treecreeper (south-eastern)	V	M
	Erythrotriorchis radiatus	Red Goshawk	E	M
	Falco hypoleucos	Grey Falcon	V	L
	Geophaps scripta scripta	Squatter Pigeon (southern)	V	L
	Grantiella picta	Painted Honeyeater	V	L
	Hirundapus caudacutus	White-Throated Needletail	V	K
	Lathamus discolour	Swift Parrot	CE	L
	Neophema chrysostoma	Blue-winged Parrot	V	M
	Rostratula australis	Australian Painted Snipe	E	L
	Stagonopleura guttata	Diamond Firetail	V	L
	Turnix melanogaster	Black-breasted Button-quail	V	M
Frog	*Mixophyes fleayi*	Fleay's Frog	E	M
Mammal	*Chalinolobus dwyeri*	Large-eared Pied Bat, Large Pied Bat	V	M
	Dasyurus maculatus maculatus	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (SE mainland population)	E	K
	Notamacropus parma	Parma Wallaby	V	M
	Nyctophilus corbeni	Corben's Long-eared Bat, South-eastern Long-eared Bat	V	M
	Petauroides Volans	Greater Glider (southern and central)	E	L
	Petaurus australis australis	Yellow-bellied Glider (south-eastern)	V	M
	Petrograte penicillatat	Brush-tailed Rock-wallaby	V	M
	Phascolarctos cinereus	Koala	E	K
	Pseudomys novaehollandiae	New Holland Mouse	V	M
	Pteropus poliocephalus	Grey-headed Flying Fox	V	F
Reptile	*Anomalopus mackayi*	Five-clawed Worm-skink, Long-legged Worm-skink	V	M
	Delma torquate	Adorned Delma, Collared Delma	V	M
	Furina dunmalli	Dunmall's Snake	V	M
	Hemiaspis damelii	Grey Snake	E	M
Migratory species				
Bird	*Hirundapus caudacutus*	White-throated Needletail	V	K
	Calidris ferruginea	Curlew Sandpiper	CE	M

Class	Scientific name	Common name	Status [1, 2]	Likelihood of occurrence [3]
Introduced species				
Frog	*Bufo marinus*	Cane toad	OI	P
Mammal	*Felis catus*	Cat	RI	P
	Canis familiaris	Wild dog	RI	P
	Vulpes vulpes	Fox	RI	P
	Sus scrofa	Pig	RI	P
	Oryctolagus cuniculus	Rabbit	RI	P

[1] Status: Vulnerable (V); Critically Endangered (CE); Endangered (E), Special Least Concern (SL)
[2] Status: Restricted invasive (RI); Other Invasive (OI)
[3] Likelihood of occurrence: Species or species habitat known to occur within area (K); Species or species habitat likely to occur within area (L); Species or species habitat may occur within area (M); Species or species habitat known to occur within area; Foraging, feeding or related behaviour likely to occur within area (F); Pest species has potential to occur within area (P)

1.2.9 Matters of State Environmental Significance (MSES)

Matters of State Environmental Significance (MSES) surrounding Warwick Limestone are illustrated in **Figure 13** and summarised in **Table 13**. Note, there is inconsistency between Queensland Globe mapping and inherited mining disturbances.

Table 13: Areas of MSES value within the mining tenements of Warwick Limestone

MSES value	Category	Legend	Description
Regulated Vegetation	Category B		• RE 11.9.9/11.9.13 • RE percent 80/20 • Vegetation Management Class Least Concern/Of Concern
	Category C		• RE 11.9.9/11.9.13 • RE percent 65/35 • Vegetation Management Class Least Concern/Of Concern
	Defined Watercourse		• 2 unnamed drainage features • Stream Order 1
	Essential Habitat		• n/a
Wildlife Habitat	Endangered or Vulnerable		• n/a
	Special Least Concern Animal		• n/a

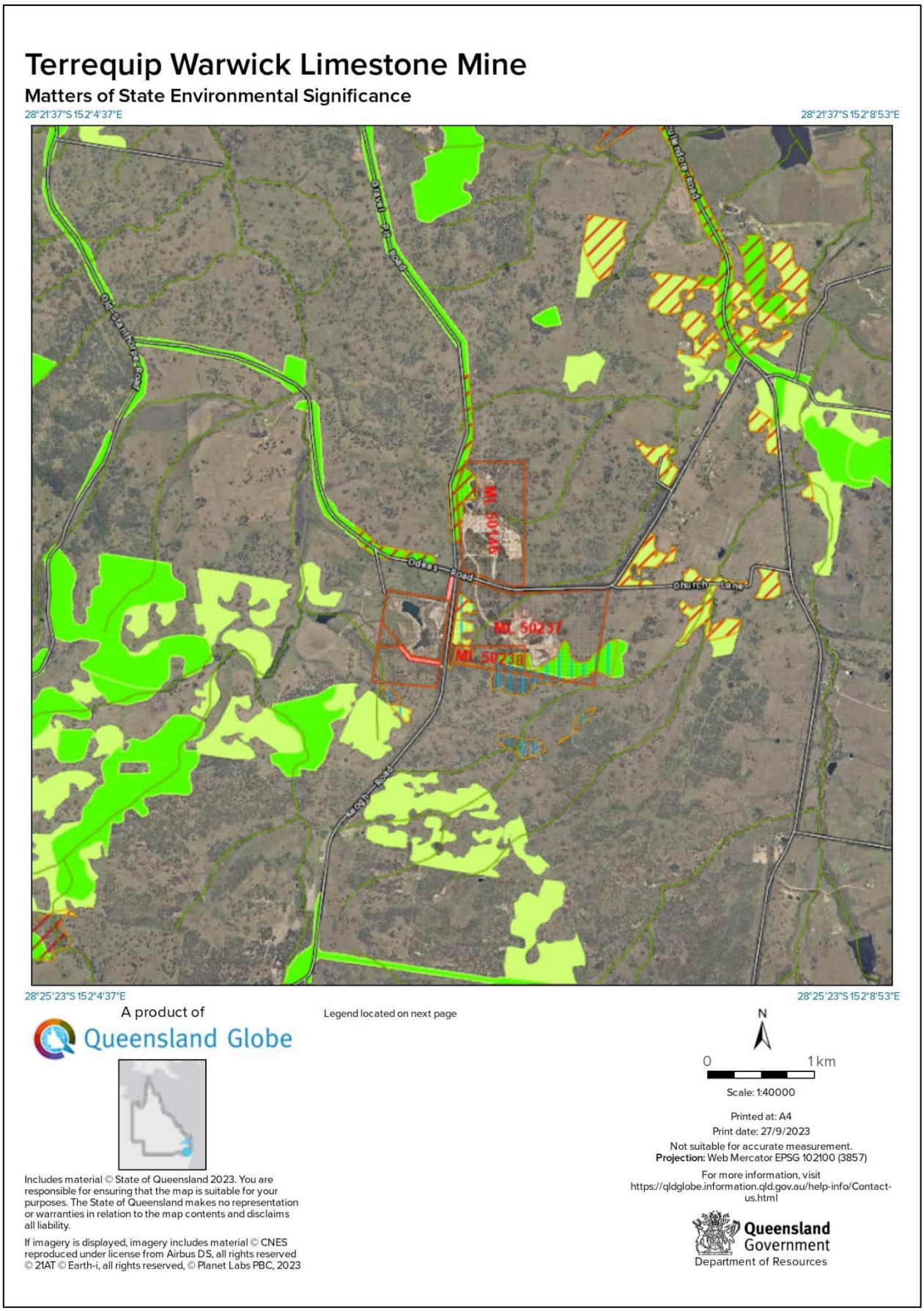


Figure 13: Areas of MSES value within the mining tenements of Warwick Limestone

1.2.10 Pre-mining Land Use

The pre-mining land use of the area is cattle grazing. Some area have previously been subject to vegetation clearing. Existing soil erosion is evident across the Warwick Limestone area is attributed to existing land use grazing activities including from historic cleared drainage lines and creeks. Other areas of Warwick Limestone have been used for grazing cattle and sheep since European settlement, with most of the original native vegetation cleared for pasture.

Prior to the acquisition of Warwick Limestone by Terrequip, historical activities in the Aspinal Pit consisted of mining limestone, gold and silver; previously known as the Marberete Quarry. Limestone mining commenced in 1931 after the issue of grant for the first mining lease.

1.2.11 Underlying Landholders

The underlying landholders for the Warwick Limestone leases are shown in **Table 14**.

Table 14: Underlying landholders for the Warwick Limestone project area

Mining lease	Property	Landholder
ML 50083	Lot 178 M34534	State of Queensland
ML 50146	Lot 106 ML623 Lot 2 RP36822	[redacted]
ML 50236	Lot 5 SP236094	Terrequip Environmental Pty Ltd
ML 50237	Lot 1219 M34519	[redacted]
ML 50238		
ML 50239	Lot 5 SP236094	Terrequip Environmental Pty Ltd

1.3 Design for Closure

This PRC plan has been developed to proactively manage progressive rehabilitation of the Warwick Limestone site to a stable PMLU, aiming to minimise long-term management requirements as well as associated closure costs. Importantly, a focussed design for closure underpins all sections of this plan from:

- existing operations methods to development of the rehabilitation knowledge base (baseline information);
- engagement with relevant stakeholders to define suitable PMLUs and in accordance with the LOD;
- defining and implementing rehabilitation practices to identify risks that could influence achievements of milestone criteria; and
- demonstrating successful rehabilitation through defined site monitoring to develop a feasible PRCP schedule.

1.4 Spatial Information

The following spatial information are submitted to support the development of this PRC plan.[26]

- Location and maximum extent of disturbance footprint for the mine life;
- The PMLUs and NUMAs for the area within the resource tenures (there are no NUMAs proposed for Warwick Limestone; and
- Any sensitive receptors.

Spatial information is provided to the administering authority via email to spatialsubmit@des.qld.au[27]

[26] Queensland Department of Environment and Science (November 2019): Progressive Rehabilitation and Closure Plan Guideline
[27] Queensland Department of Environment and Science (April 2022): Spatial Information Submission

1.5 Rehabilitation and Improvement Planning

Legislative Requirement

In accordance with section 126C(1)(b) and (c)(ii) of the EP Act, the rehabilitation planning part of the PRC plan must include:

- identification if all relevant activities on the mine site
- the predicted duration of each of the relevant activities proposed for the mine site
- the size/extent of the relevant activities; and
- whether the different relevant activities can be progressively rehabilitation.

PRCP Guideline (section 3.1)

Under section 126C(1)(j) of the EP Act, transitional PRC plans must also include the following details about any existing rehabilitation already completed at the time of submission of the proposed PRC plan:

- a description of the rehabilitation works previously carried out
- when the rehabilitation works commenced and were completed; and
- whether the rehabilitation has been applied for or approved as progressively certified under the EP Act.

1.5.1 Relevant Activities

Current relevant activities at Warwick Limestone that will require rehabilitation are provided in **Table 15.** This table summarises the relevant activities including estimate duration, area size, rehabilitation commenced and/or completed, and availability for progressive rehabilitation. Area extent (ha) listed below is a total of all relevant areas within Warwick Limestone that fall under the RA.

Table 15: Relevant activities requiring rehabilitation at Warwick Limestone

Relevant activity	Estimate availability	Area (ha)	Availability for progressive rehabilitation (including historical works)
Infrastructure (RA1)			
Fixed Plant	2037	1.20	Required to support mining operations. Available for rehabilitation once resources are exhausted.
Office / Maintenance Buildings	2037	0.50	Required to support mining operations. Available for rehabilitation once resources are exhausted.
Crib Hut and Parking	2037	0.69	Required to support mining operations. Available for rehabilitation once resources are exhausted.
Topsoil Stockpiles (RA2)			
Topsoil	2022	6.00	Re-spread as required for rehabilitation works. Available for rehabilitation once mining operations have ceased and final rehabilitation areas are available.
ROM and Product Stockpiles (RA3)			
ROM Pad and Stockpiles	2022	8.39	Required to backfill portion of Eastern Open Pit to RL 524 (per EA post mine land description). ROM Pad and stockpile areas will be rehabilitated once materials have been used in progressive rehabilitation of other mine areas.
Waste and Overburden Dumps (RA4)			

Relevant activity	Estimate availability	Area (ha)	Availability for progressive rehabilitation (including historical works)
Waste Dump (East Pit)	2024	17.93	To be used for pit backfill. Area available for rehabilitation once backfilling is complete.
Roads and Tracks (RA5)			
Roads and Tracks	2042	5.63	Available for rehabilitation once mining operations have ceased. To remain for use as farm tracks.
Sediment Dams and Stormwater Controls (RA6)			
Sediment Dams	2022	4.84	Required for water management until rehabilitation of pits. All intact water storage will remain as stock dams, per the EA post mine land description and landholder agreement.
Catchment Dams	2022	0.75	Required for water management until rehabilitation of pits. All intact water storage will remain as stock dams, per the EA post mine land description and landholder agreement.
Eastern Open Pit – Backfill RL 524* (RA7)			
Eastern Open Pit - Backfill (East-West Pit)	2022	0.77	Portion of the pit to be backfilled is available now. Backfill material will be sourced from trimming of waste dumps in the Phoenix Pit (ML50237). Approximately 40,000m^3 of material will be moved over an 8-year period to complete the backfill.
Main Pit Void – Water Storage (RA8)			
Main Pit Voids (Water Storage PMLU)	2027 – 2036	18.73	The East-West Pit will be available for rehabilitation in 2027. The Phoenix Pit will be available for rehabilitation in 2036. Resource in the Phoenix Pit will be extracted until the end of the mine life. Main pit voids will be rehabilitated to water storage per the EA post mine land description.
Main Pit Void – Grazing (RA9)			
Main Pit Void (Grazing PMLU)	2022 – 2036	1.26	Resource in the Aspinal Pit is exhausted, and the pit is available for rehabilitation. Approximately 62,800m^3 of material will be moved over a 15-year period to complete the backfill. Main pit voids will be rehabilitated to grazing land per the EA post mine land description.
Existing Rehabilitation - Grazing (RA10)			
ROM Pad & Stockpiles	2021	2.36	Rehabilitation has commenced and is in various stages of completion and/or repair. The area is yet to be certified.

Relevant activity	Estimate availability	Area (ha)	Availability for progressive rehabilitation (including historical works)
Topsoil Stockpile	2021	0.91	Rehabilitation has commenced and is in various stages of completion and/or repair. The area is yet to be certified.
Waste Dump	2021	6.04	Rehabilitation has commenced and is in various stages of completion and/or repair. The area is yet to be certified.

** EA Table 5 (Final Land Use and Rehabilitation Approval Schedule for ML50083)*

1.5.2 Rehabilitation Areas and Milestones

The activities in **Table 15** are grouped by rehabilitation area (RA). The PRCP Guideline defines a rehabilitation area as 'An area of land in the post-mine land use to which a rehabilitation milestone for the post-mining use relates. A rehabilitation milestone (RM) for the rehabilitated land, means each significant event or step necessary to rehabilitate the land to a stable condition (section 115 of the EP Act).'[26]

Rehabilitation milestones are legally enforceable commitments once the PRCP schedule is approved. Therefore, it is essential that milestones be written in a manner that delivers on SMART principles:

- Specific – it is clear what must be done;
- Measurable – it must be possible to know when it has been achieved;
- Achievable – it is capable of being achieved;
- Reasonable / Relevant – there is a clear connection between the milestone and the desired outcomes (i.e. the requirement is reasonable); and
- Time Specific – it is clear when the milestone will be completed.

The Warwick Limestone rehabilitation areas and rehabilitation milestones are summarised in **Table 16**.

Table 16: Rehabilitation areas (RAs) and rehabilitation milestones (RMs) for Warwick Limestone

Rehabilitation Areas (RA)	
RA1	Infrastructure
RA2	Topsoil stockpiles
RA3	ROM and Product Stockpiles (including Laydown Yards)
RA4	Waste and Overburden Dumps
RA5	Roads and Tracks
RA6	Sediment Dams and Stormwater Controls
RA7	Eastern Open Pit (Backfill to RL 524)
RA8	Main pit voids (East West Pit and Phoenix Pit)
RA9	Main pit voids (Aspinal Pit)
RA10	Existing rehabilitation

Rehabilitation Milestones (RM)	
RM1	Infrastructure decommissioning and removal
RM2	Landform development and reshaping
RM3	Surface preparation
RM4	Revegetation (Grazing / Water Storage catchment areas)
RM5	Establishment of Grazing PMLU surface conditions
RM6	Establishment of Water Storage PMLU conditions
RM7	Establishment of geotechnically stable surface conditions
RM8	Achievement of Grazing PMLU to a stable condition
RM9	Achievement of Water Storage PMLU to a stable condition
RM10	Achievement of Eastern Open Pit backfill to RL 524 PMLU to a stable condition
RM11	Landholder is informed of and acknowledges ongoing management

Note, the East West Pit water storage rehabilitation area includes an area outside the pit area and planned abandonment bunds. This area will be vegetated with grazing species to support surrounding rehabilitation areas with a PMLU of marginal grazing (refer to **Section 6.4.6**).

Figure 14 to **Figure 16** illustrate the rehabilitation areas for Warwick Limestone.

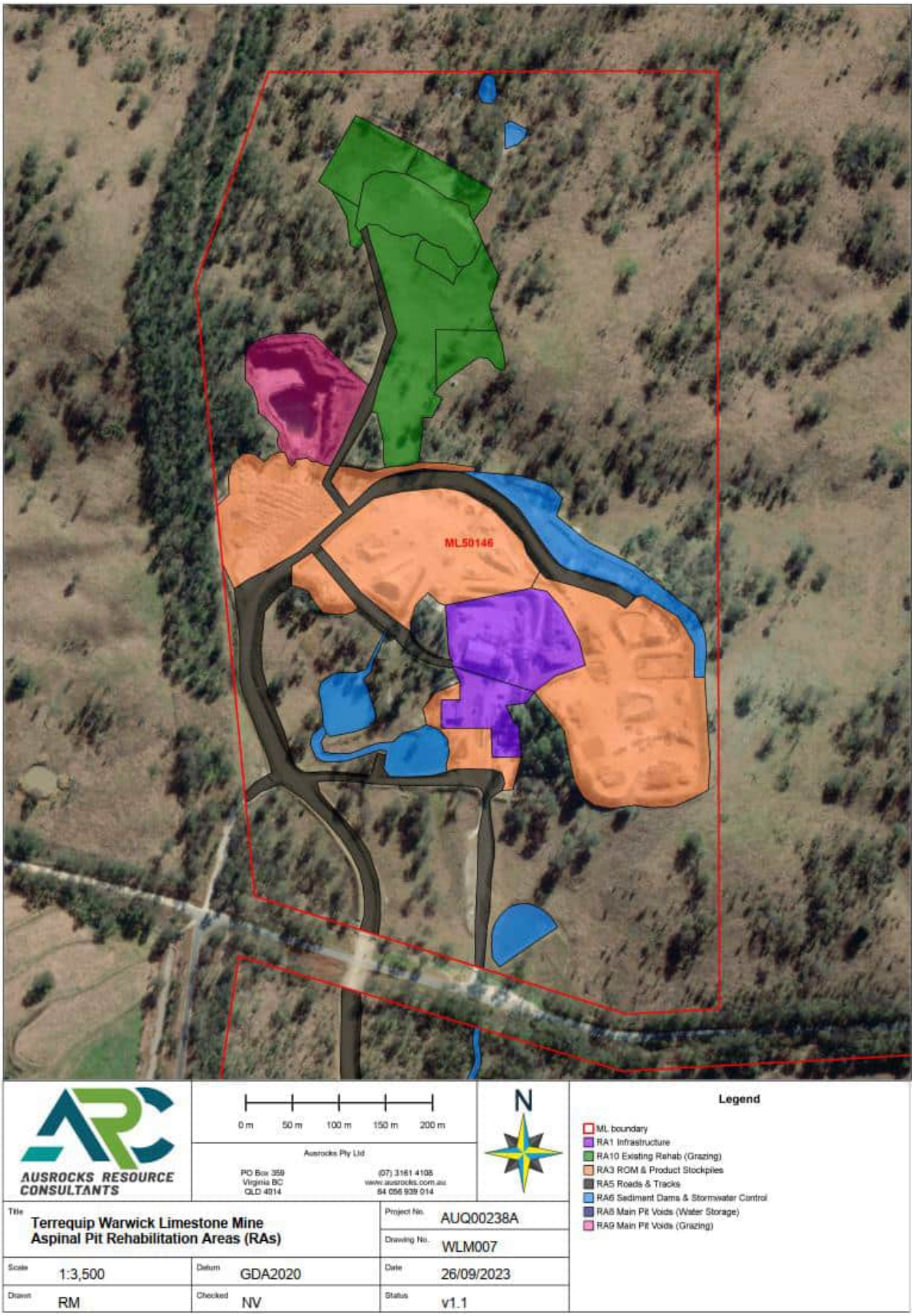


Figure 14: Aspinal Pit Rehabilitation Areas

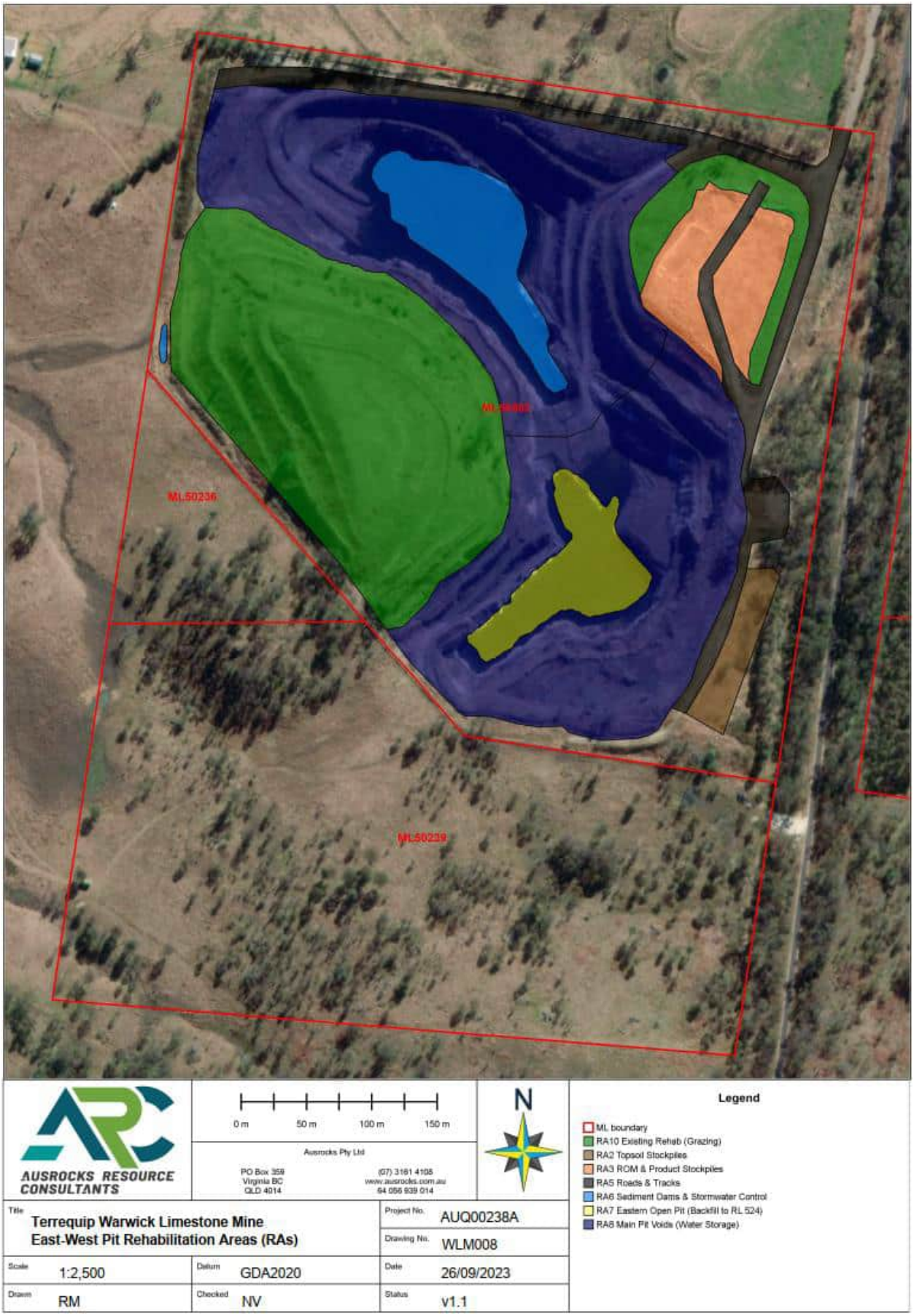


Figure 15: East-West Pit Rehabilitation Areas

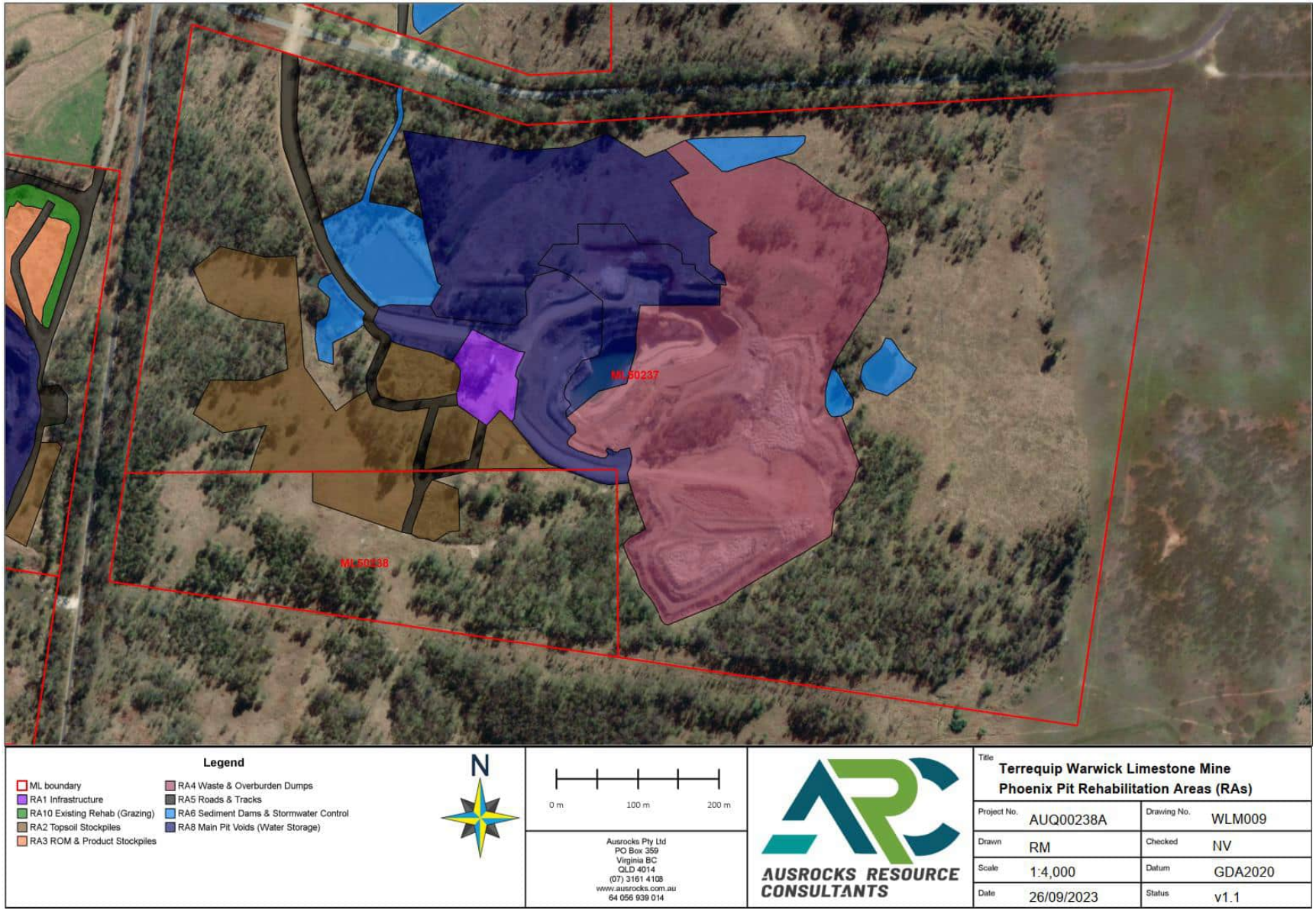


Figure 16: Phoenix Pit Rehabilitation Areas

1.5.3 Existing Rehabilitation

Rehabilitation activities undertaken in existing rehabilitation areas are likely to consist of, but are not limited to:

- backfilling waste and/or overburden material in pits;
- covering and levelling to backfilled pits to allow for settlement, and then covering with topsoil;
- removal of equipment, machinery and all waste/rubbish;
- ripping to promote regrowth;
- re-spreading topsoil (previously removed from the site) over the area;
- contour ripping immediately after topsoil placement for erosion control; and
- seeding and/or tube stock planting the area.

1.5.3.1 Existing Rehabilitation

Existing rehabilitation areas are defined within rehabilitation area RA10. These areas consist of mine areas that are in various stages of rehabilitation that are complete and/or requiring repair. Existing rehabilitation within Warwick Limestone are summarised in **Table 17**.

Table 17: Summary of existing rehabilitation areas at Warwick Limestone

Year Completed	Relevant Activity	Summary of Rehabilitation Activities
2012 – 2013	Overburden Dump	• dump edge profiled; • seeded; and • rehabilitation maintenance.
2020	Laydown yard (earthen)	• scrap removed to approved waste facility
2021	Laydown Yard Topsoil Stockpiles	• scrap removed to approved waste facility; • re-shaping profile; • rip across contour; • topsoil spread and seed.

1.5.3.2 Progressive Certification

No rehabilitation areas have applied for progressive certification under the EP Act.

2 Post-Mining Land Uses

Legislative Requirement

In accordance with section 126C(1)(d) of the EP Act, the rehabilitation planning part of the PRC plan must state the extent to which each post-mining land use or land identified in the PRCP schedule for the plan is consistent with:

- the outcome of consultation with the community in developing the plan; and
- any strategies or plans for the land of a local government, the State or the Commonwealth

PRCP Guideline (section 3.2)

A PMLU is defined under section 112 of the EP Act as the purpose for which the land will be used after all relevant activities for the PRC plan carried out on the land have ended. Relevant activity for a PRC plan is defined in the EP Act as the relevant activities to be carried out on land the subject of the plan. It is not the intention of this definition to include third-party activities or assets that continue to exist once mining activities have ceased, such as third-party pipeline easements, power easements or overlapping tenures for other EAs.

The rehabilitation planning part of the PRC plan must include a detailed description of the nominated PMLU(s) for the site. The description must include (where relevant), but is not limited to:

- a description of the use of the land
- if applicable, the specific vegetation types (e.g. RE 13.2.9) or land suitability classification (e.g. Class 4)
- identification of any permanent or essential management infrastructure to be included as part of the PMLU
- completion criteria for measuring whether the PMLU has been successfully achieved

Applicability to Transitional PRC plans

Where a PMLU has been previously addressed in a land outcome document and is able to be transitioned into the PRCP schedule, the holder is not required to complete the information requirements under section 126C(1)(j) of the EP Act in this section for those PMLUs.

However, the legislative requirements under section 126C(1)(d) of the EP Act still apply. All PMLUs transitioned into the PRCP schedule must still meet the requirements of a PMLU explained in this section, particularly that the PMLU can be rehabilitated to a stable condition.

2.1 Land Outcome Documents

In accordance with transitional provisions (section 750, EP Act), the Warwick Limestone EA is an approved land outcome document.[2] Refer to **Table 18** for a list of the approved PMLUs.

Table 18: PMLU options approved under the land outcome document (EA)

Rehabilitation domain	Description	PMLU outcome
Infrastructure and Process Equipment	• tracks • laydown yards • buildings, plant • silos, tanks • workshop • powerlines	Grazing
Roads	• access roads	Roads
Stockpiles	• topsoil stockpiles • waste and overburden dumps • rom pad	Grazing
Pits	• aspinal pit	Grazing
	• east-west pit • phoenix pit	Water Storage (Stock dam)
Water Storage	• all sediment • catchment dams	Water Storage (Stock dam)

Schedule F of the EA outlines the PMLU classification of the Project by stipulating "all areas disturbed by mining activities must be rehabilitated to the final land description as defined in Schedule F – Table 1-6." The Guideline for Agricultural Evaluation in Queensland Second Edition 2015 defines the land capability classes as per **Table 19**. The Guideline provides the following commentary to the land suitability classes:

"The first three classes of land (classes 1 to 3) are considered suitable for the specified land use, as the benefits obtained from that land use in the long term should outweigh the inputs required to initiate and maintain production.

Class 3 land may be as productive as class 1 or 2 land; however, increased inputs (e.g. fertiliser, land preparation and maintenance operations) would generally be required. It is not uncommon to find in a land resource survey that there is no land assessed as suitability class 1 for a particular land use.

Class 4 land is considered currently unsuitable for the specified land use, due to the severity of one or a number of limitations. It is implied that the inputs required to achieve and maintain production outweigh the benefits of production in the long term. This land may be upgraded to a suitable class if future agronomic, edaphic or engineering studies show it to be economically viable and environmentally sustainable. Changes in climate, economic conditions or technology may alter the level of management inputs required to achieve satisfactory long-term productivity.

Class 5 land is considered unsuitable for the specified land use, as it has limitations that singly or in aggregate are so severe that the benefits would not justify the inputs required to initiate and maintain sustainable production in the long term. Such land is unlikely to ever be suitable for the specified land use."

Table 19: Land capability classes

Land Class	Description	Categories
I	Land suitable for all agricultural pastoral uses	• Suited to a wide range of crops and is highly productive • Presents no limitations to use machinery or choice of implements • Wind and water erosion hazard are low even under intensive cultivation
II	Land suitable for all agricultural uses with slight restrictions to use for cultivation in one or more categories	• Land has some minor limitation to the choice of crops, and/or slight restrictions to productivity • Land has some minor impediment to the use of cultivation machinery, which limits the choice of implements, or restricts the conditions for successful operation • Land is used for cultivated cropping that requires simple conservation practices to reduce soil loss to an acceptable level. These include agronomic practices such as contour working, strip cropping and stubble mulching
III	Land suitable for all agricultural uses with moderate restrictions to use for cultivation in one or more categories	• Land has moderate limitations to the choice of crops and/or moderate restrictions to productivity. • Land has moderate impediment to the use of cultivation machinery, which limits the choice of implements, or restricts the conditions for successful operation. • Land is used for cultivated cropping that requires intensive conservation practices to reduce soil loss to an acceptable level. These include contour banking systems and intensive residue management involving specialised machinery.
IV	Land that in all other characteristics would be arable but has limitations that, unless removed, make cultivation impractical and/or economic – examples include swampy land that may be drained, or land that contains surface rock that could be removed at a cost	• Land is such that the choice of crops is severely restricted, and/or existing conditions severely limit productivity under cropping. • Land has severe impediment to the use of cultivation machinery, which limits the choice of implements, or severely restricts the conditions for successful operation. • Land cannot be used safely for permanent cultivation. If cropped, a pasture phase must be the major component of the cropping program to limit soil loss to an acceptable level.
V	Land that is not suitable for cultivation but is well suited to pastoral use and on which pasture improvement involving the use of machinery is practicable	n/a
VI	Land that is not suitable for cultivation but on which pastoral use is possible only with careful management; pasture improvement involving the use of machinery is not practicable	n/a
VII	Land that has such severe limitations that it is unsuited for either cultivation or grazing	n/a
VIII	Land that in all other characteristics would be arable but has limitations that, unless removed, make cultivation impractical and/or economic – examples include swampy land that may be drained, or land that contains surface rock that could be removed at a cost	n/a

2.2 Nominated PMLUs

A number of PMLUs are permitted for Warwick Limestone under the EA including grazing pasture, native ecosystem (or forestry plantation), and water storage for use as stock dams.

The EA completion criteria for the PMLUs (**Table 20**) have been transitioned to the milestone criteria in the PRCP schedule for the final milestone of achieving the post-mining land use to a stable condition.

Table 20: Land Use and Rehabilitation Approval Schedule for Warwick Limestone (EA Schedule F – Land)

Tenure ID	Disturbance Type	Surface Area (ha)	Post-Mine Land Description	Post-Mine Land (Capability/Suitability /Classification #)	Slope Range (degrees)
ML50083	Western Open Pit	5.00	Water Storage	VIII	70º
	Eastern Open Pit	5.00	Backfill to RL 524	VI	70º
	Waste Dump	5.00	General grazing land	VI	30º
	Sediment Dams and Stormwater Control	1.01	Remain as Stock Dams	VIII	30º
	ROM Pad and Stockpiles	1.50	All will be removed	VI	Max. 10º
	Roads and Tracks	1.50	Some tracks to remain as farm access tracks	VI	Max. 10º
	Topsoil	0.33	Re-spread as required	VI	Max. 10º
ML50146	Open Pit	2.50	Land not suitable for cultivation but well suited to pasture improvement	VI	70º
	Waste Dump	4.50	Re-contoured for drainage Land not suitable for cultivation but well suited to pasture improvement	VI	Min. 20º Max. 30º
	ROM Pad and Stockpiles	10.00	All will be removed or rehabilitated	VI	Max. 10º
	Roads and Tracks	3.15	Some tracks to remain as farm access tracks	VI	Max. 10º
	Sediment and Stormwater Control	2.00	Remain as Stock Dams	VII	Max. 20º
	Fixed Plant	1.24	All not required by Landowner will be removed	VI	Max. 10º
	Office/Maintenance Buildings	0.50	All not required by Landowner will be removed	VI	Max. 10º
	Topsoil	1.50	Re-spread as required	VI	Max. 10º
ML50236	Main Pit Void	0.00	-	-	-
	Waste Dump	1.62	Re-contoured for drainage, Land not suitable for cultivation but well suited to pasture improvement	VI	Min. 20º Max. 30º
	Sediment Dams	0.00	-	-	-
	Roads and Tracks	0.00	-	-	-
	Topsoil	0.00	-	-	-
ML50237	Main Pit Void	11.50	Water storage / Grazing	VI	70º

Tenure ID	Disturbance Type	Surface Area (ha)	Post-Mine Land Description	Post-Mine Land (Capability/Suitability /Classification #)	Slope Range (degrees)
	Waste Dump	14.50	Re-contoured for drainage, Land not suitable for cultivation but well suited to pasture improvement	VI	Min. 20º Max. 30º
	Sediment Dams and Stormwater Control	3.50	Remain as Stock Dams	VIII	20º
	Roads and Tracks	5.65	Roads to remain as farm access tracks	VI	Max. 10º
	Topsoil	5.00	Re-spread as required	VI	Max. 10º
	Mobile Crushing ROM and Product Stockpiles	6.60	All infrastructure to be removed for drainage Land not suitable for cultivations but well suited to pasture improvement	VI	Max. 10º
	Crib Hut and Parking	1.00	All infrastructure to be removed for drainage Land not suitable for cultivations but well suited to pasture improvement	VI	Max. 10º
ML50238	Main Pit Void	1.50	Water storage Grazing	VI	70º
	Waste Dump	1.00	Re-contoured for drainage, Land not suitable for cultivation but well suited to pasture improvement	VI	Min. 20º Max. 30º
	Sediment Dams	0.50	Re-contoured for drainage, Land not suitable for cultivation but well suited to pasture improvement	VI	Max. 10º
	Roads and Tracks	2.60	Re-contoured for drainage Land not suitable for cultivation but well suited to pasture improvement	VI	Max. 10º
	Topsoil	1.00	Re-spread as required	VI	Max. 10º
ML50239	Main Pit Void	0.38	Water Storage Grazing	VI	70º
	Waste Dump	1.74	General grazing land	VI	Min. 20º Max. 30º
	Sediment Dams	0.54	Remain as Stock Dams	VIII	20º
	Roads and Tracks	0.00	-	-	-
	Topsoil	0.00	-	-	-

2.2.1 Assessment of PMLU Options

The Project area is considered to have a transitional PRC Plan as the determination of PMLU options were decided upon by the Landowners by execution of their respective compensation agreements for the land.

The PRCP Guideline states where a PMLU has been previously addressed in a land outcome document and is able to be transitioned into the PRCP schedule, the holder is not required to complete the information requirements under section 126C(1)(j) of the EP Act in this section for those PMLUs. However, the legislative

requirements under section 126C(1)(d) of the EP Act still apply. Based on this definition, an options assessment to determine PMLU options was not completed. An assessment of the compliance of PMLU options to Community, Local, State and/or Federal legislation was conducted.

Four (4) public notification processes were conducted for Warwick Limestone between 2001 and 2019 with no submissions made by the public. It is therefore inferred that the site does not have a significant impact to the community or its key stakeholders (**Section 5 – Community Consultation**).

No rehabilitation strategies and/or plans for the State Land parcel were provided in the Sales Agreement however, the agreement states rehabilitation must be undertaken progressively and as land becomes available. Additionally, post-mining final landform described in the Warwick Limestone Quarry Management Plan must be achieved and "be consistent with all relevant requirements of the Development Approval."

Assessment of the land categorises Warwick Limestone within Class 2.1.0 land suitable for Grazing Native Vegetation (ALC). This is consistent with the findings of the soil assessment report which defines the area as suitable for grazing land management (**Appendix 2**). Soils typical of this land management are often Kurosols and Sodosols; deep, bleached dark grey to yellowish brown sandy clay loam texture contrast soils, and are therefore suitable for grazing on native and sown pastures. These classifications are in accordance with target outcomes of the EA, and historical pre-mine land use, for rehabilitation areas that are intended to be used for marginal grazing or water stores or remain as road.

The existing post-mine land use descriptions defined in the EA are determined consistent with the community expectations and legislative requirement therefore, an options assessment is not required. In accordance with the proposed community consultation plan, it is proposed that relevant stakeholders are consulted every 2-years (approximate) prior to the mine closure to provide an opportunity for alternative sustainable PMLU options to be discussed.

2.2.2 Detailed Description of Nominated PMLUS

Table 21 summarises the descriptions of nominated PMLUs.

Table 21: Compliance of PMLUs to land class and consultation decisions

Nominated PMLU	Description	Land Suitability Class	Essential Management Infrastructure	Consistency with Consultation Outcomes
Roads and Tracks	Gravel or earthen, to remain as roads/tracks for use by the Landowner post-mining	VIII	• None	• Required by Landholder to access the land and carry out PMLU activities (grazing) • PMLU option considered consistent with consultation outcomes as requirement
Grazing Land	Land that is not suitable for cultivation but is well suited to pastoral use and on which improvement involving the use of machinery is practicable	VI	• None	• Required by Landholder to feed stock and carry our PMLU activities (grazing) • PMLU option considered consistent with the consultation outcomes as requirement
Water Storage	Land that has such severe limitations, it is unsuited for PMLU of cultivation or grazing. Land to remain as an accessible bulk water storage	VIII	• Access ramps into the base of the pit allows direct access to stored water • Exclusion bunding and/or fencing and warning signs about deep excavation around the perimeter • Lockable gate to keep access secure • Spillways to be rock lined to EA capacity requirements	• Required by Landholder to drought-proof stock watering capacity to carry out PMLU activities (grazing) • Required by Landholder to facilitate watering of stock to carry out PMLU activities (grazing) • PMLU option considered consistent with the consultation outcomes as requirement

2.2.3 Residual Void Outcome

Residual voids must comply with the following outcomes:

a) Residual voids must not cause any serious environmental harm to land, surface waters or any recognised groundwater aquifer, other than the environmental harm constituted by the existence of the residual void itself, and subject to any other condition within the environmental authority; and

b) Residual voids must comply with Schedule F – Table 7 (**Table 22**).

Table 22: Residual void design (EA Schedule F – Land)

Void identification	Void wall – competent rock max slope (degrees º)	Void wall – incompetent rock max slope (degrees º)	Void maximum surface area (ha)
ML 50239 East-West	70 º	38 º	0.38
ML 50238 Phoenix	70 º	38 º	1.50
ML 50237 Phoenix	70 º	38 º	11.50
ML 50146 Aspinal	70 º	38 º	2.50
ML 50083 East Pit	70 º	38 º	1.49
ML 50083 West Pit	70 º	38 º	2.56
		Total	**19.93**

2.3 Community Considerations

Community consultation is not required as PMLU outcomes are prescribed under the LOD (EPML00136213).

In line with the proposed community consultation plan, however, it is proposed that relevant stakeholders are consulted every 2-years (approximate) prior to the mine closure to provide an opportunity for alternative sustainable PMLU options to be discussed.

2.4 Regional Planning Integration

The PMLUs at Warwick Limestone consider the pre-mining mining land use, neighbouring land use and EA conditions. Existing land use in the surrounding area consists primarily of cattle grazing. Under the Southern Downs Planning Scheme (2018)[28], Warwick Limestone is located in the Granite hills precinct in a 'rural zone'. Definitions for land use in this zone and precinct are consistent with PMLU options prescribed by the LOD

The purpose of the rural zone is to:

- provide for rural uses including cropping, intensive horticulture, intensive animal industries, animal husbandry, animal keeping, and other primary production activities;
- provide opportunities for non-rural uses that are compatible with agriculture, the environmental features, and landscape character of the rural area where the uses do not compromise the long-term use of the land for rural purposes; and
- protect or manage significant natural resources and processes to maintain the capacity for primary production.

Outcomes for the Granite hills precinct that are relevant to the site include:

- The scenic amenity and landscape character values as well as the agricultural values in this precinct are protected from development that could impact in a negative manner on these values;
- Low intensity farming including grazing activities will be the predominant use in this precinct; and
- The scenic values of the land are maintained and new development involving substantial built development is screened and well set back from frontages.

[28] Southern Downs Regional Council Planning Scheme 2018 Version 5 Commenced 29 June 2018

3 Non-Use Management Areas

Legislative Requirement

In accordance with section 126C(1)(d), (g) and (h) of the EP Act, for each proposed non-use management area, the rehabilitation planning part of the PRC plan must:

- state the reasons the applicant considers the area cannot be rehabilitated to a stable condition
- include copies of reports or other relevant evidence relied on by the applicant for each proposed non-use management area
- state the extent to which the proposed non-use management area is consistent with the outcome of consultation with the community in developing the plan; and
- state the extent to which the non-use management area is consistent with any strategies or plans for the land of a local government, the State or the Commonwealth.

PRCP Guideline (section 3.3)

A NUMA is defined in the EP Act as an area of land the subject of a PRC plan that cannot be rehabilitated to a stable condition after all relevant activities for the PRC plan carried out on the land have ended. Proposed NUMAs must be justified under the criteria set out in section 126D(2) of the EP Act.

The rehabilitation planning part of the PRC plan must also include:

a) information demonstrating that the proposed footprint of each NUMA is as small as practicable
b) an assessment of the NUMA location options, having regard to the constraint of the resource location, with an analysis of the potential environmental harm and sensitivity of the surrounding environment of each option
c) a description of the proposed location of each NUMA and the environmental values of the surrounding environment
d) evidence showing how the proposed location will prevent or minimise environmental harm

In accordance with section 126D(1)(c) of the EP Act, the applicant must develop and implement management milestones within the PRCP schedule which achieve best practice management and minimise environmental harm for any NUMAs contained in the proposed PRC plan. As part of the development of management milestones, the applicant must conduct a NUMA specific risk assessment to identify and quantify risks and associated controls. The risk assessment should have an overarching goal of identifying and controlling any significant risks to the community and the environment.

The proposed PRC plan must include a detailed description of the nominated NUMA(s) for the site. The description must include, but is not limited to:

- description of the land at surrender
- any relevant safety features
- completion criteria for measuring whether the NUMA has achieved sufficient improvement

Applicability to Transitional PRC plans

Where a NUMA has already been identified in a land outcome document and is able to be transitioned into a PRCP schedule, the applicant is not required to comply with sections 126C(1)(g) or (h) or 126D(2) or (3) of the EP Act. NUMAs transitioned into the PRCP schedule are not required to complete the information requirements under section 126C(1)(j) of the EP Act in this section for those NUMAs. However, the legislative requirements under section 126C(1)(d) of the EP Act still apply.

Where a NUMA has not been pre-approved and is proposed as part of the transition into the PRC plan, the applicant must include all of the requirements identified in this section.

3.1 Land Outcome Documents

There are no NUMAs planned for Warwick Limestone.

3.2 Nominated NUMAs

There are no NUMAs planned for Warwick Limestone.

3.3 Community Considerations

There are no NUMAs planned for Warwick Limestone.

3.4 Regional Planning Integration

There are no NUMAs planned for Warwick Limestone.

4 Voids in Floodplains

Legislative Requirement

In accordance with sections 126D(3) of the EP Act, if land the subject of the proposed PRCP schedule will contain a void situated wholly or partly in a flood plain, the schedule must provide for the rehabilitation of the land to a stable condition.

PRCP Guideline (section 3.4)

Section 41C of the EP Regulation states the decision considerations for a void situated wholly or partly in a flood plain. A void is considered to be located in a flood plain if the flood plain modelling shows that, when all relevant activities carried out on the land have ended, the land is the same height as, or lower than, the level modelled as the peak water level 0.1% AEP for a relevant watercourse under the guideline Australian Rainfall and Runoff (2019)(ARR).

Applicability to Transitional PRC plans

Where a land outcome document has been pre-approved for a void with a location specified, flood plain modelling is not required. If a void has been identified as a NUMA in a land outcome document but the location is not identified, the applicant is required to carry out flood plain modelling in accordance with this section of the guideline. While the provision in the EP Act relating to voids located within a floodplain having to rehabilitate to a stable condition does not apply, the PRC plan must include how the proposed location of the void minimises risks to the environment. Therefore, the flood plain modelling is required to support the assessment of the proposed location of the void.

If there are no land outcomes identified in a land outcome document, the applicant is required to carry out flood plain modelling in accordance with this section of the guideline.

Warwick Limestone is positioned along a ridgeline and is therefore not in a floodplain environment and is unlikely to be at risk of flooding. Flood modelling for the purposes of a void within a floodplain is not required.

5 Community Consultation

Legislative Requirement

In accordance with section 126C(1)(c)(iii) and (iv) of the EP Act, the rehabilitation planning part of the PRC plan must include:

- details of the consultation undertaken by the applicant in developing the proposed PRC plan; and
- details of how the applicant will undertake ongoing consultation in relation to the rehabilitation to be carried out under the plan.

PRCP Guideline (section 3.5)

In developing the proposed PRC plan, the community should at least be engaged on the plan for the mine, PMLUs and/or NUMAs, areas of disturbance, rehabilitation and management methods, progressive rehabilitation, and closure timeframes. Ongoing community consultation should continue throughout the stages of the mine life so that progressive rehabilitation and the socio-economic and environmental impacts related to mine closure can be discussed with the community.

Community consultation carried out through different processes, such as an EIS, may be used to address the requirements in section 126C(1)(c) of the EP Act. The details of this consultation must be provided in the rehabilitation planning part of the proposed PRC plan.

Applicability to Transitional PRC plans

Transitional PRC plans are still required to meet the legislative requirements in section 126C(1)(c) of the EP Act. All proposed PRC plans must contain a community consultation plan regardless of whether the site has an existing EA.

Community consultation is a key component of the PRC plan and is intended to ensure that anyone impacted by proposed rehabilitation and closure activities at the site has an opportunity to provide input to the planning process. Rehabilitation and closure activities at Warwick Limestone are informed by post mine land descriptions in the site EA (LOD) and landholder agreement.

Key stakeholders include the landholders on which the mine operates. There are no nearby neighbours in adjoining lots and no other community members to consult. **Figure 17** illustrates the location of sensitive receptors (neighbours) within a 1km buffer of the mining lease boundaries.

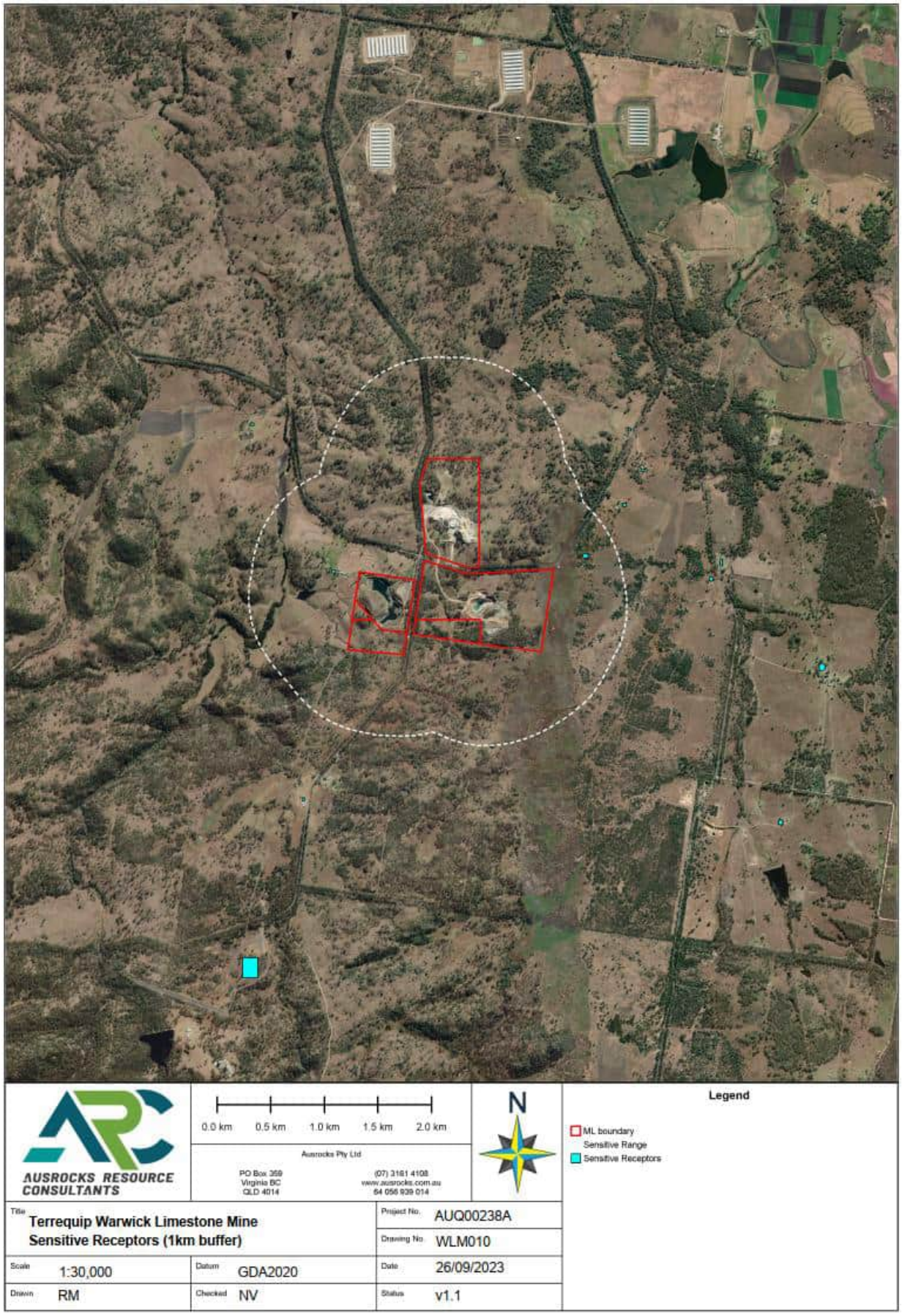


Figure 17: Identified neighbours within 1km of the mining tenements of Warwick Limestone

5.1 Consultation to Date

Community consultation of this PRC plan was conducted on an as-required-basis due to the small number of impacted and relevant stakeholders (i.e. landholders).

Community consultation and stakeholder engagement aims to assist in the preparation of and to further inform this PRC plan. The objectives of the community consultation process were to:

- identify stakeholders relevant to the project
- facilitate two-way engagement with identified stakeholders
- provide accurate, timely, and relevant information on the project
- identify any concerns and/or potential issues stakeholders may have relating to the project; and
- develop appropriate strategies to mitigate any identified concerns.

In accordance with Section 3.5 of the PRCP Guideline, this section incorporates the following information:

- summary of relevant stakeholders
- overview of consultation tools used throughout the consultation process
- community consultation register
- summary of consultation outcomes; and
- a community consultation plan.

For the purpose of this PRC Plan, the community area has been defined as the three landholders and, where consultation is required, the surrounding areas of the town of Elbow Valley, and the Southern Downs Regional Council area. **Table 23** provides a categorisation of typically relevant stakeholder groups and **Table 24** a summary of the identified stakeholders as part of the identified categories. **Table 25** provides details on community consultation to date.

Table 23: Categorisation of relevant stakeholders

Stakeholder Category	Relevant Stakeholders
Direct landholders	• Landholders whose property the mine infrastructure may be located
Adjoining landholders	• Residents located adjoining the Project area which may experience impacts during the operation of the mine (including visual, noise, dust, and traffic)
Federal, State, and Local Government Representatives	• Government representatives at the Federal, State, and Local level including local representatives and Government agencies responsible for the regulation of the Project • Police, emergency services, drug and alcohol services, housing, Indigenous, employment, and social services • All infrastructure and utility providers the Project could have an impact on during operation (including electricity, telecommunication, road usage)
Indigenous Stakeholders	• Traditional owner groups, local land councils, other Indigenous organisations where related to the Project

Stakeholder Category	Relevant Stakeholders
Business Operators and Representatives	• Business operators and employees in the locality may experience indirect impacts on business operations (e.g. increased trade due to operations) • Regional business groups, local accommodation operators and local Chambers of Commerce
Special Interest Groups	• Community organisations and groups • Schools and Childcare facilities and environmental groups
Local Community	• Residents or visitors to Elbow Valley and the Southern Downs Regional Council Area that may have an interest in the Project

Table 24: Identified stakeholder groups and relevant stakeholders

Stakeholder Category	Relevant Stakeholders
Direct landholders	Three landholders ([redacted] whose properties the mine infrastructure is located and operated on
Federal, State, and Local Government Representatives	Federal • Department of Climate Change, Energy, the Environment and Water
	State • Department of Environment and Science • Department of Agriculture and Fisheries • Department of Resources
	Local • Southern Downs Regional Council (incl amalgamated Warwick Shire Council)

A variety of consultation methods and tools were used to meet the objectives of the community consultation process. These include:

- direct stakeholder contact, including telephone calls, virtual meetings, and in-person meetings
- correspondence via letters
- public notification; and
- landholder meetings (annual).

5.2 Community Consultation Register

Table 25 details the consultation completed by Terrequip Environmental. The register is aligned with the PRCP Guideline and Section 126C(1)(c)(iii) of the EP Act.

5.3 Ongoing Consultation

Warwick Limestone is within is relatively small and is located a significant distance from the nearest major populated centre (Warwick approximately >25km by vehicle).

Warwick Limestone operates with a small group of employees (<10 people), and it is therefore, unlikely that the closure of the mine, once end of life is reached, will have a significant impact to the local community.

There are unlikely to be any ongoing environmental impacts to the local community outside of the underlying landholders as the material extracted is benign and water storages left will be open pit voids rather than contaminated tailings dams etc. There are three main community groups that have been identified as requiring consultation as part of the PRC Plan:

Affected landholders for access or operation of the ML

- adjoining landholders
- traditional owners
- local government; and
- local community groups

Affected landholders include the Queensland Government, and the [redacted] families who own land under the Mining Leases. Active consultation is carried out with the affected landholders. Recently, updated landholder agreements were made with both parties which was the result of discussing the rehabilitation requirements for the land. The landholder agreements will form the basis for shaping the final land use and the treatment of land and infrastructure following the completion of mining. Additional consultation is planned with the landholders to discuss the timing for the PRC plan, as this was not actively discussed for the landholder agreements. Records of this consultation will be recorded on the community consultation register once complete.

Table 26 summarises the Community Consultation Plan.

5.4 Public Interest Considerations

The final rehabilitated landform of Warwick Limestone will not include any non-use management areas (**NUMAs**). NUMAs are defined under Section 112 of the EP Act as an area of land the subject of a PRC plan that cannot be rehabilitated to a stable condition after all relevant activities for the PRC plan carried out on the land have ended. A public interest evaluation (**PIE**) under the EP Act will not be required as there are no NUMAs

Table 25: Community consultation register

Timing	Stakeholder	Format	Information	Issue/Concern Raised	Consideration of Issue/Concern	Outcome	Commitment of Applicant
2001	Warwick Shire Council	Public Notification	• Requisite information under the *Integrated Planning Act 1997*	• Development Application	• Planning process and outcome requirements	• n/a	• n/a
May – Jun 2011	Residents of Southern Downs Regional Council	Public Notification	• Requisite information under the *Sustainable Planning Act 2009*	• Development Application	• Planning process and outcome requirements	• No submissions made about the application	• n/a
Apr – May 2013	Residents of Southern Downs Regional Council	Public Notification	• Requisite information under the *Sustainable Planning Act 2009*	• Development Application	• Planning process and outcome requirements	• No submissions made about the application	• n/a
Jan – Feb 2019	Residents of Southern Downs Regional Council	Public Notification	• Requisite information under the *Planning Act 2016*	• Development Application	• Planning process and outcome requirements	• No submissions made about the application	• n/a
28 Jul 2021	State Government, Department of Agriculture and Fisheries (DAF) (Landholder) 178/M34534	Letter from Landholder following email discussion	• Rehabilitating lot as per DAF sales agreement; a lesser outcome than EA requirements • Extension to sales agreement not to be sought.	• Rehabilitation of mine disturbance on the lot to EA requirements • Allowing the Sales Permit to expire and not be required to renew	• DAF officer assessment	• Sales Permit allowed to expire as rehabilitation outcomes are greater with EA conditions	• Rehabilitation of 178/M34534 as per EA requirements
2 Mar 2021	[redacted] (Landholder) 2/RP36822 & 106/ML623	Annual Landholder Meeting	• Requirement for Terrequip to produce PRC Plan including PRCP Schedule regarding handing over assets to landholder after mining activities have ceased	• Items that could remain with landholder post-mining, requiring a landholder statement • Future liability after taking over assets	• Advice provided opportunity for landholder to receive assets after mining has ceased • Timeframe provided for landholder to consider their wants and needs with respect to accepting assets post-mining	• Infrastructure list, maps, and other information to be provided to landholder to inform forthcoming Landholder Agreement	• Next meeting to be held 30 Mar 2021 to discuss next steps and detail on Landholder Agreement • (N.B. meeting did not take place due to COVID-19 restrictions; communication completed via other means)
23 Jul 2021	[redacted] (Landholder) 2/RP36822 & 106/ML623	Letter received from Landholder	• n/a	• Landholder not willing to provide a landholder statement about receiving infrastructure items post-mining due to concerns around liability	• n/a	• n/a	• In absence of Landholder Statement, PRC Plan and rehabilitation requirements updated to ensure the removal of all infrastructure items discussed (sheds, plant, buildings, etc.) • This excludes items such as roads/tracks and water storage

Timing	Stakeholder	Format	Information	Issue/Concern Raised	Consideration of Issue/Concern	Outcome	Commitment of Applicant
30 Jul 2021	[redacted] (Landholder) 2/RP36822 & 106/ML623	Email to Landholder	• Response to letter received from landholder, dated 23 Jul 2021	• Clarification of landholder involvement in the development of the PRC Plan given some rehabilitation outcomes are already determined in the EA (i.e. requirement to provide a landholder agreement if the landholder wishes to take ownership of any infrastructure at the end of the mine life • Advice of the rehabilitation works undertaken on the land	• Checks made against PRC Plan and EA requirements • No indication of communication received from landholder about intention to take over ownership of any infrastructure outside of that set out in the Compensation Agreement	• None	• None
12 Mar 2021	[redacted] (Landholder) 1219/M34519	Annual Landholder Meeting	• Requirements for Terrequip to produce PRC Plan and PRCP Schedule • Specifics regarding handing over assets to landholder after mining activities have ceased • Expected life of mine	• Items that could remain with the landholder post-mining requiring a landholder statement • Future liability after taking over assets	• Advice provided opportunity for landholder to receive assets after mining has ceased • Timeframe provided for landholder to consider their wants and needs with respect to accepting assets post-mining	• Infrastructure list, maps, and other information provided to landholder • Landholder returned full acceptance of all infrastructure	• None

Table 26: Community consultation plan

Community Group	Objectives	Format	Frequency	Information Provided	Consideration of Feedback
Underlying Landowners	• Provide regular feedback on status of operations and landowner statements	• Direct mail • Email • In person meetings • Telephone correspondence	• Monthly • As required	• Mine plans • Landowner Statements • Rehabilitation Plans	• Advice requests relating to changes to mine plans that affect underlying landowners • Comments considered for future mine planning
Adjoining Landowners	• Feedback on proposed changes	• Direct mail	• If PRCP amendment poses likely impact	• Overview of changes (e.g. plans, schedule, etc.)	• Comments incorporated in the PRCP Schedule amendment • Comments recorded on the Community Consultation Register
Traditional Owners / Indigenous Groups	• Feedback on proposed changes	• Direct mail	• If PRCP amendment poses likely impact	• Overview of changes (e.g. plans, schedule, etc.)	• Comments incorporated in the PRCP Schedule amendment • Comments recorded on the Community Consultation Register
Local Government	• Advice on approval impact • General feedback	• Direct mail • Email • Pre-lodgement meetings	• If any ML renewals • If PRCP amendment poses likely impact	• Scope of proposal (for renewal) • Overview of changes (e.g. plans, schedule, etc.)	• Feedback provided considered for the submission of PRC Plan and associated documents
Local Community Groups	• General feedback on determined PMLU options	• Terrequip website • Local newspaper	• If PRCP amendment poses likely impact • 2-years prior to Mine closure via closure notification	• Relevant information as required • Plans relevant to the feedback required	• Feedback reviewed by Mine Management and considered for future mine planning

6 Rehabilitation and Management Methodology

Legislative Requirement

In accordance with sections 126C(1)(e) and (i) of the EP Act, the rehabilitation planning part of the PRC plan must:

- for each proposed post-mining land use for land, state the proposed methods or techniques for rehabilitating the land to a stable condition in a way that supports the rehabilitation milestones under the proposed PRCP schedule; and
- for each proposed non-use management area, state the proposed methodology for achieving best practice management of the area to support the management milestones under the proposed PRCP schedule for the area.

PRCP Guideline (section 3.6)

The proposed rehabilitation or management methodologies will underpin the development of the milestone criteria and support how the proposed PMLU will be achieved or the NUMA will be managed. As per Section 126C(1)(j) of the EP Act, the administering authority requires information describing how the proposed rehabilitation or management methodologies have been developed and will be implemented.

This section identifies a number of studies that must be provided in the proposed PRC plan. If any of the required information outlined below is not relevant to the specific operation, the applicant must provide justification in the PRC plan outlining why the information is not required.

6.1 General rehabilitation practices

PRCP Guideline (section 3.6.1)

This section outlines the range of information that the administering authority considers is necessary to underpin the development of the rehabilitation or management methodologies applicable to new and existing mines for most domains. The applicant must include the information as appendices to the rehabilitation planning part.

Rehabilitation of Warwick Limestone will comply with the principles of the International Council on Mining and Metals (ICMM) and the hierarchy of mine rehabilitation per the EP Act by:

- avoiding disturbance that will require rehabilitation;
- reinstating a natural ecosystem similar to the pre-mine land use (grazing); and
- reinstating previous land use (grazing).

All existing native species, including mature regrowth trees and saplings, shrubs, grasses, and forbs located outside the disturbance areas (i.e. undisturbed land within the ML) are to be retained and managed as part of the rehabilitation and maintenance phase. Additionally, habitat features including rocks, fallen branches, dead trees and shrubs are retained in situ unless they pose a safety risk to site personnel.

General rehabilitation objectives are as follows:

- identify and delineate rehabilitation and revegetate areas;
- prioritise and schedule rehabilitation works;
- control and manage the spread of invasive weed species;
- conserve and enhance existing native vegetation; and
- conserve and enhance ecological processes and habitat value.

6.1.1 Hydrogeology

PRCP Guideline (section 3.6.1)
Assess the hydrogeology of the site and all connected strata and develop a conceptual model of the mine site's groundwater systems. This information must be integrated into the design of rehabilitation strategies and choice of PMLU or NUMA.

The EA does not require a hydrological assessment for Warwick Limestone; and it is determined the mining activities do not have an impact to groundwater. EA conditions C6 to C8 outline protection measures must be undertaken to prevent groundwater contamination and that draw down is not to impact other users of the groundwater. Should an assessment be required in future, the following steps will be taken as part of the assessment:

- determine the groundwater occurrence including the existence of, and depth to, aquifers and aquitards;
- locate groundwater recharge and discharge locations locally and regionally;
- determine groundwater quality within each of the aquifers and from surface expressions (i.e. seeps and springs);
- determine current and potential future uses of groundwater including existing groundwater extraction bores;
- determine groundwater flow direction and velocity, including field tests to determine hydraulic conductivity;
- develop potentiometric mapping and hydro-stratigraphic cross sections; and
- conduct groundwater modelling to determine contaminant transport and potential changes to groundwater level from dewatering or waste storage.

Groundwater infiltration into all pits is low and de-watering generally is only necessary after a rainfall event.

A bore 38m deep is located adjacent to Dam 1, near the office area. The bore is used for domestic water requirements and has a nominal entitlement of 10ML/p.a. (megalitres per annum). Actual usage from this bore has historically been approximately 0.1ML/p.a. however is rarely used as the flow rate is very low. Drawdown on the local groundwater table is therefore considered to be negligible.

The potential sources of groundwater contamination in the Project area are confined to fuel and chemical storage areas as well as the septic tank. All chemical storage is housed in a self-bunded container as are the diesel. The septic tank is a sealed unit connected to a sprinkler which periodically waters lawn and garden areas; a function that is carried out automatically when required. Additionally, the septic tank is inspected and pumped every 3-years by an authorised and qualified contractor.

6.1.2 Flooding

PRCP Guideline (section 3.6.1)

Section 3.4 of this guideline requires flood plain modelling for the purpose of voids located within a flood plain being rehabilitated to a stable condition. In addition to this, the applicant must also assess the flooding susceptibility and influence across the site. if flooding is a consideration, develop a hydrologic model of the catchment and a hydraulic model of the proposed mining area. Knowledge of flooding is integral to the rehabilitation planning process, including the placement and design of mine domains.

The approved activities will result in a landform that is similar to the original surrounding existing and pre-mining topography. The backfilling of pits will be undertaken to achieve a stable landform that does not present long-term erosion or weathering risks, greater than rates that are naturally occurring in the area.

An assessment of flood susceptibility has been used to inform a risk-based approach to determine basis for this flood assessment.

In addition to the backfilling of pits and the final landform outcome, the assessment of flood susceptibility identified the following:

- the DNRME flood mapping (Figure) indicates limited impact to undisturbed areas from a 1% AEP flood event, and no flood impacts to pits within Warwick Limestone;
- the approved activities doe does not require diversion or interruption of creeks and/or streams; and
- there are no fourth order or higher streams present within the mine areas.

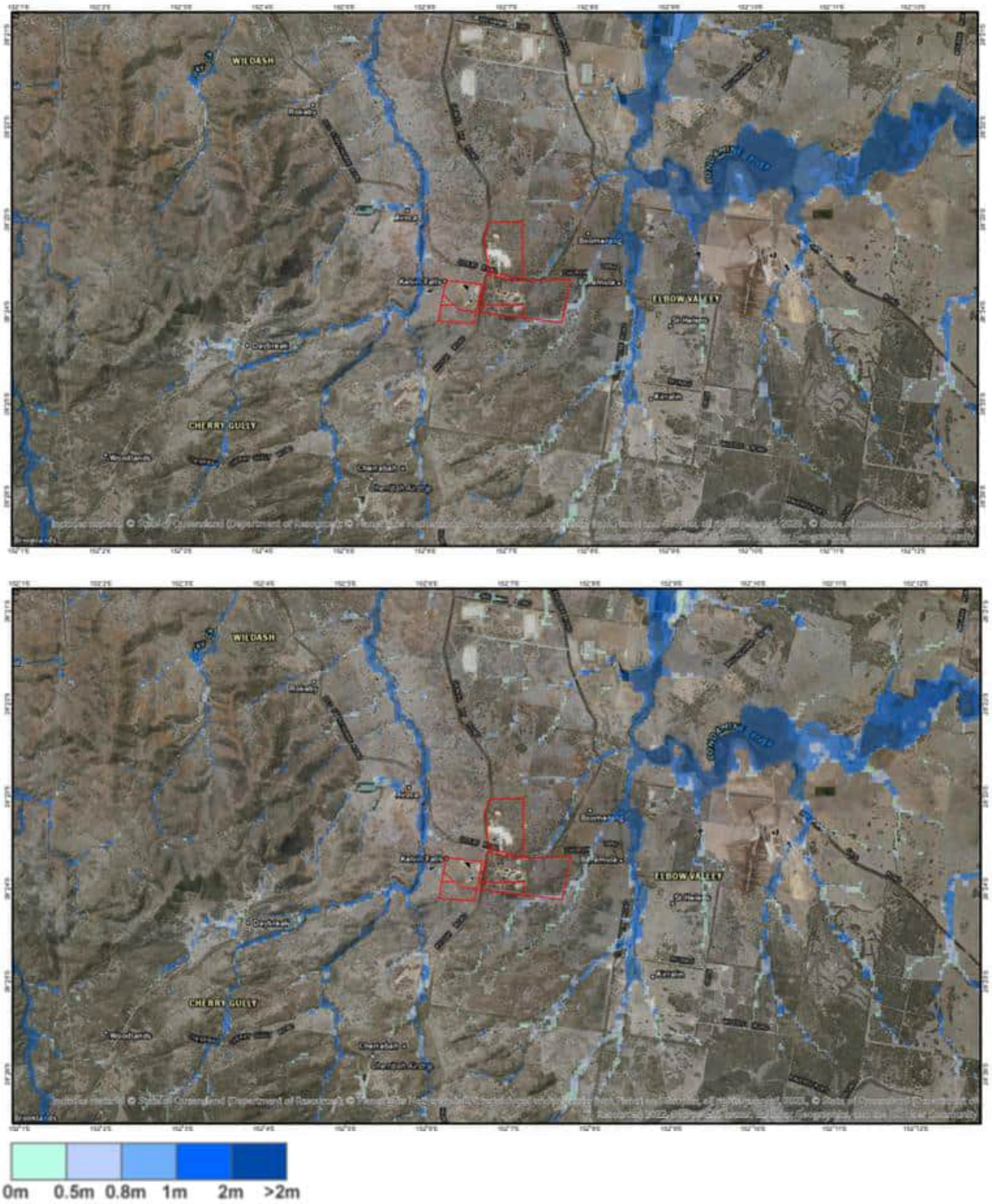


Figure 18: DNRME extreme event flood depths (top) and 1%AEP flood depths (bottom)

6.1.3 Soil and Capping Material Assessment

PRCP Guideline (section 3.6.1)

The rehabilitation and management methodology should include that soil assessment activities are supplemented by additional surveys conducted at appropriate intervals to assess soil resources in planned disturbance areas. In addition to the assessment of soils, the proposed rehabilitation methodologies in the rehabilitation planning part must also address topsoil management. Topsoil management must ensure sufficient topsoil quantity and quality is available in those instances that waste rock or tailings cannot support the proposed PMLU. Integrated soil and waste rock characterisation and mapping should form the foundation of the rehabilitation strategies. The available soil resources and capping material should be assessed prior to the commencement of operations.

6.1.3.1 Soil Erosion

Erosion can have an adverse effect on soil productivity and the associated agricultural value. Additional effects can include downstream sedimentation, and decline in fertility through loss of soil structure, increased dust generation and poor rehabilitation outcomes.

Dispersive clay subsoils with high ESPs, low Ca:Mg ratios are susceptible to tunnel and gully erosion which is particularly difficult to manage once initiated. The subsoils of the Warwick Limestone Mine have clay subsoils that have a low erosion rating when undisturbed. However, as the subsoils can be sodic to strongly sodic, these soils will erode due to clay dispersion where soil is exposed to rainfall or runoff. Management options involve minimising exposure, careful management of overland flow, maintaining vegetation cover, and where appropriate, the use of soil ameliorants such as gypsum and lime (to reduce the degree of dispersion).

Site erosion control practices are guided by the Water Management Plan (**Appendix 5**). Where applicable, the following general erosion and sediment control measures are to be implemented:

- Contour banks or planting of deep-rooted hardy grasses such as Vetiver Monto (*Chrysopogon zizanioides*) should be used at intervals appropriate to the slope and soil type to control the flow of surface water;
- Diversion and erosion and sediment control devices fully implemented to provide effective erosion control prior to land disturbance activities, and will be kept in place and maintained fully functional until the area has been effectively rehabilitated; and
- Where diversion of runoff water around a construction/rehabilitation site is required, design will need to be mindful of possible erosion effects due to concentration of flow.

6.1.3.2 Soil Amelioration Strategies

Soil amelioration will vary for different soils depending on soil chemistry. Lower cation exchange capacity soils (i.e. sandy soils) generally have a lower amendment requirement due less exchange sites for cation transfer. The guiding principles for choosing chemical amendments (i.e. to use lime, gypsum, or sulphur ameliorants) depends on both pH, ESP and Ca:Mg ratio.

A summary of the topsoil stockpile characteristics and implications for their use in rehabilitation include:

- In general, the soils were observed to be weakly-structured and possibly hard setting;

- Salinity (0.1 dS/m) was low and is not considered to be an issue for use of the material;
- Current pH (5.8 – 6.9) is unlikely to impact on vegetation growth. We do not recommend any treatment for soil pH;
- Cation Exchange Capacity (CEC) was very low (stockpile 2) to moderate (stockpiles 1 and 3);
- Sodicity was low (0.3 – 1.8 %) but the Emerson Aggregate Test (EAT) scores suggest most soils are slaking, but non- dispersive. Some of the stockpiled topsoil had low organic content; and
- Total organic carbon (OC) across the stockpiles varies but recommend that an increase in OC will be useful for long term viability of vegetation.

Given these characteristics, the primary issues around use of the material in rehabilitation will not be due to soil chemistry, but more likely be due to poor aggregation, a lack of root aeration and poor water and nutrient holding capacity. Remediation of these soils needs to therefore focus on improving aggregate stability and building organics within the soil.

Initial establishment is paramount to start the site off on the right trajectory, and therefore rehabilitation areas will have 10-20 t/ha (or approximately 86m3 hay bales per hectare) of pasture hay applied and an application of a broad- based fertilizer (containing N, P, K and S).

Following the application of the pasture hay and fertilizer, the site should have a light offset disking to anchor the material into the surface.

6.1.3.3 Topsoil Stripping

Approved disturbance areas that will require topsoil stripping for re-use in rehabilitation areas include the East-West pit (ML50083), Aspinal pit (ML50146), and the Phoenix pit (ML50237 and ML50238). Topsoil stripping is recommended at a depth no greater than 200mm.

6.1.3.4 Topsoil Management

Topsoil stockpiles are and will be established adjacent to pit areas to limit handling and transport of the material. Topsoil stockpiles are recommended at a maximum height of 2m to minimise degradation of topsoil material, maintain biological capital and maintain soil fertility.

The use of machinery on stockpiles will be minimised wherever possible to prevent occurrence of topsoil compaction. Coarse stockpile surface textures are preferred to promote infiltration and aeration, and to minimise erosion until suitable cover vegetation is established. Topsoil stockpiles will be positioned in free-draining areas to prevent occurrence of long-term soil saturation. Temporary silt fences and/or cleared vegetation will be positioned around topsoil stockpiles as a means of sediment control and erosion protection.

6.1.3.5 Topsoil Application

Topsoil will be spread wherever required to achieve safe and stable rehabilitation areas. All stockpiled topsoil will be used for the rehabilitation of disturbed areas in Warwick Limestone. The following will be considered during topsoil respreading:

- topsoil (all soil units) spread at an average thickness of 150mm;
- respreading on the contour to aid runoff control and increase soil moisture retention for subsequent plant growth (particularly for soils susceptible to erosion and concentrated runoff);
- levelling to an even surface avoiding a compacted and/or smooth surface;
- rip across the contour prior to seeding to promote relationship between topsoil and underlying materials; and
- minimise vehicle traffic accessing rehabilitation areas after topsoil is spread.

6.1.4 Landform Design

PRCP Guideline (section 3.6.1)
The final landform design must be based on the proposed PMLUs and NUMAs and demonstrate that the land will be safe and structurally stable.

Landform design considers both the landform structures such as main pit voids, but also the landform development and reshape of all relevant activity areas after removal of infrastructure and wastes, prior to the placement of topsoil.

The following approved activities at Warwick Limestone have no impact on the pre-mining landform:

- topsoil stockpiles;
- plant and workshop area;
- administration areas; and
- roads and tracks.

The following activities have resulted in changes to the pre-mining landform (note, this includes changes occurred from historical mining activities):

- main pit voids:
- waste and overburden stockpiles (any volume remaining after backfilling);
- ROM pads and stockpiles;
- mine water including sediment dams and stormwater controls.

6.1.4.1 Final Landform Design

Figure 19 to **Figure 21** illustrate the final landform contours of each pit area.

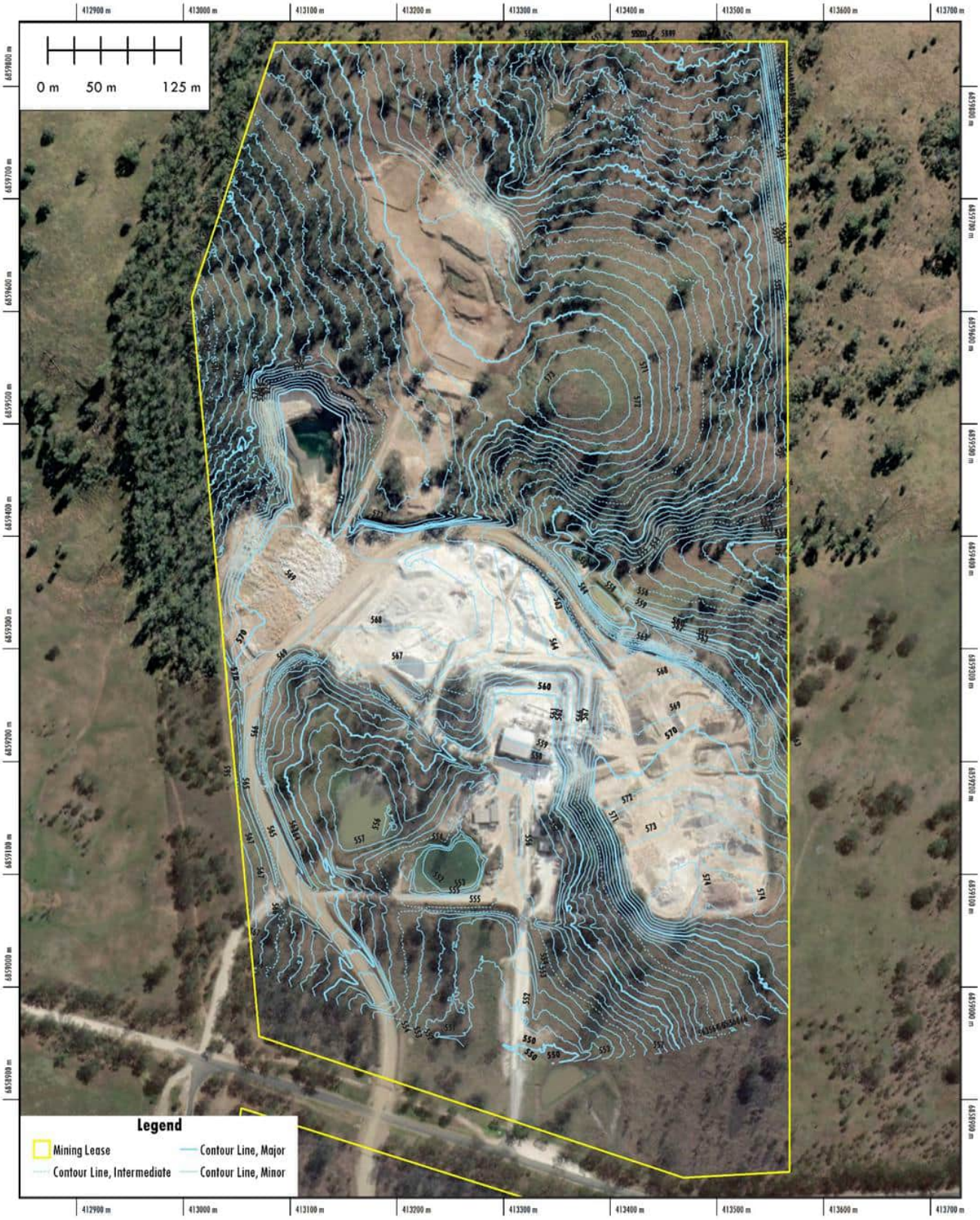


Figure 19: Aspinal Pit Final Landform Design (1m contours)

Figure 20: East-West Pit Final Landform Design (1m contours)

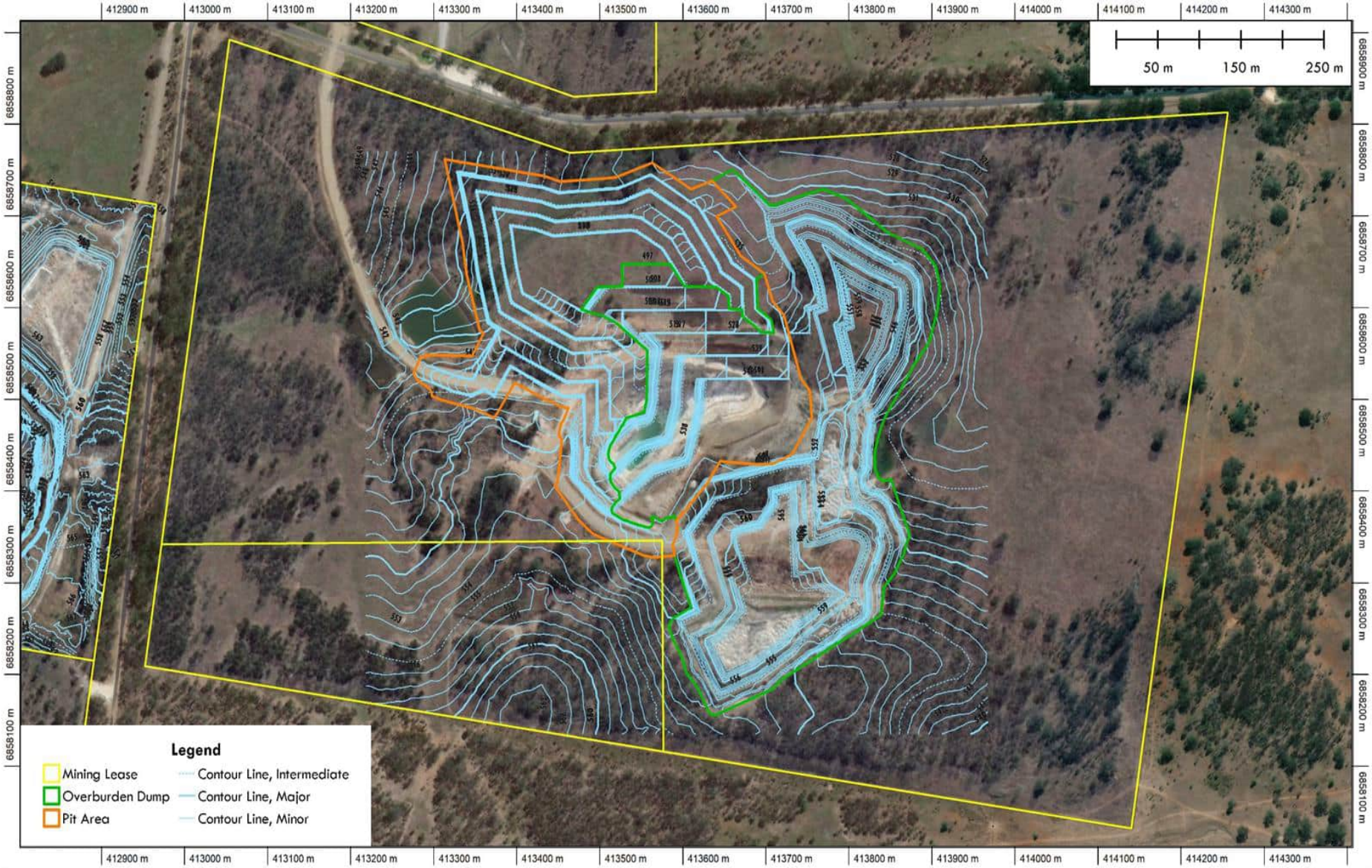


Figure 21: Phoenix Pit Final Landform Design (1m contours)

6.2 Cover Design

PRCP Guideline (section 3.6.1)

A cover design is required for the surface treatment of a mine landform or other waste material. Hence, the cover system design must be appropriate for the type(s) of waste the project will generate and reflect a risk-based approach where waste has the potential for AMD, neutral mine drainage or saline mine drainage, an appropriate cover system must be designed.

The cover design should include:

- identification and speciation of the objectives of the cover system
- a detailed description of the design including the thickness of each layer
- a detailed description of construction methodology including any proposed staging of the cover system
- a quantitative assessment that identifies the location and quantity of proposed capping material available on site; and
- proposed QA/QC for the construction of the cover system including the timely implementation of corrective actions where deviations from the design are identified.

No cover design is proposed for Warwick Limestone.

6.3 Water Management

PRCP Guideline (section 3.6.1)

The rehabilitation planning part must include a description of the following:

- a description of the contaminants that pose a risk to environmental values of the receiving environment
- source, pathway and fate of contaminants that have the potential to impact environmental values
- infiltration and seepage intervention and collection controls
- surface water diversions and long-term management requirements
- dewatering requirements
- on-going water management and reduction requirements (i.e. treatment).

Water management is aimed at minimising the potential for release of contaminants to the surrounding environment. Clean and mine-affected waters are stored separately during active mine operations in stormwater and mine water storage dams and sediment basins in accordance with conditions of the site EA. No ongoing water management requirements are proposed following the establishment of final landforms and the removal of all infrastructure (except where otherwise agreed in writing).

The Water Management Plan (**Appendix 5**) describes monitoring and methods for sediment control in the sediment dams and basins on site.

Recommended performance criteria is based on EA conditions of water quality with pH between 6.0 and 9.0, and EC <1500µS/cm. All surface water sampling will be conducted as per the Queensland Monitoring and Sampling Manual (EHP 2009) as well as per more recent methodologies published by DES (2018).

Assessment of sediment dams in the Project area identified deficiencies in capacities due to the progressive expansion of mine operation as well as discrepancies in EA specifications for sediment dam capacities. No deficiency was identified in 'Sediment Dam 8'. Pump and pipe systems have been utilised to manage uncontrolled discharge and transfer excess run-off to other available water storage areas including voids located

in the Aspinal pit and East-West pit. The performance criteria to restore sediment capacity to >80% design is based on a target of improving on these deficiencies post-mine.

6.3.1 Potential Contaminants

Due to the age of the mine, there is no access to or record of preliminary site investigations. Pre-mining land uses of the Warwick Limestone mining leases are identified to have predominantly been cattle grazing. Activities associated with cattle grazing that have the potential for contamination such as cattle dips, workshop areas, homesteads or waste disposal areas were not found to be present based on available historical aerial imagery.[29]

Activities related to approved activities that have the potential to generate contaminants, if inappropriately managed, could pose a risk to the environmental values of the receiving environment. These include:

- Mine affected or storm waters stored within water storages or sediment basins; and
- Sewage wastes.

The above potential sources of contamination are determined to have a low risk level.

Main pit voids will be backfilled with mobile infrastructure and plant equipment removed, including water storage and sediment basins. This excludes any infrastructure and selected water storages to remain upon closure (**Appendix 7**). Any remaining infrastructure is not considered a source of potential contamination. Remaining water storages will be made suitable for livestock use therefore, are also not considered a source of potential contamination.

6.3.2 Sources

Approved relevant activities have the potential to create the following sources of contaminants that could pose a risk to the environmental values of the receiving environment:

- backfilling of pits;
- removal of all infrastructure including water storage structures (except where otherwise agreed in writing);
- removal of all ROM and/or product stockpiles from the site;
- revegetation of backfilled areas and/or revegetation of residual overburden stockpiles;
- leaks/spills/discharges from water storage structures used to manage water from disturbance areas; and
- untreated sewage leaks/spills/discharges.

6.3.3 Potential Water Receptors

The proposed PMLU is marginal grazing and water storage in main pit voids. Post-mining potential receptors have been identified to include:

- land managers and/or employees;
- cattle;
- residents within nearby properties surrounding Warwick Limestone;

[29] https://qldglobe.information.qld.gov.au/ (accessed July 2023)

- public users of O'Deas Road and other publicly accessible locations;
- terrestrial ecosystems including rehabilitation areas; and
- groundwater dependent ecosystems (GDEs) (where relevant).

6.3.4 Potential Water Exposure Routes

Potential pathways for contaminant migration between identified sources and receptors with the ability to impact water management upon closure include:

- surface water flows during rainfall events in contact with contaminated material; and
- uptake of groundwater by GDEs (where relevant).

6.3.5 Potentially Complete Pathways

The ongoing management of water resources upon surrender is not considered required based on:

- backfilling of pit voids;
- EA limited maximum disturbance areas; and
- removal of all infrastructure (unless where otherwise agreed in writing).

No infiltration, seepage and/or collection controls, surface water diversions or other long-term water management is deemed suitable or required upon surrender.

In accordance with the landholder agreement, on the completion of the mining operations any intact water storage dams on the mining lease land are to remain.

6.4 Revegetation

PRCP Guideline (section 3.6.1)
The revegetation plan must propose activities that will establish self-sustaining vegetation communities that are appropriate for the intended PMLU (e.g. natural ecosystems, grazing, forestry and some agricultural and other land uses). Revegetation should, therefore, not only establish a ground cover, but also, in some domains, establish associated fauna habitat and other ecological services.

6.4.1 Revegetation Objectives

Warwick Limestone rehabilitation objectives are to rehabilitate land disturbed by mining activities to be:

- safe for humans and wildlife;
- non-polluting;
- stable;
- revegetated with species endemic appropriate to achieve the agreed post-mining land use and post-mining land descriptions per the site EA;
- be free of declared pest species; and
- compliant with all conditions of the environmental authority (EPML00136213).

Where final landforms will not be used for water storage for stock dams, the land will be blended in with the surrounding existing and pre-mining topography. A grazing PMLU can be achieved with materials available on-

site for rehabilitation. Types of topsoils existing within Warwick Limestone mining leases are described in **Section 1.2.5**. Land suitability requirements for grazing PMLU are described in **Section 1.2.6**.

Based on the final landform, the topsoil materials available for rehabilitation and the pre-mining land use suitability assessment of a marginal grazing PMLU is achievable through revegetation activities associated with pasture seeding and additional soil amelioration (where required).

6.4.2 Revegetation Pasture Species and Seed Mixes for Marginal Grazing PMLU

There are no requirements listed in the EA for the inclusion of any species of conservation significance or fauna habitat and/or analogue sites for the purpose of a PMLU of marginal grazing (improved pasture grasses).

A large proportion of all topsoiled areas within the Warwick Limestone area will be sown with pasture grass species to meet the final rehabilitated landform outlined by the EA to re-establish the area for light grazing land use. Unless specifically directed by the relevant landowner prior to the seeding event, grass species that will be sown will include:

- Kangaroo Grass (*Themeda triandra*);
- Rhodes Grass (*Chloris gayana*);
- Slender Bamboo Grass (*Austrostipa verticillate*);
- Barbed Wire Grass (*Cymbopogon refractus*);
- Creeping Bluegrass (*Bothriochloa insculpta*);
- Couch Grass (*Elymus repens*);
- Shrubby Stylo (*Stylosanthes scabra*); and
- Fine Stem Stylo (*Stylosanthes guianensis var. intermedia*).

The seed mix will be liberally sown at a minimum rate of 5kg/ha during favourable conditions that will maximise germination (i.e. prior to rainfall events during the warmer months of the year). The seed mix will also be chemically treated to protect it from ants.

Where applicable, and to increase the success of direct seeding germination, seeding will be undertaken with an annual sterile cover crop species. Cover crops are sterile, and their rapid growth provides competition to minimize the emergence of undesirable weed species and enhance the desirable micro flora and fauna activity in the soil. This practice has been used elsewhere with the Japanese Millet, for example, however it is best to obtain advice from local agricultural seed distributers on the best species to use in the area.

6.4.3 Establishing and Managing Revegetation

Selected pasture seed mix consists of both native and exotic species that are cognisant of grazing best management practices. Sowing campaigns will be planned around the wetter months (October to March). Seed quality will be assessed prior to planting to ensure the greatest potential for vegetation establishment. The seed bed will be ripped on the contour to create a friable base on which seed mix will be directly planted using

agricultural equipment. Note, surface ripping may not be required in all disturbance areas. Amelioration and application rates will be determined prior to rehabilitation surface preparation commencing.

6.4.4 Planting Schedule

In addition to selected pasture species and seed mixes (**Section 6.4.2**), the following tree and groundcover species are recommended per the site Rehabilitation Plan planting schedule (**Appendix 8**).

- Queensland Blue Gum (*Eucalyptus tereticornis*);
- Gum Topped Box (*E. moluccana*);
- Narrow-leaved Ironbark (*E. crebra*);
- Shotgrass (*Paspalidium distans*);
- Blady Grass (*Imperata cylindrica*);
- Cotton Grass (*Digitaria brownii*);
- Slender Nineawn (*Enneapogon gracilis*);
- Corkscrew Grass (*Austrostipa setacea*);
- Buck Spinifex (*Triodia mitchellii*);
- Brown's Lovegrass (*Eragrosits brownii*);
- Tall Chloris (*Chloris ventricosa*);
- Redleg Grass (*Bothriochloa macra*);
- Kangaroo Grass (*Themeda triandra*);
- *Digitaria ramularis*;
- *Aristida lignosa;*
- Hairy Panic (*Panicum effusum*);
- Silky Browntop (*Eulalia aurea*);
- Pacific Bent Grass (*Lachnagrostis filiformis*);
- Longhair Plumegrass (*Dichelachne crinita*);
- Slender Bamboo Grass (*Austrostipa verticillata*); and
- Button Grass (*Dactyloctenium radulans*).

6.4.5 Topsoil

Sufficient topsoil is available on-site to respread over disturbance areas.

6.4.6 Revegetation Around Water Storage Areas

An area of the East-West Pit outside the pit and proposed abandonment bund area will be topsoiled and seeded with groundcover and/or grazing species. The intention of vegetating this area is to support surrounding rehabilitation areas with marginal grazing PMLU and to mitigate potential risks of erosion. Placement of vegetation around catchment areas can help slow runoff and reduce the loss of soil from the catchment.

6.5 Tailings Storage Facility

PRCP Guideline (section 3.6.2)

The tailings require characterisation to determine the geochemistry, rheology and geotechnical parameters that influence the rehabilitation or management strategies and the capacity of the site to support revegetation.

The design for a TSF must include relevant elements:

a) lining of TSF (i.e. embankments and base of structure)
b) leak detection systems
c) cellular design of TSF
d) seepage collection systems
e) design storage allowance
f) spillway location
g) designing TSF for progressive rehabilitation

No tailings storage facility exists within Warwick Limestone.

6.6 Voids

PRCP Guideline (section 3.6.3)

The information requirements of this domain are dependent on the nature of the proposed PMLU or NUMA for the void. For mine sites with voids, the rehabilitation planning part must include a void closure plan, which includes options for minimising final void area and volume; final void dimension; pit wall geotechnical and geochemical stability, final slope angles, void hydrology, groundwater modelling, water balance and predicted long-term water quality.

A geotechnical report should focus on how the void will achieve post-closure slopes that will exhibit stability characteristics consistent with the planning and design of the post-closure mine void.

If floodwaters are likely to move over backfilled material, an assessment of the hydraulic properties must be conducted to assess whether instability may occur.

The rehabilitation and management strategies in the plan must include the supervision, verification and auditing of engineering works carried out to achieve the post-closure void landform, to ensure construction is consistent with the geotechnical design.
The rehabilitation and management strategy must also include confirmation that the post-closure landform demonstrates the level of stability as specified by the design.

Schedule F, Condition F4 and F5 of the EA pertain to the outcomes of residual voids at Warwick Limestone whereby “residual voids must not cause any serious environmental harm to land, surface waters or any recognised groundwater aquifer, other than the environmental harm constituted by the existence of the residual void itself and subject to any other condition within this environmental authority; and residual voids must comply with Schedule F – Table 7.” Furthermore, “the environmental authority holder must complete an investigation into residual voids and submit a report to the administering authority proposing completion criteria outcomes in (F3) and landform design criteria in Schedule F – Table 7, two (2) years prior to the relinquishment of any lease associated with this environmental authority.”

This PRC plan proposes three (3) residual voids will remain on site once mining activities have ceased. These pits are prescribed in the LOD and will be located within the Phoenix pit (ML50237) and East-West pit (ML50238 and ML50239) (Refer to tables in Section 2.2 of this PRC plan).

6.6.1 Minimising Final Void

The location, size and geometry of final voids are prescribed by the LOD and therefore cannot exceed the limits imposed. The final land use and rehabilitation of these voids are designated as grazing / water storage, with an area in the Eastern Open pit of the East-West pit backfilled to RL 524.

6.6.2 Final Void Geometry (Dimensions, Wall Stability, Wall Angles)

Final geometry of residual voids are defined per LOD (EA) requirements and input from landholder consultation.

6.6.2.1 EA Void Requirements

Residual void requirements are defined per Conditions F4 and F5. These requirements are summarised in **Table 27** and **Table 28** below.

Table 27: Land outcome document prescribed residual void design (EA Schedule F – Table 7)

Pit area	Void identification	Void wall – competent rock max. slope (degrees º)	Void wall – incompetent rock max. slope (degrees º)	Void max. surface area (ha)
Aspinal pit	ML 50146	70º	38º	1.49
East-West pit	ML 50239 East-West	70º	38º	0.38
	ML 50083 East	70º	38º	1.49
	ML 50083 West	70º	38º	2.56
Phoenix pit	ML 50237	70º	38º	1.50
	ML 50238	70º	38º	11.50

Table 28: Land outcome document approved void PMLUs (adapted from EA Schedule F)

Pit area	Void identification	Void max. surface area (ha)	PMLU	Land class	Slope (º)
East-West pit	ML 50239 East-West	0.38	Water Storage / Grazing	VI	70º
	ML 50083 East	5.00	Backfilled to RL 524	VI	70º
	ML 50083 West	5.00	Water Storage	VIII	70º
Phoenix pit	ML 50237	11.50	Water Storage / Grazing	VI	70º
	ML 50238	1.50	Water Storage / Grazing	VI	70º

6.6.2.2 Landholder Void Requirements

Through consultation and landholder agreement, the landholder will accept residual voids post-mining once rehabilitated to a PMLU of water storage. These areas are intended to be used as stock dams and/or grazing land.

6.6.3 Void Design Plan

6.6.3.1 Final Void Landform Design

Final void landform designs are required to meet conditions of the EA and the landholder.

The East-West pit has the greatest surface area and depth of the proposed three (3) remaining voids; note, within all pits the maximum depth occurs centrally reducing towards each end of the pit. The Geotechnical Report summarises the average specifications of each of pit.

6.6.3.1 Final Void Stability

The site Geotechnical Report (**Appendix 4**) documents qualitative and quantitative analyses of long-term pit stabilities. The investigation identified all pit walls to have propensities to be unstable at bench and wall scales where the primary risk identified is related to rock fall and erosion. The grazing PMLU will help mitigate these risks by vegetating exposed ground with pasture species. Final void stabilities will be in accordance with the requirements described in the LOD.

6.6.3.2 Partially Backfill Aspinal Pit Void

The Aspinal pit is proposed to be partially backfilled to eliminate hazards associated with wall instabilities and to eliminate requirements to install abandonment barriers around the pit. As per Schedule F – Table 6 (Final Land Use and Rehabilitation Approval Schedule for ML50146), the land is not suitable for cultivation, however, is well suited to pasture improvement and determined PMLU land suitability Class VI. Partial backfilling of the Aspinal pit will also significantly reduce long-term residual risks associated with potential rockfalls. In contrast, this risk cannot be reduced in the East-West and Phoenix pits; hence these areas will remain post-mine as residual voids.

It is proposed to backfill the Aspinal pit to a free-draining landform. Backfill materials are proposed to comprise of superfluous ore, fines, and waste rock materials stockpiled near the Aspinal pit. Wherever possible, selected materials will be of uniform grade to assist in providing consistent level of compaction. Rock materials <25mm in size will be screened out in the selection process, and oversized rock will be used to construct the rock armour layer. Undersized materials will therefore be used as the primary backfill material. Owing to the nature of this planned material for backfilling, it is expected that the Aspinal pit void will be gradually backfilled throughout the life of the mine.

6.6.3.3 East-West Pit and Phoenix Pit Voids

The Geotechnical Report findings outline slope stability issues within the East-West and Phoenix pits. Shallow instabilities triggered by erosion were observed to have occurred on batters cut in soil and in highly weathered rocks. Attempting to reduce the level of risk in these pits will not be as effective nor cost effective as mitigation efforts in the Aspinal Pit.

Assessment of overland flows and water occurring within these pits found water flow erosion has cut gullies alongside the sides of all ramps and along some haul roads where gullies are most evident on these sections at the eastern and western side of the East-West Pit and Phoenix Pit. Water ponding of groundwater has been

observed in similar areas of both pits. Due to reasons of inability to reduce inherent risk of rockfall, water flow erosion, and water ponding, and in accordance with the EA, it is deemed acceptable that the East-West Pit and Phoenix Pit remain as residual voids to be used as stock dam water storage by the Landholder.

The presence of the East-West and Phoenix pits voids will not be promoted and their accessibility by the public and/or unauthorised persons will be limited by the following – a minimum of one (1) physical barrier will be placed beyond potential failure zones behind the crest of each wall and will fully encircle pits per Geotechnical Report:

Abandonment Bunds

Bunds will be used rather than fences wherever it is safe and practical and will remain in place for the long-term (>100 years) requiring negligible maintenance. Bunds will be constructed to the following specifications:

- material sourced from unweathered, durable limestones excavated from adjacent waste rock dumps using a top-down method;
- where feasible, rocks will be screened of fine fraction (<5mm) to promote free-draining bunds;
- minimum bund height of 2m with base width of 5-6m; and
- gaps 0.5m wide left at the toes of bund at contour lows where water has obviously been flowing.

An abandonment bund will fully encircle the East-West pit and will be accessible via a gate within the bund to enable access to the road leading to the central ramp. A bund will be placed along the south wall of the East-West pit and along the crest of the north wall of the dump and proceed up the east and west slopes of the dump. This new bund will replace the existing 0.5m bund.

An abandonment bund will fully encircle the Phoenix pit and will be accessible via a gate within the bund to enable access to the road leading to the main ramp. A 316m long and 3-5m high bund has been installed behind the create of the eastern wall of the Phoenix pit. This is acceptable for an abandonment bund in its current state (**Appendix 4**).

Fences

Fences will be installed where required and where the placement of abandonment bunds is not suitable. Fences will be installed to the following specifications:

- type B style fencing used – 7 plain-strand, high tensile, 2.5mm diameter wires (barbed wires not used);
- upper wire of the fence will be a minimum of 1.15m above ground level to discourage persons from stepping over;
- posts will be spaced no greater than 5.4m apart;
- intermediate start droppers will be spaced no greater than 1.8m apart;
- gates will be placed to allow vehicle access; and
- signage placed along each run of each fence and to gates.

Fences are expected to remain functional for 10 to 15 years and will require routine inspection to ensure integrity is maintained.

Signs

Appropriate signage will be placed at bunds, fences and gates warning of “danger deep void” or similar. Installed signs will require the following:

- incorporate a drawing of the hazard in addition to words to ensure clear interpretation of the sign;
- comprise of aluminium sheets a minimum of 30cm x 30cm in size;
- letters at least 3.5m high and graphics enamelled;
- be placed at a maximum of 20m spacings;
- secured to sturdy posts via galvanised fasteners;
- placement of signs to be visible by persons approaching from any direction and placed wherever an access route and/or track meets a fence; and
- use of secure galvanised fasteners to attach signs to posts, gates and/or fences.

Pit Access

Access to the East-West and Phoenix pit voids will be restricted via physical barriers (bunds, fences, gates). All ramps into the pit that are not required by the landholder will be deep ripped. Where pit access is necessary and multiple ramps into the pit exist, only one (1) ramp will be retained. Other ramps and access routes into the pit will be deep ripped prior to the installation of physical barriers behind the pit crest. Where ramps are to be retained for pit access these will be the least hazardous of available ramps based on the:

- widths of ramps (wider preferrable);
- competency of rock underlying benches (surface cracks not present and bench not blast-damaged); and
- conditions and performances of adjacent slopes are evidenced by low numbers and small sizes of rocks on the ramps.

The main ramp along the east pit wall in the Phoenix pit will be used as the main pit access ramp. The central ramp on the north wall or the western ramp on the west wall of the East-West pit will be used as the main pit access ramp.

Gates to pit access ramps will be appropriately signed to warn of “danger rockfall hazard” and “danger deep void” or similar per the sign requirements described above.

Pit Floor

Safe access to pit floors will be achieved by the following:

- deep ripping areas around the pit floor that are accessible but are not required;
- placement of toe bunds (rock traps) on the floor out from each wall; and

  - to limit traverses of rocks rolling off walls
  - to reduce the likelihood of rocks entering accessible areas
  - prevent vehicle and persons access from accessing potentially more hazardous areas
- toe bunds constructed to the following;
  - a minimum 1.8m height
  - material sourced from rocks with the same characteristics as those used in abandonment bunds
  - constructed to the same procedure as abandonment bunds.

Pit accessibility restrictions are further detailed in the Geotechnical Report (see reports sections '*7.2 Accessibility to East-West and Phoenix Pits*' and '*7.4 Access into Pits*')(**Appendix 4**).

6.6.3.4 Long-Term Management Requirements

The Geotechnical Report identifies there will be non-mitigable residual risks for the long-term due to the presence of the pits and waste dumps. Upon surrender of the mining tenements, the landholder must manage these risks over the long-term to ensure they remain acceptable.

Ongoing long-term maintenance will include, but may not be limited to:

- Routine inspections at yearly intervals, or whenever the landholder is nearby and/or onsite, to check for damage and identify other conditions that require maintenance or repair;
- Installation of additional safety measures such as lining gullies with geotextile fabric and check dams; and
- Engagement of mining rock mechanics specialist, or other appropriately qualified persons, whenever an event occurs implying risks to persons.

The landholder will be informed of long-term and ongoing maintenance requirements and acknowledgement of understanding will be obtained prior to the surrender of mining tenements. A more detailed list of ongoing long-term maintenance is described in the Geotechnical Report (see report section '*9 Inspections and Maintenance*'; **Appendix 4**).

6.6.4 Void Hydrology

6.6.4.1 Surface Water

The Aspinal pit areas are located on a natural ridgeline which drains to the northeast via Lucky Valley Gully towards the Condamine Creek, approximately 3km to the northeast. As this pit will be backfilled, there will be no relationship between the hydrology of the environment and the pit (i.e. no water will be stored).

The East-West pit area is located on the western side of a local topographic high; rainfall run-off drains westward via Lord John Creek towards Oaky Creek, and north into the Condamine River approximately 9.7km to the north of the mine area. The Phoenix pit area is located on the eastern side of the Keogh Road which is a local topographic high and drainage divide between the East-West and the Phoenix pit areas drainage lines control

the run-off in a north-easterly direction via 'Frenchman's Gully' towards Lucky Valley Gully before draining to the Condamine River.

6.6.4.2 Groundwater

The Project area is within the Balonne-Condamine Groundwater Management Area (QLD Globe Mapping). Local groundwater levels are approximately 20m to 25m depth below ground level as observed from dill logs and minor seepage in pits. Groundwater flow is very slow as observed from minor pit seepage. Rainfall run-off and slow percolation and subsurface drainage are the main sources of water to these pits.

A groundwater bore located near the East-West pit (ML50083) (Bore Licence WL86305T) is currently inactive and has been for several years. On site personnel estimate yields are less than 1L/sec (Litre per second). Groundwater levels in the area are below 15m below the surface. Historical data suggests groundwater salinity is in the range of 750EC to 2240EC (electrical conductivity) (ERM 2008). Minor groundwater seepage is observed in the Phoenix pit at approximately 20m below ground level.

Typically, aquifer transmissivity is low in limestone; that is, the impacts on other groundwater users in the area is considered negligible as a result. This is also influenced by the proximity of users to potential mine influence. The nearest bore (Bore Number 86326) in the area sits approximately 2km to the east in weathered granite recorded yields of <0.5L/sec. groundwater quality is described as potable water from a drill depth of 22m, with pH8.4 and salinity 2191EC.

Proposed reshaping and/or bunding of the crest of residual voids will prevent any surrounding or nearby catchment areas from reporting to the final voids as water storage

6.6.4.3 Surrounding Water Use

The Project area is surrounded by farmland predominantly used for cattle grazing; hence the primary water users are farmers for stock (cattle) drinking water. Further down the catchment, the Condamine River supplies water used for irrigation, raw drinking water supply, and recreational activities and other activities of environmental value (**Appendix 5**).

6.6.4.4 Water Balance

Figure 22 illustrates a conceptual model of a water balance on a void.

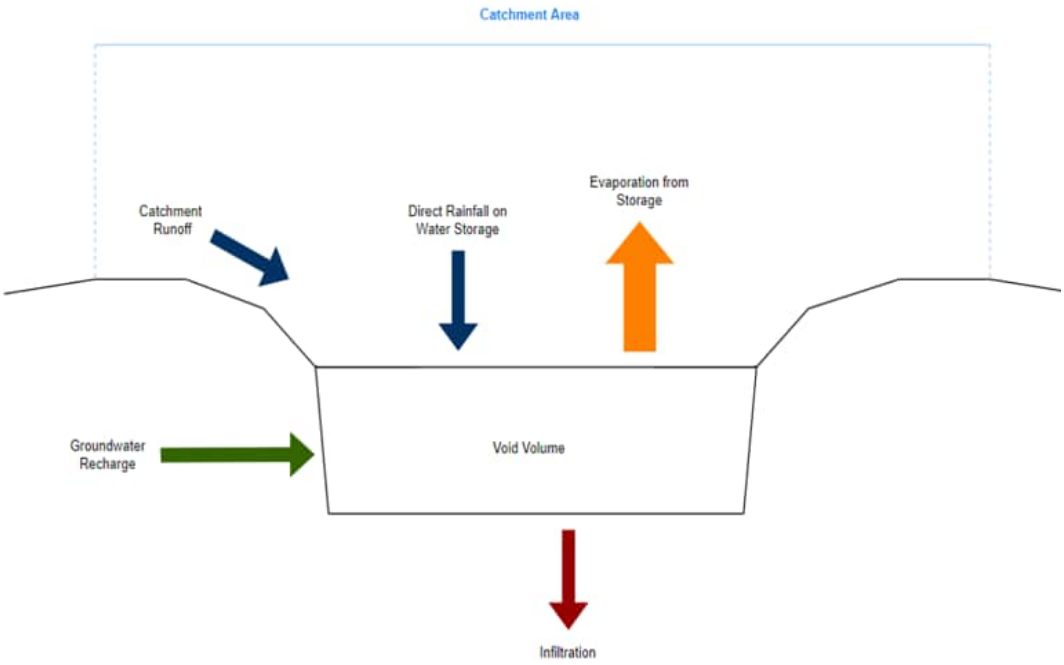
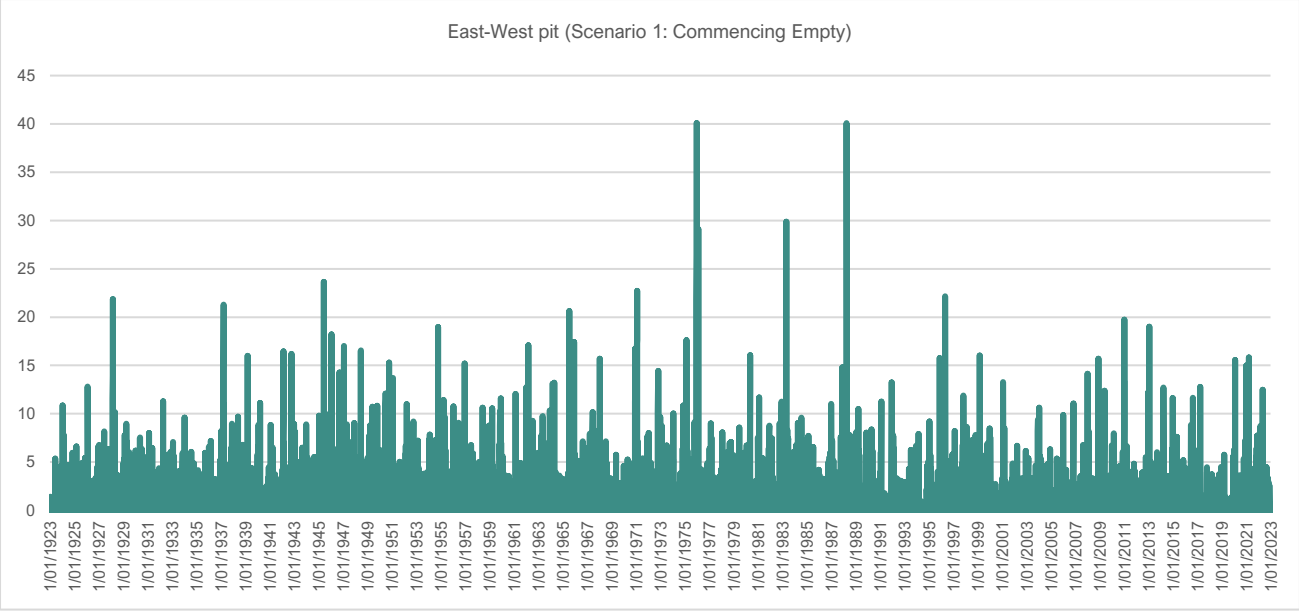


Figure 22: Conceptual water balance model of a void

This model forms the basis for a simple assessment of water balance on residual voids at the site. Water balance assessments consider void catchment inflow versus outflow parameters including daily rainfall, catchment runoff, groundwater recharge, and potential evapotranspiration and infiltration, respectively.

The site water assessment is limited available data from site. An assessment of total rainfall and evapotranspiration over a 100-year period indicates a strongly negative water balance indicating there is no risk of overtopping of water storage voids. This is illustrated in the figures below which shows starting with a hypothetical empty void, the water level within voids never reaches the maximum storage capacity of the structures. Similarly, this is the case in a hypothetical full void (i.e. water storage is at capacity). Due to the high evaporation rates, the water is not in a situation to overtop. The figures below illustrate the results of assessment based on two scenarios: starting with an empty pit volume and an at capacity scenario.

It is noted that the pattern in change in storage between pits is the same. This is attributed to the use of the SILO climate data, which is not specific to each pit, but rather for a point area (latitude -28.40 and longitude 152.10). A strongly negative water balance is shown due to low daily rainfall and potential evapotranspiration (based on 100-years of SILO data). There is no risk of residual voids overflowing due however, there is a risk for drying out.



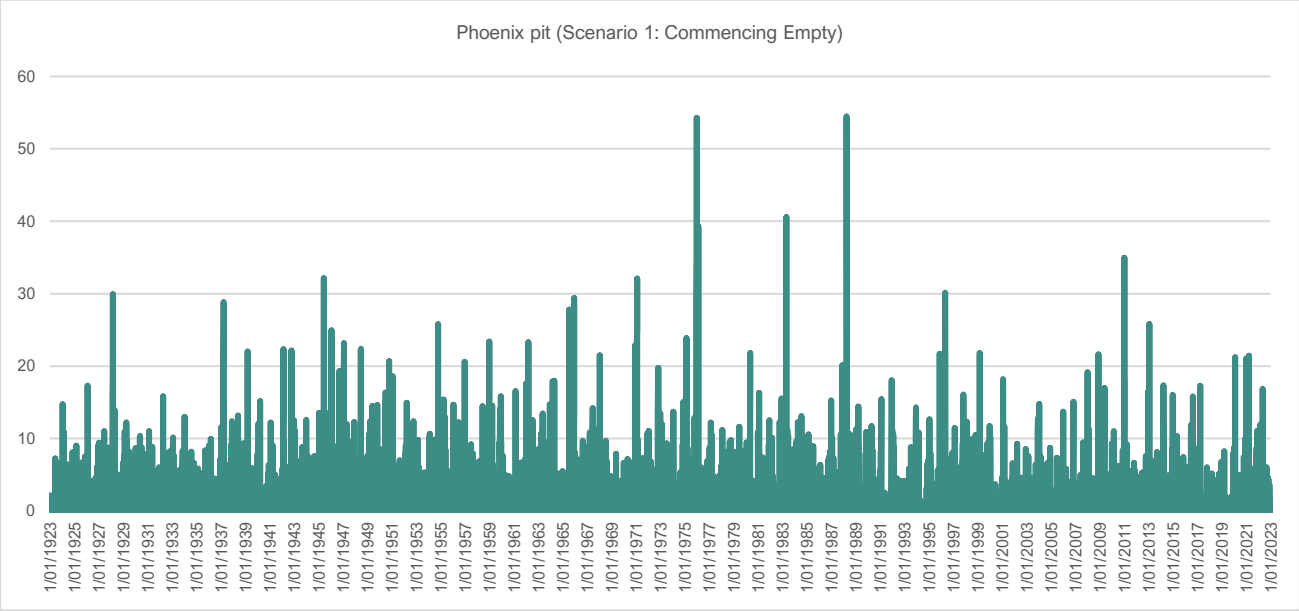
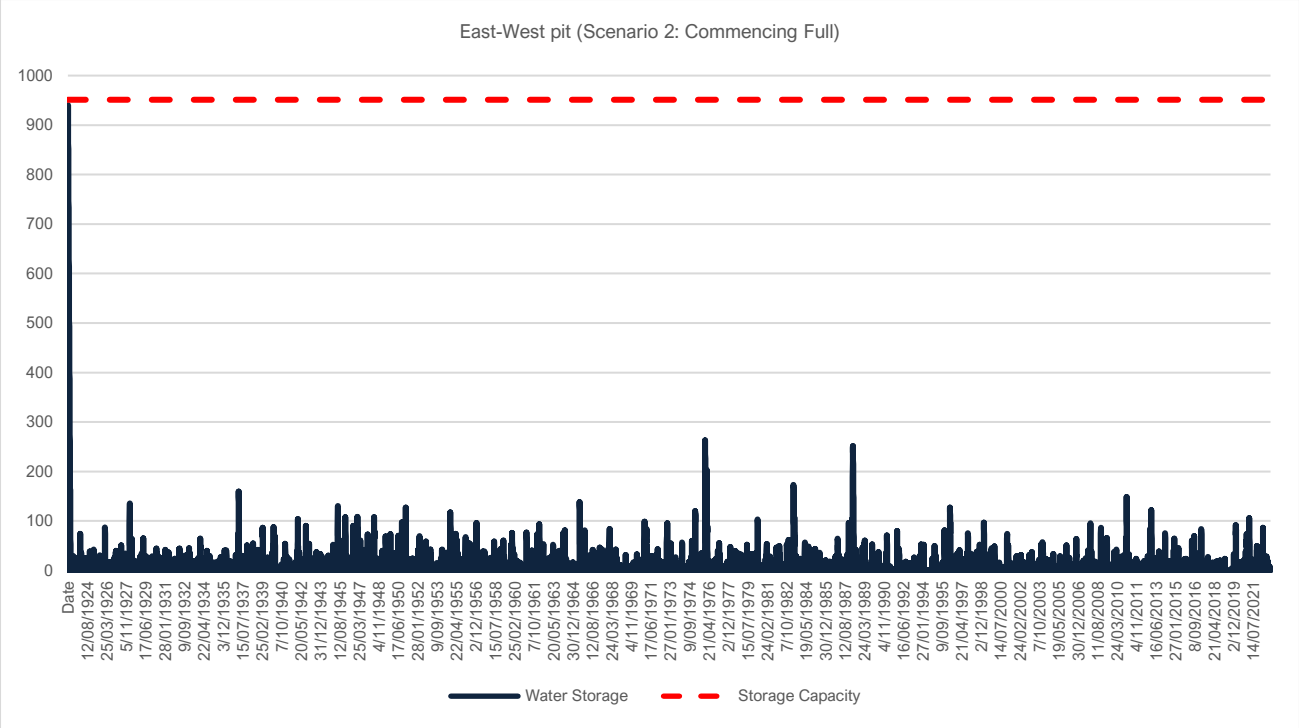


Figure 23: Residual voids water storage assessment scenario 1 (empty): East-West (top), Phoenix (bottom)



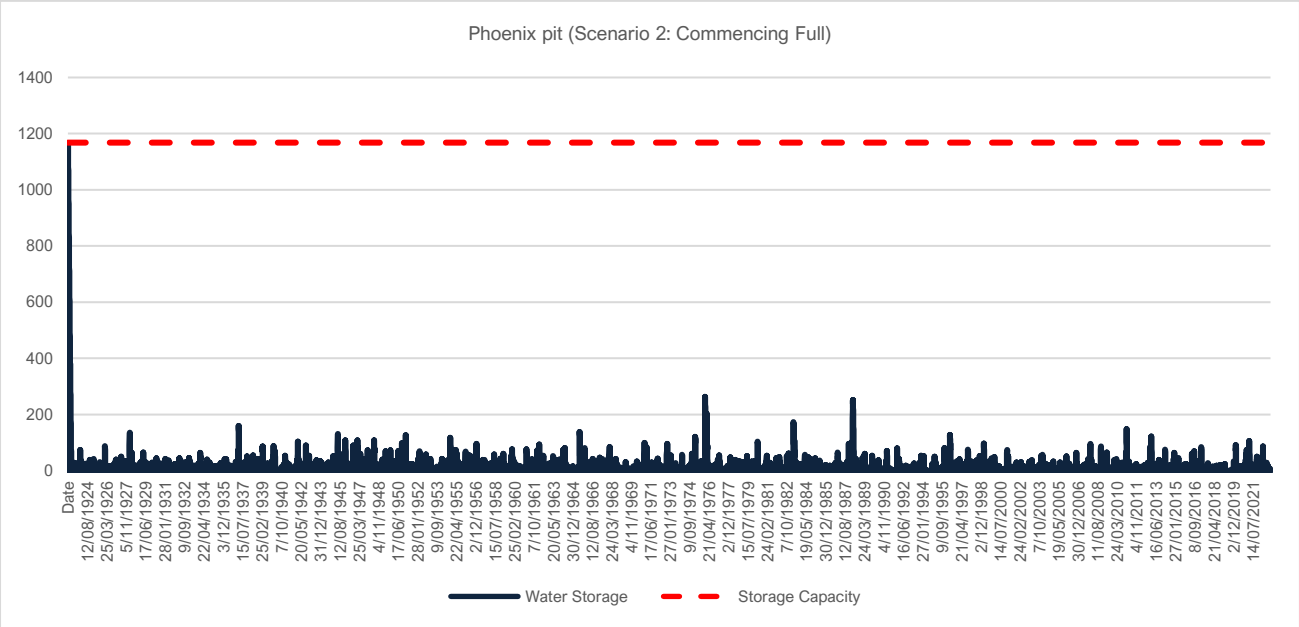


Figure 24: Residual voids water storage assessment scenario 2 (full): East-West (top), Phoenix (bottom)

6.6.4.5 Water Quality

For the duration of the mine life, Warwick Limestone must comply with the conditions of Schedule C in the EA for water. The site implements and operates under the Unimin Warwick Limestone Deposit Site Water Management Plan (September 2008) to ensure compliance with these conditions.

There is a strongly negative water balance on site due to low rainfall and high potential evapotranspiration, based on 100-years of data. There is potential for evaporation of water from void catchments to slowly increase salt concentrations however, increased salinity is not considered a risk to groundwater as there is no interaction between possible groundwater and residual voids.

Due to the lack of available historical data from site, the rehabilitation of residual voids, up to their surrender, will be monitored during dry periods to ensure practicable measures are implemented to protect wall integrity[30]. These measures will be planned when required.

6.7 Underground Mining

PRCP Guideline (section 3.6.4)

For underground mining operations, the rehabilitation planning part must include:

- a geotechnical study
- an assessment of groundwater interactions and potential lower of groundwater levels
- the development of a hydrogeological conceptual model
- subsidence analysis and modelling and a subsidence vegetation/habitat impact assessment
- consideration of how potential entries to underground workies will be sealed (i.e. through some form of capping or back filling)
- how surface ponding and cracking will be mitigated
- identification of post-closure stabilisation of underground workings in order to manage the potential for unplanned surface subsidence and unplanned ground collapse such as sinkholes and pot holing.

Underground mining is not applicable to Warwick Limestone.

6.8 Built Infrastructure

PRCP Guideline (section 3.6.5)

The administering authority's expectation of rehabilitation relating to built infrastructure is that it will be decommissioned, demolished, salvaged and/or disposed of unless it is being formally retained by the landholder to achieve an appropriate PMLU.

The rehabilitation planning part must include:

- identification of infrastructure that will be decommissioned and the methods for decommissioning
- a description of infrastructure that will remain post rehabilitation and the identification of ongoing maintenance requirements
- evidence of agreement for any infrastructure that will have ownership transferred.

[30] Agriculture Victoria. (2020, July 1). Maintaining your farm dam. https://agriculture.vic.gov.au/farm-management/water/managing-dams/maintaining-your-farm-dam

6.8.1 Decommissioning, Demolition and Removal

In accordance with the EA Schedule F – Land, all infrastructure not required by the land holder will be removed. Current infrastructure within Warwick Limestone are summarised below.

Table 29: Infrastructure associated with approved activities at Warwick Limestone

Infrastructure	Description
Built infrastructure	• Office buildings – administration buildings, sheds, crib hut, parking • Workshop and plant • Associated infrastructure – power, water, communication services
Water storage	• Sediment dams and stormwater controls • Catchment dams
Roads and tracks	• Unsealed dirt roads and tracks connecting mine areas

6.8.1.1 Landholder Agreement Conditions

Per the landholder agreement, the following conditions must be met for listed infrastructure to be accepted upon surrender:

- repair, reinstate, rehabilitate or make good in respect of any damage done to landholder's fences, gates, buildings, dams, stock, pastures or crops arising from access to or exploration or mining activities on the ML land or gaining access to ML land; and
- on the completion of the mining operations, leave intact any water storage dams on the ML land.

6.8.1.2 Built Infrastructure

Except where agreed in writing, decommissioning of built infrastructure will include:

- disconnecting all services;
- demolition and removal of all built and service infrastructure including buildings, pipes, pumps, power lines, etc.
- removal of all concrete bitumen and aggregate from buildings, roads, carparks, laydown areas, footpaths, etc.; and
- removal of all waste products and rubbish.

6.8.1.3 Water Storage

Per the EA Schedule F – Land, sediment dams will remain as stock dams. This is in accordance with landholder agreement conditions.

6.8.1.4 Roads and Tracks

In accordance with EA Schedule F – Land, roads and tracks will remain as farm access tracks or use by the landholder. Where required, minor rehabilitation repair may be carried out to ensure roads and tracks are in a safe and stable condition suited to their continued use.

6.8.2 Contaminated Land Assessment

In accordance with EA Schedule E – Waste, the handling and disposal of all waste produced on site is to be conducted using methods to avoid contamination of land and surface and groundwater. Contamination at Warwick Limestone is unlikely, however, in the event a contamination is suspected, a contaminated land assessment will be completed on all infrastructure areas list in **Table 29**, as well as locations adjacent operational areas, where required. The purpose of such as assessment will be to confirm that no contamination unsuitable for the post-mining land use is occurring.

6.9 Summary of Rehabilitation Methodology

The rehabilitation strategy is to commence rehabilitation of each rehabilitation area within 6-months of the area becoming available for rehabilitation. Each rehabilitation area will require different intensities of rehabilitation work therefore, the time to complete these works is varied (i.e. areas for rehabilitation now may not be completed until other areas have commenced and/or completed rehabilitation).

6.9.1 Completion Criteria

Rehabilitation milestones, criteria, and outcomes are described in the following section of this PRC plan. However, **Table 30** outlines the completion criteria used to ensure pasture grazing lands can be measured as rehabilitated land.

Table 30: Proposed rehabilitation acceptance

Disturbance	Vegetation Cover (% of analogue)	Species Diversity (sp./ha)	Max. Slope Angle	Geotechnical Stability	Severe Active Rill / Gully Erosion	Soil pH	Soil Dispersion (ESP.%)	Soil Salinity (ECse,, dS/m)	Soil Organic Carbon (%)
Dump	≥ 75	≥ 4	< 25º	Stable	Absence	5 - 8.4	<6	< 5.5	>1
ROM Pad and Stockpile	≥ 75	≥ 4	< 10º	Stable	Absence	5 - 8.4	<6	< 5.5	>1
Infrastructure	≥ 75	≥ 4	< 10º	Stable	Absence	5 - 8.4	<6	< 5.5	>1

Rehabilitation methodology and techniques are summarised in **Table 31**.

Table 31: Rehabilitation methodology

Rehabilitation Work	Methodology
Delineate Rehabilitation Areas (RAs)	• Rehabilitation areas are to be clearly delineated on the ground with native fauna-fencing where necessary • Fencing will need to be designed to preclude cattle from entering rehabilitation areas
Control and/or Removal of Weed and Exotic Plant Species	• Priority and environmental weeds are to be removed immediately on detection • If using herbicides, particular care must be taken to avoid poisoning native species, particularly young saplings, native grasses, and herbaceous species • Exotic grasses are to be treated (by spraying) 2-3 weeks prior to replanting – particular care must be taken to avoid spraying native grasses. Woody and herbaceous weed species are also to be treated prior to planting • Two weeks following spraying of rank exotic grasses, that are not required for pasture, these are to be knocked down by brush cutting – particular care must be taken to avoid slashing native species
Preparation of Site	• Any rubbish will need to be collected and disposed of offsite at a Council approved location or rubbish disposal depot
Mulch	• Mulching will be undertaken across the rehabilitation site when planting tube stock • Weed free mulch is to be applied to a depth of 100mm across the rehabilitation area
Plant Supply	• Seedlings shall be sourced from local provenance stock (where possible). • Recommend species for rehabilitation are provided in Table 2 of the Rehabilitation Plan (BAAM 2010) • Densities are to be determined at a later date prior to initiation of rehabilitation • activities • Planting stock shall be provided in forestry tubes with a minimum plant height of 20cm and a well-developed root system • Seedlings are to be healthy and displaying signs of active growth – any plants displaying yellowing, disease, root curling or are root bound are not to be planted, nor are any plants with weeds growing in the pot
Planting	• Tube stock - Plant in a slight shallow twice the size of the tube container, ensuring football is just below soil surface. Fertiliser tablet to be placed adjacent to, but not touching, the root ball • Soil to be backfilled to the same level as when the plant was in the container Mulch to a depth of 100mm to surround plant, but not touch the stem • Seedlings are to be randomly arranged at the determined densities • Seedlings must be moist at time of planting, if necessary, water stock prior to planting
Water	• Seedlings are to be watered with a minimum of 5 – 10 litres of water each at the time of planting and then watered as part of general maintenance requirements
Habitat Features	• For all Rehabilitation Zones, habitat features such as rocks, fallen branches and dead trees and shrubs in all zones are to be retained in situ unless they pose a safety risk
Groundwater	• Monitor groundwater level and quality from existing bore(s) • Record groundwater inflow to pits when used for water storage and notify administering authority of any anomalies
Maintenance and Monitoring	• Plantings will be maintained for a period of 24-months during the rehabilitation phase

6.9.2 Rehabilitation and management strategies

The primary risks impacting successful rehabilitation of these voids to grazing and/or water storage is erosion and associated rockfalls, and risk of movement of any contaminated waters and sediment off site. The Water Management Plan (**Appendix 5**) outlines best practice methods for managing these risks as does the Geotechnical Report (**Appendix 4**).

The following summarises the strategies presented by these reports to reduce erosion and promote long-term rehabilitation of the voids.

6.9.2.1 Hydroseeding

The primary risk of the residual voids is risk of rockfall and slope instability. Both these risks are caused by the process and rate of erosion on the land. Reducing the rate of erosion for the long-term requires the establishment of grasses within the soils where root structures will increase structure and reduce the displacement of rock and soil downslope. Additionally, grasses are known to reduce the rate of runoff and allow water to infiltrate soil rather than flow over it (water flow erosion).

The combination of hydroseeding and hydro-mulching is an accepted method of rehabilitation of mine slopes comprising of soils and weathered materials similar to that of the batter of the East-West and Phoenix pits. This method is particularly cost-effective for the larger area of the steep slopes (approx. 3020m2 and 30º to 50º), the crest, and the ripped haul road behind the crest. Hydro-mulching the batter with a product suitable for steep slopes is recommended after hydroseeding will protect grass seeds from rain and wind, reduce soil losses, and prevent further erosion. Hydroseeding is likely to remain effective for 6- to 12-months during which time the seeds will have had time to establish. Spraying is also recommended to occur at a time when the likelihood of regular rainfall is higher, and temperatures are mild to encourage the germination of seeds.

6.9.2.2 Matting

Gullying is observed in topsoils, karst fills, and in weathered limestones on the eastern batter of the Phoenix Pit adjacent to the main ramp. This erosion is attributed to waterflows from rainfall directly impacting the batter as well as to surface water flowing over the crest of the wall. If these erosive processes will be ongoing in the medium- to long-term and, if they are not addressed, will trigger future instabilities in the pit wall. The pit ramp may be deemed unusable during mine-operations.

A bund at approximately 1m height along the crest of the pit wall should suffice in preventing surface flows. Additionally, the rate of erosion and occurrence of gullying can be reduced with the installing of quality erosion control matting. However, this can be a costly venture and without seeding, matting can only offer a medium-term solution to erosion.

7 Risk Assessment

Legislative Requirement

In accordance with sections 126C(1)(f) of the EP Act, the rehabilitation planning part of the PRC plan must identify the risks of a stable condition for land described as a post-mining land use not being achieved, and how the applicant intends to manage or minimise the risks.

PRCP Guideline (section 3.7)

As per section 126C(1)(j) of the EP Act, the administering authority considers it necessary for the proposed PRC plan to contain a risk assessment of all proposed NUMAs. The risk assessment must be carried out to identify the risks of the NUMA causing environmental harm and not being safe and structurally stable and detail how the applicant intends to manage and minimise the identified risks.

The AS ISO 31000:2018 Risk Management – Guidelines (Standards Australia, 2018) describes risk assessment as the overall process of risk identification, risk analysis, risk evaluation and risk treatment. Each of these aspects must be included in the risk assessment in the rehabilitation planning part.

Applicability to Transitional PRC plans

Information requirements in this section apply to all applicants whether or not they are an existing EA holder. Existing holders may have the required information available from previously submitted plans/reports/applications that, if still valid, can be used in the PRC plan.

7.1 Identifying, Assessing and Treating Risks

7.1.1 Risk assessment Framework

Analysis of the likelihood and consequence of the associated hazards of the PMLU option was conducted to determine both the inherent (no risk treatment applied) and residual risks (risk treatment applied). **Figure 25** details the criteria matrix used in the analysis.

7.1.2 Risk Treatment

The risk assessment incorporates a comprehensive list of risks based on events that may impact the rehabilitation of the Project area to a stable condition. These have been explored in **Table 32** where the cause and source of identified risks and their positive or negative impacts, the likelihood of their occurrence, and level of consequence for occurring (risks are listed in no particular order but are grouped based on a determined category of risk).

Figure 25: Risk assessment criteria matrix

			Consequence				
			Extreme 5	Major 4	Moderate 3	Minor 2	Insignificant 1
			Severe long-term environment impact, fatalities or permanent injury, major prosecution, extreme financial loss	Major environment impact, requires significant remedy, major prosecution, substantial financial loss	Reversible environment impact, regulation breach, , moderate financial loss	Low environment impact, fines for breach, small financial loss	Very low environment impact, no legal breach, negligible financial loss
Likelihood	Almost certain 5	Expected to very likely to occur in most circumstances	Extreme 25	Extreme 20	Extreme 15	High 10	Moderate 5
	Likely 4	Likely to occur in most circumstance	Extreme 20	Extreme 16	High 12	Moderate 8	Low 4
	Possible 3	Likely to occur more than once during a lifetime	Extreme 15	High 12	Moderate 9	Moderate 6	Low 3
	Unlikely 2	Likely to occur once during a lifetime	High 10	Moderate 8	Moderate 6	Low 4	Low 2
	Rare 1	Unlikely to very unlikely to occur in a lifetime	Moderate 5	Low 4	Low 3	Low 2	Very Low 1

Table 32: Rehabilitation risk assessment for Warwick Limestone

Risk	Hazards	Potential Impacts	Inherent Risk	Mitigation Measure / Risk Treatment (Proposed Actions)	Justification for Risk Treatment	Responsibility	Resource Requirements	Performance Measures	Reporting and Monitoring Requirements	Residual Risk	Applicable Rehabilitation Milestone
General	Insufficient skills and experience and/or insufficient management of rehabilitation personnel	• Poor rehabilitation outcomes • Rehabilitation does not meet standards or requirements of the EA and/or landholder • Rehabilitated areas degrade quickly • Increased cost to rehabilitation works • Delayed PRCP progression	**Low 4**	• Due diligence checks to ensure consultants, personnel, and/or contractors are suitable qualified to carry out rehabilitation works and planning • Regular meetings with required members to ensure PRCP and rehabilitation progression is occurring as planned	• Allow for early identification of insufficiencies of skill and experience required to complete works and reduce deviations from the PRCP schedule	All personnel	• Adequate time allocated for meetings	• Regular reviews and meetings • Active communication throughout PRCP schedule and rehabilitation works	• Prior to engagement of consultants, personnel, and/or contractors	**Low 2**	RM1 – RM10
	Lack of clearly defined responsibilities	• Breakdown of communication • Delayed PRCP progression • Delayed rehabilitation works • Rehabilitation works not actioned to plan • Potential increased cost to PRCP	**Low 4**	• Regular meetings with required members to ensure PRCP and rehabilitation progression is occurring as planned	• Allow for early identification of gaps in understanding and/or unfilled roles to complete works and reduce deviations from the PRCP schedule	All personnel	• Adequate time allocated for meetings	• Regular meetings and review • Active communication throughout PRCP schedule and rehabilitation works	• Throughout PRCP schedule	**Very Low 1**	RM1 – RM10
	Insufficient funding for or prioritisation of rehabilitation activities	• Delayed PRCP progression • Delayed rehabilitation works • Potential to reject surrender of Project area if rehabilitation does not standards or requirements of the EA and/or landholder	**High 12**	• Regular meetings with relevant personnel and teams • Financial planning and forecasting with relevant financial team • Stage rehabilitation works instead of leaving until mine closure.	• Allow for best use of Project budget • Allow for suitable allocation and distribution of funds across Project requirements to ensure success and completion of PRCP Schedule • Staging allows costs to be spread and lowers risk of wholesale rehabilitation failure	Project team; Financial teams; and Site management	• Adequate budget for rehabilitation works	• Regular meetings and financial reviews with relevant personnel and teams	• Prior to and throughout PRCP schedule	**Moderate 6**	RM1 – RM10
	Improper maintenance and/or storage of biological resources and/or soil stockpiles for rehabilitation	• Improper practice can result in WH&S accidents • Biological resources are unusable or of a poor quality • Introduction of weed species resulting in heavy seed burdens • Delayed rehabilitation works • Inappropriate soil mixing techniques	**High 12**	• Adopt and implement best practice methods for maintaining and storing, limit erosion, and deter weeds • Topsoil stripped and stockpiled separately to subsoil stockpiles with appropriate labelling/signage	• Follow industry standard practice for optimal utilisation of biological resources for rehabilitation phase • Maintaining accurate soil inventory facilitates rehabilitation planning and works	Environment team; Site management; Contractors (rehabilitation)	• Stockpile management procedure • Personnel and/or contractors required for stockpile management, maintenance, and application for rehabilitation	• Rehabilitation monitoring • Inspections by suitably qualified person(s)	• Rehabilitation monitoring and reporting • Inspections and reporting	**Moderate 6**	RM3; RM6; RM8
	Clearing in adverse seasonal and weather conditions when salvaging biological resources	• Impacts rehabilitation outcomes further down the track • Reduced viability of biological resources for rehabilitation • Increased cost to obtain additional resources	**Extreme 15**	• Confer weather data and predictions to ensure planned clearing does not occur during severe dry or severe wet weather	• Clearing during adverse weather conditions can impact rehabilitation success, soil integrity, erosion, etc.	Project team; Site management and personnel; Contractors	• PRCP Schedule • Climate data	• Weather monitoring	• Rehabilitation monitoring and reporting	**Moderate 5**	RM6; RM8
Climate Change	Increased severity in weather patterns – extreme and/or prolonged wet and dry seasons, more devastating impacts from natural disaster events, etc.	• Increased cost to meet environmental standards and PRCP requirements • Damage from winds resulting in unsuccessful revegetation • Changes in rainfall patterns • Rehabilitation failure due to severe weather events and patterns	**Moderate 5**	• Regular monitoring rehabilitated areas to ensure original objectives of the PRCP are achieved • Reasonable adjustments as deemed relevant to adapt to changed weather patterns and/or severe weather events	• Severe weather events are highly variable and infrequent in the area • Due diligence and appropriate action will be determined based on early warning and during the weather event on how to best manage WH&S and protect rehabilitation areas	All personnel; Environment team	• PRCP Schedule • Climate data	• Rehabilitation monitoring	• Rehabilitation monitoring and reporting	**Low 4**	RM1 – RM10

Risk	Hazards	Potential Impacts	Inherent Risk	Mitigation Measure / Risk Treatment (Proposed Actions)	Justification for Risk Treatment	Responsibility	Resource Requirements	Performance Measures	Reporting and Monitoring Requirements	Residual Risk	Applicable Rehabilitation Milestone
Climate Change	Increased risk of bushfires and extreme bushfires	• Increased cost to meet environmental standards and PRCP requirements • Fire danger and associated risks to staff and land increased • Potential increased liability	**High 12**	• Implement and maintain fire breaks around Project area • Continuous monitoring of rehabilitation areas and areas prone to fire risks or near mapped bushfire areas • No siting of infrastructure in high hazard bushfire areas.	• Monitoring of rehabilitation areas and areas prone to fire risk to ensure indication or triggers of fire risks are monitored • Monitoring of rehabilitation areas and areas prone to fire risk to ensure fire breaks are in suitable condition	All personnel	• Personnel and equipment required to establish and maintain fire breaks	• Rehabilitation monitoring	• Rehabilitation monitoring and reporting	**Low 4**	RM1 – RM10
	Success of long-term vegetation is impacted	• Increased cost to meet environmental standards and PRCP requirements • Degraded environment and poor execution of PMLU option • Increased erosion due to poor vegetation and root structures • Allows for compaction and reduced land stability	**Extreme 15**	• Ensure revegetation and planting is conducted during a period with expected rainfall sufficient to promote establishment of plants • Sufficient manual watering and monitoring of rehabilitation areas if planting occurs during a drought or severe dry period • Make use of hay or other means to assist in retaining moisture and protecting bare ground from evaporation • Follow progressive rehabilitation schedule of PRC Plan	• Planned planting for a period of expected rainfall allows for natural establishment of vegetation • Monitoring of rehabilitation areas to ensure plants are sufficiently watered and conditions are suitable for fostering growth • Progressive rehabilitation allows for better management of rehabilitation areas to ensure successful long-term outcomes	Environment team; Site personnel; Contractors	• PRCP Schedule • Climate Data • Aerial surveying	• Rehabilitation monitoring	• Rehabilitation monitoring and reporting	**Moderate 6**	RM4; RM6+; RM8
	Increased and/or pro-longed heavy rainfall events	• Increased cost to meet environmental standards and PRCP requirements • Increased erosion (splash erosion and rain drop impact) • Increased potential for flooding • Potential for overflow of onsite water storage facilities (OSWF) • Collection of water in residual voids and/or pits	**High 12**	• Regular monitoring or rehabilitated areas to ensure early detection of poor performance • During periods of inadequate rainfall, manual watering can be conducted at regular intervals (e.g. November to February) • Provision of sufficient water to promote establishment • Supplementary seeds and revegetation works may be required if initial rehabilitation is damaged due to inundation of water • Utilise water management via bunds, etc. to direct flow of water • Training provided to relevant site personnel and contractors in accordance with required rehabilitation and management	• Monitoring of rehabilitation areas over the life of the Project will inform on the effectiveness and robustness of rehabilitation strategies • Timing rehabilitation activities so that groundcover is well established prior to wet season reduces rainfall damage.	Environment team; Site personnel; Contractors	• PRCP Schedule • Water Management Plan • Climate data	• Rehabilitation monitoring	• Performance reporting as part of rehabilitation monitoring and reporting	**Low 4**	RM1 – RM10
Waste	Improper disposal of waste and/or improper waste management	• Contamination of the receiving and surrounding environment • WH&S risk of waste stockpiling of waste on site • Stockpiling of hazardous material • Disposal of waste rock	**High 12**	• Regular monitoring of rehabilitation areas for waste and cleaning up where required • Ensure sufficient receptacles for waste available in Project area and waste management plan	• Provision of waste receptacles and waste management plan will promote proper disposable of materials • Regular monitoring of rehabilitation areas over the life of the Project will ensure it is not polluted with improper waste disposal	All personnel	• PRCP Schedule	• Rehabilitation monitoring	• Rehabilitation monitoring and reporting	**Low 2**	RM1; RM4; RM6; RM8

Risk	Hazards	Potential Impacts	Inherent Risk	Mitigation Measure / Risk Treatment (Proposed Actions)	Justification for Risk Treatment	Responsibility	Resource Requirements	Performance Measures	Reporting and Monitoring Requirements	Residual Risk	Applicable Rehabilitation Milestone
Land Stability & Erosion	PMLU land is degraded and/or is of poorer quality than pre-mine	• Unable to achieve PMLU option • Unable to achieve EA final landform requirements • Poor land function • Low pasture diversity and productivity • Increased risk of erosion and/or faster rates of erosion • Revegetation success impacted • Unable to blend PMLU with surrounding and existing landform • Final landform unsuitable for final land use • Extended water ponding	**High 12**	• Ongoing assessment and monitoring of the stability of landform • Adaptive implementation of PRC Plan and regular monitoring to facilitate early intervention if required • Erosion and sediment control practices to manage soil and landform quality	• Regular monitoring of rehabilitation areas will provide early indicators of failure and allow for adaptive measures • Compliance with requirements of the EA	Contractors (rehabilitation)	• PRCP Schedule • Geotechnical Report • Rehabilitation strategies recommended in the Soil Survey Report	• Rehabilitation monitoring	• Rehabilitation monitoring and reporting	**Low 4**	RM2; RM7; RM8; RM10
	Ground compaction	• Results in unplanned residual voids • Impacts success of long-term vegetation • Good quality soil is eroded • Soil integrity and quality is degraded • Extended water ponding	**Moderate 6**	• Use of reclaimed stockpiled materials to backfill voids • Sufficient time allowed for settlement prior to topsoiling. • Management of temporary stockpiles • Follow soil testing procedure and monitoring metrics	• Regular monitoring of rehabilitation areas to assess quality of soil and provide early indication of significant changes to natural rates of erosion • Proper techniques for storing and maintaining stockpiles of topsoil and subsoil	Environment team; Site personnel; Contractors (rehabilitation)	• Environmental Management Plan • Rehabilitation strategies recommended in the Soil Survey Report	• Rehabilitation monitoring	• Rehabilitation monitoring and reporting	**Low 4**	RM2; RM2; RM7; RM8
	Subsoil and topsoil deficit for rehabilitation activities	• Physical and structural properties substrate • Substrate inadequate to support revegetation or agricultural land capability	**High 12**	• Implement proper storage of stockpile topsoil, subsoil, and other materials deemed relevant for rehabilitation	• Regular monitoring and auditing of stockpile materials to ensure suitability for use in rehabilitation when required	Environment team; Contractors (rehabilitation)	• Management and rehabilitation strategies recommended in the Soil Survey Report	• Rehabilitation monitoring	• Stockpile monitoring and reporting • Adequate auditing of stockpile quality	**Moderate 5**	RM2; RM8; RM8
	Residual voids unstable	• Increased risk of rock falls • Wall integrity of residual voids used for water storage impacted • Unable to meet EA conditions • Unable to have rehabilitated areas signed off for completion • Delayed PRCP Schedule • Increased cost to rehabilitation	**High 12**	• Geotechnical assessment of residual voids • Backfilling Aspinal Pit to avoid residual void	• Rehabilitation strategies for void closure plan promotes the use of mulching and matting to reduce void instability risks	Environment team; Site personnel; Contractors (rehabilitation)	• Void Closure Plan • Geotechnical Report	• Rehabilitation monitoring	• Rehabilitation monitoring and reporting • Investigation and/or review of residual voids by suitably qualified person	**Moderate 6**	RM2;RM7; RM8; RM10
Weeds	Poor weed management	• Proliferation of weeds and declared weed species on site and in surrounding area • Rehabilitation progress and success is delayed and impacted • Establishment of desired species for revegetation are inhibited • Unsuitable grazing pasture due to high risk weeds	**Moderate 8**	• Strict vehicle washdown entering the Project area to limit spread of weeds • Conduct regular weed monitoring programs to allow for early identification of weed communities and allow for early intervention to prevent spread	• Regular monitoring of rehabilitation areas and Project areas (e.g. annual weed monitoring) promotes awareness and vigilance • Prevent the introduction of weed species which may impede on rehabilitation success • Uphold requirements of biosecurity (e.g. for declared weed species)	Environment team; All personnel	• PRCP Schedule • Environmental Management Plan	• Rehabilitation monitoring • <10% weed contribution	• Rehabilitation monitoring and reporting	**Low 4**	RM3; RM4; RM8

Risk	Hazards	Potential Impacts	Inherent Risk	Mitigation Measure / Risk Treatment (Proposed Actions)	Justification for Risk Treatment	Responsibility	Resource Requirements	Performance Measures	Reporting and Monitoring Requirements	Residual Risk	Applicable Rehabilitation Milestone
Services & Infrastructure	Breakdown of communication between contractors to remove/disconnect services and/or infrastructure	• Increase cost to project above quote and/or budget • Flow on effect delaying other aspects of the PRCP schedule and rehabilitation works • Increased cost if new contractors are required • Disconnection and/or removal works take longer than anticipated	**Moderate 6**	• Ensure appropriate contractual agreements are in place and agreed upon/signed prior to the commencement of works	• Contractual agreements are a legal document • Contractors will be obligated to complete works and uphold terms and conditions of contractual agreement to conduct works in a safe and timely manner (as close to schedule as possible)	Project team; Contractors (infrastructure & service)	• Legal advice / Contractual agreements	• Regular review of contracts • Adequate time allocated for meeting with contractors	• Internal reporting and maintenance of contractual agreements	**Low 4**	RM1; RM8
Contamination	Unidentified contamination during decommissioning activities	• Contamination of groundwater, surface water and/or soil • New cost to the project to rectify and manage contamination • Delays rehabilitation works and achievement of milestones	**High 12**	• Ensure all personnel working and/or visiting site receive adequate induction and training/awareness of contamination • Maintain accurate records of incidents with potential to result in contamination (e.g. spills and leaks) • Conduct site investigation and/or remediation as required	• To ensure compliance with legislative requirements of EA and *Environment Protection Act 1994*	All personnel; Environment team	• Environment Management Plan • Incident Reporting System/Record	• Investigation and remediation directed by a suitably qualified person	• Monitoring of incident areas to manage newly identified contamination • Review of documentation	**Moderate 6**	RM1; RM6; RM9
Rehabilitation & Revegetation	Rehabilitation not completed progressively	• Rehabilitation works not completed to schedule • Impact to ability to meet PRCP requirements and planning/schedule • Increased costs due to reduced time to meet rehabilitation deadlines • Unable to revegetate the land suitable for grazing • PRCP schedule is delayed with potential to increase overall cost and liability	**High 12**	• Ongoing review of PRC Plan and Schedule • Regular monitoring of rehabilitation areas and Project areas for any issues that may impact rehabilitation timing • Spreading out rehabilitation throughout mine life with hard deadlines	• Budget allocated for rehabilitation will be a driving factor for the achievement of works to schedule	Environment team; Site personnel; Contractors (rehabilitation)	• PRCP Schedule • Rehabilitation Plan • Rehabilitation monitoring data	• Rehabilitation monitoring • Adequate time allocated for meetings to discuss PRCP Schedule	• Rehabilitation monitoring and reporting	**Moderate 5**	RM1 – RM10
	Incorrect, inappropriate, or unsuitable vegetation species or seed mix used, or poor tubestock used	• Unable to achieve final land use for grazing • Unable to blend landform with surrounding areas • Rehabilitation works delayed • Increased cost for rehabilitation works to remedy unsuitable species • Plants don't establish due to poor quality tubestock and/or poor seed viability and seed dormancy	**High 12**	• Contractual agreement with seed supplier to provide specified seeds required for rehabilitation • Seed mix determined based on Landholder input and commonly used grasses in the area for surrounding grazing land • Conduct revegetation and reseeding works during periods of expected rainfall to provide suitable conditions for growth	• Meet rehabilitation requirements of the EA and *Environment Protection Act 1994* • Meet PMLU required by the Landholder • Budget allocated for rehabilitation sufficient for procuring good quality seed and tubestock, etc.	Project team; Environment team; Site personnel; Contractors (rehabilitation)	• PRCP Schedule • Rehabilitation monitoring • Environment Management Plan • Climate data	• Rehabilitation monitoring	• Rehabilitation monitoring and reporting	**Low 4**	RM3; RM4; RM6; RM8

Risk	Hazards	Potential Impacts	Inherent Risk	Mitigation Measure / Risk Treatment (Proposed Actions)	Justification for Risk Treatment	Responsibility	Resource Requirements	Performance Measures	Reporting and Monitoring Requirements	Residual Risk	Applicable Rehabilitation Milestone
Rehabilitation & Revegetation	Revegetation does not reach a self-sustaining level	• Unable to achieve rehabilitation goals and sign off as certified rehabilitation • Unable to achieve EA conditions and Landholder requirements for the land • Rehabilitation works prolonged and costs increased • Impacted due to insufficient rainfall and/or poor landform stability • Seed damaged during revegetation process and/or insufficient seed stock available • Ant and insect predation • Topsoil and subsoil deficit • Insufficient availability and/or poor quality of target seed resource including genetic integrity	**High 12**	• Decision of seed supplier to be made early in the operational phase for rehabilitation of each RA to ensure sufficient stock available • Regular monitoring and reporting of rehabilitation areas to ensure plants are growing suitably and allows for early identification of any impediment to long-term vegetation success • Manual watering and fertiliser if required (e.g. during dry or drought periods) • Variety of seeds used to allow for greatest opportunity for success • Variety of seeds allow for faster growing species to provide cover and protection of slow establishing seeds from pests and prevent colonisation of weeds	• Meet rehabilitation requirements of the EA and *Environment Protection Act 1994* • Meet PMLU required by the Landholder • Budget allocated for rehabilitation sufficient for procuring good quality seed and tubestock, etc.	Environment team; Site personnel; Contractors (rehabilitation)	• PRCP Schedule • Rehabilitation monitoring • Environment Management Plan	• Rehabilitation monitoring	• Rehabilitation monitoring and reporting • Regular monitoring for weeds to prevent invasion	**Low 4**	RM3; RM4; RM6; RM8
	Stock fence failure	• Intruding livestock destroy and/or compact rehabilitation areas before vegetation has grown to a suitable level to withstand disturbance • Premature grazing impedes rehabilitation efforts • Success and longevity of pasture species inhibited by premature grazing	**Low 4**	• Regular monitoring of rehabilitation areas will ensure any damage or concern regarding stock fences can be addressed quickly • Implement suitable cattle-proof fencing surrounding rehabilitation areas to prevent cattle access (where applicable as rehab areas are surrendered)	• PMLU of rehabilitated areas will be grazing land for use by the Landholder's cattle • Need to provide rehabilitation areas time to establish strong communities to withstand future grazing	Environment team; Site personnel	• PRCP Schedule • Environmental Management Plan	• Rehabilitation monitoring	• Rehabilitation monitoring and reporting • Monitoring of fence infrastructure (where required)	**Very Low 1**	RM6; RM8
Water	Impacts to aquifers and groundwater loss to water users including the environment	• Surrounding groundwater users will have supply and/or access impacted • Water quality is lowered • EV and WQO are affected	**Moderate 6**	• Implement monitoring techniques in Water Management Plan • Regular monitoring of rehabilitation areas will ensure occurrence and level of impact is mitigated	• Determined low transmissivity to groundwater and aquifers on Project area due to limestone environment	Environment team; Site personnel; Contractors	• PRCP Schedule • Water Management Plan	• Rehabilitation monitoring • Water quality monitoring	• Rehabilitation monitoring and reporting • Water management monitoring and reporting	**Low 4**	RM2; RM5; RM7; RM8
	Redirection of creek and river flows	• Fluvial networks surrounding the Project area are altered affecting hydrology of surrounding Project area	**Low 4**	• Regular monitoring of rehabilitation areas ensure occurrence or redirection is limited • Monitoring for redirection will protect against water erosion and severe gully formation near pits and bunds	• Maintenance of bunds and water management structures on site will ensure surface flows on site are contained and do not affect or interact with waters and fluvial networks outside of the Project area	Environment team; Site personnel; Contractors	• PRCP Schedule • Water Management Plan	• Rehabilitation monitoring • Water quality monitoring	• Rehabilitation monitoring and reporting • Water management monitoring and reporting	**Very Low 1**	RM2; RM5; RM7; RM8; RM10

Risk	Hazards	Potential Impacts	Inherent Risk	Mitigation Measure / Risk Treatment (Proposed Actions)	Justification for Risk Treatment	Responsibility	Resource Requirements	Performance Measures	Reporting and Monitoring Requirements	Residual Risk	Applicable Rehabilitation Milestone
Monitoring & Maintenance	Failure to implement program	• PRCP and Rehabilitation goals and milestones are not met • Land is not rehabilitated to planned and/or required state • Unable to surrender land as scheduled in the PRC Plan • Land is not analogous to surrounding land uses • Land does not meet EA final land use conditions	**Extreme 15**	• Regular monitoring of rehabilitation areas • Periodic regular meetings with relevant teams and personnel to ensure plan is progressing accordingly and rectify any issues raised • Multiple layers of accountability with Site management, consultants and department officers.	• Regular monitoring of rehabilitation areas allows for early intervention in the event rehabilitation methods are not implemented correctly or to plan, or amend poor performance	Project team; Environmental team; Site personnel; Contractors	• PRCP Schedule • Adequate time allocated for meetings	• Regular reviews and meetings • Active communication throughout PRCP schedule and rehabilitation works	• Rehabilitation monitoring and reporting • Throughout PRCP Schedule	**Low 4**	RM1 – RM10
	Unsuccessful rehabilitation	• PRCP and Rehabilitation goals and milestones are not met • Land cannot be surrendered as scheduled • Achievement of rehabilitation goals are delayed and prolonged • Increased financial burden to Project • Increased liability to Project • Unable to uphold Landholder agreement and/or EA conditions to surrender land in agreed condition	**Extreme 15**	• Regular monitoring of rehabilitation areas allows for early intervention in the event rehabilitation methods are not implemented correctly or to plan, or amend poor performance	• Regular monitoring of rehabilitation areas allows for early intervention in the event rehabilitation methods are not implemented correctly or to plan, or amend poor performance	Project team; Environmental team; Site personnel; Contractors	• PRCP Schedule • Adequate time allocated for meetings	• Regular reviews and meetings • Active communication throughout PRCP schedule and rehabilitation works	• Rehabilitation monitoring and reporting • Throughout PRCP Schedule	**Low 4**	RM1 – RM10

8 Monitoring and Maintenance

PRCP Guideline (section 3.8)

In accordance with section 126C(1)(j) of the EP Act, the administering authority considers monitoring and maintenance necessary to decide if the PRC plan is consistent with the requirements of the legislation. The rehabilitation planning part must contain a monitoring and maintenance program that identifies and describes the monitoring systems that will be carried out in order to demonstrate a milestone and milestone criteria have been achieved. the program must include, where relevant to the milestone and milestone criteria (but is not limited to):

- schedule of monitoring, reporting and review for each milestone
- description of methodologies and standards, which could include field-based assessments and the application of new remote sensing, GIS and other relevant emerging technologies
- monitoring that enables the repeatable collection of relevant statistically valid data
- monitoring using appropriate assurance and data management processes and systems
- regular analysis of site data including multi-year comparison trends and bench-marking against analogue/reference sites
- contingency strategies if monitoring data indicates milestone criteria are not being met
- post-closure monitoring to ensure milestone criteria has been demonstrated
- intent of monitoring reports, such as provision of results and key findings

Applicability to Transitional PRC plans

The information requirements in this section will apply to all applicants whether or not they are an existing EA holder. However, existing holders may already have the required information available from previously submitted plans/reports/applications that, if still valid, could be used in the PRC plan. If there has/is any monitoring or maintenance of areas already rehabilitated, details must be included in the PRC plan.

8.1 Milestone Monitoring

To demonstrate the achievement of rehabilitation milestones, as they relate to achieving nominated PMLUs of grazing and water storage, analogue sites will be used as benchmarks for safe and stable conditions to determine rehabilitation success.

8.1.1 Analogue Sites and PMLU Monitoring

Although monitoring of analogue (or reference) sites is not a requirement of the current EA, five (5) analogue sites have been selected as being representative of marginal grazing in areas surrounding Warwick Limestone. Coordinates of analogue sites are provided in **Appendix 9** (refer to plan titled '*Terrequip Warwick Limestone Mine Rehabilitation Areas & Analogue Sites*').

Areas assigned grazing PMLU will be assessed against:

- pasture condition assessment based on standard methods and industry guidelines[31]; and
- land suitability assessment based on the Guidelines for Agricultural Land Evaluation in Queensland[32].

Similarly, areas assigned water storage PMLU will be assessed against:

[31] Future Beef. (2017, 12 June). *Stocktake: balancing supply and demand* (reviewed 5 July 2022). https://futurebeef.com.au/stocktake-balancing-supply-demand/
[32] DSITI & DNRM. (2015, December). *Guidelines for Agricultural Land Evaluation in Queensland* (2nd Ed). Queensland Government, Brisbane.

- void geometry requirements prescribed in the EA (Schedule F – Table 7); and
- assessment of land capability / suitability classification.

8.1.2 Selection of Analogue Sites

Five (5) analogue sites have been selected for benchmarking completion criteria of rehabilitation areas (Refer Appendix 9 – Plan WLM012). The selection of these areas are based on the following:

- area is representative of marginal grazing land use in the surrounding area;
- located within areas of similar soils to rehabilitation areas; and
- within or near areas that have had soil assessments.

These analogue sites will also be used in BioCondition Assessments (**Section 8.3.3**) of rehabilitation areas using appropriate attributes (e.g. for grasslands)[33]. Assessable attributes may include, but are not limited to:

- non-native plant cover;
- native perennial grass cover (%)
- litter cover;
- size of patch;
- context; and
- connectivity or distance to artificial water.

8.1.3 Grazing PMLU Monitoring

Monitoring of grazing PMLUs is proposed to be undertaken by site personnel at regular intervals (minimum 6-month periods) until specific site criteria are met and a stable and safe condition is achieved.

The following information will be collected as part of the monitoring program:

- photo images of existing and new rehabilitation areas (RAs) for comparison with surrounding areas of similar land use;
- records of treatments used for each new RA including seeding rate, soil treatment, and topsoil source;
- summary of plant species within RAs including cover percentage and species diversity;
- presence and abundance of weed species;
- soil testing program for each uniform RA (testing >1 sample locations per 6ha, and >3 sample locations per RA) – samples taken at max. 100mm increments and depth no less than topsoil capping depth;
- soil testing conducted by NATA accredited laboratory for pH, ESP, ECse and OC;
- summary of any fauna re-settling;
- landform monitoring (slope angle, contour bank spacing, waterways, presence/absence of severe rill or gully erosion); and

[33] Treeless or non-woody species dominant ecosystems (e.g. grasslands) cannot suitably be assessed against woody-type BioCondition attributes. Woody-type attributes should therefore be discounted from final assessment scores where these attributes are naturally absent. Queensland Herbarium BioCondition Assessment Manual.

- summary of poor rehabilitation activities, maintenance applied and/or proposed for each affected RA.

Rehabilitation monitoring will also be conducted by an appropriately qualified and experienced person(s) at regular intervals depending on the RA and its progress in relation to the PRCP schedule. It is anticipated yearly monitoring will be required in initial stages of rehabilitation. New RAs will be added as they become available and is dependent on establishment success. This form of AQP monitoring will continue until all rehabilitation activities achieve relevant completion criteria and reach a safe and stable condition, and until the surrender of the Warwick Limestone mining tenements.

The monitoring and maintenance plan for grazing PMLUs is summarised in **Table 33**.

Table 33: Grazing PMLU monitoring and maintenance plan

Monitoring item	1 to 3 months after planting	3 to 24 months after planting
Weed Control	• Monthly check for weeds • Control via removal by hand, spot spraying • Take care not to damage planted and re-generating native species including grasses and forbs	• Monthly check or weeds • Control as required as per methods used in monitoring between 1 to 3 months after planting
Watering	• Water each seedling with a minimum of 5-10L of water weekly, especially during the first month • Depending on prevailing weather conditions, water to continue monthly as required until seedlings have established (in approx. 3-6 months)	• Continue watering seedlings as required as per methods used in monitoring between 1 to 2 months after planting • Frequency dependent on prevailing weather conditions
General Site Maintenance	• Remove waste dumped on site • Monitor for signs of erosion	• Remove waste dumped on site • Monitor for signs of erosion
Replacement Planting	• Replace dead or senescent plants as per methods described in the Rehabilitation Methodology of this PRC Plan	• Replace dead or senescent plants as per methods described in the Rehabilitation Methodology of this PRC Plan
Monitoring	• Conduct frequent and regular monitoring • Take photographic records of reference points	• Conduct frequent and regular monitoring • Take photographic records of reference points
Mulching	• Replace as required on site	• Replace mulch as required • If mulch is depleted and weeds are present, replace mulch in affected area with course forest mulch or sugar care mulch to a depth of 100mm and diameter of 1m • Ensure weed preventing mulch does not come in contact with native species

8.1.4 Water Storage PMLU Monitoring

Monitoring of water storage PMLUs is proposed to be undertaken by stie personnel at regular intervals (minimum 6-month periods) until specific site criteria are met and a stable and safe condition is achieved.

The following information will be collected as part of the monitoring program:

- photo images of existing and new rehabilitation areas (RAs) for comparison with surrounding areas of similar land use;
- records of treatments and/or works applied for each new RA including, but not limited to backfilling, re-profiling, geotechnical and/or safety inspections;
- all requirements approved and prescribed in the Site Water Management Plan;
- landform monitoring (slope, angle, contour bank spacing, waterways, presence/absence of severe rill or gully erosion); and
- summary of poor rehabilitation activities, maintenance applied and/or proposed for each affected RA.

Rehabilitation monitoring will also be conducted by an appropriately qualified and experienced person(s) at regular intervals depending on the RA and its progress in relation to the PRCP schedule. It is anticipated yearly monitoring will be required in initial stages of rehabilitation. New RAs will be added as they become available and is dependent on establishment success. This form of AQP monitoring will continue until all rehabilitation activities achieve relevant completion criteria and reach a safe and stable condition, and until the surrender of the Warwick Limestone mining tenements.

8.2 Maintenance

Maintenance will be engaged if rehabilitation issues are identified during monitoring, or if milestone criteria are not being met. Determination of the most appropriate remedial action will be based on the likely cause of the issue. For example, these may be due to, but are not limited to:

- climate conditions (e.g. droughts, prolonged wet seasons);
- weed infestation;
- poor drainage design;
- insufficient vegetation cover;
- influence from adjacent land use(s); and/or
- soil type and/or soil deficiencies.

8.3 Data Analysis and Reporting

Rehabilitation monitoring data will be collected and analysed by an appropriately qualified and experienced person(s). The aim of data analysis and reporting will be to identify changes and trends to identify if rehabilitation progress in on schedule to meeting milestones or identify if remedial and/or maintenance works are required.

Rehabilitation monitoring data will be collected and managed by Terrequip and/or their nominated environmental manager(s).

8.3.1 Annual Reporting

Annual rehabilitation reports will be provided to the administering authority with the submission of each annual return. This report will provide qualitative data comprising of photographic records of previous and current rehabilitation works in planned RAs.

The annual rehabilitation report will include the following details:

- summary description of visual monitoring for severe rill and/or gully erosion within the first 12-months after seeding and heavy rain events;
- photographic records of the works undertaken to establish new rehabilitation areas;
- photographic records of the new rehabilitation areas from permanent reference points
- summary record of rehabilitation treatments including seeding rates, soil treatment, topsoil source
- a summary description of any failure of rehabilitation works and maintenance conducted or proposed to be conducted for these areas; and
- assessment of existing rehabilitation areas against their milestone criteria to determine if steps to achieve progressive rehabilitation certification should commence.

8.3.2 BioCondition Assessment Method

Warwick Limestone will implement an annual rehabilitation inspection to evaluate the success and progress of rehabilitation works in accordance with the submission of annual rehabilitation reports with each annual return. The scope of inspection includes all existing and recently completed rehabilitation across the site.

The BioCondition Assessment Framework[34] will be used to assess ecosystem condition in addition to assessing rehabilitation against completion criteria. A BioCondition Assessment is a site-based and quantitative assessment that can be used in any vegetation state and is therefore repeatable. Annual inspections will allow for easy and comparable assessment to be made between inspection years, allowing rehabilitation to be monitored and adapted where required.

The BioCondition Assessment Framework aims to provide simple, robust and easy to follow monitoring program for rehabilitation to marginal grazing land. Using the BioCondition Assessment in rehabilitation monitoring rehabilitation is useful for tracking progress, mitigate issues and allowing adaptation of rehabilitation methods to reduce and/or prevent risk of failure. The primary goal of rehabilitation is to create an environment that is safe, stable, and able to sustain an ecosystem condition that is similar to that existing pre-mining.

8.3.3 BioCondition Assessment for Rehabilitated Areas

The BioCondition Assessment Method will be used to evaluate rehabilitated areas. The assessment unit will consist of a 100m x 10m plot along which established photo monitoring points will be used to track the progress of rehabilitation at a designated point along the transect. Along a 100m transect the relevant indicators will be

[34] Office of the Queensland Mine Rehabilitation Commissioner (March 2023): Evaluating Methods For Assessing Native Ecosystem Mine Rehabilitation Success (Technical Paper).

recorded per the BioCondition Assessment Manual[35] (the manual) and each attribute will be scored according to manual descriptions with corresponding weightings (assigned as a percentage). Field assessment techniques are further outlined in the manual.

8.3.4 Field Sheets

Completed field sheets and photographs (taken at established photo monitoring points) will be filed for each BioCondition Assessment. Record keeping this information will be useful for informing future reports that must be prepared in order to surrender the EA and reclaim financial assurance. Information gathered from previous BioCondition Assessments will form useful lesson learned and can be used to inform future rehabilitation efforts.

In the event any issues are identified during or following a BioCondition assessment, Warwick Limestone will engage a suitably qualified and experienced person to assist in rectifying and managing the rehabilitation issue. The engagement of the a suitably qualified and experienced person will be dependent on the type of expertise required to mitigate the rehabilitation issue.

8.4 Quality Assurance and Quality Control

Figure 26 illustrates the quality assurance and quality control (QA/QC) process to be followed as part of ongoing rehabilitation monitoring at Warwick Limestone. The process allows for:

- initial execution of rehabilitation in accordance with rehabilitation measures
- verification of how the execution was conducted in accordance with rehabilitation measures
- if required, the implementation of corrective action/maintenance in rehabilitation areas; and
- further rehabilitation monitoring of rehabilitation and corrected/maintained areas.

The QA/QC process allows for repetition for an execution/verification/monitoring approach to ensure rehabilitation areas continue to progress towards achieving rehabilitation milestones and future certification.

[35] Queensland Herbarium, Science Delivery (February 2015): BioCondition Assessment Manual.

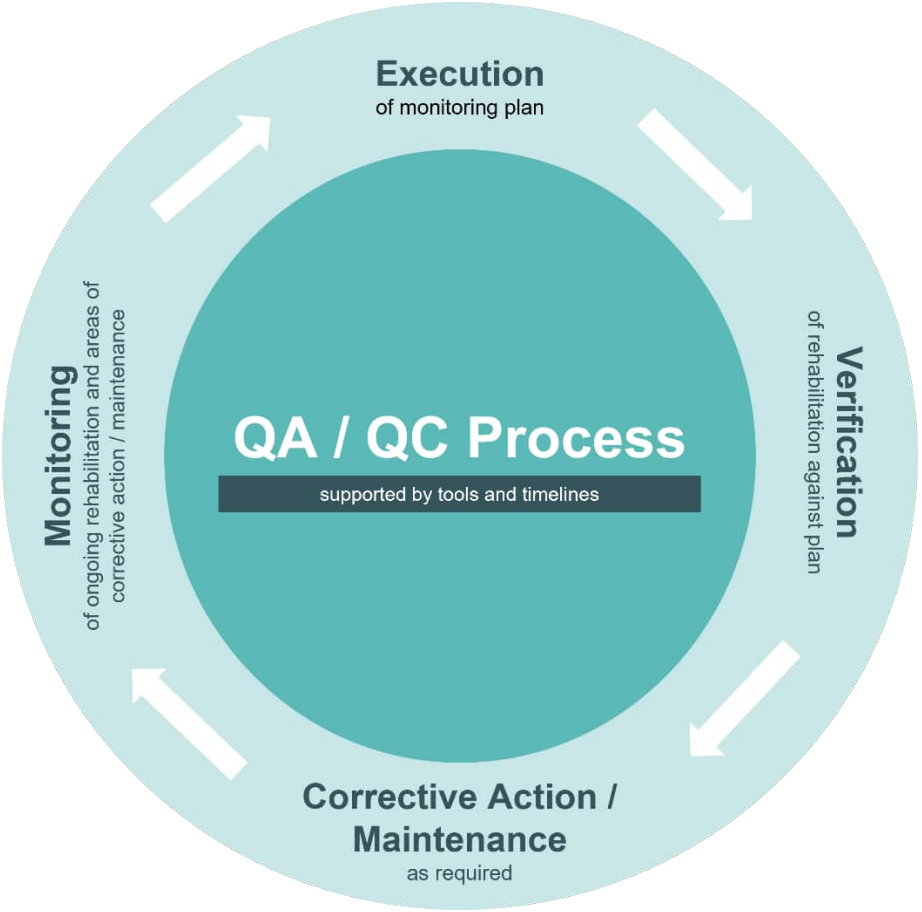


Figure 26: Quality assurance and quality control processes to be followed to support ongoing rehabilitation monitoring at Warwick Limestone

PART B: PRCP SCHEDULE

9 PRCP Schedule

Legislative Requirement

In accordance with sections 126D(1) of the EP Act, the PRCP schedule in the PRC plan must:

a) describe the area of each resource tenure either a post-mining land use or non-use management area, and
b) for each post-mining land use state:
   i. each rehabilitation milestone required to achieve a stable condition, and
   ii. when each rehabilitation milestone is to be achieved, and
c) for each non-use management area state:
   i. each management milestone required to achieve a stable condition, and
   ii. when each management milestone is to be achieved, and
d) include maps showing the land mentioned in (a), (b) and (c).

Post-mining land uses (PMLU)										
Rehabilitation area	RA1									
Relevant activities	Infrastructure									
Total rehabilitation area size (ha)	2.39									
Commencement of first milestone: RM1	2037									
PMLU	Grazing									
Date area is available	10/12/2037	10/12/2041								
Cumulative area available (ha)	2.39	2.39								
Milestone completed by	10/12/2041	10/12/2042								
Milestone Reference	Cumulative area achieved (ha)									
RM1	2.39									
RM2	2.39									
RM3	2.39									
RM4	2.39									
RM5	2.39									
RM8		2.39								

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA2									
Relevant activities	Topsoil Stockpiles									
Total rehabilitation area size (ha)	6.00									
Commencement of first milestone: RM2	2022									
PMLU	Grazing									
Date area is available	10/12/2022	10/12/2030	10/12/2036	10/12/2041						
Cumulative area available (ha)	0.33	0.33	6.00	6.00						
Milestone completed by	10/12/2030	10/12/2036	10/12/2041	10/12/2042						
Milestone Reference	Cumulative area achieved (ha)									
RM2	0.33		6.00							
RM3	0.33		6.00							
RM4	0.33		6.00							
RM5	0.33		6.00							
RM8		0.33		6.00						

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA3									
Relevant activities	ROM and Product Stockpiles									
Total rehabilitation area size (ha)	8.39									
Commencement of first milestone: RM2	2022									
PMLU	Grazing									
Date area is available	10/12/2022	10/12/2030	10/12/2037	10/12/2041						
Cumulative area available (ha)	0.92	0.92	8.39	8.39						
Milestone completed by	10/12/2030	10/12/2037	10/12/2041	10/12/2042						
Milestone Reference	**Cumulative area achieved (ha)**									
RM1			8.39							
RM2	0.92		8.39							
RM3	0.92		8.39							
RM4	0.92		8.39							
RM5	0.92		8.39							
RM8		0.92		8.39						

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
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3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA4									
Relevant activities	Waste and Overbuden Dumps									
Total rehabilitation area size (ha)	12.92									
Commencement of first milestone: RM2	2024									
PMLU	Grazing									
Date area is available	10/12/2024	10/12/2026	10/12/2028	10/12/2030	10/12/2036	10/12/2041				
Cumulative area available (ha)	1.43	2.89	4.19	8.89	12.92	12.92				
Milestone completed by	10/12/2026	10/12/2028	10/12/2030	10/12/2036	10/12/2041	10/12/2042				
Milestone Reference	Cumulative area achieved (ha)									
RM2	1.43	2.89	4.19	8.89	12.92					
RM3			1.43	8.89	12.92					
RM4			1.43	8.89	12.92					
RM5			1.43	1.43	12.92					
RM8				1.43	8.89					
RM9						12.92				
RM11						12.92				

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
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3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA5									
Relevant activities	Roads and Tracks									
Total rehabilitation area size (ha)	5.63									
Commencement of first milestone: RM2	2040									
PMLU	Road									
Date area is available	10/12/2040	10/12/2041								
Cumulative area available (ha)	5.63	5.63								
Milestone completed by	10/12/2041	10/12/2042								
Milestone Reference	Cumulative area achieved (ha)									
RM2	5.63									
RM11		5.63								

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA6									
Relevant activities	Sediment Dams and Stormwater Controls									
Total rehabilitation area size (ha)	5.59									
Commencement of first milestone: RM2	2022									
PMLU	Water Storage									
Date area is available	10/12/2022	10/12/2030	10/12/2036	10/12/2041						
Cumulative area available (ha)	0.01	0.01	5.59	5.59						
Milestone completed by	10/12/2030	10/12/2036	10/12/2041	10/12/2042						
Milestone Reference	Cumulative area achieved (ha)									
RM2	0.01		5.59							
RM6		0.1		5.59						
RM9		0.1		5.59						

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
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4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA7									
Relevant activities	Eastern Open Pit (Backfill to RL 524)									
Total rehabilitation area size (ha)	0.77									
Commencement of first milestone: RM5	2022									
PMLU	Water Storage									
Date area is available	10/12/2022	10/12/2030								
Cumulative area available (ha)	0.77	0.77								
Milestone completed by	10/12/2030	10/12/2031								
Milestone Reference	Cumulative area achieved (ha)									
RM2	0.77									
RM6	0.77									
RM7		0.77								
RM10		0.77								
RM11		0.77								

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
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4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area				RA8						
Relevant activities				Main Pit Voids (East-West Pit; Phoenix Pit)						
Total rehabilitation area size (ha)				18.73						
Commencement of first milestone: RM1				2027						
PMLU				Water Storage						
Date area is available	10/12/2027	10/12/2030	10/12/2036	10/12/2041						
Cumulative area available (ha)	16.74	16.74	18.73	18.73						
Milestone completed by	10/12/2030	10/12/2036	10/12/2041	10/12/2042						
Milestone Reference	**Cumulative area achieved (ha)**									
RM1	16.74		18.73							
RM2	16.74		18.73							
RM3	0.64									
RM4	0.64									
RM6	16.74		18.73							
RM7	16.74		18.73							
RM9		16.74		18.73						
RM11				18.73						

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
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3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA9									
Relevant activities	Main Pit Voids (Aspinal Pit)									
Total rehabilitation area size (ha)	1.26									
Commencement of first milestone: RM5	2022									
PMLU	Grazing									
Date area is available	10/12/2022	10/12/2037	10/12/2041							
Cumulative area available (ha)	1.26	1.26	1.26							
Milestone completed by	10/12/2037	10/12/2041	10/12/2042							
Milestone Reference	**Cumulative area achieved (ha)**									
RM2	1.26									
RM3	1.26									
RM4	1.26									
RM5		1.26								
RM7		1.26								
RM8			1.26							
RM11			1.26							

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

Post-mining land uses (PMLU)										
Rehabilitation area	RA10									
Relevant activities	Existing Rehabilitation									
Total rehabilitation area size (ha)	9.31									
Commencement of first milestone: RM2	2022									
PMLU	Grazing									
Date area is available	10/12/2022	10/12/2030								
Cumulative area available (ha)	9.31	9.31								
Milestone completed by	10/12/2030	10/12/2031								
Milestone Reference	Cumulative area achieved (ha)									
RM2	9.31									
RM3	9.31									
RM4	9.31									
RM5	9.31									
RM8		9.31								

1) Insert new columns to the yellow table to include further rehabilitation milestone dates.
2) Insert new columns to the blue table to match rehabilitation milestone dates.
3) Insert new rows to the blue table to include additional rehabilitation milestone references.
4) Insert the relevant number in the "Milestone reference" column (i.e. RM1).

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APPENDICES

Appendix 1 Warwick Limestone Environmental Authority (EMPL00136213) (5 April 2019)

Appendix 2 Horizon Soil Science and Engineering (16 September 2022): Report on the Soil Survey Leases of the Warwick Limestone Quarry Rev 1.0

Appendix 3 Epic Environmental Pty Ltd (17 November 2020): Environmental Management Plan – Warwick Limestone Mine

Appendix 4 Rocktest Rock Engineering Consultants (5 June 2019): Warwick Limestone Mine Geothechnical Risk Assessment and Management for Sibelco Version 1.0

Appendix 5 Epic Environmental Pty Ltd (20 November 2020): Water Management Plan – Warwick Limestone Mine

Appendix 6 Australian Laboratory Services Pty Ltd (19 May 2020): Material Testing Certificate of Analysis Ref BR20104442

Appendix 7 Landholder Agreements

Appendix 8 BAAM Ecological Consultants: Rehabilitation Plan for the Warwick Mining Leases Areas

Appendix 9 Plans and Maps

Appendix 1

Warwick Limestone Environmental Authority (EMPL00136213) (5 April 2019)

Permit

Environmental Protection Act 1994

Environmental authority EPML00136213

This environmental authority is issued by the administering authority under Chapter 5 of the Environmental Protection Act 1994.

Environmental authority number: EPML00136213

Environmental authority takes effect on 05 April 2019

Environmental authority holder(s)

Name(s)	Registered address
SIBELCO AUSTRALIA LIMITED	Level 16 111 Pacific Highway NORTH SYDNEY NSW 2060

Environmentally relevant activity and location details

Environmentally relevant activity/activities	Location(s)
Resource Activity, Schedule 2A, 21: A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20	ML50237
Resource Activity, Schedule 2A, 21: A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20	ML50239
Resource Activity, Schedule 2A, 21: A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20	ML50238
Resource Activity, Schedule 2A, 21: A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20	ML50236
Prescribed ERA, ERA 16 - Extraction and Screening, 2: Extracting, other than by dredging, in a year, the following quantity of material, (b) more than 100,000t but not more than 1,000,000t	Lot 178/M34534
Prescribed ERA, ERA 16 - Extraction and Screening, 2: Extracting, other than by dredging, in a year, the following quantity of material, (b) more than 100,000t but not more than 1,000,000t	Lot 106/ML623
Prescribed ERA, ERA 16 - Extraction and Screening, 2: Extracting, other than by dredging, in a year, the following quantity of material, (b) more than 100,000t but not more than 1,000,000t	Lot 2/RP36822

ABN 46 640 294 485

Queensland Government

Environmentally relevant activity/activities	Location(s)
Prescribed ERA, ERA 16 - Extraction and Screening, 2: Extracting, other than by dredging, in a year, the following quantity of material, (b) more than 100,000t but not more than 1,000,000t	Lot 1291/M34534
Prescribed ERA, ERA 16 - Extraction and Screening, 2: Extracting, other than by dredging, in a year, the following quantity of material, (b) more than 100,000t but not more than 1,000,000t	Lot 5/SP236094
Prescribed ERA, ERA 16 - Extraction and Screening, 2: Extracting, other than by dredging, in a year, the following quantity of material, (b) more than 100,000t but not more than 1,000,000t	Lot 1219/M34519
Prescribed ERA, ERA 16 - Extraction and Screening, 3: Screening, in a year, the following quantity of material, (b) more than 100,000t but not more than 1,000,000t	Lot 5/SP236094
Prescribed ERA, ERA 16 - Extraction and Screening, 3: Screening, in a year, the following quantity of material, (b) more than 100,000t but not more than 1,000,000t	Lot 1219/M34519
Resource Activity, Schedule 2A, 21: A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20	ML50083
Resource Activity, Schedule 2A, 21: A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20	ML50146

Additional information for applicants

Environmentally relevant activities

The description of any environmentally relevant activity (ERA) for which an environmental authority (EA) is issued is a restatement of the ERA as defined by legislation at the time the EA is issued. Where there is any inconsistency between that description of an ERA and the conditions stated by an EA as to the scale, intensity or manner of carrying out an ERA, the conditions prevail to the extent of the inconsistency.

An EA authorises the carrying out of an ERA and does not authorise any environmental harm unless a condition stated by the EA specifically authorises environmental harm.

A person carrying out an ERA must also be a registered suitable operator under the Environmental Protection Act 1994 (EP Act).

Contaminated land

It is a requirement of the EP Act that an owner or occupier of contaminated land give written notice to the administering authority if they become aware of the following:

ABN 46 640 294 485

- the happening of an event involving a hazardous contaminant on the contaminated land (notice must be given within 24 hours); or
- a change in the condition of the contaminated land (notice must be given within 24 hours); or
- a notifiable activity (as defined in Schedule 3) having been carried out, or is being carried out, on the contaminated land (notice must be given within 20 business days);

that is causing, or is reasonably likely to cause, serious or material environmental harm.

For further information, including the form for giving written notice, refer to the Queensland Government website www.qld.gov.au, using the search term 'duty to notify'.

Take effect

Please note that, in accordance with section 200 of the EP Act, an EA has effect:

a) if the authority is for a prescribed ERA and it states that it takes effect on the day nominated by the holder of the authority in a written notice given to the administering authority-on the nominated day; or
b) if the authority states a day or an event for it to take effect-on the stated day or when the stated event happens; or
c) otherwise-on the day the authority is issued.

However, if the EA is authorising an activity that requires an additional authorisation (a relevant tenure for a resource activity, a development permit under the Planning Act 2016 or an SDA Approval under the State Development and Public Works Organisation Act 1971), this EA will not take effect until the additional authorisation has taken effect.

If this EA takes effect when the additional authorisation takes effect, you must provide the administering authority written notice within 5 business days of receiving notification of the related additional authorisation taking effect.

If you have incorrectly claimed that an additional authorisation is not required, carrying out the ERA without the additional authorisation is not legal and could result in your prosecution for providing false or misleading information or operating without a valid environmental authority.

Filiz Tansley
Department of Environment and Science
Delegate of the administering authority
Environmental Protection Act 1994

Date issued: 05 April 2019

Enquiries:
Minerals Business Centre
Department of Environment and Science
Phone: 07 4222 5352
Email: ESCairns@des.qld.gov.au

Obligations under the Environmental Protection Act 1994

In addition to the requirements found in the conditions of this environmental authority, the holder must also meet their obligations under the EP Act, and the regulations made under the EP Act. For example, the holder must comply with the following provisions of the Act:

- general environmental duty (section 319)
- duty to notify environmental harm (section 320-320G)
- offence of causing serious or material environmental harm (sections 437-439)
- offence of causing environmental nuisance (section 440)
- offence of depositing prescribed water contaminants in waters and related matters (section 440ZG)
- offence to place contaminant where environmental harm or nuisance may be caused (section 443)

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This approval incorporates the following Schedules:

- Schedule A – General
- Schedule B – Air
- Schedule C – Water
- Schedule D – Noise and Vibration
- Schedule E – Waste
- Schedule F – Land
- Schedule G – Community
- Schedule H – Definitions

Agency interest: Special Condition

S1 **Scale of the activity:** The activities associated with this approval on Lot 1219 Plan M34519 are to be conducted only within the land identified as "quarry pit footprint" in Figure - ERA 16 Sibelco Warwick (Regional Ecosystems) dated 2013/02/12 (Attachment 1) and within the co-ordinates identified on this figure and listed below.

GPS Quarry pit footprint	Easting	Northing	Datum	Zone
Point 1	413534	6858367	GDA 94	MGA Zone 56
Point 2	413467	6858428		
Point 3	413477	6858492		
Point 4	413574	6858580		
Point 5	413653	6858584		
Point 6	413763	6858508		
Point 7	413700	6858437		
Point 8	413623	6858453		

Note: For Lot 5 *Plan SP236094 this permit allows the extraction and processing* of *limestone as aggregate within the land bounded by two mining leases (ML 50236 and ML 50239).*

Schedule A – General

A1 **Definitions:** Words and phrases used throughout this EA are defined in Schedule H - Definitions. Where a definition for a term used in this EA is sought and the term is not defined within this EA, the definitions in the Environmental Protection Act 1994, its Regulations and Environmental Protection Policies must be used.

A2 **Financial assurance**: Provide a financial assurance in the amount and form required by the administering authority prior to the commencement of activities proposed under this environmental authority.

NOTE: The calculation of financial assurance for condition (A2) must be in accordance with Guideline 17 and may include a performance discount. The amount is defined as the maximum total rehabilitation cost for complete rehabilitation of all disturbed areas, which may vary on an annual basis due to progressive rehabilitation. The amount required for the financial assurance must be the highest Total Rehabilitation Cost calculated for any year of the Plan of Operations and calculated using the formula: (Financial Assurance = Highest Total Annual Rehabilitation Cost x Percentage Required)

A3 The financial assurance is to remain in force until the administering authority is satisfied that no claim on the assurance is likely.

NOTE: Where progressive rehabilitation is completed and acceptable to the administering authority, progressive reductions to the amount of financial assurance will be applicable where rehabilitation has been completed in accordance with the acceptance criteria defined within this environmental authority.

A4 **Maintenance of measures, plant and equipment:**

The environmental authority holder must ensure:

- That all measures, plant and equipment necessary to ensure compliance with the conditions of this environmental authority are installed;
- That such measures, plant and equipment are maintained in a proper condition; and
- That such measures, plant and equipment and operated in a proper manner.

A5 **Monitoring:** Record, compile and keep for a minimum of five years all monitoring results required by this environmental authority and make available for inspection all or any of these records upon request by the administering authority.

A6 Where monitoring is a requirement of this approval, ensure that a competent person(s) conducts all monitoring.

A7 **Storage and handling of flammable and combustible liquids:** Spillage of all flammable and combustible liquids must be contained within an on-site containment system and controlled in a manner that prevents environmental harm (other than trivial harm) and maintained in accordance with Section 5.9 of AS 1940 - Storage and Handling of Flammable and Combustible Liquids of 2004.

A8 The base and walls of all bunded areas must be constructed with a material impervious to its contents and be maintained free from gaps or cracks that may result in the loss of containment.

Schedule B - Air

B1 **Dust nuisance:** Subject to Conditions (B2) and (B3) the release of dust or particulate matter or both resulting from the activity must not cause an environmental nuisance, at any sensitive or commercial place.

B2 When requested by the administering authority, dust and particulate monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive or commercial place, and the results must be notified within 14 days to the administering authority following completion of monitoring.

B3 If the holder can provide evidence through monitoring that the following limits are not being exceeded then the holder is not in breach of (B1):

(a) Dust deposition of 120 milligrams per square meter per day, averaged over one month, when monitored in accordance with AS 3580.10.1 Methods for sampling and analysis of ambient air - Determination of particulate matter - Deposited matter - Gravimetric method of 2003; and/or

(b) A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometer (µm) (PM10) suspended in the atmosphere of 150 micrograms per cubic meter over a 24 hour averaging time, at a sensitive place down wind of the

operational land, when monitored in accordance with:

- Particulate matter - Determination of suspended particulate PM10 high-volume sampler with size-selective inlet - Gravimetric method, when monitored in accordance with AS 3580.9.6 Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - PM (sub) 10 high volume sampler with size-selective inlet - Gravimetric method of 2003; or
- Any alternative method of sampling PM 10 which may be permitted by the 'Air Quality Sampling Manual' as published from time to time by the administering authority.

NOTE: You must propose which monitoring method is appropriate in accordance with condition (B3) (a) or (b) or both.

B4 If monitoring indicates exceedance of the relevant limits in Condition (B3), then the environmental authority holder must:

(a) Address the complaint including the use of appropriate dispute resolution if required; or
(b) Immediately implement dust abatement measures so the emissions of dust from the activity do not result in further environmental nuisance.

B5 Dust emissions from activities must be suppressed by the use of water or by any other suitable manner to prevent a dust nuisance at a sensitive place.

B6 All reasonable and practicable measures must be taken to ensure effective dust suppression equipment is installed and maintained at any potential source of dust on the processing plant.

B7 Temporary roads used for material haulage must be watered or treated in any other suitable manner, to minimise wind-blown and/or traffic generated dust.

B8 Rehabilitation must be carried out in such a manner as to minimise releases of wind-blown dust and erosion.

B9 **Odour Nuisance:** The release of noxious or offensive odour(s) or any other noxious or offensive airborne contaminant(s) resulting from the activity must not cause an environmental nuisance at any sensitive or commercial place.

Schedule C - Water

C1 **Release to waters**:

(a) **With respect to ERA 16-(2c) Extractive, 16-(2b) Extractive, 16-(3b) Screening:** Contaminants must not be released from the boundary to any waters or the bed banks of any waters other than authorised by this schedule.

(b) **With respect to Schedule 2A 21 Mining Activities:** Contaminants must not be released from the boundary of the mining lease(s) to any waters or the bed and banks of any waters other than authorised by this schedule.

C2

(a) **With respect to ERA 16-(2c) Extractive, 16-(2b) Extractive, 16-(3b) Screening:** Not withstanding condition C1(a), in the event of a significant rainfall event (i.e. a 1:10 year rainfall event) that may cause any sediment dam(s) and/or water supply dam(s) to overtop, the holder of this approval is authorised to release treated/settled stormwater, supply water and sediment dam water to drainage lines in accordance with the contaminant release limits defined in Schedule C - Table 1.

(b) **With respect to Schedule 2A 21 Mining Activities:** Notwithstanding condition C1(b), in the event of a significant rainfall event (i.e. a 1:100 year rainfall event) that may cause any sediment dam(s) and/or water supply dam(s) to overtop, the holder of this environmental authority is authorised to release treated/settled stormwater, supply water and sediment dam water to drainage lines in the catchment of Lord John Creek (including Lucky Valley Gully and Frenchman Gully) in accordance with the contaminant release limits defined in schedule C-Table 1.

Schedule C - Table 1 (Contaminant release limits)

Parameter	Units	Minimum	Maximum
pH	-	6.0	9.0
Electrical conductivity	µS/cm	-	1500

C3 (a) **With respect to ERA 16-(2c) Extractive, 16-(2b) Extractive, 16-(3b) Screening:** Any release must be managed in accordance with the Unimin Australia Limited *Warwick Limestone Deposit Site Water Management Plan* (September 2008) or subsequent amendment.

(b) **With respect to Schedule 2A 21 Mining Activities:** With respect to condition (C2)(b), the release must be managed in accordance with the Site Water Management and Monitoring Plan in a manner that will ensure the contaminant release limits specified in Schedule C - Table 1 are not exceeded.

C4 **Erosion and sediment control:** Erosion protection measures and sediment controls must be provided and maintained to effectively minimise the likelihood of erosion and release of sediments from the site and be maintained during site clearing, construction, mining operations and rehabilitation. Such measures should include diversion drainage works and sedimentation traps and dams.

C5 Erosion control and sediment control structures must be maintained at all times and repaired or replaced as required after rainfall events.

C6 **Groundwater:** All reasonable and practicable measures must be taken to prevent the contamination of groundwater.

C7 Contaminants must not be directly or indirectly released to any groundwater as a result of mining activities.

C8 Any draw down of groundwater must not impact on the users of groundwater.

C9 **Site Water Management and Monitoring Plan:**

(a) **With respect to ERA 16-(2c) Extractive, 16-(2b) Extractive, 16-(3b) Screening:** The holder of this approval must implement the Unimin Warwick Limestone Deposit Site Water

Management Plan (September 2008) or subsequent amendment.

(b) **With respect to Schedule 2A 21 Mining Activities:** The holder of this environmental authority must develop and implement a Site Water Management and Monitoring Plan, within twelve (12) months of the date this environmental authority takes effect, for the site.

C10 The Site Water Management Plan must:

(a) be carried out by a person possessing appropriate qualifications and experience in the field of surface water monitoring program design to be able to competently make recommendations about these matters;
(b) identify the environmental values of the licensed place and water quality objectives (i.e. ANZECC trigger levels for stock water) by monitoring locations (i.e. sediment dams) on the site for water quality characteristics (including total dissolved solids mg/l, total suspended solids mg/l, and pH) and identify any potential receiving waters in the event of an uncontrolled release that will be protected;
(c) provide representative water sampling, in consideration of the availability of water on the site, carried out with sufficient regularity and spatial and temporal replication to make statistically valid conclusions about the water quality on the site;
(d) give considerations to relevant methodology and water quality criteria by the Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand in Australian Guidelines for Water Quality Monitoring and Reporting 2000 and "Australian and New Zealand Guidelines of Fresh and Marine Water Quality 2000";
(e) determine potential environmental harm within the predicted zone of influence arising from mining activities;
(f) incorporate a risk management approach to how changing levels of flood, drought and water quality risks should be addressed e.g. increasing the lip of sediments ponds to increase capacity;
(g) Determine measures to manage and/or recycle storm water discharges to minimise stormwater contaminated from the mining activities reaching any surrounding watercourses;
(h) develop and implement a system for emergency spills or discharges including procedures to minimise extent and duration of release, staff training, investigation and reporting procedures;
(i) manage the environmental impacts of any uncontrolled release of wastewater to the environment so that any impacts are minimised e.g. improving sediment control measures and/or separating clean water from undisturbed areas and water from disturbed areas;
(j) manage site water quality and quantity during the (3) phases of mining: development, operation and decommission;
(k) safeguard against the potential for soil erosion;
(l) provide details of operational monitoring and monitoring of hydrological processes including associated performance indicators.

C11 With respect to condition (C9)(b), the holder of this environmental authority must submit to the administering authority a draft of the Site Water Management and Monitoring Plan as soon as practicable following the date of issue of the environmental authority for comment prior to implementation of the plan.

C12 A copy of the Site Water Management Plan and any subsequent amendment of the Site Water Management Plan must be kept at the place to which this approval relates and be

available for examination by Emergency Services Personnel or an authorised person on request.

C13 A record of the results of the surface water-monitoring conducted, including background water quality monitoring, must be kept and forwarded to the administering authority on request.

C14 **Water Storage:** Sediment collection and water supply dams must be designed and maintained to prevent overtopping in accordance with Schedule C - Table 2 and to facilitate the settlement of suspended solids in stormwater contaminated by approved activities.

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Schedule C - Table 2 (Storage Design - all mining leases unless specified otherwise)

Storage Type	Design Wet Period Storage (4 month wet season)	Spillway Critical design Storm*
Sediment Dams Any new sediment dams	1:10	>1:10
Water Supply Dams (Two (2) on ML50146) Any new water supply dams	1:50	>1:50

**the critical storm has a duration that produces the peak discharge for the catchment*

C15 The base and walls of the sediment dams must be constructed, installed and maintained:

(a) to minimise the likelihood of effluent through the bed or banks of the dam to any waters (including groundwater);
(b) to ensure the stability of the dams construction; and
(c) to maintain a minimum freeboard of 0.5m.

C16 (a) **With respect to ERA 16-(2c) Extractive, 16-(2b) Extractive, 16-(3b) Screening:** Water and/or stormwater collected in excavation pits must be utilised (i.e. for dust suppression) and/or redirected to the sediment dam(s) and/or water supply dam(s) on the mine site as soon as practicable after accumulation in the pits.

(b) **With respect to Schedule 2A 21 Mining Activities:** Water and/or stormwater collected in excavation pits one - three (1-3) on mining lease 50083 must be utilised (i.e. for dust suppression) and/or redirected to the sediment dam(s) and/or water supply dam(s) on the mine site as soon practicable after accumulation in the pits.

END OF CONDITIONS FOR SCHEDULE C

Schedule D - Noise and vibration

D1 **Noise Nuisance:** Subject to Conditions (D2) and (D3) noise from the mining activity must not cause an environmental nuisance, at any sensitive place.

D2 When requested by the administering authority, noise monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken

belief in the opinion of the authorised officer) of environmental nuisance at any sensitive or commercial place, and the results must be notified within 14 days to the administering authority following completion of monitoring.

D3 If the environmental holder can provide evidence through monitoring that the limits defined in Schedule D - Table 1 are not being exceeded then the holder is not in breach of Condition (D1). Monitoring must include:

(a) $L_{A, max adj.}$ T; and
(b) the level and frequency of occurrence of impulsive or tonal noise; and
(c) atmospheric conditions including wind speed and direction; and
(d) location, date and time of recording.

D4 If monitoring indicates exceedance of the limits in Schedule D - Table 1 and 2, then the holder must:

(a) address the complaint including the use of appropriate dispute resolution if required; or
(b) immediately implement noise abatement measures so that emissions of noise from the activity do not result in further environmental nuisance.

D5 The method of measurement and reporting of noise levels must comply with the latest edition of the Department of Environment and Resource Management's Noise Measurement Manual.

Schedule D - Table 1 (Noise Limits)

Noise Level dB(A) measured as	Monday to Saturday			Sundays and Public Holidays		
	7am – 6pm	6pm – 10pm	10pm – 7am	9am – 6pm	6pm – 10pm	10pm – 9am
	Noise measured at a 'Noise sensitive place'					
LAeq, adj, 15 mins	45	40	40	45	40	40
LAmax, adj, T	50	45	45	50	45	45

Note: The method of measurement and reporting of noise levels must comply with the latest edition of the Department Noise Manuals

D6 **Blasting:** The instantaneous sound pressure level when measured at a noise sensitive or commercial place must not exceed those levels in Schedule D - Table 2.

D7 Blasting is to be carried out only between 7am and 5pm Monday to Friday and 9am to 1pm on Saturdays.

Schedule D - Table 2 (Airblast Overpressure Level)

Location	Monday to Friday 7am to 5.00pm Saturdays 9am – 1pm	Remainder of Saturdays, Sundays and Public Holidays
Sensitive or commercial place	Air blast overpressure level of 115 db (linear peak.) for nine (9) out of ten (10) consecutive blasts initiated and not greater than 120 db (Linear peak) at any time.	**Blasting not permitted**

Note: The method of measurement and reporting of over pressure levels must comply with the latest edition of the Departmental vibration and air blast overpressure monitoring guideline.

D8 **Vibration nuisance:** Subject to Conditions (D9) and (D10) vibration from the activity must not cause an environmental nuisance, at any sensitive or commercial place.

D9 When requested by the administering authority vibration monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive or commercial place, and the results must be notified within 14 days to the administering authority following completion of monitoring.

D10 If the holder can provide evidence through monitoring that the limits defined in Schedule D - Table 3 are not being exceeded then the holder is not in breach of (D8). Monitoring must include:

(a) location of the blast(s) within the activity area (including which bench level); and
(b) atmospheric conditions including temperature, relative humidity and wind speed and direction; and
(c) location, date and time of recording.

D11 If monitoring indicates exceedance of the relevant limits in Schedule D - Table 3, then the holder must:

(a) address the complaint including the use of appropriate dispute resolution if required; or
(b) immediately implement vibration abatement measures so that vibration from the activity does not result in further environmental nuisance.

Schedule D – Table 3 (Vibration Limits)

Location	Vibration Measured	
	Monday to Friday 7am to 5.00pm Saturdays 9am – 1pm	**Remainder of Saturdays, Sundays and Public Holidays**
Sensitive or commercial place	5mm/s peak particle velocity for nine (9) out of ten (10) consecutive blasts and not greater than 10mm/s peak particle velocity at any time	**Blasting not permitted.**

Note: The method of measurement and reporting of vibration levels must comply with the latest edition of the Departmental vibration and air blast overpressure monitoring guideline.

Schedule E – Waste

E1 **Waste Management:** The handling and disposal of all waste produced on site is to be conducted using methods to avoid contamination of land and surface and groundwater.

E2 Waste must be managed in accordance with the principles of the waste management hierarchy (i.e. waste avoidance, waste re-use, waste recycling, energy recovery from waste and waste disposal).

E3 The environmental authority holder must remediate any contaminated land resulting from mining activities within the mine site prior to the surrender of any relevant mining lease.

E4 **Storage of tyres:** Tyres stored awaiting disposal or transport for take-back and, recycling, or waste-to-energy options should be stockpiled in volumes less that 3m in height and 200m² in area and at least 10m from any other tyre storage area.

E5 All reasonable and practicable fire prevention measures must be implemented, including

removal of grass and other materials within a 10m radius of the scrap tyre storage area.

E6 **Disposal of tyres:** Where practicable, scrap tyres resulting from the mining activities can be disposed of in underground stopes provided this practice does not cause an unacceptable fire risk or compromise mine safety.

E7 Disposing of scrap tyres resulting from the mining activities in spoil emplacements is acceptable, provided tyres are placed as deep in the spoil as reasonably practicable.

E8 Scrap tyres resulting from the mining activities disposed within the operational land must not impede saturated aquifers or compromise the stability of the consolidated landform.

E9 **Emergency Response / Contingency Plan:**

(a) **With respect to ERA 16-(2c) Extractive, 16-(2b) Extractive, 16-(3b) Screening:** The holder of this approval must implement the Unimin ***Warwick Limestone Deposit Emergency Response / Contingency Plan*** to manage the environmental impacts of uncontrolled release of contaminants to the environment.

(b) **With respect to Schedule 2A 21 Mining Activities:** The holder of this environmental authority must develop and implement an Emergency Response I Contingency Plan, within six (6) months of the date this environmental authority takes effect, to manage the environmental impacts of uncontrolled release of contaminants to the environment.

E10 The Emergency Response / Contingency Plan must address at least the following matters:

(a) response procedures to be implemented to reduce the likelihood of any release of contaminants to the environment;
(b) response procedures to prevent any further release or if such is not practicable, minimise the extent and duration of any release to the greatest practicable extent;
(c) the practices and procedures to be employed to restore the environment, or if such is not practicable, mitigate any environmental impacts of the release;
(d) a description of the resources to be used in response to a release;
(e) the training of staff that will be called upon to respond to a release;
(f) procedures to investigate the cause of any release, and where necessary, implement remedial actions to reduce the likelihood of recurrence of a similar event;
(g) the provision and availability of documented procedures to staff attending any release to enable them to effectively respond; and
(h) timely and accurate reporting of the circumstance and nature of release events to the administering authority.

E11 A copy of the Emergency Response / Contingency Plan and any subsequent amendment of the Emergency Response / Contingency Plan must be kept at the place to which this activity relates and be available for examination by Emergency Services Personnel or an authorised person on request.

Schedule F - Land

F1 **Rehabilitation landform criteria:**

(1) **With respect to ERA 16-(2c) Extractive, 16-(2b) Extractive, 16-(3b) Screening:** The holder of this approval must implement the Unimin Australia ***Limited Limestone Deposit Final Land Use and Rehabilitation Plan*** to ensure that all area disturbed by activities will be suitably rehabilitated.

(2) **With respect to Schedule 2A 21 Mining Activities:** The holder of this environmental authority must develop and implement a Final Land Use and Rehabilitation Plan, within twelve (12) months of the date this environmental authority takes effect, to ensure that all areas disturbed by mining activities will be suitably rehabilitated in accordance with Schedule F Tables1-4. The Plan must include, but is not limited to the following:

(a) a description of rehabilitation management techniques incorporating works and monitoring programs and timetables;
(b) indicators for success; and
(c) keeping of appropriate records or rehabilitation measures implemented including taking of photographs demonstrative of rehabilitation achieved and the preparation of annual rehabilitations progress reports. A summary of the annual rehabilitation progress report must be submitted to the administering authority with each annual return.

Note: The Final Land Use and Rehabilitation Plan is to be managed through the Plan of Operations.

F2 Progressive rehabilitation must commence when areas become available within the operational land.

F3 All areas disturbed by mining activities must be rehabilitated to the final land description as defined in Schedule F - Table 1 - 6.

Schedule F – Table 1 (Final Land Use and Rehabilitation Approval Schedule for ML50236)

Tenure ID	Disturbance type	Surface area (ha)	Post Mine land description	Post mine land (capability / suitability) classification #	Slope range (degrees ^{o})
ML50236	Main Pit Void	0.00	-	-	-
	Waste Dump	1.62	Re-contoured for drainage, Land not suitable for cultivations but well suited to pasture improvement	vi	Min of 20° Max of 30°
	Sediment Dams	0.00	-	-	-
	Road and Tracks	0.00	-	-	-
	Topsoil	0.00	-	-	-

 # "land capability" as defined in the DME 1995 Technical Guideline for the Environmental management of Exploration and Mining in Queensland.

Schedule F – Table 2 (Final Land Use and Rehabilitation Approval Schedule for ML50238)

Tenure ID	Disturbance type	Surface area (ha)	Post Mine land description	Post mine land (capability / suitability) classification #	Slope range (degrees o)

ML50238	Main Pit Void	1.50	Water storage / Grazing	vi	70º
	Waste Dump	1.00	Re-contoured for drainage, Land not suitable for cultivations but well suited to pasture improvement	vi	Min of 20º Max of 30º
	Sediment Dams and Stormwater Control	0.50	Re-contoured for drainage. Land not suitable for cultivations but well suited to pasture improvement.	vi	Max 10 º
	Mobile Crushing ROM and Product Stockpiles	2.60	Re-contoured for drainage, Land not suitable for cultivations but well suited to pasture improvement	vi	Max 10 º
	Road and Tracks	2.50	Re-contoured for drainage, Land not suitable for cultivations but well suited to pasture improvement	vi	Max of 10º
	Topsoil	1.00	Respread as required	vi	Max of 10º

 # "land capability" as defined in the DME 1995 Technical Guideline for the Environmental management of Exploration and Mining in Queensland.

Schedule F – Table 3 (Final Land Use and Rehabilitation Approval Schedule for ML50237)

Tenure ID	Disturbance type	Surface area (ha)	Post Mine land description	Post mine land (capability / suitability) classification #	Slope range (degrees º)
ML50237	Main Pit Void	11.50	Water storage / Grazing	vi	70º
	Waste Dump	14.50	Re-contoured for drainage, Land not suitable for cultivations but well suited to pasture improvement	vi	Min of 20º Max of 30º
	Sediment Dams and	3.50	Remain as Stock Dams	viii	20º

	Stormwater Control				
	Road and Tracks	5.65	Roads to remain as farm access tracks	vi	Max of 10º
	Topsoil	5.00	Respread as required	vi	Max of 10º
	Mobile Crushing ROM and Product Stockpiles	6.60	All infrastructure to be removed and area re-contoured for drainage. Land not suitable for cultivations but well suited to pasture improvement.	vi	Max 10 º
	Crib Hut and Parking	1.00	All infrastructure to be removed and area re-contoured for drainage. Land not suitable for cultivations but well suited to pasture improvement.	vi	Max 10 º

A# "land capability" as defined in the DME 1995 Technical Guideline for the Environmental management of Exploration and Mining in Queensland.

Schedule F – Table 4 (Final Land Use and Rehabilitation Approval Schedule for ML50239)

Tenure ID	Disturbance type	Surface area (ha)	Post Mine land description	Post mine land (capability / suitability) classification #	Slope range (degrees º)
ML50239	Main Pit Void	0.38	Water storage / Grazing	vi	70º
	Waste Dump	1.74	General Grazing Land	vi	Min of 20º Max of 30º
	Sediment Dams	0.54	Remain as Stock Dams	viii	20º
	Road and Tracks	0.00	-	-	-
	Topsoil	0.00	-	-	-

 # "land capability" as defined in the DME 1995 Technical Guideline for the Environmental management of Exploration and Mining in Queensland.

Schedule F – Table 5 (Final Land Use and Rehabilitation Approval Schedule for ML50083)

Tenure ID	Disturbance type	Surface area (ha)	Post Mine land description	Post mine land (capability / suitability) classification #	Slope range (degrees ^{o})
ML50083	Western Open Pit	5.00	Water Storage	viii	70 ^{o}
	Eastern Open Pit	5.00	Backfilled to RL 524	vi	70 ^{o}
	Waste Dump	5.00	General Grazing Land	vi	30 ^{o}
	Sediment Dams and Stormwater Control	1.01	Remain as Stock Dams	viii	30 ^{o}
	ROM Pad and Stockpiles	1.50	All will be removed	vi	Max of 10 ^{o}
	Roads and Tracks	1.50	Some tracks to remain as farm access tracks	vi	Max of 10 ^{o}
	Topsoil	0.33	Respread as required	vi	Max of 10 ^{o}

 # "land capability" as defined in the DME 1995 Technical Guideline for the Environmental management of Exploration and Mining in Queensland.

Schedule F – Table 6 (Final Land Use and Rehabilitation Approval Schedule for ML50146)

Tenure ID	Disturbance type	Surface area (ha)	Post Mine land description	Post mine land (capability / suitability) classification #	Slope range (degrees ^{o})
ML50146	Open Pit	2.50	Land not suitable for cultivation but well suited to pasture improvement	vi	70 ^{o}
	Waste Dump	4.50	Re-contoured for drainage. Land not suitable for cultivation but well suited to pasture improvement	vi	Min of 20° Max of 30°
	ROM Pad and Stockpiles	10.00	All will be removed or rehabilitated	vi	Max 10 ^{o}

	Roads and Tracks	3.15	Some tracks to remain as farm access tracks	vi	Max 10 º
	Sediment and Stormwater Control	2.00	Remain as Stock Dams	viii	Max 20 º
	Fixed Plant	1.24	All not required by land holder will be removed	vi	Max 10 º
	Office/Maintenance Buildings	0.50	All not required by land holder will be removed	vi	Max 10 º
	Topsoil	1.50	Respread as required	vi	Max of 10 º

 # "land capability" as defined in the DME 1995 Technical Guideline for the Environmental management of Exploration and Mining in Queensland.

F4 **Residual void outcome:** Residual voids must comply with the following outcomes;

(a) residual voids must not cause any serious environmental harm to land, surface waters or any recognised groundwater aquifer, other than the environmental harm constituted by the existence of the residual void itself and subject to any other condition within this environmental authority; and
(b) residual voids must comply with Schedule F - Table 7.

F5 The environmental authority holder must complete an investigation into residual voids and submit a report to the administering authority proposing acceptance criteria to meet the outcomes in (F3) and landform design criteria in Schedule F - Table 7, two (2) years prior to the relinquishment of any lease associated with this environmental authority.

Schedule F – Table 7 (Residual Void Design)

Void Identification	Void wall – competent rock max slope (degrees º)	Void wall – incompetent rock max slope (degrees º)	Void maximum surface area (ha)
ML50239 East/West	70 º	38 º	0.38
ML50238 Phoenix	70 º	38 º	1.50
ML50237 Phoenix	70 º	38 º	11.50
ML50146 Aspinal	70 º	38 º	2.50
ML50083 East Pit	70 º	38 º	1.49
ML50083 West Pit	70 º	38 º	2.56

Impacts to Prescribed Environmental Matters

F6 Significant residual impacts to prescribed environmental matters, are not authorised under this environmental authority or the *Environmental Offsets Act 2014* unless the impact(s) is specified in Schedule C – Table 8 (Significant residual impacts to prescribed environmental matters) and all information required for Schedule C - Table 8 (Significant residual impacts to prescribed environmental matters) has been provided to the administering authority.

Schedule F – Table 8 (Significant residual impacts to prescribed environmental matters)

Prescribed environmental matter	Location of impact	Maximum extent of impact
Regulated Vegetation – Of Concern (Category B) RE11.9.9/11.9.13	ML50146	1.80ha[1]
Regulated Vegetation – Of Concern (Category B) RE11.9.9/11.9.13	ML50237	4.41ha[1]
Regulated Vegetation – Of Concern (Category B) RE11.9.9/11.9.13	ML50238	1.82ha[1]
Regulated Vegetation – essential Habitat	ML50146	TBA[2]
Regulated Vegetation – essential Habitat	ML50237	TBA[2]
Regulated Vegetation – intersecting a watercourse	ML50237	0.7km[1]
Regulated Vegetation – Intersecting a watercourse	ML50238	0.04km[1]

[1]The activities associated with this environmental authority are to be conducted only within the areas identified as Figure3 – MSES Features on Proposed Mine Plan dated February 2019 (Attachment 2).

[2]TBA means to be agreed at least four (4) months prior to the commencement of impacts to prescribed environmental matters.

F7 Records demonstrating that each impact to a prescribed environmental matter not listed in Schedule F – Table 8 (Significant residual impacts to prescribed environmental matters) did not, or is not likely to, result in a significant residual impact to that matter must be:

a) Completed by an appropriately qualified person; and

b) kept for the life of the environmental authority.

F8 An environmental offset made in accordance with the *Environmental Offsets Act 2014* and *Queensland Environmental Offsets Policy*, as amended from time to time, must be

undertaken for the maximum extent of impact to each prescribed environmental matter authorised in Schedule F – Table 8 (Significant residual impacts to prescribed environmental matters), unless a lesser extent of the impact has been approved in accordance with condition F11.

F9 Prior to the commencement of any impacts to a prescribed environmental matter for which an environmental offset is required by condition F8, a report completed by an appropriately qualified person that contains an analysis of the estimated maximum extent of impact to each prescribed environmental matter must be provided to the administering authority.

F10 The report required by condition F9 must be approved by the administering authority before the notice of election, if applicable, is given to the administering authority.

F11 The notice of election for the environmental offset required by condition F10, if applicable, must be provided to the administering authority no less than three months before the proposed commencement of the significant residual impacts for which the environmental offset is required.

Schedule G – Community

G1 **Complaint response:** All complaints must be recorded including details of complainant, reasons for the release of contaminants not in accordance, or reasonably expected to be not in accordance with the condition of the approval, the holder of the environmental authority must notify the administering authority of the release by telephone or facsimile.

G2 **Notification of Emergencies and Incidents:** As soon as practicable after becoming aware of any emergency or incident which results in the release of contaminants not in accordance, or reasonably expected to be not in accordance with the conditions of this approval, the holder of this environmental authority must notify the administering authority of the release by telephone or facsimile.

G3 The notification of emergencies or incidents as required by condition (G2) must include but not be limited to the following:

(a) the holder of the approval;
(b) the location of the emergency or incident;
(c) the number of the approval;
(d) the name and telephone number of the designated contact person;
(e) the time of the release;
(f) the time the holder of the approval became aware of the release;
(g) the suspected cause of the release;
(h) the environmental harm and or environmental nuisance caused, threatened, or suspected to be caused by the release; and
(i) actions taken to prevent further any release and mitigate any environmental harm and or environmental nuisance caused by the release.

G4 Not more than fourteen (14) days following the initial notification of an emergency or incident, the holder of the approval must provide written advice of the information supplied in accordance with condition (G3) in addition to:

(a) proposed actions to prevent a recurrence of the emergency or incident;
(b) outcomes of actions taken at the time to prevent or minimise environmental harm and or environmental nuisance; and
(c) the results of any environmental monitoring performed.

Schedule H - Definitions

Key terms and/or phrases used in this document are defined in this section and **bolded** throughout this document. Applicants should note that where a term is not defined, the definition in the *Environmental Protection Act 1994*, its regulations or environmental protection policies must be used. If a word remains undefined it has its ordinary meaning.

"acceptance criteria" means the measures by which the actions implemented to rehabilitate the land are deemed to be complete. The acceptance criteria indicate the success of the rehabilitation outcome or remediation of areas which have been significantly been disturbed by the mining activities. Acceptance criteria may include information regarding:

- vegetation establishment, survival and succession;
- vegetation productivity, sustained growth and structure development;
- fauna colonisation and habitat development;
- ecosystem processes such as soil development and nutrient cycling, and the recolonisation of specific fauna groups such as collembola, mites and termites which are involved in these processes;
- microbiological studies including recolonisation by mycorrhizal fungi, microbial biomass and respiration;
- effects of various establishment treatments such as deep ripping, topsoil handling, seeding and
- fertiliser application on vegetation growth and development;
- resilience of vegetation to disease, insect attack, drought and fire;
- vegetation water use and effects on ground water levels and catchment yields.

"airblast overpressure" means energy transmitted from the blast site within the atmosphere in the form of pressure waves. The maximum excess pressure in this wave, above ambient pressure is the peak airblast overpressure measured in decibels linear (dB).

"ambient (or total) noise" at a place, means the level of noise at the place from all sources (near and far), measured as the Leq for an appropriate time interval.

"appropriately qualified person" means a person who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis on performance relating to the subject matter using the relevant protocols, standards, methods or literature.

"authority" means environmental authority (mining activities) under the Environmental Protection Act 1994.

"blasting" means the use of explosive materials to fracture-

(a) rock, coal and other minerals for later recovery; or

(b) structural components or other items to facilitate removal from a site or for reuse.

"commercial place" means a work place used as an office or for business or commercial purposes, which is not part of the mining activity and does not include employees accommodation or public roads.

"competent person" means a person with the demonstrated skill and knowledge required to carry out the task to a standard necessary for the reliance upon collected data or protection of the environment.

"dam" means a containment or proposed containment whether permanent or temporary, which is designed to contain, divert or control flowable substances. However this does not include a fabricated or manufactured tank or container designed to a recognised standard.

"environmental authority holder" means the holder of this environmental authority.

"hazardous waste" means any substance, whether liquid, solid or gaseous, derived by or resulting from, the processing of minerals that tends to destroy life or impair or endanger health.

"LA 10, adj, 15 min," means the A-weighted sound pressure level, *(adjusted for tonal character and impulsiveness of the sound)* exceeded for 10% of any 15-minute measurement period, using Fast response.

"LA 1, adj, 16 min," means the A-weighted sound pressure level, *(adjusted for tonal character and*

impulsiveness of the sound) exceeded for 1 % of any 15-minute measurement period, using Fast response

"LA, max adj, T" means the average maximum A-weighted sound pressure level, adjusted for noise character and measured over any 10 minute period, using Fast response.

"land" in the "land schedule" of this document means land excluding waters and the atmosphere,

"land capability" as defined in the DME 1995 Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland.

"land suitability" as defined in the DME 1995 Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland".

"land use" term to describe the selected post mining use of the land, which is planned to occur after the cessation of mining operations.

"mandatory reporting level" means the volume below the spillway crest, equivalent to the lower of the AEP, 72 hour storm or the AEP wave allowance (AEP is the annual exceedance probability).

"mineral" means a substance which normally occurs naturally as part of the earth's crust or is dissolved or suspended in water within or upon the earth's crust and includes a substance which may be extracted from such a substance, and includes-

(a) clay if mined for use for its ceramic properties, kaolin and bentonite;
(b) foundry sand;
(c) hydrocarbons and other substances or matter occurring in association with shale or coal and necessarily mined, extracted, produced or released by or in connection with mining for shale or coal or for the purpose of enhancing the safety of current or future mining operations for coal or the extraction or production of mineral oil therefrom;
(d) limestone if mined for use for its chemical properties;
(e) marble;
(f) mineral oil or gas extracted or produced from shale or coal by in situ processes;
(g) peat;
(h) salt including brine;
(i) shale from which mineral oil may be extracted or produced;
j) silica, including silica sand, if mined for use for its chemical properties;
(k) rock mined in block or slab form for building or monumental purposes; but does not include-
(l) living matter;
(m) petroleum within the meaning of the Petroleum Act 1923;
(n) soil, sand, gravel or rock (other than rock mined in block or slab form for building or monumental purposes) to be used or to be supplied for use as such, whether intact or in broken form;
(o) water.

"noxious" means harmful or injurious to health or physical well being, other than trivial harm,

"non-standard" means a mining operation that if in the opinion of the administering authority does not have a low risk of serious environmental harm and the activities can not comply with the criteria for standard mining activities prescribed in schedule 1A of the Environmental Protection Regulation 1998. The standard mining activity trigger criteria are as follows;

- the mining activities do not or will not cause more than 10 ha of land to be significantly disturbed at any one time;
- the mining activities do not or will not cause more than 5 ha of land to be significantly disturbed at any one time;
  (a) in a riverine area;
  (b) because of mine workings;
- the mining activities are not or will not be carried out in, or within 2 km of a category A Environmentally Sensitive Area;
- the mining activities are not or will not be carried out in, or within 1 km of a category B environmentally sensitive area;
- the mining activities do not include a level 1 environmentally relevant activity
- no more than 20 persons are carrying out or will, at any one time, carry out the mining

activities;

"offensive" means causing reasonable offence or displeasure; is disagreeable to the sense; disgusting, nauseous or repulsive, other than trivial harm.

"peak particle velocity (ppv)" means a measure of ground vibration magnitude which is the maximum rate of change of ground displacement with time, usually measured in millimetres/second (mms^{-1}).

"prescribed environmental matters" has the meaning in section 10 of the *Environmental Offsets Act 2014*, limited to the matters of State environmental significant listed in schedule 2 of the Environmental Offsets Regulation 2014.

"progressive rehabilitation" means rehabilitation (defined below) undertaken progressively or a staged approach to rehabilitation as mining operations are ongoing,

"protected area" means - a protected area under the Nature Conservation Act 1992; or
- a marine park under the Marine Parks Act 1992; or
- a World Heritage Area.

"progressive rehabilitation" means rehabilitation (defined below) undertaken progressively or a staged approach to rehabilitation as mining operations are ongoing.

"reference site" (or analogue site) may reflect the original location, adjacent area or another area where rehabilitation success has been completed for a similar biodiversity. Details of the reference site may be as photographs, computer generated images and vegetation models etc.

"rehabilitation" the process of reshaping and revegetating land to restore it to a stable landform and in accordance with the acceptance criteria set out in this environmental authority and, where relevant, includes remediation of contaminated land.

"representative" means a sample set which covers the variance in monitoring or other data either due to natural changes or operational phases of the mining activities.

"residual void" means an open pit resulting from the removal of ore and/or waste rock which will remain following the cessation of all mining activities and completion of rehabilitation processes.

"self-sustaining" means an area of land which has been rehabilitated and has maintained the required acceptance criteria without human intervention for a period nominated by the administering authority.

"sensitive place" means;
- a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises; or
- a motel, hotel or hostel; or
- an educational institution; or
- a medical center or hospital; or
- a protected area under the Nature Conservation Act 1992, the Marine Parks Act 1992 or a World Heritage Area; or
- a public park or gardens,

"significant disturbance" - includes land
(a) if it is contaminated land; or
(b) it has been disturbed and human intervention is needed to rehabilitate it.
i. to a state required under the relevant environmental authority; or
ii. if the environmental authority does not require the land to be rehabilitated to a particular state - to its state immediately before the disturbance.

Some examples of disturbed land include:
- areas where soil has been compacted, removed, covered, exposed or stockpiled;
- areas where vegetation has been removed or destroyed to an extent where the land has been made susceptible to erosion; (vegetation /-- AMPERSAN --/ topsoil)
- areas where land use suitability or capability has been diminished;
- areas within a watercourse, waterway, wetland or lake where mining activities occur;
- areas submerged by tailings or hazardous contaminant storage and dam walls in all cases;
- areas under temporary infrastructure. Temporary infrastructure includes any infrastructure (roads, tracks, bridges, culverts, dams, bores, buildings, fixed machinery, hardstand areas, airstrips, helipads etc.) which is to be removed after mining activities have

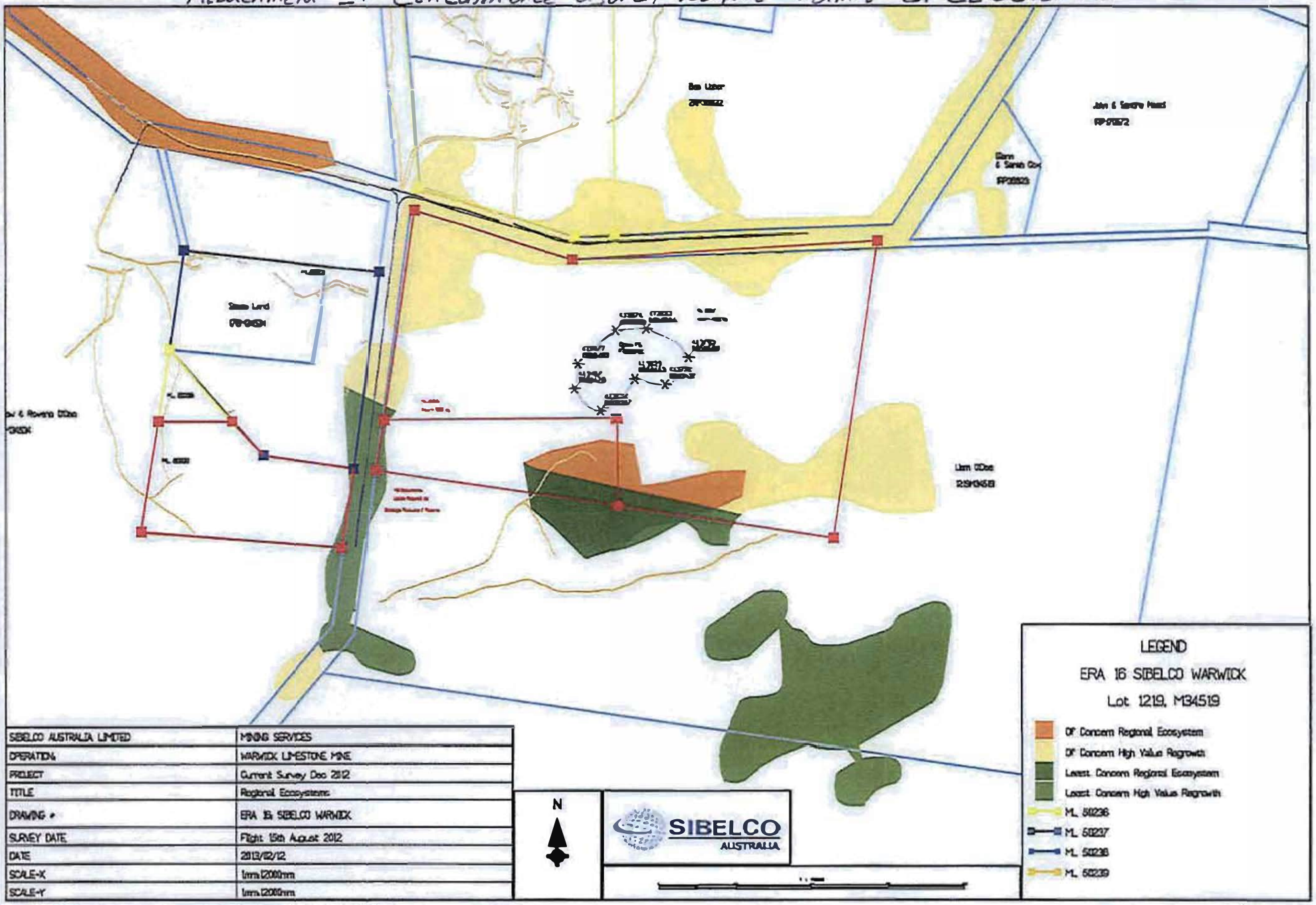
ceased; or
- areas where land has been contaminated and a suitability statement has not been issued.

However, the following areas are not included:
- areas off lease (e.g. roads or tracks which provide access to the mining lease);
- areas previously significantly disturbed which have achieved the rehabilitation outcomes;
- by agreement with the EPA, areas previously significantly disturbed which have not achieved the rehabilitation objective(s) due to circumstances beyond the control of the mine operator (such as climatic conditions);
- areas under permanent infrastructure. Permanent infrastructure includes any infrastructure (roads, tracks, bridges, culverts, dams, bores, buildings, fixed machinery, hardstand areas, airstrips, helipads etc.) which is to be left by agreement with the landowner. The agreement to leave permanent infrastructure must be recorded in the Landowner Agreement and lodged with the EPA;
- disturbances that pre-existed the grant of the tenure unless those areas are disturbed during the term of the tenure.

"significant residual impact" has the meaning in section 8 *Environmental Offsets Act 2014*.
"spillway" means passage or outlet from the dam through which surplus water flows.
"stable" means geotechnical stability of the rehabilitated landform where instability related to the excessive settlement and subsidence caused by consolidation I settlement of the wastes deposited, and sliding/slumping instability has ceased.
"trivial harm" means environmental harm which is not material or serious environmental harm and will not cause actual or potential loss or damage to property of an amount of, or amounts totaling more than $5,000.
"watercourse" - Means a river, creek or stream in which water flows permanently or intermittently in a visibly defined channel (natural, artificial or artificially improved) with:
(a) continuous bed and banks;
(b) an extended period of flow for some months after rain ceases, and
(c) an adequacy of flow that sustains basic ecological processes and maintains biodiversity,
"waters" includes river, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, bed and bank of any waters, dams, non-tidal or tidal waters (including the sea) or any part-thereof.

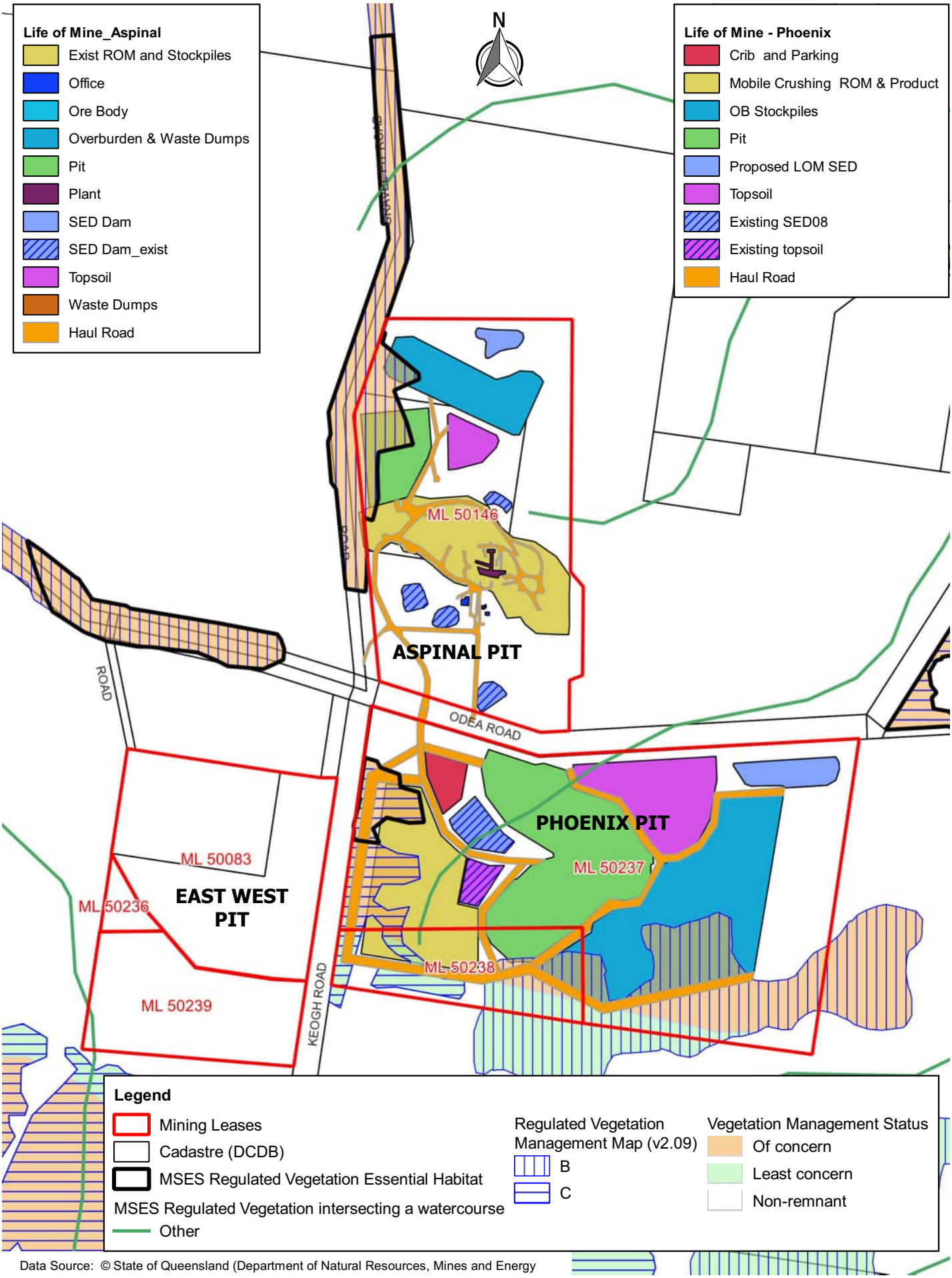
END OF CONDITIONS

Attachment 1. Concurrence agency response Permit SPCE05131713



SIBELCO AUSTRALIA LIMITED	MINING SERVICES
OPERATION	WARWICK LIMESTONE MINE
PROJECT	Current Survey Dec 2012
TITLE	Regional Ecosystems
DRAWING #	ERA 16 SIBELCO WARWICK
SURVEY DATE	Flight 15th August 2012
DATE	2013/02/12
SCALE-X	1mm:2000mm
SCALE-Y	1mm:2000mm

Attachment 1 - EPML00136213



QGIS 2017 File Path: G:\GIS\Epic Environmental\Projects\BE170038.01 Sibelco

epic ENVIRONMENTAL

0 0.25 0.5 km

Scale: 1:12,500 @ A4
Datum: GDA94 Projection: MGA56

Sibelco
Warwick Limestone Mine

Figure 3
MSES Features on Proposed Mine Plan

Appendix 2

Horizon Soil Science and Engineering (16 September 2022): Report on the Soil Survey Leases of the Warwick Limestone Quarry Rev 1.0

Horizon
Soil Science and Engineering

Report on the

Soil Survey of Leases of the

Warwick Limestone Quarry

Prepared for: Ausrocks

Revision 1.0 (Final report)

Revision date: 16/09/2022

Disclaimer

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1. Scope and Deliverables

The Warwick Limestone Quarry (WLQ) is an open-pit mining development operated by Terrequip Environmental (Mining lease areas: ML50083, ML50146, ML50236, ML50237, ML50238 and ML50239), hereafter referred to as the "project area". The locality of the lease areas are shown in Appendix 1 Maps: Mine Lease Boundaries. Limestone mined at site is used in various application including agricultural lime, decorative aggregates, crushed rock and road base.

Horizon Soil Science and Engineering (Horizon) were engaged by Ausrocks Consulting Mining Engineers (Ausrocks) to conduct a land assess survey in non-disturbed areas of the project area to provide background data of the existing landscape as a baseline for rehabilitation purposes.

1.1 Scope

The scope of work was to conduct a land assessment of the project area to:

- Assist Ausrocks devise and execute a land assessment survey (including chemistry sampling) in non-disturbed areas to provide background data of the existing landscape as a baseline for rehabilitation purposes;
- Conduct sampling of stockpiled topsoil samples and assess the suitability of stockpiled material for use in rehabilitation;
- Investigate the soil condition of any previously rehabilitated areas;
- Provide a report summarising the land assessment and stockpile characteristics across the project areas; and
- Assist Ausrocks to develop a soil rehabilitation methodology and topsoil amelioration procedure.

1.2 Deliverables

The key deliverables for the project included:

1. A soil survey report for the project area that:
    - Maps the boundaries of soil types across the non-disturbed areas;
    - Provides key physical and chemical characteristics of the mapped soils;
    - Provides key physical and chemical characteristics of stockpiled material; and
    - Classifies the project area agricultural land capability using an appropriate method.
2. Assist Ausrocks to develop:
    - Soil rehabilitation methodology;
    - Topsoil amelioration procedure;
    - A soil testing program/procedure; and
    - Metrics to measure future rehabilitation performance based on soil testing program results.

This report represents the Deliverable 1 – a soil survey report that provides advice on soil amelioration. Deliverable 2 will be developed in collaboration with Ausrocks and will be reported within a site rehabilitation plan.

2. Desktop Review and Survey Design

2.1 Desktop Review

A desktop review was completed to assist with defining landscape characteristics and soil boundaries. The desktop review included geology, land resource and land management data.

2.1.1 Geology

The surface geology of the survey area is shown in Appendix 1 Maps: Geology. The majority of the survey area surface geology is derived from Bald Hill formation (Early Devonian) with a mix of coarse and fine grained igneous rocks (Gabbroids and Mafites) and Carbonates (Limestone). Fringing the south of the project area are Stanthorpe Granites. Geological units display a high degree of spatial viability across the site due to the vertical orientation of geological units (Viriseff pers. comm)

2.1.2 Land Resources and Soils

The only soils mapping available for the site is the National scale (1:2,000,000) ASRIS mapping (https://www.asris.csiro.au/) which provides little detail at the scale of our investigation. The entire project area is classified under a single unit, Ub63. The primary soil associated with this unit are Sodosols. Further summary details of the unit are show below.

Ub63	Strongly hilly to undulating: chief soils of the undulating to low hilly areas are hard-setting loamy soils with mottled yellow clayey subsoils (Dy3.42 and Dy3.43) and some (Dr2) soils. Associated are: hilly ridges of rock outcrops, (Uc) and (Um) soils with some shallow (Dy) and (Dr) soils; steep slopes of red earths (Gn2.14 and Gn2.15) with rock outcrops; and narrow valleys of undescribed soils some of which are affected by salinity

2.1.3 Grazing Land Management

The project area is mapped as grazing land management (GLM) unit BR07 - Granite plains and rises with mixed grassy woodlands (Source: Future Beef, 2018). Soils of this GLM unit are described as deep, bleached dark grey to yellowish brown sandy clay loam texture contrast soils (Kurosols, Sodosols).

The GLM is described as suitable for grazing on native and sown pastures. Minimal ground disturbance of the landscape is recommended as the dispersive soils erode easily, and grazing pressures should be managed to maximise ground cover and minimise soil loss.

The unit is considered to have land use limitation that include:

- Low fertility and very low to low water holding capacity.
- Poorly structured and drained subsoils that may cause waterlogging (particularly in winter).
- Rocky outcrops restrictive to cultivation opportunities.

2.2 Survey Design

The field survey was designed in accordance with sampling intensities recommended in the Australian Guidelines for Surveying Soil and Land Resources (McKenzie *et al,* 2008). The footprint area of the WLQ is approximately 172 ha with a proposed sample density of 6 ha /site for soil mapping at 1:25,000 scale giving a minimum of 30 observation sites.

The number of sites sampled for detailed analysis and chemistry are shown and exceed the percentage of sites criteria required by McKenzie *et al.* (2008).

Table 1: Sample numbers

	Mapping Observations	Detailed Description	Soil profile Chemistry sites
Recommended	15-29	10-20% (3-6)	5-10% (2-3)
Proposed	30	10	5
Actual	30	27	5

In addition to the survey sites, 3 stockpile sites were sampled (3 replicate samples per site), and one (1) site in a previously rehabilitated area was also sampled (including chemistry).

2.2.1 Field Descriptions

Field descriptions were undertaken in accordance with the Australian Soil Survey and Land Survey Field Handbook 3rd edition (The National Committee on Soil and Terrain, 2009) and classified using The Australian Soil Classification (Isbell, 2016). Field descriptions included a combination of mapping observations and detailed observations with a subset of detailed observations analysed for chemistry as described below:

1. Mapping observation are primarily used to identify land type boundaries. They include a description of:
   - Landform;
   - Vegetation;
   - Other distinguishing surface characteristics (e.g., gilgai and rockiness).
2. Detailed observations make up >20 % of the survey locations. The sample locations are provided in Appendix 2, profile logs and photographs are provided in Appendix 3. These sites were sampled using a soil rig include soil profile descriptions and observations of:
   - Horizon depths, designation and boundary distinctness;
   - Field texture;
   - Munsell Colour;
   - Mottles colour and abundance;
   - Coarse fragments size and abundance;
   - Structure;
   - Segregations and abundance.

2.2.2 Chemistry

Chemistry sites make up >10 % of the survey locations. 5 sample depths were analysed per site based on soil horizons; generally, this included the A1, upper and lower B2 and C horizon. The key parameters analysed are provided in Table 2. Analysis was conducted by the NATA accredited ALS Laboratory. The Certificate of Analysis is provided in Appendix 3.

Table 2: Soil chemistry analysis parameters

Parameter	ALS Method/ Package Code	Technique/ Method Reference	Limit of Reporting (mg/kg) (or as indicated)
Electrical Conductivity (1:5)	IN-4S	APHA 2510 B 1:5	1 □S/cm
pH (1:5)		APHA 4500 H B 1:5	0.1 pH Unit
CEC - Exchangeable Cations with pre-treatment (Ca, Mg, Na, K, Al)	ALS to determine based on pH and EC	calc	0.1
Exchangeable Sodium Percent (ESP) – base saturation calc		ALS to determine based on pH and EC	0.1 meq/100g
Ca:Mg ratio			0.10%
Chloride	ED045G	APHA 4500 Cl 1:5	10
Emerson Aggregate Test	EA058	AS1289.3.8.1	
Total Organic Carbon (OC) in Soil	EP003	ALS In house	0.02 %

Saturated extract soil salinity (EC_{se}) was estimated from $EC_{1:5}$ data using Shaw (1994) soil chloride and cation exchange method.

For reference the following acronyms are used for soil chemistry in this report:

- EC_{se} - Saturated extract soil salinity.
- CEC – Cation Exchange Capacity.
- ESP -Exchangeable sodium Percentage.
- Ca:Mg – Calcium: Magnesium ratio.
- EAT – Emerson Aggregate Test.
- OC - Organic Carbon

3. Soil Survey Results

A soil survey of the project area was conducted on the 22nd and 23rd March 2022. Sampling was conducted using a 4WD mounted push tube sampling rig with a 75 mm diameter push tube.

3.1 Soil Physical Characteristics Descriptions

Four soil types were described within the project area using the Austrlian Soil Classification (ASC) system (Isbell, 2021). A summary of the soils, the areal extent and number of sites described and sampled for chemistry are given in Table 3. The most common soil type across the project area were Brown and Red Sodosol and cover > 80% of the project area.

Table 3: Summary of soil type areal extent, number of sites described and sampled for chemistry

Australian Soil Classification	Mapped area (ha)	Number of Site Descriptions	Number of Soil Chemistry sites
Brown and Red Sodosol	143.3	16	3
Brown Tenosol	10.4	5	1
Red Dermosol	5.1	11	1
Brown Vertosol	13.1		

Sodosols are texture contrast soils, typically characterised by sandy loam or clay loam surfaces over light to medium clay sub-soils that are sodic in the upper portion of the B-horizon. Minor areas of Tenosol (deep sands) were associated with the Stanthorpe granite geology, and minor areas of Dermosol/Vertosol (uniform clay soils) were described. Example soil profiles for the ASC are given in **Error! Not a valid bookmark self-reference.**. All full site descriptions are given in Appendix 2.

Table 4: Typical Physical Characteristics of Soil Types

Soil Description
Australian Soil Classification: Red Sodosol **A1** Very dark brown (7.5YR 2.5/3) clay loam with weak granular structure, a few medium pebbles on surface, to 0.3m, clear change to; **B2** Yellowish red (5YR 4/6) medium clay with moderate polyhedral structure, many manganese concretions, to 1.0m, diffuse change to; **B3** Dark reddish brown (5YR 3/4) silty light clay (siltstone) with moderate polyhedral structure, with abundant yellow mottles and common carbonates, to 1.4m.
Australian Soil Classification: Brown Tenesol **A1** Brown (10YR 4/3) loamy sand, non-coherent structure, abundant small gravel on surface and common through horizon, to 0.35m, clear change to; **B2** Brown (10YR 5/3) loamy sand, non-coherent structure, common small gravel, to 0.6m, diffuse change to; **C** Brown (7.5YR 5/3) clayey sand, non-coherent structure, abundant small gravel, to 1.5m.

Soil Description
Australian Soil Classification: Brown Vertosol **A1** Very dark brown (7.5YR 2.5/3) heavy clay with strong angular blocky structure, a few large pebbles on surface, to 0.1m, gradual change to; **B21** Brown (7.5YR 4/2) heavy clay with moderate angular blocky structure, a few carbonates, to 0.8m, gradual change to; **B22** Brown (7.5YR 4/3) heavy clay with weak angular blocky structure, many medium gravel , with a few dark mottles, common carbonates and manganese concretions, to 1.3m, clear change to; **C** Brown (7.5YR 4/3) silty light clay (siltstone), massive structure, with many yellow and red mottles, to 1.4m.
Australian Soil Classification: Red Dermosol **A1** Reddish brown (5YR 4/4) silty light clay with weak polyhedral structure, to 0.2m, clear change to; **B21** Yellowish red (5YR 4/6) medium clay with moderate polyhedral structure, with many yellow and black mottles, common manganese, to 0.65m, diffuse change to; **B22** Brownish Yellow (10YR 6/8) silty medium clay with weak polyhedral structure, with many red mottles, to 0.95m, diffuse change to; **C** Brownish Yellow (10YR 6/8) silty light clay with weak polyhedral structure, to 1.5m.

3.2 Summary of Soil Chemistry

Five baseline and one rehabilitation location were selected for soil chemistry sampling. Site numbers, soil classification and sample locations are given in Table 5. The survey reference number can be cross referenced with the Appendix 1 Map: Soil Classification and Sample Locations, and the soil chemistry sample number with the Certificate of analysis in Appendix 3.

Table 5: Soil chemistry sample location reference

Survey reference	Australian Soil Classification	Soil chemistry sample number
TW_05	Brown Tenosol	Site 1
TW_10	Brown Sodosol	Site 2
TW_12	Brown Vertosol	Site 3
TW_22	Red Sodosol	Site 4
TW_34	Grey Anthroposol	Site 5
TW_40	Brown Sodosol	Site 6

Soil chemistry profiles of the key characteristics are show in Figure 1 . Table 6 shows the classification of the profiles based on Hazelton and Murphy (2016). Emerson Aggregate Test (EAT) scores are given in Table 7. Note that for the Brown and Red Sodosol sites (TW_10, TW_12 and TW_22) an average profile soil chemistry is presented.

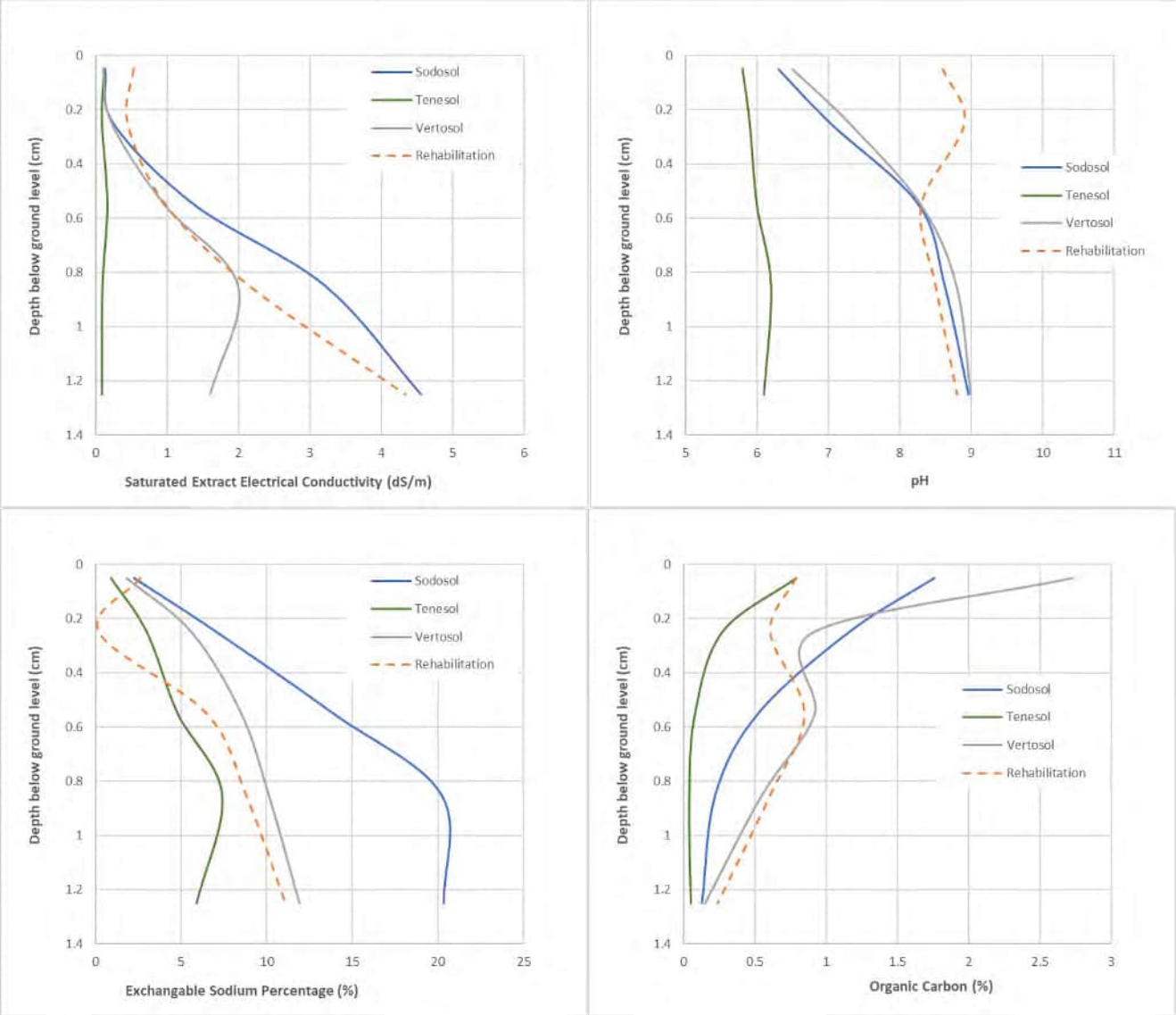

Figure 1: Chemistry by soil type and depth (Salinity EC_{se}, pH, ESP and OC)

Summarising soil chemistry by soil type the soils were found to be:

- Brown and Red Sodosol;
  - pH profiles slightly acid at surface to strongly alkaline at depth;
  - Non-saline at surface to moderately saline to depth;
  - High organic carbon in the surface declining to low at depth, with
  - Low to very low CEC, non-sodic at surface increasing to strongly sodic at depth with low Ca:Mg ratio;
  - EAT scores suggest non-dispersive topsoils with dispersive subsoils.

- Brown Tenesol;
    - pH profiles moderately acid at surface increasing to slightly acid to depth;
    - Non-saline throughout;
    - Moderate organic carbon in the surface declining to low at depth;
    - Very low CEC, non-sodic at surface to marginally sodic to depth with low Ca:Mg ratio;
    - EAT scores suggest non-dispersive topsoils with dispersive subsoils.
- Black and Brown Vertosol;
    - pH profiles slightly acid at surface to strongly alkaline at depth;
    - Non-saline throughout;
    - High organic carbon in the surface declining to low at depth.
    - Low CEC at surface increasing to moderate at depth, non-sodic at surface increasing sodic at depth with low Ca:Mg ratio;
    - EAT scores suggest dispersive topsoils and subsoils.
- Rehabilitated soil;
    - pH profiles slightly acid at surface to strongly alkaline at depth;
    - Non-saline throughout;
    - High organic carbon in the surface declining to low at depth.
    - Low CEC at surface increasing to moderate at depth, non-sodic at surface increasing sodic at depth with low Ca:Mg ratio;
    - EAT scores suggest slaking but non-dispersive topsoils and sub-soils.

Table 6: Chemical Characteristics of Soil Types

Australian Soil Classifications	Profile	pH	ECse	CEC	ESP (%)	OC (%)
Brown and Red Sodosol	Topsoil	Slightly acid	Non-saline	Low	Non-sodic	High
	Sub-soil	Neutral to moderately acid	Non-saline	Very low to low	Sodic	Moderate
	Sediment	Strongly alkaline	Moderately saline	Low	Strongly sodic	Low
Brown Tenesol	Topsoil	Moderately acid	Non-saline	Very low	Non-sodic	Moderate
	Sub-soil	Moderately acid	Non-saline	Very low	Non-sodic	Low
	Sediment	Slightly acid	Non-saline	Very low	Non-sodic to sodic	Low
Black and Brown Vertosol	Topsoil	Slightly acid	Non-saline	Low	Non-sodic	High
	Sub-soil	Neutral to moderately acid	Non-saline	Low to moderate	Sodic	Moderate
	Sediment	Strongly alkaline	Non-saline	Moderate	Sodic	Low
Rehabilitation area	Topsoil	Slightly acid	Non-saline	Low	Non-sodic	Moderate
	Sub-soil	Neutral to moderately acid	Non-saline	Low to moderate	Sodic	Moderate
	Sediment	Strongly alkaline	Non-saline	Moderate	Sodic	Low

Table 7: Emerson Aggregate Scores by soil type and depth

Emerson Class Number	Soil Type			
Soil depth (mm)	Sodosol	Tenosol	Vertosol	Rehabilitation
0 -100	7	7	3	4
200- 300	2	7	3	4
500- 600	2	2	2	5
800- 900	2	2	2	4
1200 – 1300	2	2	2	4

3.3 Stockpile material

Three (3) stockpiles of topsoil across the project area were randomly sampled (0-100 mm depth). 3 replicate samples were taken per stockpile and Table 8 gives the average chemistry. The physical characteristics of the stockpiles were:

- Stockpile 1 and 3 were similar, with brown to reddish brown medium to heavy clay texture, a few brown mottle and common medium gravel, chemistry described as:
    - Neutral pH;
    - Non-saline ;
    - Moderate to high organic carbon;
    - Moderate CEC, non-sodic with low Ca:Mg ratio;
    - EAT scores suggest slaking but non-dispersive soils.
- Stockpile 2 was a light yellowish brown silty sand, chemistry described as:
    - Moderately acid;
    - Non-saline;
    - Moderate organic carbon;
    - Low CEC, non-sodic with balanced Ca:Mg ratio;
    - EAT scores suggest slaking but non-dispersive soils.

.

Table 8: Stockpile material Soil Chemistry Summary

Site	ECse	pH	ESP (%	CEC	Ca:Mg ratio	OC (%)	EAT
SP1	0.1	6.9	1.8	16.3	3.0	1.1	3
SP2	0.1	5.8	1.7	2.8	1.4	0.9	4
SP3	0.1	6.9	0.3	19.7	5.5	2.0	3

4. Agricultural Land Evaluation

A number of frameworks and references are referred to establish the agricultural land evaluation for the project area.

4.1 Strategic Cropping Land

None of the area was defined as Strategic cropping land (SCL) on the trigger maps. Queensland Globe (2022) (last access 10/5/2022). Therefore, no further assessment is required under this framework.

4.2 Regional Land Suitability Frameworks

Five land suitability classes are defined for use in Queensland (DNRM and DSITIA, 2013), with land suitability decreasing progressively from Class 1 to Class 5. These classes are used to describe an area of land in terms of suitability for a particular land use which allows optimum, sustainable production with current technology while minimising degradation to the land resource in the short, medium or long-term. The five land suitability classes are defined below:

- **Class 1** Suitable land with negligible limitations. This is highly productive land requiring only simple management practices to maintain economic production.
- **Class 2** Suitable land with minor limitations which either reduce production or require more than the simple management practices of class 1 land to maintain economic production.
- **Class 3** Suitable land with moderate limitations which either further lower production or require more than those management practices of class 2 land to maintain economic production.
- **Class 4** Marginal land, which is presently considered unsuitable due to severe limitations. The long term significance of these limitations on the proposed land use is unknown or not quantified. The use of this land is dependent upon undertaking additional studies to determine whether the effect of the limitation(s) can be reduced to achieve sustained economic production.
- **Class 5** Unsuitable land with extreme limitations that preclude its use.

The first three classes of land are considered suitable for the specified land use, as the benefits from using the land for that land use in the long term should outweigh the inputs required to initiate and maintain production.

Class 4 land is regarded as marginal land, currently unsuitable for a particular land use due to the severity of one or a number of limiting factors. It is doubtful that the inputs required to achieve and maintain production outweigh the benefits in the long-term.

Class 5 land is regarded as unsuitable for a particular land use because it has limitations that singularly or in aggregate are so severe that the benefits would not justify the inputs required to initiate and maintain sustainable production in the long term.

An overall suitability class for each land use is then determined on a scale of 1 to 5.

Using the Suitability framework for the Eastern Downs area (DNRM and DSITIA, 2013) Regional Land Suitability Frameworks for Queensland we have assessed the suitability of the site for various dryland crops in aggregate. We have made this assessment for the Brown Red Sodosol soil unit only, as neither other soil units (Tenosol or Dermosol) represent sufficient area as to be suitable for any form of dryland cropping activity.

Table 9: Suitability Framework Score

Suitability Framework Category	Suitability Score Range	Most common Score
E - Water erosion	2 - 4	3
Es - Erosion hazard, subsoil erodibility	3 - 5	4
M – Soil water availability	2 - 4	3
Pm - Narrow moisture range	3 - 4	4
Ps - Surface condition	1 - 3	2
R - Rockiness	3 - 5	2
Tm - Microrelief	1 - 2	1
W - Wetness	2 - 4	2
Overall class		4

The overall classification was a suitability score of 4, Marginal land, which considered unsuitable due to severe limitations

4.3 Agricultural Land Classification

Agricultural land classification in Queensland follows a simple hierarchical scheme that is applicable across the state (DSITI & DNRM, 2015). It allows the presentation of interpreted land evaluation data to indicate the location and extent of agricultural land that can be used sustainably for a wide range of land uses with minimal land degradation. Three broad classes of agricultural land and one non-agricultural land class are identified:

- **Class A** – Crop land
- **Class B** – Limited crop land
- **Class C** – Pasture land
- **Class D** – Non-agricultural land.

A review of the Agricultural Land Classification . Queensland Globe (2022) (last access 10/5/2022) define the project area as either C1 or C2 class. C1 land is the higher fertility grazing land typically used for beef cattle fattening and lands that are not suitable for cropping. C2 land is more typically suited to sheep and cattle breeding, while C3 is restricted to grazing with low stocking rates.

Based on the mapping unit of C1 or C2 class, and including outcomes from Section 4.2 where the suitability assessment classed the site overall as Class 4, the site would be defined as C2 classification (DSITI & DNRM, 2015). The site is considered suitable for livestock fattening where stock can be removed as required to maintain vegetative cover, protecting the soils from erosion risk.

5. Land Management and Amelioration

5.1 Soil Erosion

Erosion can have an adverse effect on soil productivity and the associated agricultural value. Additional effects can include downstream sedimentation, and decline in fertility through loss of soil structure, and increased dust generation and poor rehabilitation.

Dispersive clay subsoils with high ESPs, low Ca:Mg ratios are susceptible to tunnel and gully erosion which is particularly difficult to manage once initiated. The subsoils of the WLQ have clay subsoils that have a low erosion rating when undisturbed. However, as the subsoils can be sodic to strongly sodic, these soils will erode due to clay dispersion where soil is exposed to rainfall or runoff. Management options involve minimising exposure, careful management of overland flow, maintaining vegetation cover, and where appropriate, the use of soil ameliorants such as gypsum and lime (to reduce the degree of dispersion).

While site practices will be guided by site specific Erosion and Sediment Control plans. Where applicable, the following general erosion and sediment control measures are recommended:

- Contour banks should be used at intervals appropriate to the slope and soil type to control the flow of surface water.
- Diversion and erosion and sediment control devices should be fully implemented to provide effective erosion control prior to land disturbance activities, and kept in place and maintained until the area has been effectively rehabilitated.
- Where diversion of runoff water around a construction/rehabilitation site is required, design will need to be mindful of possible erosion effects due to concentration of flow.

5.2 Soil Amelioration

Soil amelioration will vary for different soils depending on soil chemistry. Lower cation exchange capacity soils (i.e., sandy soils) generally have a lower amendment requirement due less exchange sites for cation transfer. The guiding principles for choosing chemical amendments, i.e., to use lime, gypsum, or sulphur ameliorants, depends on both pH, ESP and Ca:Mg ratio.

A summary of the topsoil stockpile characteristics and implications for their use in rehabilitation include:

- In general, the soils were observed to be weakly-structured and possibly hardsetting.
- Salinity (0.1 dS/m) was low and is not considered to be an issue for use of the material.
- Current pH (5.8 – 6.9) is unlikely to impact on vegetation growth. We do not recommend any treatment for soil pH.
- Cation Exchange Capacity was very low (stockpile 2) to moderate (stockpiles 1 and 3).
- Sodicity was low (0.3 – 1.8 %) but The EAT scores suggest most soils are slaking, but non-dispersive. Some of the stockpiled topsoil had low organic content.
- Give these characterises, the primary issues around use of the material in rehabilitation will not be due soil chemistry, but more likely be due to poor aggregation, a lack of root aeriation and poor water and nutrient holding capacity. Remediation of these soils needs to therefore focus on improving aggregate stability and building organics within the soil.
- Total organic carbon across the stockpiles varies, but recommend that an increase in OC will be useful for long term viability of vegetation. Initial establishment is paramount to start the site

off on the right trajectory, and therefore we recommend rehabilitation areas have 10-20 t/ha of pasture hay applied, ideally the hay has seeding in the grass cut, and an application of a broad-based fertilizer (containing N,P,K and S). We suggest contacting a local fertiliser supplier for a recommendation of available product.

- Following the application of the pasture hay and fertilizer, the site should have a light offset disking to anchor the material into the surface.

If the sub-soil material (Sodosol soils) is used for rehabilitation, we recommend amendment application to manage the sodicity.

- Gypsum should be applied at a rate of 5 kg/m^3 of soil to be treated, or 15 t/ha if broadcast as a surface ameliorant to treat the top 30 cm of material.
- Alternatively, Lime may be used were soil pH permits (not recommended for material where pH is >8.4) at a rate of 2.5 kg/m^3 , or 7.5 t/ha if broadcast as a surface ameliorant to treat the top 30 cm of material.

6. Rehabilitation Soil Testing and Monitoring Metrics

Horizon were requested to provide:

- A soil testing program/procedure; and
- Metrics to measure future rehabilitation performance based on soil testing program results.

Our proposed methodology is provided below:

6.1 Soil testing program/procedure

The following steps detail the proposed sampling program:

1. The testing program plan for each uniform rehabilitation area should be at a density of:
   - Minimum of 1 sample site per 6 hectares of rehabilitation: and
   - Have a minimum of 3 sample sites per rehabilitation area.
2. At each site, samples should be taken at a maximum of 100 mm increments to a depth not less than the topsoil capping depth. Sampling should ensure that soil from different depths does not mix.
3. Minimum sample size should 250 g. Samples to be labelled with sampler name, site, sample number, sample depth and date of sample.
4. Photograph to be taken of the samples, and surrounding area, with a hole identifier label and date visible.
5. Samples to be submitted to a NATA accredited laboratory for analysis of:
   a. Moisture Content @ 40°C.
   b. Electrical Conductivity (1:5).
   c. pH (1:5).
   d. Exchangeable Cations (Ca, Mg, Na, K, Al). With Ca:Mg ratio, and Exchangeable Sodium Percent (ESP) derived.
   e. Chloride.
   f. Total Organic Carbon (TOC) in Soil.

Soil salinity to be estimated as Saturated Extract Electrical Conductivity (EC_{se}) using the methods outlined in Shaw (1994).

6.2 Metrics for Soil Rehabilitation Performance.

The metrics for soil rehabilitation performance should be estimated using a minimum of three (3) samples for each uniform rehabilitation area. The measurement being expressed as a mean measurement with standard error of measurement presented.

The metric for success of the soil rehabilitation should be assessed against the following criteria:

1. The pH is between 5 and 8.4 pH units; and
2. The Exchangeable Sodium Percentage is less than six percent (< 6%); and
3. The soil salinity, expressed as EC_{se} is less than 5.5 dS/m; and
4. The organic carbon percentage (OC %) is greater than 1.0 %.
5. The site should be stable and not exhibiting evidence of rilling.

7. References

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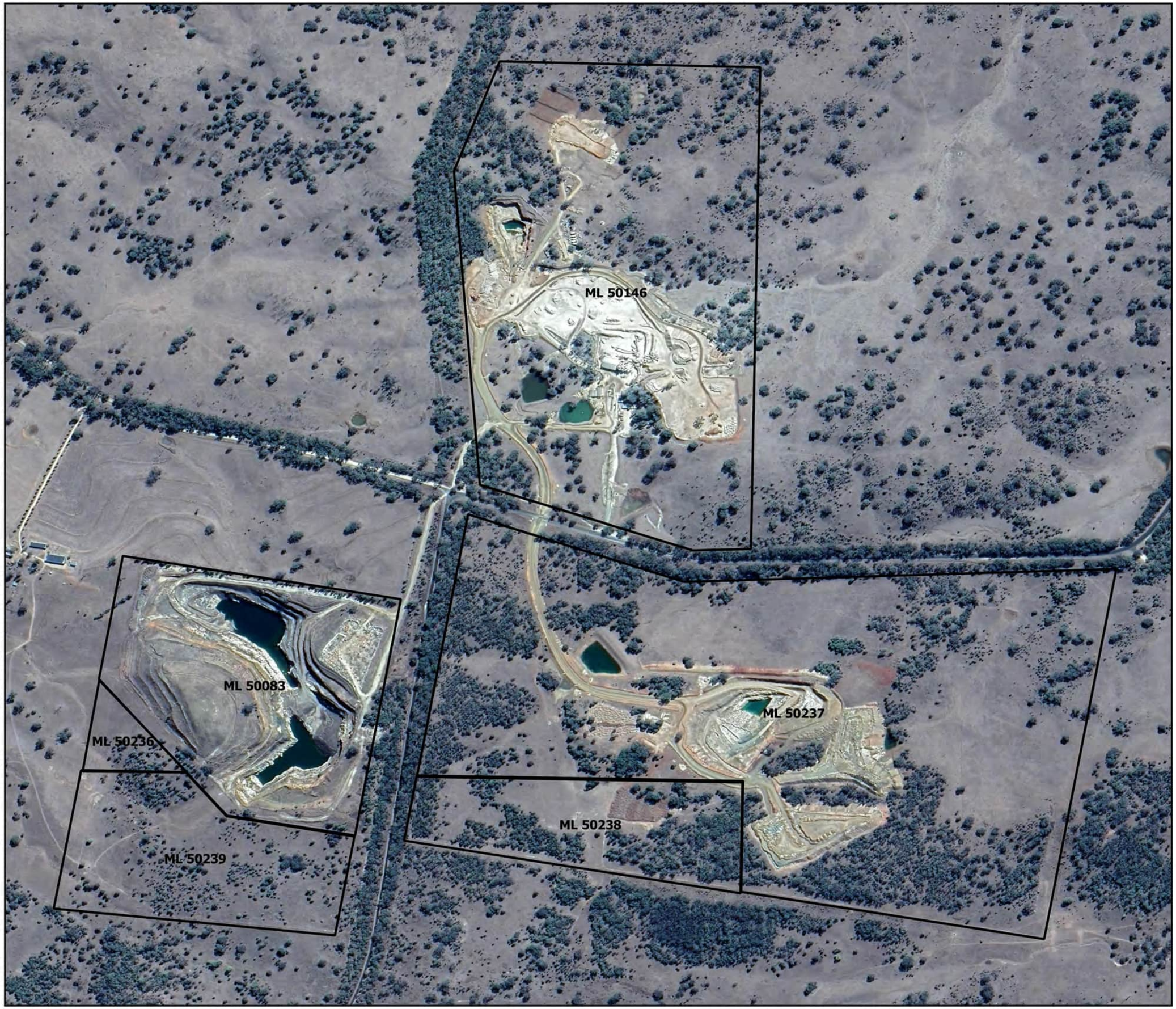
Appendix 1: Maps



Mining Lease Boundaries

Project:
Warwick Limestone Quarry

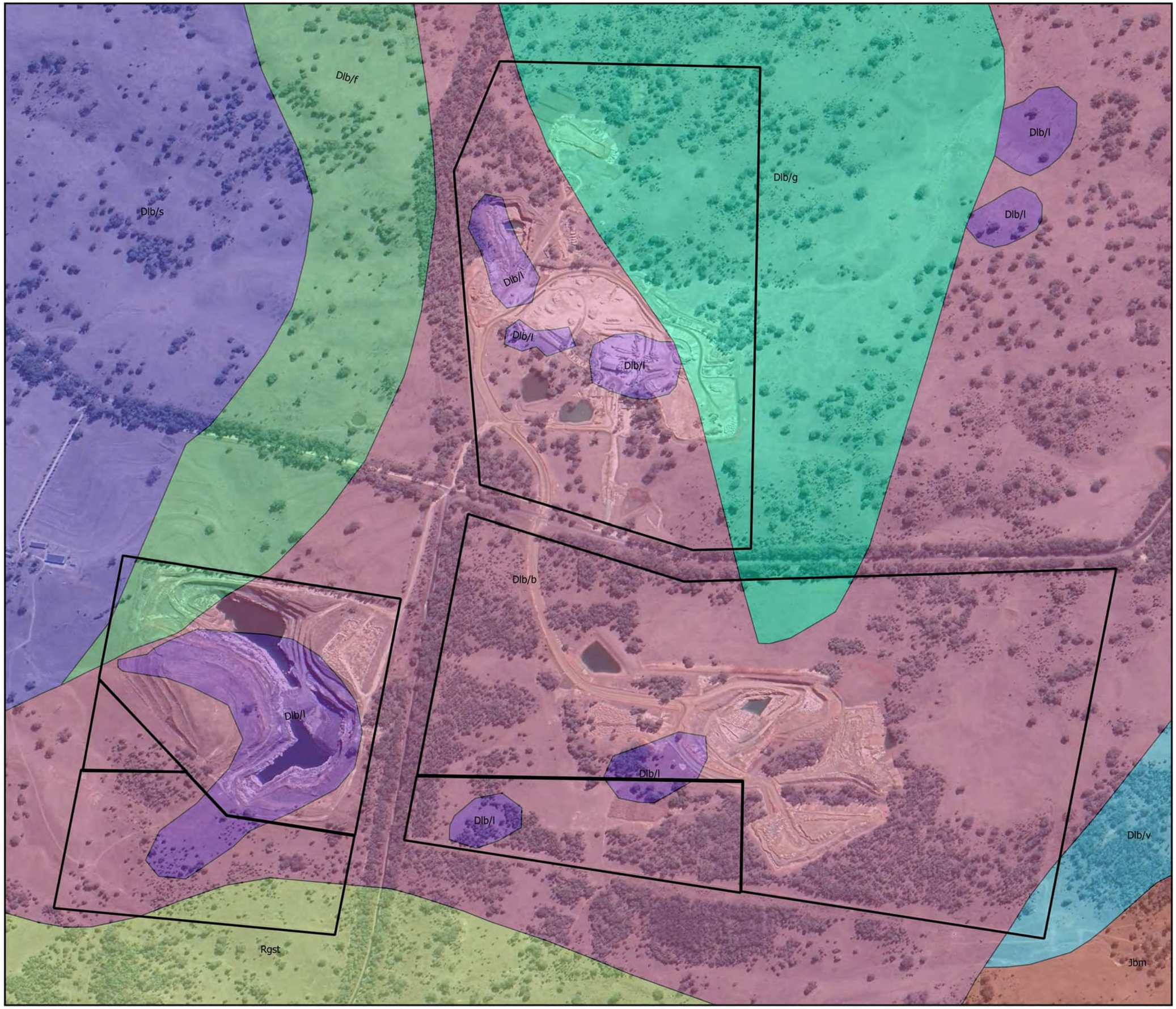
Version Number: 1.0
Date: 10/05/2022

0 0.2 0.4 km

Legend

Mining Lease Boundaries
Google Satellite

Horizon
Soil Science and Engineering



Geology

Project:
Warwick Limestone Quarry

Version Number: 1.0
Date: 10/05/2022

0 0.2 0.4 km

Legend

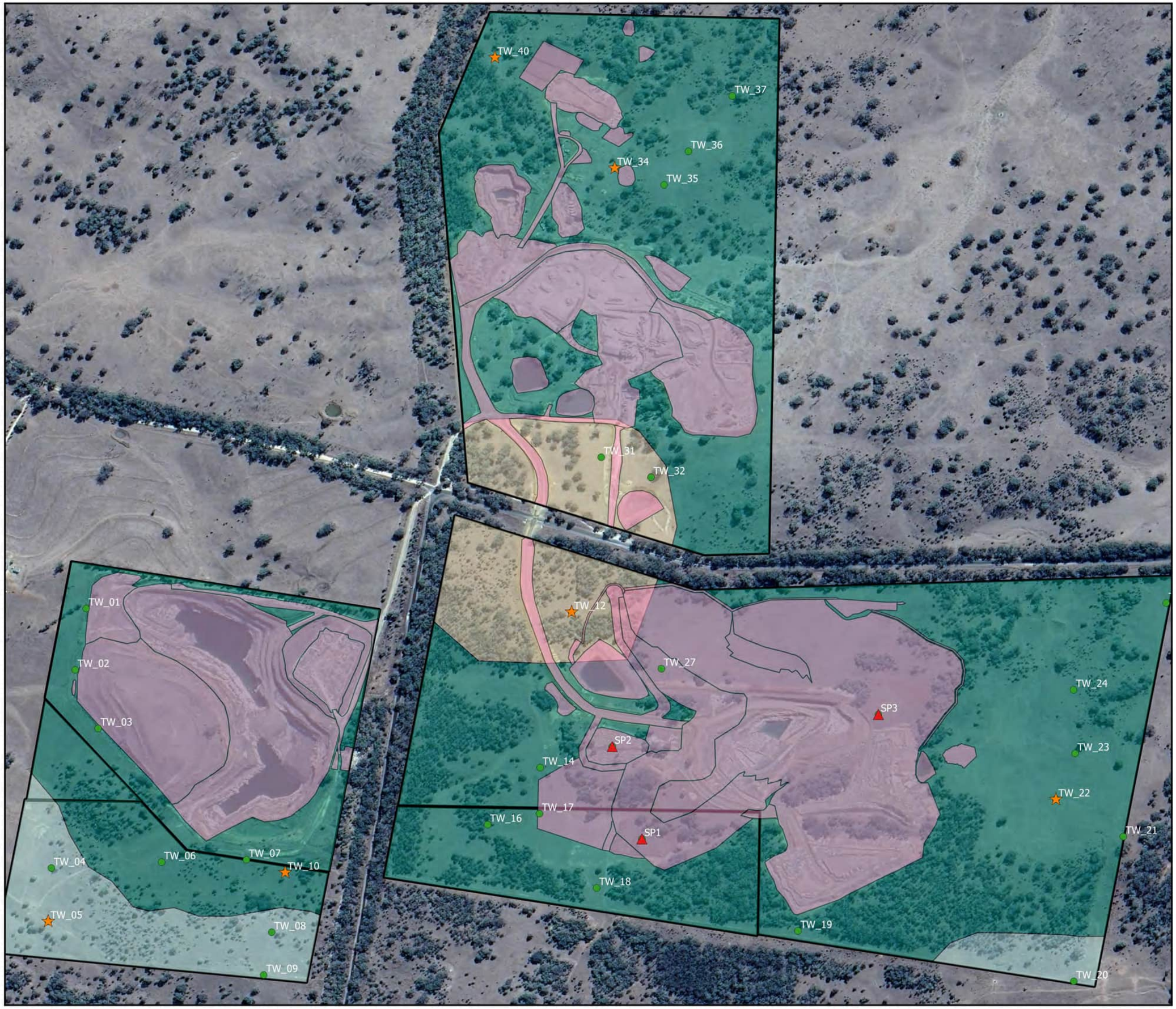
- Mining Lease Boundaries

QLD Geology

- Bald Hill Formation/b (Dlb/b)
- Bald Hill Formation/f (Dlb/f)
- Bald Hill Formation/g (Dlb/g)
- Bald Hill Formation/l (Dlb/l)
- Bald Hill Formation/s (Dlb/s)
- Bald Hill Formation/v (Dlb/v)
- Marburg Subgroup (Jbm)
- Stanthorpe Granite (Rgst)

Google Satellite

Horizon
Soil Science and Engineering



Soil Boundaries and Sample Locations

Project:
Terraquip Warwick

Version Number: 1.0
Date: 29/03/2022

0 0.15 0.3 km

Legend

- Sample locations
- Chemistry locations
- Stockpile locations
- Mining Lease Boundaries
- Future disturbance Areas

Soil boundaries

- Chromosol
- Tenesol
- Vertosol

Google Satellite

Horizon
Soil Science and Engineering

Soils Classification and Sample Locations

Project:
Warwick Limestone Quarry

Version Number: 1.1
Date: 16/05/2022

0 0.2 0.4 km

Legend

- Detailed Description
- Chemistry locations
- Stockpile locations
- Future disturbance Areas
- Mining Lease Boundaries

Soil boundaries

- Dermosol
- Sodosol
- Tenesol

Google Satellite

Horizon
Soil Science and Engineering

Appendix 2: Detailed Descriptions

Site number	Description	Photos
Site ID: TW01 **Location:** S28.39514° E152.10617° **Described by:** Dan Rattray **Date:** 22/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Midslope **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Well drained **Rock outcrop:** Slightly rocky **Surface coarse fragments:** Nil **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**Australian Soil Classification (ASC): Red Dermosol** **A1** Reddish brown (5YR 4/4) silty light clay with weak polyhedral structure, to 0.2m, clear change to; **B21** Yellowish red (5YR 4/6) medium clay with moderate polyhedral structure, with many yellow and black mottles, common manganese, to 0.65m, diffuse change to; **B22** Brownish Yellow (10YR 6/8) silty medium clay with weak polyhedral structure, with many red mottles, to 0.95m, diffuse change to; **C** Brownish Yellow (10YR 6/8) silty light clay with weak polyhedral structure, to 1.5m.	

Site number	Description	Photos
Site ID: TW02 **Location:** S28.39620° E152.10601° **Described by:** Dan Rattray **Date:** 22/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Midslope **Permeability:** Slowly permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** Slightly rocky **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Brown Dermosol** **A1** Very dark greyish brown (2.5Y 3/2) silty light clay with moderate polyhedral structure, many small gravel on surface, to 0.15m, clear change to; **B2** Oliver brown (2.5Y 4/4) medium clay with weak polyhedral structure, common medium gravel, with many yellow and grey mottles, a few manganese, to 0.45m, clear change to; **B3** Dark grey (2.5Y 4/1) light clay with massive nil structure, with many yellow and red mottles, to 0.6m, gradual change to; **C** Dark grey (2.5Y 4/1) fine sandy light clay, to 1.5m.	

Site number	Description	Photos
Site ID: TW03 **Location:** S28.39717° E152.10642° **Described by:** Dan Rattray **Date:** 22/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Midslope **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Well drained **Rock outcrop:** No bedrock exposed **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Red Dermosol** **A1** Very dark greyish brown (2.5Y 3/2) silty light clay with moderate polyhedral structure, many small gravel on surface, to 0.15m, clear change to; **B2** Yellowish red (5YR 4/6) medium clay with weak polyhedral structure, common medium gravel, with many yellow and black mottles, a few manganese, to 0.45m, clear change to; **B3** Dark grey (2.5Y 4/1) light clay with massive nil structure, with many yellow mottles, to 0.6m, gradual change to; **C** Dark grey (2.5Y 4/1) fine sandy light clay, to 1.5m.	

Site number	Description	Photos
Site ID: TW04 **Location:** S28.39957° E152.10568° **Described by:** Dan Rattray **Date:** 22/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Bottom hill **Permeability:** Slowly permeable **Microrelief:** None **Drainage:** Poorly drained **Rock outcrop:** No bedrock exposed **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Grey Tenosol** **A1** Dark brown (10YR 3/3) loamy sand with massive nil structure, common small gravel, to 0.15m, clear change to; **B2** Light brownish grey (10YR 6/2) loamy sand with massive nil structure, common small gravel, to 0.6m, diffuse change to; **B31** Light yellowish brown (10YR 6/4) coarse sandy clay with massive nil structure, many small gravel, to 0.9m, clear change to; **B32** Yellowish brown (10YR 5/6) clayey sand with massive nil structure, common small gravel, with abundant grey and a few black mottles, common iron-manganese, to 1.2m.	

Site number	Description	Photos
Site ID: TW05 **Location:** S28.40045° E152.10563° **Described by:** Dan Rattray **Date:** 22/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Bottom hill **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Well drained **Rock outcrop:** No bedrock exposed **Surface condition:** Loose **Disturbance:** Extensive clearing **Sample site:** SITE 1	**ASC: Brown Tenosol** **Description** **A1** Brown (10YR 4/3) loamy sand, non-coherent structure, abundant small gravel on surface and common through horizon, to 0.35m, clear change to; **B2** Brown (10YR 5/3) loamy sand, non-coherent structure, common small gravel, to 0.6m, diffuse change to; **C** Brown (7.5YR 5/3) clayey sand, non-coherent structure, abundant small gravel, to 1.5m.	

Site number	Description	Photos
Site ID: TW06 **Location:** S28.39923° E152.10736° **Described by:** Dan Rattray **Date:** 22/03/2022 **Geology:** Bald hill formation, Limestone **Landfrom pattern:** Low Hills **Element:** Midslope **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Imperfectly drained **R Rock outcrop:** Rocky **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Brown Dermosol** **A1** Very dark greyish brown (10YR 3/2) heavy clay with strong polyhedral structure, a few small and medium gravel, to 0.2m, clear change to; **B2** Dark brown (10YR 3/3) heavy clay with moderate polyhedral structure, with a few red mottles, to 0.5m, clear change to; **B3** Olive brown (2.5Y 4/3) heavy clay with weak polyhedral structure, many small gravel, with common dark mottles, a few manganese, to 0.9m. Refusal on rock	

Site number	Description	Photos
Site ID: TW07 **Location:** S28.39933° E152.10901° **Described by:** Dan Rattray **Date:** 22/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Midslope **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** No bedrock exposed **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Red Dermosol** **A1** Very dark greyish brown (10YR 3/2) loam with weak polyhedral structure, to 0.15m, abrupt change to; **B21** Reddish brown (5YR 4/4) medium clay with moderate polyhedral structure, with common grey mottles, to 0.45m, gradual change to; **B22** Dark yellowish brown (10YR 4/4) medium clay with moderate polyhedral structure, many medium gravel, a few manganese, to 0.7m, clear change to; **R** Grey (10YR 5/1) basalt.	

Site number	Description	Photos
Site ID: TW08 **Location:** S28.40059° E152.10947° **Described by:** Dan Rattray **Date:** 22/03/2022 **Geology:** Stanthorpe Granite **Landfrom pattern:** Low Hills **Element:** Midslope **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Well drained **Rock outcrop:** Rocky **Surface condition:** Loose **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Brown Tenosol** **A11** Dark brown (10YR 3/3) loamy sand with massive nil structure, common medium gravel, to 0.25m, clear change to; **A12** Yellowish brown (10YR 5/6) loamy sand with massive nil structure, many medium gravel, to 0.5m, abrupt change to; **R** White (7.5YR 8/1) granite.	

Site number	Description	Photos
Site ID: TW09 **Location:** S28.40133° E152.10933° **Described by:** Dan Rattray **Date:** 22/03/2022 **Geology:** Standthorpe Granite **Landfrom pattern:** Low Hills **Element:** Top **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Well drained **Rock outcrop:** No bedrock exposed **Surface condition:** Loose **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Brown Tenosol** **A1** Dark brown (10YR 3/3) loamy sand with massive nil structure, common medium gravel, to 0.15m, abrupt change to; **B2** Yellowish brown (10YR 5/4) loamy sand with massive nil structure, many medium gravel, to 0.4m, clear change to; **C** Reddish yellow (7.5YR 6/8) clayey sand with massive nil structure, abundant medium gravel, to 0.9m.	

Site number	Description	Photos
Site ID: TW10 **Location:** S28.39955° E152.10967° **Described by:** Dan Rattray **Date:** 22/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Midslope **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** No bedrock exposed **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** SITE 2	**ASC: Brown Sodosol** **A1** Very dark brown (10YR 2/2) sandy loam with weak polyhedral structure, a few small gravel, to 0.2m, abrupt change to; **B2** Yellowish brown (10YR 5/6) medium heavy clay with weak polyhedral structure, many small gravel, with common dark mottles, a few manganese, to 1.3m.	

Site number	Description	Photos
Site ID: TW012 **Location:** S28.39507° E152.11448° **Described by:** Dan Rattray **Date:** 22/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Drainge line **Permeability:**Slowly permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** No bedrock exposed **Surface coarse fragments:** A few large pebbles **Surface condition:** Self mulching **Disturbance:** Extensive clearing **Sample site:** SITE 3	**ASC: Brown Vertosol** **Description** **A1** Very dark brown (7.5YR 2.5/3) heavy clay with strong angular blocky structure, a few large pebbles on surface, to 0.1m, gradual change to; **B21** Brown (7.5YR 4/2) heavy clay with moderate angular blocky structure, a few carbonates, to 0.8, gradual change to; **B22** Brown (7.5YR 4/3) heavy clay with weak angular blocky structure, many medium gravel, with a few dark mottles, common carbonates and manganese concretions, to 1.3m, clear change to; **C** Brown (7.5YR 4/3) silty light clay (siltstone), massive structure, with many yellow and red mottles, to 1.4m.	

Site number	Description	Photos
Site ID: TW14 **Location:** S28.39759° E152.11390° **Described by:** Dan Rattray **Date:** 22/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Midslope **Permeability:** Slowly permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** Slightly rocky **Surface condition:** Loose **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Brown Sodosol** **A1** Brown (10YR 5/3) sandy clay with weak granular structure, common medium gravel, to 0.2m, abrupt change to; **B2** Strong brown (7.5YR 5/8) medium clay with weak polyhedral structure, many medium gravel, with many grey mottles, a few carbonates, to 0.8m, clear change to; **B3** Strong brown (7.5YR 5/8) medium clay with massive nil structure, abundant medium and large gravel, with many grey mottles, a few carbonates, to 1.2m, clear change to; **C** Yellowish brown (10YR 5/4) sandstone with massive nil structure, to 1.4m.	

Site number	Description	Photos
Site ID: TW15 **Location:** S28.39841° E152.11585° **Described by:** Dan Rattray **Date:** 22/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Midslope **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** No bedrock exposed **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Brown Dermosol** **A1** Very dark brown (7.5YR 2.5/3) heavy clay with strong angular blocky structure, a few large gravel on surface, to 0.1m, gradual change to; **B21** Brown (7.5YR 4/2) heavy clay with moderate angular blocky structure, a few carbonates, to 0.8m, gradual change to; **B22** Brown (7.5YR 4/3) heavy clay with weak angular blocky structure, many medium gravel, with a few dark mottles, common carbonates, to 1.3m, clear change to; **C** Brown (7.5YR 4/3) silty light clay with massive angular blocky structure, with many yellow mottles, to 1.4m.	

Site number	Description	Photos
Site ID: TW16 **Location:** S28.39867° E152.11313° **Described by:** Dan Rattray **Date:** 22/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Top **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** No bedrock exposed **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Brown Sodosol** **A1** Very dark brown (7.5YR 2.5/3) loamy sand with weak granular structure, common small gravel, to 0.25m, abrupt change to; **B2** Strong brown (7.5YR 5/6) medium clay with weak polyhedral structure, many small and medium gravel, with a few grey mottles, to 0.6m, abrupt change to; **R** White (7.5YR 8/1) coarse grained rock.	

Site number	Description	Photos
Site ID: TW17 **Location:** S28.39849° E152.11398° **Described by:** Dan Rattray **Date:** 22/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Top **Permeability:** Slowly permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** Slightly rocky **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Brown Sodosol** **A1** Brown (10YR 5/3) sandy loam with weak granular structure, common medium gravel, to 0.2m, abrupt change to; **B2** Strong brown (7.5YR 5/8) medium clay with weak polyhedral structure, many medium gravel, common carbonates, to 1.2m.	

Site number	Description	Photos
Site ID: TW18 **Location:** S28.39973° E152.11497° **Described by:** Dan Rattray **Date:** 22/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Top **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Moderly drained **Rock outcrop:** No bedrock exposed **Surface condition:** Hardsetting **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Red Sodosol** **A1** Brown (7.5YR 5/4) clayey sand with weak granular structure, common medium gravel, to 0.3m, abrupt change to; **B2** Red (2.5YR 4/6) medium clay with weak polyhedral structure, many small gravel, with many dark/grey mottles, common manganese, to 1.4m.	

Site number	Description	Photos
Site ID: TW19 **Location:** S28.40040° E152.11841° **Described by:** Dan Rattray **Date:** 23/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Top **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** Slightly rocky **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Red Sodosol** **A1** Very dark brown (7.5YR 2.5/3) sandy loam with moderate polyhedral structure, a few medium gravel, to 0.15m, abrupt change to; **B2** Dark Red (2.5YR 3/6) light clay with moderate polyhedral structure, a few medium gravel, with a few yellow mottles, to 0.7m, abrupt change to; **B3** Strong brown (7.5YR 5/6) light clay with massive nil structure, many medium and large gravel, with abundant grey/yellow mottles, to 1.3m.	

Site number	Description	Photos
Site ID: TW20 **Location:** S28.40087° E152.12279° **Described by:** Dan Rattray **Date:** 23/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Bottom hill **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Poorly drained **Rock outcrop:** No bedrock exposed **Surface condition:** Loose **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Grey Tenosol** **A1**1 Dark greyish brown (10YR 4/2) loamy sand with weak granular structure, abundant small gravel on surface, to 0.3m, abrupt change to; **A1**2 Pale brown (10YR 6/3) clayey sand with weak granular structure, many medium gravel, to 0.6m, clear change to; **C** Pale brown (10YR 6/3) medium clay with massive nil structure, abundant medium gravel, with abundant red mottles, to 1.2m.	

Site number	Description	Photos
Site ID: TW21 **Location:** S28.39871° E152.12395° **Described by:** Dan Rattray **Date:** 23/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Top **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** Rocky **Surface condition:** Hardsetting **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Red Sodosol** **A1** Dark reddish brown (5YR 3/4) silty light clay with weak granular structure, many small and medium gravel on surface, to 0.2m, abrupt change to; **B2** Yellowish red (5YR 4/6) medium clay with moderate polyhedral structure, with a few yellow mottles, a few manganese, to 0.6m, clear change to; **R** Reddish yellow (5YR 6/8) ironstone.	

Site number	Description	Photos
Site ID: TW22 **Location:** S28.39809° E152.12277° **Described by:** Dan Rattray **Date:** 23/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Broad valley **Permeability:**Slowly permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** No bedrock exposed **Surface coarse fragments:** A few medium pebbles **Surface condition:** Firm **Disturbance:** Complete clearing **Sample site:** SITE 4	**ASC: Red Sodosol** **Description** **A1** Very dark brown (7.5YR 2.5/3) clay loam with weak granular structure, a few medium pebbles on surface, to 0.3m, clear change to; **B2** Yellowish red (5YR 4/6) medium clay with moderate polyhedral structure, many manganese concretions, to 1.0m, diffuse change to; **B3** Dark reddish brown (5YR 3/4) silty light clay (siltstone) with moderate polyhedral structure, with abundant yellow and dark mottles and common carbonates, to 1.4m.	

Site number	Description	Photos
Site ID: TW23 **Location:** S28.39726° E152.12283° **Described by:** Dan Rattray **Date:** 23/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Midslope **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Poorly drained **Rock outcrop:** No bedrock exposed **Surface condition:** Loose **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Brown Sodosol** **A1** Dark brown (7.5YR 3/4) loamy sand with weak granular structure, to 0.2m, abrupt change to; **B2** Strong brown (7.5YR 5/6) medium clay with weak polyhedral structure, a few medium gravel, with common dark mottles, common manganese, to 0.5m, clear change to; **R** Grey (10YR 5/1) basalt.	

Site number	Description	Photos
Site ID: TW24 **Location:** S28.39622° E152.12287° **Described by:** Dan Rattray **Date:** 23/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Midslope **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** No bedrock exposed **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Brown Sodosol** **A1** Very dark greyish brown (10YR 3/2) loam with weak granular structure, a very few medium gravel on surface, to 0.3m, abrupt change to; **B2** Yellowish brown (10YR 5/6) light clay with weak polyhedral structure, with many grey/red mottles, a few manganese, to 0.8m, clear change to; **R** Very dark grey (10YR 3/1) basalt.	

Site number	Description	Photos
Site ID: TW26 **Location:** S28.39490° E152.12432° **Described by:** Dan Rattray **Date:** 23/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Bottom hill **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Poorly drained **Rock outcrop:** No bedrock exposed **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Brown Dermosol** **A1** Very dark brown (10YR 2/2) silty light clay with weak polyhedral structure, to 0.2m, clear change to; **B2** Very dark greyish brown (10YR 3/2) medium clay with strong polyhedral structure, common small and medium gravel, a few manganese, to 0.4m, gradual change to; **B3** Dark yellowish brown (10YR 4/6) medium clay with weak polyhedral structure, abundant medium gravel, with abundant dark/grey mottles, many manganese, to 0.8m, gradual change to; **R** Very dark greyish brown (10YR 3/2) basalt.	

Site number	Description	Photos
Site ID: TW27 **Location:** S28.39543° E152.11651° **Described by:** Dan Rattray **Date:** 23/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Bottom hill **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Well drained **Rock outcrop:** No bedrock exposed **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Sodosol**	

Site number	Description	Photos
Site ID: TW31 **Location:** S28.39240° E152.11491° **Described by:** Dan Rattray **Date:** 23/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Bottom hill **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** No bedrock exposed **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Black Vertosol** **A1** Black (10YR 2/1) heavy clay with strong subangular blocky structure, a few medium gravel, to 0.1m, clear change to; **B2** Black (10YR 2/1) heavy clay with strong subangular blocky structure, a few small gravel, common manganese, to 0.3m, clear change to; **B3** Dark yellowish brown (10YR 4/4) heavy clay with strong subangular blocky structure, with many dark mottles, to 1.4m.	

Site number	Description	Photos
Site ID: TW32 **Location:** S28.39273° E152.11577° **Described by:** Dan Rattray **Date:** 23/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Midslope **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** Slightly rocky **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Brown Dermosol** **A1** Very dark brown (10YR 2/2) silty medium clay with moderate subangular blocky structure, common cobbles on surface, to 0.1m, clear change to; **B2** Dark brown (7.5YR 3/3) heavy clay with moderate subangular blocky structure, with common dark mottles, a few manganese, to 0.4m, abrupt change to; **R** White (10YR 8/1) limestone.	

Site number	Description	Photos
Site ID: TW34 **Location:** S28.38752° E152.11503° **Described by:** Dan Rattray **Date:** 23/03/2022 **Geology:** Bald hill formation, Gabbroid **Landfrom pattern:** Low Hills **Element:** Midslope **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** No bedrock exposed **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** SITE 6	**ASC: Rehabilitation (Grey Anthroposol)** **A1** Dark brown (10YR 3/3) sandy clay with moderate polyhedral structure, many medium and large gravel on surface, to 0.4m, abrupt change to; **B2** Dark greyish brown (10YR 4/2) heavy clay, to 0.85m, gradual change to; **B3** Dark yellowish brown (10YR 4/6) heavy clay, common small gravel, to 1.5m.	

Site number	Description	Photos
Site ID: TW35 **Location:** S28.38775° E152.11591° **Described by:** Dan Rattray **Date:** 23/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Top **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** Rocky **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Red Sodosol** **A1** Very dark brown (7.5YR 2.5/3) clay loam with weak polyhedral structure, to 0.1m, clear change to; **B2** Dark reddish brown (5YR 3/4) medium clay with moderate polyhedral structure, common small and medium gravel, with a few yellow mottles, to 0.6m, abrupt change to; **B3** Yellowish brown (10YR 5/6) silty sand with massive nil structure, with many red/yellow mottles, many manganese, to 1.3m.	

Site number	Description	Photos
Site ID: TW36 **Location:** S28.38717° E152.11632° **Described by:** Dan Rattray **Date:** 23/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Midslope **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** No bedrock exposed **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Brown Sodosol** **A1** Very dark brown (7.5YR 2.5/3) clay loam with weak polyhedral structure, to 0.15m, clear change to; **B2** Dark brown (7.5YR 3/4) medium clay with moderate subangular blocky structure, with common dark mottles, a few manganese, to 0.5m, abrupt change to; **R** White (10YR 8/1) limestone.	

Site number	Description	Photos
Site ID: TW37 **Location:** S28.38623° E152.11707° **Described by:** Dan Rattray **Date:** 23/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Bottom hill **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** Slightly rocky **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** Nil	**ASC: Brown Sodosol** **A1** Very dark brown (7.5YR 2.5/3) clay loam with weak polyhedral structure, to 0.15m, clear change to; **B2** Dark brown (7.5YR 3/4) medium clay with moderate subangular blocky structure, with common dark mottles, a few manganese, to 0.5m, abrupt change to; **R** White (10YR 8/1) limestone.	

Site number	Description	Photos
Site ID: TW40 **Location:** S28.38563° E152.11299° **Described by:** Dan Rattray **Date:** 23/03/2022 **Geology:** Bald hill formation, Mafites **Landfrom pattern:** Low Hills **Element:** Top **Permeability:** Moderately permeable **Microrelief:** None **Drainage:** Imperfectly drained **Rock outcrop:** No bedrock exposed **Surface condition:** Firm **Disturbance:** Extensive clearing **Sample site:** SITE 5	**ASC: Brown Sodosol** **A1** Very dark greyish brown (10YR 3/2) silty light clay with weak polyhedral structure, many medium gravel on surface, to 0.1m, abrupt change to; **B21** Dark yellowish brown (10YR 4/6) silty medium clay with weak polyhedral structure, a few medium gravel, common manganese, to 0.6m, gradual change to; **B22** Yellowish brown (10YR 5/6) fine sandy medium clay with moderate polyhedral structure, a few medium gravel, common carbonates, to 1.05m, gradual change to; **B3** Yellowish brown (10YR 5/6) clayey sand with massive nil structure, a few medium gravel, with many grey mottles, to 1.35m.	

Appendix 3: Certificate of Analysis

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2208185**	Page	: 1 of 11
Client	: **Horizon Soil Science and Engineering**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAN RATTRAY	Contact	: Customer Services EB
Address	: Condamine Alliance EcoHub 266 Margaret Street Toowoomba Toowoomba 4350	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Terraquip Warwick	Date Samples Received	: 24-Mar-2022 13:28
Order number	: ----	Date Analysis Commenced	: 28-Mar-2022
C-O-C number	: ----	Issue Date	: 06-Apr-2022 16:26
Sampler	: DAN RATTRAY		
Site	: ----		
Quote number	: BN/158/21 V3		
No. of samples received	: 39		
No. of samples analysed	: 39		

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
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Inorganics, Stafford, QLD
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 Acid Sulphate Soils, 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.

- ED045G (Chloride): Some samples were diluted due to matrix interference. LOR adjusted accordingly.
- ALS is not NATA accredited for the analysis of Exchangeable Aluminium and Exchange Acidity in soils when performed under ALS Method ED005.
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- ED007 (Exchangeable Cations): Unable to calculate Magnesium/Potassium Ratio result as required Exchangeable Potassium results are less than the limit of reporting.
- ED006 (Exchangeable Cations on Alkaline Soils): Unable to calculate Magnesium/Potassium Ratio results for some samples as required Exchangeable Potassium results are less than the limit of reporting.
- EA058 Emerson: V. = Very, D. = Dark, L. = Light, VD. = Very Dark
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	TW_Site1_SOIL_0_202203231201	TW_Site1_SOIL_200_202203231202	TW_Site1_SOIL_500_202203231203	TW_Site1_SOIL_800_202203231204	TW_Site1_SOIL_1200_202203231205
			Sampling date / time	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00
Compound	CAS Number	LOR	Unit	EB2208185-001	EB2208185-002	EB2208185-003	EB2208185-004	EB2208185-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.8	5.9	6.0	6.2	6.1
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	10	3	<1	2	4
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	3.7	5.2	5.9	4.9	5.2
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Very Dark Grayish Brown (10YR 3/2)	Dark Grayish Brown (10YR 4/2)	Brown (7.5YR 5/3)	Brown (7.5YR 5/3)	Brown (7.5YR 4/4)
Texture	----	-	-	Clay Loam Sandy	Sandy Clay Loam	Sandy Loam	Clayey Sand	Clayey Sand
Emerson Class Number	EC/TC	-	-	7	7	2	2	2
ED005: Exchange Acidity								
ø Exchange Acidity	----	0.1	meq/100g	<0.1	0.2	0.3	----	----
ø Exchangeable Aluminium	----	0.1	meq/100g	<0.1	<0.1	0.1	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	0.9	0.4	0.1	0.2	0.6
Exchangeable Magnesium	----	0.1	meq/100g	0.3	0.2	0.2	0.3	0.4
Exchangeable Potassium	----	0.1	meq/100g	0.1	0.1	<0.1	0.1	0.1
Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	----	1.0	0.8	----	----
Cation Exchange Capacity	----	0.1	meq/100g	1.4	----	----	1.0	1.3
Exchangeable Sodium Percent	----	0.1	%	0.9	3.0	4.8	7.4	5.9
Calcium/Magnesium Ratio	----	0.1	-	3.0	2.0	0.5	0.7	1.5
Magnesium/Potassium Ratio	----	0.1	-	2.2	1.8	----	2.8	3.0
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	0.79	0.27	0.08	0.04	0.05

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	TW_Site2_SOIL_0_202203231206	TW_Site2_SOIL_200_202203231207	TW_Site2_SOIL_500_202203231208	TW_Site2_SOIL_800_202203231209	TW_Site2_SOIL_1200_202203231210
			Sampling date / time	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00
Compound	CAS Number	LOR	Unit	EB2208185-006	EB2208185-007	EB2208185-008	EB2208185-009	EB2208185-010
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.4	7.2	7.9	8.3	8.7
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	17	39	93	232	524
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	22.3	21.6	10.7	7.8	14.4
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Very Dark Gray (7.5YR 3/1)	Brown (10YR 4/3)	Brown (10YR 5/3)	Brown (10YR 4/3)	Brown (7.5YR 5/3)
Texture	----	-	-	Loam	Heavy Clay	Medium Heavy Clay	Medium Clay	Medium Heavy Clay
Emerson Class Number	EC/TC	-	-	7	2	1	1	1
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	----	2.2	2.7	4.0
ø Exchangeable Magnesium	----	0.2	meq/100g	----	----	4.7	6.1	10.1
ø Exchangeable Potassium	----	0.2	meq/100g	----	----	<0.2	<0.2	<0.2
ø Exchangeable Sodium	----	0.2	meq/100g	----	----	1.4	2.1	3.8
ø Cation Exchange Capacity	----	0.2	meq/100g	----	----	8.3	10.9	17.9
ø Exchangeable Sodium Percent	----	0.2	%	----	----	16.8	19.2	21.1
ø Calcium/Magnesium Ratio	----	0.2	-	----	----	0.4	0.4	0.4
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	4.9	4.6	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	1.7	9.7	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	0.2	0.2	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	0.2	1.7	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	7.1	16.2	----	----	----
Exchangeable Sodium Percent	----	0.1	%	2.6	10.5	----	----	----
Calcium/Magnesium Ratio	----	0.1	-	2.9	0.5	----	----	----
Magnesium/Potassium Ratio	----	0.1	-	6.6	55.9	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	10	50	120	270	790
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	1.21	0.42	0.31	0.20	0.11

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	TW_Site3_SOIL_0_202203231211	TW_Site3_SOIL_200_202203231212	TW_Site3_SOIL_500_202203231213	TW_Site3_SOIL_800_202203231214	TW_Site3_SOIL_1200_202203231215
			Sampling date / time	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00
Compound	CAS Number	LOR	Unit	EB2208185-011	EB2208185-012	EB2208185-013	EB2208185-014	EB2208185-015
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.5	7.3	8.3	8.8	9.0
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	15	31	130	330	296
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	20.8	26.2	23.0	18.7	17.4
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Black (5YR 2.5/1)	Dark Brown (7.5YR 3/2)	Brown (7.5YR 4/2)	Dark Brown (7.5YR 3/3)	Brown (7.5YR 4/3)
Texture	----	-	-	Medium Clay	Medium Heavy Clay	Medium Heavy Clay	Medium Heavy Clay	Medium Clay
Emerson Class Number	EC/TC	-	-	3	3	2	2	2
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	----	14.2	11.5	13.5
ø Exchangeable Magnesium	----	0.2	meq/100g	----	----	10.2	9.3	10.3
ø Exchangeable Potassium	----	0.2	meq/100g	----	----	<0.2	<0.2	<0.2
ø Exchangeable Sodium	----	0.2	meq/100g	----	----	2.3	2.3	3.2
ø Cation Exchange Capacity	----	0.2	meq/100g	----	----	26.7	23.1	27.0
ø Exchangeable Sodium Percent	----	0.2	%	----	----	8.5	10.1	11.9
ø Calcium/Magnesium Ratio	----	0.2	-	----	----	1.4	1.2	1.3
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	16.1	19.5	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	8.8	16.0	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	0.4	0.2	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	0.5	2.1	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	25.8	37.9	----	----	----
Exchangeable Sodium Percent	----	0.1	%	1.8	5.6	----	----	----
Calcium/Magnesium Ratio	----	0.1	-	1.8	1.2	----	----	----
Magnesium/Potassium Ratio	----	0.1	-	24.7	68.6	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	10	40	150	210	150
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	2.73	0.91	0.92	0.55	0.15

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	TW_Site4_SOIL_0_202203231216	TW_Site4_SOIL_200_202203231217	TW_Site4_SOIL_500_202203231218	TW_Site4_SOIL_800_202203231219	TW_Site4_SOIL_1200_202203231220
			Sampling date / time	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00
Compound	CAS Number	LOR	Unit	EB2208185-016	EB2208185-017	EB2208185-018	EB2208185-019	EB2208185-020
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.1	6.7	8.0	8.2	9.1
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	17	12	103	522	764
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	20.2	17.2	20.7	21.2	18.2
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Dark Brown (7.5YR 3/2)	Very Dark Brown (7.5YR 2.5/2)	Reddish Brown (5YR 4/4)	Reddish Brown (5YR 4/4)	Brown (7.5YR 4/3)
Texture	----	-	-	Light Clay	Light Medium Clay	Medium Heavy Clay	Heavy Clay	Medium Clay
Emerson Class Number	EC/TC	-	-	7	3	2	2	2
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	----	5.7	5.0	5.9
ø Exchangeable Magnesium	----	0.2	meq/100g	----	----	8.2	9.8	12.3
ø Exchangeable Potassium	----	0.2	meq/100g	----	----	<0.2	<0.2	<0.2
ø Exchangeable Sodium	----	0.2	meq/100g	----	----	1.8	3.2	4.6
ø Cation Exchange Capacity	----	0.2	meq/100g	----	----	15.7	18.1	22.9
ø Exchangeable Sodium Percent	----	0.2	%	----	----	11.8	17.5	20.1
ø Calcium/Magnesium Ratio	----	0.2	-	----	----	0.7	0.5	0.5
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	7.0	6.9	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	3.8	5.2	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	0.6	0.2	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	0.1	0.3	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	11.6	12.6	----	----	----
Exchangeable Sodium Percent	----	0.1	%	1.0	2.6	----	----	----
Calcium/Magnesium Ratio	----	0.1	-	1.8	1.3	----	----	----
Magnesium/Potassium Ratio	----	0.1	-	6.1	26.4	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	10	110	870	1060
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	1.89	2.17	0.67	0.41	0.15

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	TW_Site5_SOIL_0_202203231221	TW_Site5_SOIL_200_202203231222	TW_Site5_SOIL_500_202203231223	TW_Site5_SOIL_800_202203231224	TW_Site5_SOIL_1200_202203231225
			Sampling date / time	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00
Compound	CAS Number	LOR	Unit	EB2208185-021	EB2208185-022	EB2208185-023	EB2208185-024	EB2208185-025
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.4	7.2	8.9	9.4	9.1
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	23	33	357	406	430
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	15.0	21.9	17.6	7.7	15.9
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Very Dark Grayish Brown (10YR 3/2)	Dark Brown (10YR 3/3)	Brown (10YR 4/3)	Brown (10YR 4/3)	Brown (10YR 4/3)
Texture	----	-	-	Medium Clay	Medium Heavy Clay	Light Medium Clay	Sandy Clay Loam	Clay Loam Sandy
Emerson Class Number	EC/TC	-	-	7	2	2	2	2
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	----	6.2	5.8	5.8
ø Exchangeable Magnesium	----	0.2	meq/100g	----	----	9.0	7.4	7.3
ø Exchangeable Potassium	----	0.2	meq/100g	----	----	<0.2	<0.2	<0.2
ø Exchangeable Sodium	----	0.2	meq/100g	----	----	2.3	4.1	3.2
ø Cation Exchange Capacity	----	0.2	meq/100g	----	----	17.6	17.3	16.4
ø Exchangeable Sodium Percent	----	0.2	%	----	----	13.1	23.9	19.8
ø Calcium/Magnesium Ratio	----	0.2	-	----	----	0.7	0.8	0.8
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	11.2	10.2	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	9.9	16.4	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	0.2	0.2	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	0.7	2.4	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	22.0	29.2	----	----	----
Exchangeable Sodium Percent	----	0.1	%	3.2	8.2	----	----	----
Calcium/Magnesium Ratio	----	0.1	-	1.1	0.6	----	----	----
Magnesium/Potassium Ratio	----	0.1	-	44.6	101	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	50	230	280	340
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	2.18	0.89	0.59	0.06	0.13

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	TW_Site6_SOIL_0_202203231226	TW_Site6_SOIL_200_202203231227	TW_Site6_SOIL_500_202203231228	TW_Site6_SOIL_800_202203231229	TW_Site6_SOIL_1200_202203231230
			Sampling date / time	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00
Compound	CAS Number	LOR	Unit	EB2208185-026	EB2208185-027	EB2208185-028	EB2208185-029	EB2208185-030
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.6	8.9	8.3	8.5	8.8
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	119	92	207	356	553
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	7.8	11.0	26.1	23.5	18.9
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Brown (7.5YR 4/2)	Brown (7.5YR 4/2)	Dark Grayish Brown (10YR 4/2)	Brown (7.5YR 4/2)	Brown (7.5YR 4/3)
Texture	----	-	-	Medium Clay	Medium Clay	Medium Heavy Clay	Medium Heavy Clay	Medium Heavy Clay
Emerson Class Number	EC/TC	-	-	4	4	5	4	4
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	6.6	5.1	15.2	9.5	6.4
ø Exchangeable Magnesium	----	0.2	meq/100g	1.7	1.0	13.4	12.8	11.1
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	<0.2	<0.2	<0.2	<0.2
ø Exchangeable Sodium	----	0.2	meq/100g	0.2	<0.2	2.0	2.1	2.2
ø Cation Exchange Capacity	----	0.2	meq/100g	8.5	6.1	30.6	24.4	19.7
ø Exchangeable Sodium Percent	----	0.2	%	2.6	<0.2	6.5	8.8	11.1
ø Calcium/Magnesium Ratio	----	0.2	-	3.9	5.2	1.1	0.7	0.6
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	70	240	670
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	0.79	0.61	0.85	0.61	0.24

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	TW_Stock1_SOIL_Rep1_202203231231	TW_Stock1_SOIL_Rep2_202203231232	TW_Stock1_SOIL_Rep3_202203231233	TW_Stock2_SOIL_Rep1_202203231234	TW_Stock2_SOIL_Rep2_202203231235
			Sampling date / time	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00
Compound	CAS Number	LOR	Unit	EB2208185-031	EB2208185-032	EB2208185-033	EB2208185-034	EB2208185-035
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.2	7.9	6.7	5.8	6.3
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	21	27	10	11	12
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	11.5	20.3	19.2	6.8	5.6
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Dark Brown (7.5YR 3/2)	Dark Reddish Brown (5YR 3/3)	Dark Reddish Brown (5YR 3/3)	Very Dark Grayish Brown (10YR 3/2)	Brown (7.5YR 4/2)
Texture	----	-	-	Medium Clay	Medium Heavy Clay	Medium Heavy Clay	Light Clay	Light Medium Clay
Emerson Class Number	EC/TC	-	-	3	4	3	7	3
ED005: Exchange Acidity								
ø Exchange Acidity	----	0.1	meq/100g	----	----	----	0.2	----
ø Exchangeable Aluminium	----	0.1	meq/100g	----	----	----	<0.1	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	7.8	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	----	2.4	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	----	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	----	<0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	----	10.2	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	----	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	----	3.3	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	7.0	----	19.8	1.8	1.0
Exchangeable Magnesium	----	0.1	meq/100g	6.4	----	4.2	0.8	0.8
Exchangeable Potassium	----	0.1	meq/100g	0.2	----	0.2	0.4	<0.1
Exchangeable Sodium	----	0.1	meq/100g	0.7	----	0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	3.2	----
Cation Exchange Capacity	----	0.1	meq/100g	14.2	----	24.4	----	1.9
Exchangeable Sodium Percent	----	0.1	%	4.8	----	0.5	0.4	3.8
Calcium/Magnesium Ratio	----	0.1	-	1.1	----	4.7	2.2	1.2
Magnesium/Potassium Ratio	----	0.1	-	33.0	----	18.4	2.0	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	10	<10	<20	<10	<10

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	TW_Stock1_SOIL_Rep1_202203231231	TW_Stock1_SOIL_Rep2_202203231232	TW_Stock1_SOIL_Rep3_202203231233	TW_Stock2_SOIL_Rep1_202203231234	TW_Stock2_SOIL_Rep2_202203231235
			Sampling date / time	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00
Compound	CAS Number	LOR	Unit	EB2208185-031	EB2208185-032	EB2208185-033	EB2208185-034	EB2208185-035
				Result	Result	Result	Result	Result
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	**0.86**	**1.29**	**1.11**	**1.33**	**0.48**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	TW_Stock2_SOIL_Rep3_202203231236	TW_Stock3_SOIL_Rep1_202203231237	TW_Stock3_SOIL_Rep2_202203231238	TW_Stock3_SOIL_Rep3_202203231239	----
			Sampling date / time	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	23-Mar-2022 00:00	----
Compound	CAS Number	LOR	Unit	EB2208185-036	EB2208185-037	EB2208185-038	EB2208185-039	--------
				Result	Result	Result	Result	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.4	6.9	7.2	6.7	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	6	26	22	23	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	10.6	16.0	15.4	22.3	----
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Brown (7.5YR 4/3)	Dark Reddish Brown (5YR 3/2)	Dark Reddish Brown (5YR 3/3)	Very Dark Gray (5YR 3/1)	----
Texture	----	-	-	Clay Loam Sandy	Medium Heavy Clay	Medium Heavy Clay	Heavy Clay	----
Emerson Class Number	EC/TC	-	-	3	3	3	3	----
ED005: Exchange Acidity								
ø Exchange Acidity	----	0.1	meq/100g	0.8	----	----	----	----
ø Exchangeable Aluminium	----	0.1	meq/100g	<0.1	----	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	0.8	16.8	12.7	10.9	----
Exchangeable Magnesium	----	0.1	meq/100g	1.2	4.2	1.1	11.1	----
Exchangeable Potassium	----	0.1	meq/100g	0.4	0.7	0.8	0.6	----
Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	<0.1	0.1	----
Cation Exchange Capacity	----	0.1	meq/100g	3.2	----	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	----	21.8	14.6	22.7	----
Exchangeable Sodium Percent	----	0.1	%	0.8	0.2	0.2	0.4	----
Calcium/Magnesium Ratio	----	0.1	-	0.7	4.0	11.5	1.0	----
Magnesium/Potassium Ratio	----	0.1	-	3.0	5.8	1.4	18.1	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<20	<10	----
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	0.88	2.66	2.02	1.44	----

Appendix 3

Epic Environmental Pty Ltd (17 November 2020): Environmental Management Plan – Warwick Limestone Mine

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Terrequip Environmental Pty Ltd

Environmental Management Plan - Warwick Limestone Mine

Terrequip Environmental Pty Ltd

Environmental Management Plan - Warwick Limestone Mine

17 November 2020

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Document History and Status

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1 Introduction

1.1 The Project

Terrequip Environmental Pty Ltd (Terrequip Environmental) currently operate the Warwick Limestone Mine (the Project) located at 401 O'Deas Road, Elbow Valley, Queensland (the Site). The Project is located approximately 21 kilometres (km) south south-east of Warwick (**Figure 1**). The Mining Lease (ML) areas occupy a total of 172.1 hectares (ha).

The operational phase of the existing Warwick Limestone Mine began around 1930 and involved the production of agricultural lime, crushed rock, marble chips and (previously) small amounts of burnt lime. Prior to this, the land was used for agricultural purposes.

Limestone is removed from the operational open cut limestone pit using conventional open cut benching methods. The limestone is trucked to either the crusher plant situated in Aspinal Pit (ML50146) or a mobile crusher and screened and/or crushed in an on-site plant to a specified size (determined by market requirements). The final product is then trucked off-site to the respective customers.

1.2 Purpose and Context

Environmental management and regulation of the mining industry in Queensland is administered by the Department of Environment and Science (DES) (previously Department of Environment and Heritage Protection [DEHP]) through the provisions of the *Environmental Protection Act 1994* (EP Act). Within this regulatory system, the Project operates under Environmental Authority (EA) EPML00136213.

This Environmental Management Plan (EMP) has been prepared to amalgamate and update the two pre-existing EMPs for the Site. This EMP supersedes previous EMPs which were known as:

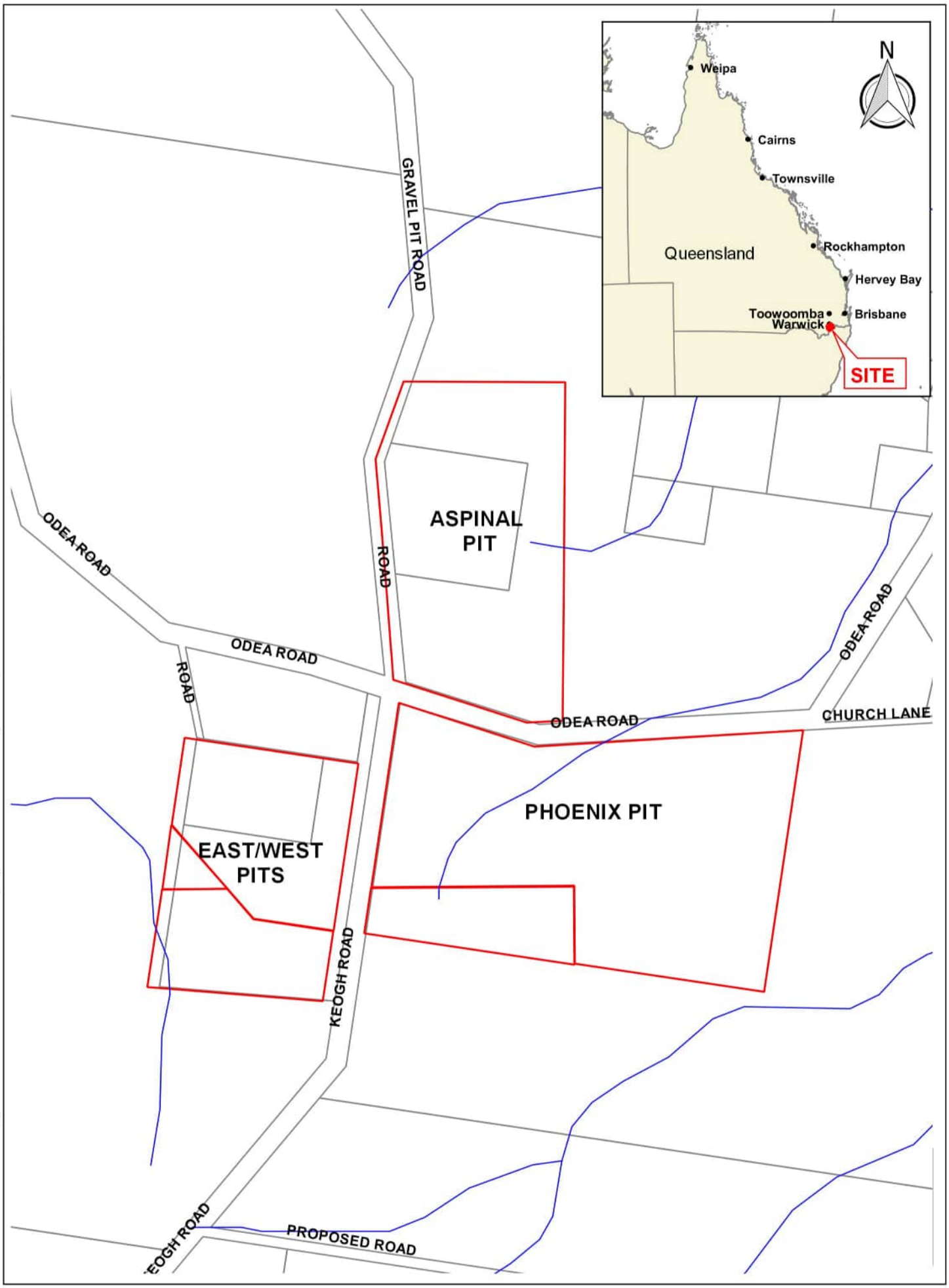
- Warwick Limestone Deposit Environment Management Plan (URS Australia Pty Ltd, 2006) – ML50083 and ML50146; and
- Unimin Warwick Mine Site Environmental Management Plan (URS Australia Pty Ltd, 2010) – ML50236, ML50237, ML50238 and ML50239.

This updated version of the EMP encompasses the entire Site and includes the latest ecological survey results and recommendations. Specifically, this EMP applies to ML50146, ML50083, ML50236, ML50237, ML50238 and ML50239. The purpose of this EMP is to:

- Identify the potential for harm to environmental values;
- Provide mitigation measures to minimise the potential for harm to environmental values;
- Document operating criteria for the site to minimise harm to environmental values;

- Provide corrective actions to be implemented in the event of harm to environmental values; and
- Comply with the conditions of EA EPML00136213.

Figure 1: Project Location



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0 250 500 m

Scale: 1:15,000 @ A4

Datum: GDA94 Projection: MGA56

Terrequip Environmental Pty Ltd
Warwick Limestone Mine

Figure 1
Project Location

2 Existing Operations

This section provides an overview of the existing operations at the Site.

2.1 Overview of Warwick Limestone Mine

The operational phase of the existing Project began around 1930 and involved the production of agricultural lime, crushed rock, marble chips and (previously) small amounts of burnt lime. Prior to this the land was used for agricultural purposes. Based on calculations of remaining limestone deposits, it is planned that the mining operations will continue for the medium term.

Limestone is removed from the operational open cut limestone pit using conventional open cut benching methods. The limestone is trucked to either the crusher plant situated in Aspinal Pit (ML50146) or a mobile crusher and screened and/or crushed in an on-site plant to a specified size (determined by market requirements). The final product is then trucked off-site to the respective customer.

Activities carried out at the Project include:

- Mining;
- Separation of limestone from its natural state;
- Stockpiling of product;
- Overburden stockpiling;
- Activities supporting mining (i.e. supply of power or water, equipment maintenance, administration support);
- Rehabilitation; and
- Environmental monitoring, implementation and review of environmental controls to prevent environmental harm.

The Terrequip Environmental Warwick Limestone Mine employs 10 full-time personnel. These employees are supported by 5-8 contract personnel.

The nearest habitation is a cluster of buildings including a homestead and other buildings, approximately 300 metres (m) north-west of ML50236 and a homestead approximately 300 m north-east of ML50237.

Although there is little through traffic on the public roads passing the operation, it is noted that Keoghs Road (along the western side of ML50237) provides the only access to the Cherrabah Tourist Resort.

2.2 Mining Tenure Details

Tenure and title details are shown in **Table 1**.

Table 1: Mining Tenure Details

Lease	Proposed Activity	Land Tenure	Landowner	Status	Area (ha)
ML50083	Open pit mining	Lot 5 SP236094, Lot 178 M34534	Terrequip Environmental Pty Ltd State of Queensland	Current	22.9
ML50146	Open pit mining	Lot 106 ML623, Lot 2 RP36822	[redacted]	Current	51.03
ML50236	Open pit mining	Lot 5 SP236094	Terrequip Environmental Pty Ltd	Current	1.85
ML50237	Open pit mining	Lot 1219 M34519	[redacted]	Current	71.38
ML50238	Open pit mining	Lot 1219 M34519	[redacted]	Current	11.33
ML50239	Open pit mining	Lot 5 SP236094	Terrequip Environmental Pty Ltd	Current	13.51

2.3 Operational Activities

The operational phase of the existing mine began around 1930. Based on the current LOM Plan, mining operations will continue for the medium term, focussing on Phoenix Pit (ML50237 and ML50238) and Aspinal Pit (ML50146).

Within Phoenix Pit, mining of the southern and northern orebodies will occur at the same time to maintain longer term product quality. The mining sequence assumes that all pit development (footprint extension) will be done by 2024, whereafter the pit will increase in depth only. Mining benches will be at 10 m depth intervals. With regards to mining lease boundaries, a 10 m buffer zone has been allowed for around the lease boundary where no mining activity or disturbances will occur. Trees planted along the lease boundary will be maintained for vegetative screening purposes.

Aspinal Pit will continue to undergo mining activities to further target the limestone orebody. If market conditions allow, the Aspinal Pit will be extended to the north and west of the current pit location. To allow this to occur, additional waste dump, topsoil storage and sediment dam areas are required.

2.3.1 Current Operations

The following activities have been or are currently being conducted at the Site:

- Mining on ML50237 and ML50238 will continue in line with the Life of Mine (LOM) Plan.
- Mining on ML50146 will continue in line with the LOM Plan.
- Waste dumps are located adjacent to the Phoenix pit on ML50237, as well as the East/West pits on ML50083 and the extension on ML50236 / ML50239.

- Access to the Phoenix Pit is via the haul road within ML50237 which joins O'Deas Road approximately 320 m to the east of its junction with Keoghs Road. This junction is approximately 30 m west of the entrance to the Aspinal Pit (ML50146).
- There will be no "permanent infrastructure" located on any MLs other than the sedimentation dams and some roads, which will benefit the landowner and will be retained on relinquishment of the mining tenements. It is initially planned that all crushing, screening and processing of the limestone ore will be undertaken at the existing plant on ML50146. However, some mobile crushing may be undertaken in the pit on ML50237 in the future. This may also include portable office buildings.
- No permanent fuel storage is planned for the mining leases at this time. Fuel is delivered on an as-needs basis by the local distributor. Deliveries are usually once or twice per week. Diesel is stored on site in one above-ground bunded tank, of 10,500 litre (L) capacity.
- Fuel and any other flammable or combustible liquids are stored adjacent to the road between the weighbridge and workshop within Aspinal Pit (ML50146).

2.3.2 Project Extraction Rates and Reserves

The approximate planned extraction rate will be up to 140,000 tonnes (t) of product saleable limestone. The mine production rates for 2020 and forecast rates for 2021 are presented in **Table 2**.

Table 2: Existing and Forecast Production Rates

Mine Production	2020 Production Actual (t)	2021 Production Forecast (t)
Run-of-Mine (ROM)	167,000	175,000
Product[2]	131,000	150,000
Waste/Overburden	221,000	200,000
Total Tonnes Moved[1]	**388,000**	**385,000**

Notes:

[1] Total tonnes moved is the total material mined (i.e. ROM and waste/overburden) at the Project.

[2] Product limestone is saleable material processed from ROM limestone.

Any planned increase in the extraction rates listed in **Table 2** will undergo formal risk assessment prior to implementation.

2.3.3 Operational Hours

The mine currently operates between 6:00am to 5:00pm on weekdays. Road truck haulage to/from site is normally between 6:30am to 5:00pm. Blasting is undertaken on average one-two times per month, generally between 10:00am and 3:00pm.

2.3.4 Environmentally Relevant Activities

The Environmentally Relevant Activities (ERAs) for the operation as per the EA EPML00136213 are outlined in **Table 3**.

Table 3: ERAs for the Site

Type	ERA	Location(s)
Extractive	ERA 16(2)(b) – Extractive and screening activities – extracting, other than by dredging more than >100,000 t but <1,000,000 t yr.	Lot 106 Plan ML623, Lot 1291 Plan M34534, Lot 178 Plan M34534, Lot 2 Plan RP36822
Extractive	ERA 16(2)(b) – Extractive and screening activities – extracting, other than by dredging more than >100,000 t but <1,000,000 t yr. ERA 16(3)(b) – Extractive and screening activities >100,000 t but <1,000,000 t yr.	Lot 1219 Plan M34519 and Lot 5 Plan SP236094
Mining	Schedule 2A 21: A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20.	ML50236, ML50237, ML50238, ML50239, ML50083, ML50146

2.3.5 Notifiable Activities

Notifiable activities are outlined in the Plan of Operations as: (29) Petroleum product or oil storage – storing petroleum products or oil (b) in above ground tanks with (ii) for petroleum products or oil in class 3 in packaging groups 3 of the dangerous goods code – more than 5,000 L capacity.

2.4 Environmental Management

The Project operates under the following statutory documents under the EP Act:

1. Environmental Authority EPML00136213; and
2. Plan of Operations 1 February 2020 to 31 January 2021, renewed annually.

This EMP has been produced for the Project, encompassing the entire site and includes the latest ecological survey results and recommendations. This EMP will be reviewed and amended as required for the Project moving forward. The Plan of Operations, which is renewed annually, provides for a detailed action program for implementing environmental protection and control commitments.

In addition, the Site operates under an Environment and Sustainability Policy which forms the basis for rigorous and consistent environmental management. The Environment and Sustainability Policy is a management tool implemented by Terrequip Environmental rather than a statutory requirement.

2.5 Rehabilitation

The rehabilitation progress and plans for the Project are outlined in **Section 6**.

3 General Environmental Management Conditions

Terrequip Environmental is committed to the following general environmental management conditions for the Project. The commitments below meet DES' requirements for:

- Estimated Rehabilitation Costs;
- Maintenance of measures for plant and equipment;
- Monitoring; and
- Storage and handling of flammable and combustible liquids.

3.1 Legislative Requirements

Terrequip Environmental is required to ensure that mining operations are conducted in accordance with all legislative requirements, including the *Mineral Resources Act 1989*, *Planning Act 2016* and the EP Act. Whilst this EMP is not a statutory requirement, it will be utilised to manage and mitigate potential environmental impacts at the Site.

3.2 Estimated Rehabilitation Costs

In accordance with Section 297 of the EP Act, Terrequip Environmental cannot carry out an activity or allow the carrying out of an activity under the EA unless an ERC decision is in effect, paid the scheme assurance and complied with the requirements under the MERFP Act. Terrequip Environmental is required to provide an Estimated Rehabilitation Cost (ERC) to DES in accordance with Section 298 of the EP Act. The ERC application is to state the amount the holder considers to be an estimate of the total estimated rehabilitation cost in accordance with the approved method in the DES guideline '*Estimated rehabilitation cost under the Environmental Protection Act 1994 (ESR/2018/4425)*'.

The total proposed ERC for the Project is **$2,349,377.**

3.3 Maintenance of Measures, Plant and Equipment

With regards to maintenance measures of plant and equipment, Terrequip Environmental is required to ensure:

- That all measures, plant and equipment necessary to ensure compliance with the conditions of the EA are installed;
- That such measures, plant and equipment are maintained in a proper condition; and
- That such measures, plant and equipment are operated in a proper manner.

3.4 Monitoring

Terrequip Environmental is required to:

- Record, compile and keep for a minimum of five years all monitoring results required by the EA and make available for inspection all or any of these records upon request by the administering authority.
- Where monitoring is a requirement of approval, ensure that a competent person(s) conducts all monitoring.

3.5 Storage and Handling of Flammable and Combustible Liquids

Fuel is delivered on an as-needs basis by the local distributor. Deliveries are usually once or twice per week. Diesel is stored onsite in one above-ground bunded tank, of 10,500 L and one portable 2,000 L fuel cell. All spillage of flammable and combustible liquids must be contained within an on-site containment system and controlled in a manner that prevents environmental harm (other than trivial harm) and maintained in accordance with Section 5.9 of AS1940 – Storage and Handling of Flammable and Combustible Liquids of 2004.

The base and walls of all bunded areas must be constructed with a material impervious to its contents and be maintained free from gaps or cracks that may result in the loss of containment.

Flammable and/or combustible liquids are stored adjacent to the roadway between the weighbridge and workshop within Aspinal Pit (ML50146). Lubricants and waste oil are stored in a certified self-bunded dangerous goods storage container adjacent to the workshop. The Contractors' waste oil is temporarily stored in drums in an earthen bund, before regular removal by the mining contractor to an approved disposal facility.

3.6 Environmental Auditing

An internal environmental audit program is in place for the Project. Audits of the Project are used to ensure compliance with the EA (EPML00136213) and monitor environmental performance against Terrequip Environmental's Environment and Sustainability Policy Statement (**Appendix A**) and the commitments contained in this EMP.

3.7 Aesthetic Values

In order to improve the aesthetic appearance of the Site and reduce the visual impact of the mining operations, the following activities have been undertaken:

- Rows of tree screens have been planted along the roadside edge of ML50237 (fronting O'Deas Road)
- Tree screens have been planted along the northern and western boundary of ML50083;
- The office area (ML50146) has been improved by the planting of lawn and trees;
- Progressive rehabilitation is undertaken where possible; and
- Waste heaps are being reprocessed and disused excavations have been backfilled with waste rock wherever economically possible.

Clearing of existing trees will be minimised and suitable treed buffer strips have been provided adjacent to the O'Deas Road frontage to minimise the visual impact from mining use to adjoining properties and the road. Where existing tree cover is inadequate, additional tree planting will be carried out. A visual amenity report has been completed for the Site and is included in **Appendix B**.

4 Existing Environment

4.1 Regional Description

The Site is located in the Southern Downs and Granite Belt of Southeast Queensland, 160 km south-west of Brisbane and 21 km south south-east of the town of Warwick, within the Warwick Shire. The Shire covers an area of 4,725 km^2 and has a population of more than 21,000 people. With an elevation of approximately 450 m, the region has a temperate climate with mild summers and cold winters. The main industries in the region are agriculture, forestry and fishing.

4.2 Project Site

The Site is situated approximately 21 km south south-east of Warwick. The area consists of rolling hills and is located at the top of the Condamine River catchment which is a sub-basin of the greater Murray Darling and Bulloo Basin.

The nearest habitation is a cluster of buildings including a homestead and other buildings, located approximately 300 m north-west of ML50236 and a homestead approximately 300 m north-east of ML50237. The Cherrabah Resort is located approximately 3 km south-west of the Site. Although there is little through traffic on the public roads passing the operation, it is noted that Keoghs Road along the western side of ML50237 provides the only access to the Cherrabah Resort.

4.3 Site Topography

The Site is characterised by low undulating hills dominated by a mosaic of open pastures and isolated patches of mid-high regrowth open forests on crests. The Site is largely cleared and grassed for grazing purposes. Few large, mature trees are present. Small trees are present throughout, but these mainly appear to be regrowth in previously cleared areas.

4.4 Climate

The Site lies between two weather monitoring stations, Warwick (21 km north-west, Station No. 041525) and Applethorpe (27 km south-west, Station No. 041175). Climate data for these weather monitoring stations is shown in **Table 4**. The prevailing wind direction at the mining operation is south to south-easterly.

Table 4: Climate Data for Warwick and Applethorpe

Data	Units	Warwick	Applethorpe
Mean daily maximum temperature	°C	30.1	28.5
Mean daily minimum temperature	°C	3.0	1.9
Mean annual rainfall	mm	681.6	763.6

Source: Bureau of Meteorology, 2017.

4.4.1 Air Quality

Monitoring of dust deposition gauges has been undertaken at 12 locations around the Project's boundaries. The annual average and maximum monthly average insoluble dust deposition monitoring data is presented in **Table 5** and **Table 6**, respectively.

Table 5: Annual Average Insoluble Dust Deposition Data (g/m^2/month)

Dust Gauge	1	2	3	4	5	6	7	8	9	10	11	12
2012	1.6	4.3	1.0	1.1	7.2	1.6	2.9	5.2	1.5	1.3	1.6	1.9
2013	2.0	1.1	1.1	1.4	0.8	1.1	0.6	1.6	2.3	0.7	1.2	1.6
2014	2.0	1.2	1.6	1.8	1.8	0.9	0.7	1.2	2.1	1.2	0.8	0.7
2015	1.7	1.3	1.2	1.7	1.0	0.9	0.9	1.2	1.7	1.8	0.9	1.1
2016	1.3	0.9	0.7	1.2	0.6	0.7	0.5	1.1	1.1	1.0	1.1	0.7
2017	1.2	0.9	0.6	0.9	0.6	0.5	0.5	0.5	0.8	1.0	1.0	0.6
2018[1]	0.9	0.6	0.6	1.2	0.6	0.5	0.4	0.7	0.6	0.5	0.6	0.4

Note:

[1] 2018 data was collected up to 17 October 2018.

Table 6: Maximum Monthly Average Insoluble Dust Deposition Data (g/m^2/month)

Dust Gauge	1	2	3	4	5	6	7	8	9	10	11	12
2012	2.6	8.6	2.8	2.2	5.3	4.2	8.3	3.9	3.0	3.9	2.8	4.5
2013	4.5	4.4	3.4	2.9	2.8	3.4	4.8	3.7	12.7	2.8	2.8	4.2
2014	3.8	2.7	3.2	3.7	4.2	1.5	2.2	2.8	6.3	2.8	1.9	1.4
2015	3.9	2.4	2.5	4.1	2.4	3.5	3.6	2.4	4.9	6.5	2.3	5.8
2016	2.6	1.7	1.1	1.8	1.3	2.5	1.5	3.5	3.4	2.5	2.7	0.9
2017	1.9	1.2	0.9	1.3	1.1	0.9	0.8	0.8	1.3	2.5	1.8	1.2
2018[1]	1.6	1.1	1.2	3.9	1.0	0.9	0.6	3.3	1.6	0.7	1.2	0.9

Note:

[1] 2018 data was collected up to 17 October 2018.

The most significant pollutant potentially generated from the mining operation is particulate matter (PM_{10}) (particles that have an aerodynamic diameter less than or equal to 10 µm). The EA specifies a limit of 120 mg/m^2/day, equivalent to 3.6 g/m^2/month, at any sensitive or commercial place. The monitoring locations are all within the boundaries of the mining lease, and so exceeding the limit at

these locations is not a breach of the EA, rather it provides a screening measurement that there may be an issue.

There are less than 35 residential dwellings and businesses within a 5 km radius of the mining operations. Dust gauge 12 is approximately 300 m west south-west from a residential dwelling. Although vegetation on the property would provide some reduction in dust levels, it has been recommended that a directional dust deposition gauge be installed at this location if an exceedance occurs again. This would assist with identification of sources.

There are no other known additional operations in the general vicinity of the mining operations that are considered a major source of dust.

4.4.2 Noise

Sources of noise and vibration at the Site include mining and processing, activities include:

- Vegetation clearing;
- Topsoil stripping and stockpiling;
- Overburden stockpiling;
- Crushing, grinding and screening;
- Movement of trucks;
- Blasting; and
- Mining.

The mine currently operates from 6:00am to 5:00pm on weekdays (extractive activities between 6:30am and 4:30pm). Road truck haulage to/from site is normally between 6:30am to 5:00pm. Blasting is undertaken on average one or two times per month, generally between 10:00am and 3:00pm.

Palmer Acoustics have conducted four noise assessment reports for the processing operations from 2012 to 2016. Based on Palmer Acoustic's reporting, the noise levels from the mobile crusher have been determined to achieve the daytime EA limits but exceed the evening and night limits. Noise from the fixed plant (i.e. crusher and related activities) has been determined to achieve the day, evening and night noise limits.

Mining and crushing (both fixed and mobile) are complaint if restricted to daytime hours (e.g. 7am to 6pm Monday to Saturday).

4.5 Local Watercourses

The Site is located at the top of the Condamine River catchment which is a sub-basin of the greater Murray Darling and Bulloo Basin. There are two key receiving waterways for the Site, namely; Lord John Creek and the Condamine River. Both of these watercourses are recognised under the *Water Act 2000*.

Lord John Creek, an ephemeral creek, is located to the west of the East West Pit (ML50083, ML50236 and ML50239). The Site is located on a ridge line and as such most of the catchment for the East West Pit operational area flows west into Lord John Creek. Lord John Creek flows for approximately 9 km to the confluence with Oaky Creek which is a tributary of the Condamine River.

The Condamine River is located to the north-east of the Site. The Aspinal (ML50146) and Phoenix (ML50237 and ML50238) catchment drain to the Condamine River along several unnamed tributaries.

4.6 Onsite Water Storage

The majority of surface water generated from the Site is surface runoff from disturbed areas such as the product stockpiles and out-of-pit waste dumps. To manage water at the Site, Terrequip Environmental has numerous water storages, drains and pumps to both ensure ongoing supply of water to the Site for on-site dust suppression and to retain and settle any contaminated water prior to any release off-site during rainfall events.

A Water Management Plan exists for the Site and incorporates all operations (**Appendix C**). This plan details the specifications and locations of the sedimentation dams. No Referable Dams, Hazardous Waste Dams or potable water supply dams are planned on the site.

4.7 Stormwater

Stormwater is controlled on the Site through the use of East West Pit (ML50083) which can be pumped to top up site dams as required. Excess water can be pumped to a holding dam on ML50083. The Site currently has a storage capacity of 130 cubic metres (m^3) for each hectare of disturbance in the form of catch drains, silt traps and sedimentation ponds.

The Plan of Operations states that stormwater control bunds will be constructed around waste dumps, to separate mine affected water from clean water runoff areas.

4.8 Groundwater

The MLs lie predominantly in an area of aquifer lithology with the following descriptions:

- Acid to intermediate volcanics (e.g. andesite, rhyolite, tuff); and

- Sedimentary strata (e.g. sandstone, shale and conglomerate).

Groundwater resources in the vicinity of the MLs are characterised as suitable for most purposes, marginal for human consumption and low salt-tolerant crops, with a salinity range of 500-1500 mg/L (total dissolved salts) and a bore yield less than 5 litres per second.

The operation uses one sub-artesian bore located on ML50146 to take underground water from a depth of 38 m below the ground surface. This bore is licensed for industrial purposes and has a nominal allocation of 10 megalitres.

4.9 Geology

4.9.1 Regional Geology Description

There are five specific geological formations within the operational area contained by the mining leases as shown in **Table 7**.

Table 7: Geological Formations Within the Mining Leases

Period (oldest to youngest)	Formation	Description
Upper Permian or Triassic (Palaeozoic)	Connolly Volcanics	Coarse andesitic pyroclastics and flows; minor lithic sandstone; limestone lenses near top
Silurian to Lower Devonian (Palaeozoic)	Rosenthal Creek Formation	Sandstone and mudstone, chert, intra-formational conglomerate, limestone
Upper Permian or Triassic (Palaeozoic)	Greymore Granodiorite	Diorite
Lower Triassic (Mesozoic)	Stanthorpe Adamellite	Adamellite
Lower Jurassic (Mesozoic)	Marburg Sandstone	Feldspathic to feldspathic sublabile sandstone, pebbly in part, lesser siltsone, mudstone Basal pebbly arkose in west

Source: Australia 1:250,000 Geological Series, Warwick Sheet SH56-2 (1972)

4.9.2 Site Geology Description

The Warwick limestones have been metamorphosed and fault-dissected to form small, scattered lenses of coarse-grained marbles. The marble is mostly near white and generally contains fractures coated with an iron oxide film. There are also large patches of grey marble and a streaky grey-white variety. The host formation consists of sandstones, siltstones and volcanic rocks, intersected by green andesite dykes.

The marbles are generally massive with no visible bedding as they are likely near vertical to steeply dipping. At places along the western side of the existing quarry on ML50083, there is a steep dipping contact between the marbles and the dark greenish-grey shale that strikes roughly north-south. It appears that no limestone occurs beyond this contact. The depth of the marble has not been determined.

4.10 Soils

According to the Soil Map of Australia (Queensland) 5M, the dominant soil type in the immediate vicinity of the mining operations is yellow and yellow-grey duplex soils (Dy). A duplex soil is often characterised by a sandy or loamy surface horizon with a sharp to clear boundary to a clay subsoil (Northcote, K.H., 1979).

4.10.1 Strategic Cropping Land

The purpose of the *Regional Planning Interests Act 2014* (RPI Act) is to identify areas of Queensland that are of regional interest because they contribute to Queensland's economic, social and environmental

prosperity. Strategic Cropping Area (SCA) is defined under the RPI Act as an area of regional interest which is comprised of Strategic Cropping Land (SCL). SCL is land that is or likely to be highly suitable for cropping based on the land's soil, climate and landscape features.

Under the RPI Act, it is an offence to carry out a development on SCL, or potential SCL, that has a permanent or temporary impact on the land without approval. Resource developments must avoid and minimise to the maximum extent possible any temporary or permanent impacts on identified SCL. Where this is not possible, mitigation of permanent impacts may be required.

As shown on

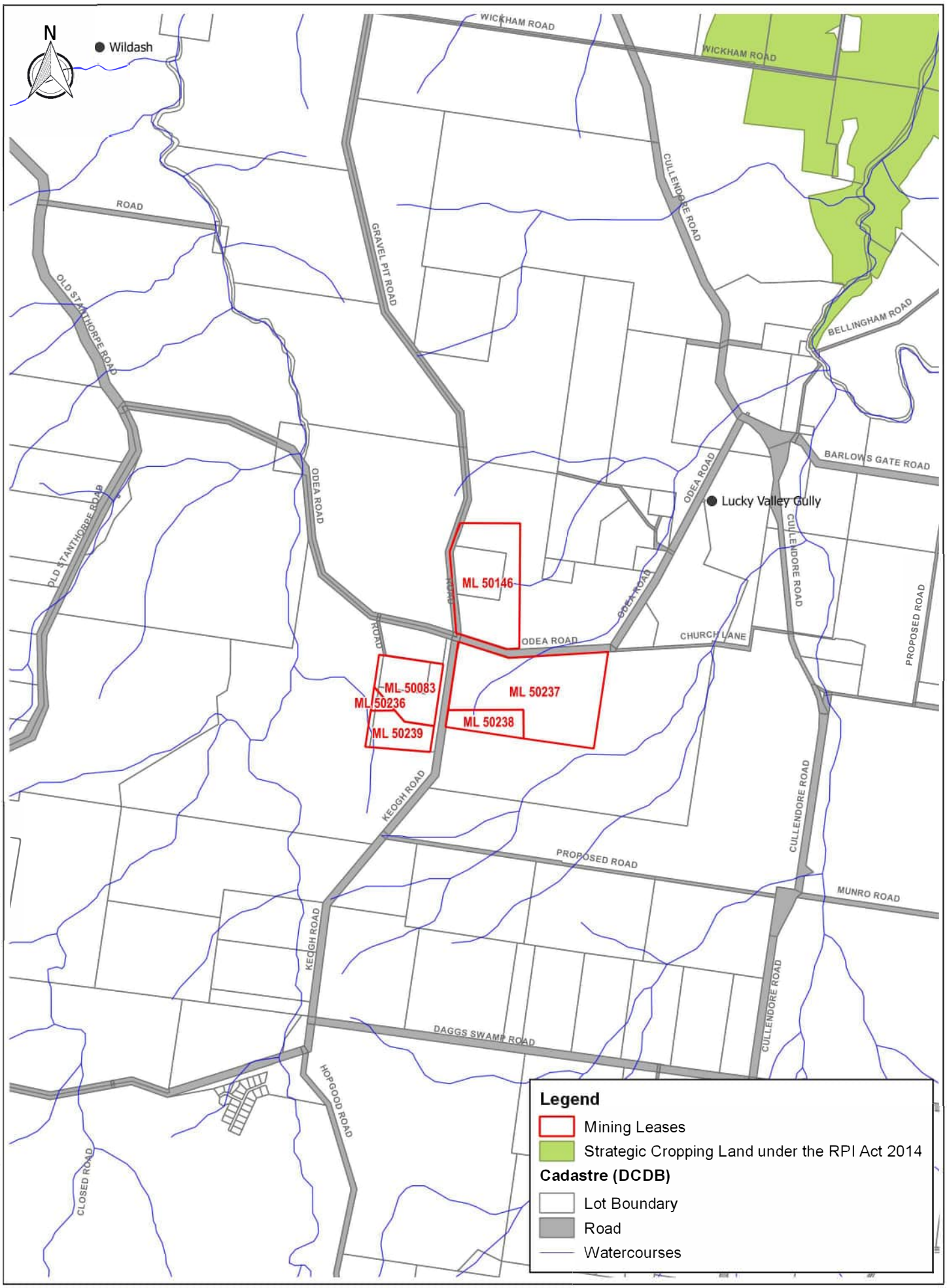
Figure 2 there is no SCL located within the ML areas or within the vicinity of the Project.

4.10.2 Good Quality Agricultural Land

Good Quality Agricultural Land (GQAL) is a system which is used to determine if land is capable of sustaining agricultural use without causing degradation of the land itself or other natural resources. Class A is considered to be GQAL in all locations, however, Class B and C are only conditionally identified as GQAL. The implementation of the State Planning Policy requires Local and State Governments, as well as applicants, to be aware of GQAL.

GQAL for the site was assessed through current mapping data. As shown on **Figure 3** there is no GQAL located within the MLs or within the vicinity of the Project.

Figure 2: Strategic Cropping Land



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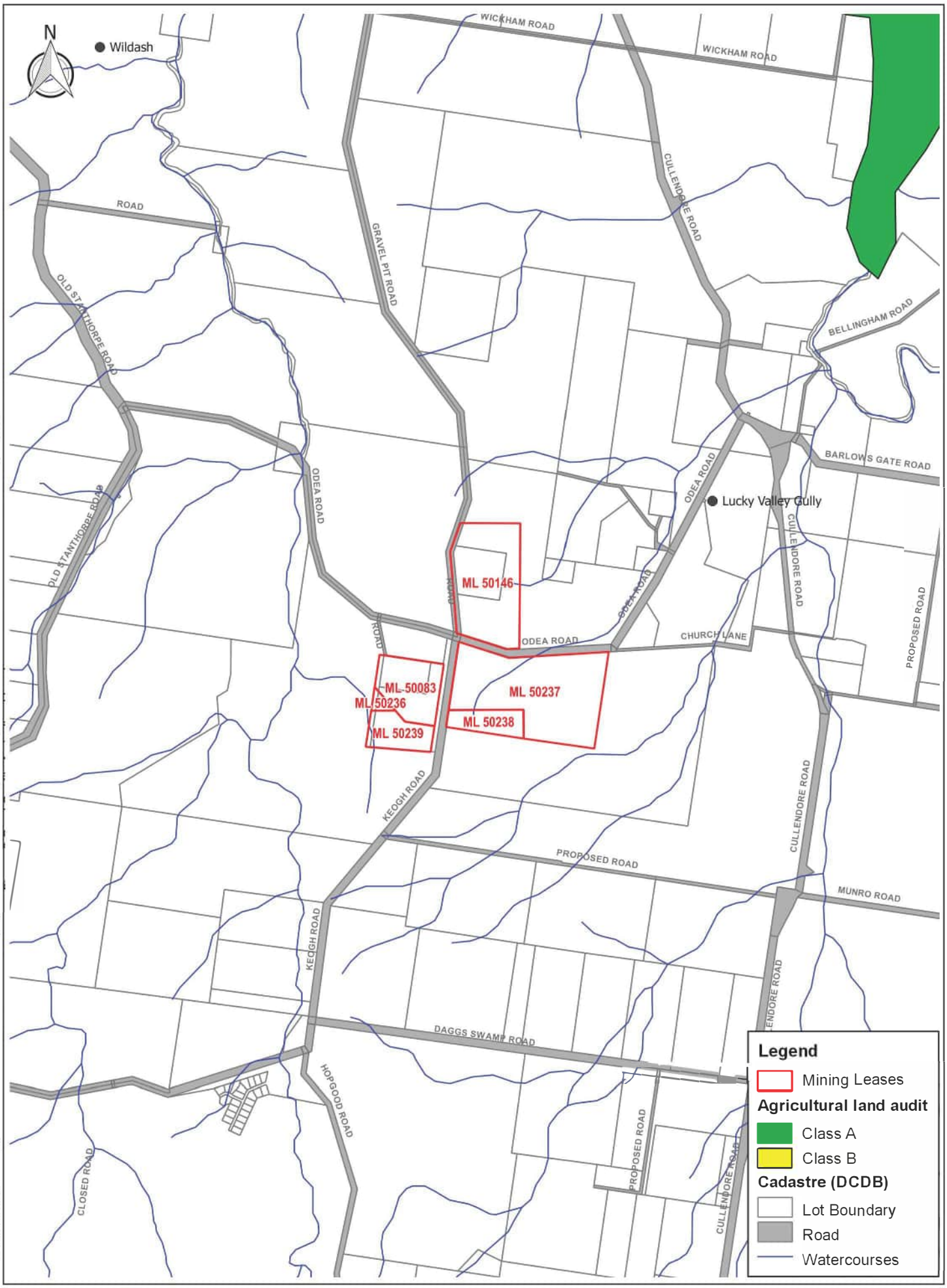
Scale: 1:40,000 @ A4

Datum: GDA94 Projection: MGA56

Terrequip Environmental Pty Ltd
Warwick Limestone Mine

Figure 2
Strategic Cropping Land

Figure 3: Good Quality Agricultural Land



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0 0.5 1 1.5 2 km

Scale: 1:40,000 @ A4

Datum: GDA94 Projection: MGA56

Terrequip Environmental Pty Ltd
Warwick Limestone Mine

Figure 3
Good Quality Agricultural Land

4.11 Nature Conservation

Three terrestrial flora and fauna surveys and assessments have been undertaken at the Project:

- *Targeted Flora and Terrestrial Vertebrate Fauna Assessment* (Biodiversity Assessment and Management Pty Ltd [BAAM], 2009).
- *Warwick Limestone Mine – Phoenix Pit Ecology Report* (Epic Environmental, 2017) i.e. based on current mining operations only in ML50237 and ML50238.
- *Warwick Limestone Mine – Aspinal Pit Ecology Report* (Epic Environmental, 2018) i.e. based on current mining operations only in ML50146.

The findings from these reports are outlined in the following sections, with a focus on Phoenix Pit and Aspinal Pit (i.e. current focus of mining operations).

The locations of ecological features applicable to the Project can be seen in **Figure 4**.

4.11.1 Flora (Phoenix Pit)

The grassland located north of the existing pit was considered to possibly be the Commonwealth Threatened Ecological Community (TEC) *Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland* (BAAM 2009). Whilst the grassland meets several criteria; it is mapped as occurring on sandstone derived sediments (Land Zone 9) and is not associated with an alluvial area. Therefore, the grassland does not qualify as a TEC.

Historical aerial mapping of the site shows that the grassland area has been untouched for over 20 years and site assessment of species composition suggests that the grassland could be regarded as Remnant under the VM Act and in good condition. If mapped as a grassland it could only be considered to be RE 11.9.3, a Least Concern (VM Act) with a biodiversity status of “No Concern at present”. It is however more likely to be an open patch of grassland formed by historic clearing of the surrounding grassy woodland RE 11.9.9 and is therefore considered to be a “derived” grassland. Being Least Concern under the VM Act and having a No Concern at Present Biodiversity status, this grassland does not represent a development constraint at the State level.

There appears to be no statutory reason for the identification of habitat trees within the Project area. Review of the threatened species likely to occur on the site, either via online searches or by on-ground confirmation of habitat, suggest that the trees do not provide habitat for threatened species and therefore, do not present a constraint to development of the site.

4.11.2 Flora (Aspinal Pit)

Previously the vegetation located on the western side of Aspinal Pit was mapped as RE 11.9.9/11.9.13. A ground-truthing vegetation survey was undertaken of the extant remnant vegetation community (under the *Vegetation Management Act 1999* (VM Act)) within the mapped Essential Habitat area on the west side of Aspinal Pit. This vegetation is described as tall grassy woodland whose canopy is dominated by gum-topped box *Eucalyptus moluccana* with associated occurrences of narrow-leaved ironbark *E. crebra*. The shrub layers of this community are very sparse to almost absent and the ground layer is dominated by a mixture of native grasses with very sparse occurrences of native forbs.

The occurrence of narrow-leaved ironbark throughout this community defines this Regional Ecosystem as the Least Concern (VM Act) RE 11.9.9.

RE 11.9.13 was not present within the area surveyed and was not observed within the neighbouring road reserve. Government based mapping will need to be updated to reflect this ground-truthed mapping change. As at time of writing, a Property Map of Assessable Vegetation (PMAV) Application has not been submitted to DNRME to undertake this change.

4.11.3 Fauna (Phoenix Pit)

No threatened species of fauna were considered likely to occur. The field survey identified a total of 102 fauna species of which none were species of national and/or state-level conservation significance.

4.11.4 Fauna (Aspinal Pit)

In order to adequately address the Essential Habitat mapping and the associated record of Spotted-tailed Quoll *Dasyurus maculatus* located within Aspinal Pit (specifically, -28.3876, 152.1136 with an error of 500 m), a targeted survey was undertaken on 31 May 2018.

Spotted-tailed Quoll is listed as Vulnerable under the *Nature Conservation Act 1992* (NC Act) and Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

It is noted that there is no species-specific survey method for Spotted-tailed Quoll recommended by the Queensland Government. Survey methods are however provided by the Commonwealth in *Survey guidelines for Australia's threatened mammals*. These methods include:

- Daytime searches for habitat resources, including potential den sites;
- Daytime searches for signs of activity, scats and latrines;
- Baited hair funnels (hair tubes); and
- Camera traps.

Hair funnels should be in place for a minimum of 14 consecutive nights and camera traps for three weeks.

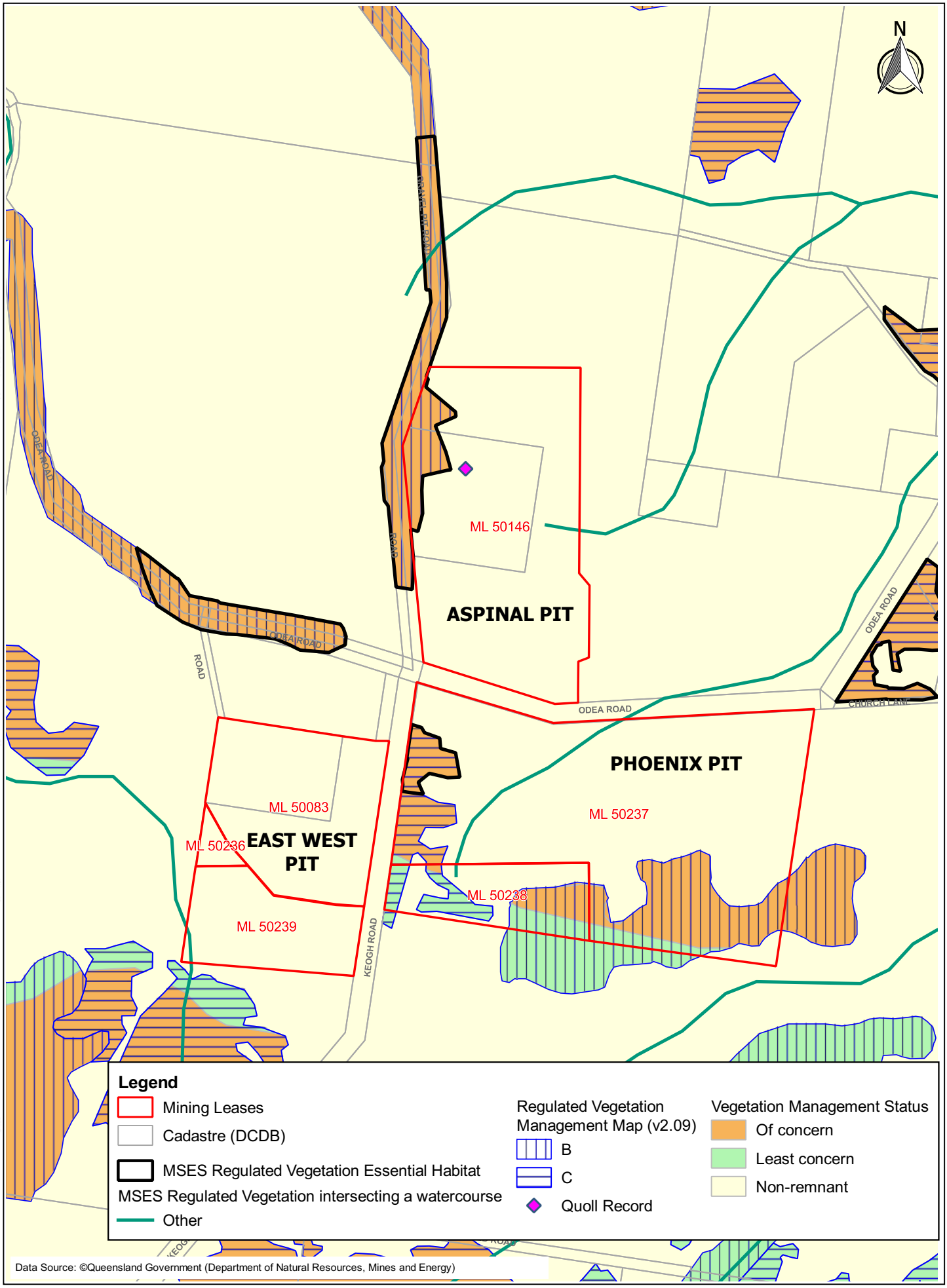
For the fauna survey undertaken on Aspinal Pit, five (5) camera traps were installed, and twenty-four (24) baited hair funnels were placed within the Essential Habitat area and direct surrounds. It is noted that Aspinal Pit is a current, active mine site and traps were located to concentrate on the area of interest and avoided areas such as the mine pit, stockpiles areas and haul roads. The placement of the camera traps and the baited hair funnels provided a well-covered sampling regime, with the Site being 51.03 ha. Additionally, the site was searched for four hours, with an emphasis on potential den sites and scats / latrines. Hair funnels and camera traps were left onsite for three weeks and collected on 20 June 2018.

No evidence of the presence (either current or historic) of Spotted-tailed Quoll was found on the Site during the presence absence survey.

Furthermore, the Essential Habitat documented factors for Spotted-tailed Quoll in relation to vegetation community requirements were not identified on the Site nor in the adjoining road reserve. There are no rocky areas or ridges present at the site nor are there any coastal heathlands or riparian forests. Whilst hollow logs were present, there were no recent or historic Spotted-tailed Quoll scats or latrines located in their vicinity (or anywhere on the Site). This was further supported by the presence absence survey which did not detect any evidence of Spotted-tailed Quoll at the Site.

Based on area, habitat quality, ongoing disturbance from cattle and the current ongoing, operational mining activity, the Site is not considered to provide essential resources for use by Spotted-tailed Quoll at any stage of its life-cycle and should not be considered Essential Habitat for the species. This assertion has been documented to both DNRME and DES during the 2018 EA Amendment Application process.

Figure 4: Ecological Features



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(J:) > 2020 > BE > BE200142.01 - Terrequip - Warwick Limestone Mgmt Plan Updates > 2. Deliverables > 1. EMP > BE170038.02_EMP_Figures

epic ENVIRONMENTAL

0 0.25 0.5 km

Scale: 1:15,000 @ A4

Datum: GDA94 Projection: MGA56

Terrequip Emvironmental Pty Ltd
Warwick Limestone Mine

Figure 4
Ecological Features - Matters of State Environmental Significance (MSES)

Pest Animals

Pest species recorded on-site are detailed in **Table 8** along with their category listing under the *Biosecurity Act 2014*.

Table 8: Pest Animals

Scientific Name	Common Name	Category under *Biosecurity Act 2014*
Felis catus	Cat	3, 4, 6
Oryctolagus cuniculus	European Rabbit	3, 4, 5, 6

Both pest animal species are listed as Category 3, 4 and 6 matters under the *Biosecurity Act 2014*, the European Rabbit is also listed under Category 5. These categories mean that you cannot supply these species to another person or release them into the environment. Furthermore, a person cannot spread these pest species nor encourage their presence by feeding them.

4.11.5 Ecology Surveys (2017 and 2018) - Vegetation Communities and Regional Ecosystem Classification

The Herbarium Regional Ecosystem mapping was found to be accurate with RE 11.9.9 and RE Regional Ground-truthed Regional Ecosystems (REs) which occur in both Aspinal Pit (ML50146) and Phoenix Pit (ML50237 and ML50238) are tabulated in **Table 9**.

Table 9: Ground-truthed Regional Ecosystems

Regional Ecosystem	Brief Description	VM Act Status*	Biodiversity Status	Total Area within ML (ha)
Aspinal Pit (ML50146)				
11.9.9	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks	LC	NC	5.2
Phoenix Pit (ML50237 and ML50238)				
11.9.9/11.9.13	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks / *Eucalyptus moluccana* or *E. microcarpa* open forest on fine grained sedimentary rocks	OC	OC	11.4
11.9.9	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks	LC	NC	2.9

*VM Act = *Vegetation Management Act 1999*; LC = Least Concern, OC = Of Concern, NC = No Concern

Of these REs, it is recognised that RE 11.9.9/11.9.13 which occurs within Phoenix Pit is classified as regulated vegetation (Category B).

Habitat Diversity and Connectivity

Most of the Site is composed of non-remnant vegetation with patches of remnant vegetation dominated by ironbark open forests. Minor occurrences of gum-topped box and forest redgum open forest occur scattered throughout the site. Habitat connectivity within the site is slightly fragmented due to current mining operations. Habitat connectivity to the wider landscape is maintained through connection of remnant and regrowth woody vegetation within a soft matrix of open grazing pasture.

4.12 Cultural Heritage

4.12.1 Aboriginal Heritage

Aboriginal cultural heritage remains are a record of the past occupation of the landscape by Aboriginal people. There is the potential for isolated Aboriginal archaeological artefacts (e.g., stone tools) or surface scatters (e.g., shell middens) to be present on land within the project area. These are more likely to occur in areas close to sources of permanent water (rivers, creeks and wetlands) or around stony rises.

There is no recorded Aboriginal cultural heritage on the Site. Terrequip Environmental has a duty of care to take all reasonable and practicable measures to ensure the activities of the Warwick Limestone Mine do not harm Aboriginal cultural heritage. Terrequip Environmental is committed to ensuring that no damage is done to cultural heritage sites of significance in the areas they are responsible for. Due to the previous disturbance by farming activities on the lease areas, it is unlikely that mining activities will impact on any unknown Aboriginal archaeological artefacts.

4.12.2 European Heritage

Searches of State and National databases have indicated that there is no recorded European cultural heritage on site. The property located approximately 330 m north-west of ML50236 is claimed by the owner to be of historical interest. Terrequip Environmental is committed to actions that will protect the environs of the lease area.

4.13 Local Community and Industry

There are less than 35 residential dwellings and businesses within a 5 km radius of the mining operations. Within the last five years, no known complaints have been received from local businesses with regards to mining operations. Terrequip Environmental is pro-actively managing surrounding landowners by keeping them involved and informed throughout ongoing operations.

A traffic survey was conducted on O'Deas Road in July 2009, which measured traffic volumes and average vehicle speeds. The results indicated that the survey is consistent with an earlier survey conducted in 2003. The survey confirmed that traffic volume along O'Deas Road is very low compared to road capacity and that no impact or delays are expected due to haulage vehicles crossing the road. Speed reduction signage (60 km/hr) has been installed at the junction with the haul road to reduce current travel speeds.

4.13.1 Community Consultation

Terrequip Environmental is committed to respecting the rights and interests of individual citizens, relevant organisations and the communities in which it operates. Terrequip Environmental engages with

affected stakeholders (including; adjoining properties, local and State Government, Traditional Owners and local community groups) and the wider regional community through its established procedure on Community and Stakeholder Engagement.

A range of two-way communication tools are being used to engage stakeholders and the community, including, but not limited to; one-on-one meetings, community meetings and Terrequip Environmental's website.

Terrequip Environmental have an approved Cultural Heritage Clearance Statement and associated Cultural Heritage Management Agreement (CHMA), which provides for the protection or relocation of any cultural heritage artefact/s.

4.14 Waste

Waste relates to non-mineral waste and includes regulated waste under the EP Act and general waste. Proposed amendment activities are not expected to significantly change the sources or volumes of waste generated, which are managed on the existing MLs.

4.15 Visual Amenity

In order to improve the aesthetic appearance of the existing Site and reduce the visual impact of mining operations, the following activities have been undertaken:

- Tree screens have been planted along the roadside of ML50237 (fronting O'Deas Road)
- Tree screens have been planted along the northern and western boundary of ML50083;
- The office area on ML50146 has been improved by the planting of lawn and trees;
- Progressive rehabilitation is undertaken where possible; and
- Waste heaps are being reprocessed and disused excavations have been backfilled with waste rock wherever economically possible.

Where existing tree cover is inadequate, additional tree planting will be carried out. A Visual Amenity Report has been appended for further information (**Appendix B**).

5 Environmental Commitments

This section outlines commitments for the relevant environmental values at the Warwick Limestone Mine. These commitments are designed to ensure appropriate strategies are in place for environmental protection.

In addition to these commitments, Terrequip Environmental must comply with the conditions outlined in EA EPML00136213.

5.1 Air

The limestone processing plant is a crushing and grinding plant, consisting of dry processes. Therefore, dust generation is the primary impact of the mining operations related to air quality. There are no other known additional operations in the general vicinity of the mining operations that are considered a major source of dust.

5.1.1 Air Quality Protection Commitments

A Dust Management Plan (DMP) has been developed for the site (**Appendix D**). This includes details of procedures for minimisation of fugitive dust, monitoring of dust emissions, recording and investigation of complaints and other aspects of air emissions management.

Air quality environmental protection commitments for the operation have been provided in **Table 10**. Commitments include objectives, indicators / standards and control strategies to minimise dust emissions.

Table 10: Environmental Protection Commitments – Air

Aspect	Commitment
Objectives	To maintain ambient air quality level within currently measured values for existing operations and ensure that emissions do not affect sensitive sites.
	To minimise the air pollution caused by operational activities and reduce emissions to the lowest practicable level.
	The release of dust or particulate matter or both resulting from the mining activity must not cause an environmental nuisance, at any sensitive or commercial place.
Indicators / Standards	Management of manufacturing process and parameters to reduce emissions.
	The use of well-maintained plant only.
	Compliance with the Queensland *Environmental Protection (Air) Policy 2008* and other DES air quality guidelines.
	Implementation of and conformance with the Site DMP.
Control Strategies	Minimisation of fugitive dust emissions: ▪ Cessation of blasting and removal of topsoil when critical wind speeds of 5.4 m/s in the direction of sensitive receptors are reached. ▪ Review of processing on the site when critical wind speeds of 5.4 m/s in the direction of sensitive receptors are reached.

Aspect	Commitment
	▪ Orientation of topsoil and overburden stockpiles in consideration of prevailing wind directions to minimise potential for windblown dust. ▪ Revegetation of topsoil and overburden stockpiles of as soon as practicable to minimise wind erosion. ▪ Extraction of material by excavator and truck at a grade beneath the mine face where practicable (occasionally oversize material is transported to an area where it can be broken outside of the pit and then loaded onto haul trucks). ▪ Regular inspection of cyclones during drilling to ensure that they are functioning properly. ▪ Inspection and maintenance of dust collectors to ensure they are operating properly. ▪ Location of mobile crushing and screening operations in an area with the least potential to result in adverse dust impacts (i.e. use topographical shielding from natural landforms or man-made barriers). ▪ Water spraying of stockpile area as required based on visual inspection, or when wind speeds exceed 5.4 m/s in a direction towards sensitive receptor locations. ▪ Location of stockpiles in areas with natural or alternative shielding whenever and wherever practicable. ▪ Assessment of the need to construct windbreaks along the boundary of stockpiling area(s). ▪ Limitation of stockpile size where possible. Priority should be given to minimising stockpiling for materials with low threshold velocities wherever and whenever practicable. ▪ Watering of haul roads during adverse wind conditions, as assessed by visual inspection. ▪ Covering of haulage trucks transporting materials off site with tarpaulins after being loaded. ▪ Strict adherence to speed limit onsite. ▪ No burning of material will be conducted onsite. ▪ Maintenance of appropriate buffer distances between dust generating activities and sensitive receptors. Monitoring of dust emissions: ▪ Undertaking of air quality monitoring in accordance with the DMP. ▪ Modification of non-compliant dust sources as appropriate. ▪ Regular inspection of plant and equipment operating at the Site to ensure that it is in good working order, with maintenance and repair as required. ▪ Regular monitoring of operators' manner of operation to ensure that potential for dust emissions is minimised. ▪ Recording and investigation of all complaints, with implementation of corrective actions as appropriate, in accordance with the DMP. ▪ Regular review of monitoring data, investigation of any non-conforming results and amendment of operational procedures and activities as appropriate.

5.2 Noise

The mine currently operates between 6:00am to 5:00pm on weekdays (extractive activities between 6:30am and 4:30pm). Road truck haulage to/from site is normally between 6:30am to 5:00pm. Blasting is undertaken on average one-two times per month, generally between 10:00am and 3:00pm.

Sources of noise and vibration at the Site include mining and processing, activities include:

- Vegetation clearing;
- Topsoil stripping and stockpiling;
- Overburden stockpiling;
- Crushing, grinding and screening;
- Movement of trucks;
- Blasting; and
- Mining.

To ensure sensitive receptors are not impacted by noise, Terrequip Environmental has implemented measures such as restricting blasting activities to specific daylight hours and limiting hours of operation.

5.2.1 Noise Protection Commitments

Noise related environmental protection commitments for the operation of the Project are outlined in **Table 11**. Commitments include objectives, indicators / standards and control strategies to minimise noise related complaints and issues.

Table 11: Environmental Protection Commitments – Noise

Aspect	Commitment
Objectives	To avoid or satisfactorily mitigate the industrial deafness and general noise pollution risks.
	To comply with relevant noise limits and relevant legislation, including *Environmental Protection (Noise) Policy 2008* (EPP Noise) and the *Work Health & Safety Regulation 2011*.
	Noise from the mining activity must not cause an environmental nuisance, at any sensitive or commercial place.
Indicators / Standards	Compliance with relevant noise limits and relevant legislation, including EPP Noise, Occupational Health & Safety regulations and other DES noise guidelines.
	The provision of appropriate hearing protection (where required) for onsite personnel and contractors.
	No justifiable complaints received about noise.
Control Strategies	To continue to advise DES as soon as practicable on receipt of any environmental noise complaints.
	To conduct investigations of environmental noise complaints if and when received, and amendment of operational procedures and activities as appropriate.
	Management of noise in accordance with the EPP Noise.
	Restriction of blasting activities to specific daylight hours.
	Implementation of Noise Management Program including procedures for responding to noise complaints, identification and assessment of actual and potential sources of noise and corrective and preventive measures to minimise nuisance noise.

5.3 Water

5.3.1 Water Supply

A Site Water Management Plan (**Appendix C**) has been developed for the Project and details the specifications and locations for the sedimentation dams. Stormwater and accumulated groundwater from the existing and proposed operations will be directed as described in the Site Water Management Plan. However, the location and size of some sedimentation dams have been modified as a result of changes to pit and waste dump design.

5.3.2 Water Usage

The processes used to produce limestone products at the Project are generally dry processes. Therefore, site water usage is anticipated to be moderate and limited to stockpile watering, and dust suppression for plant, access roads and haul roads.

Potential impacts of Project activities on existing water resources include run-off from product stockpiles and overburden dumps causing sediment deposition. Acid drainage from the waste dumps is not considered to be a problem, given the type of material mined is limestone.

5.3.3 Water Protection Commitments

Water related environmental protection commitments for the operation of the Project are included in **Table 12**. Commitments include objectives, indicators / standards and control strategies to minimise dust emissions.

Table 12: Environmental Protection Commitments – Water Supply and Usage

Aspect	Commitment
Objectives	Minimisation of water usage.
	To ensure that operations do not impact off-site surface water or groundwater values.
Indicators / Standards	Compliance with QWQG (2013).
	Compliance with *Water Act 2000* if required.
	Compliance with *Environmental Protection (Water) Policy 2009*.
	Compliance with relevant ANZECC (2000) water quality and monitoring guidelines where relevant.
	Compliance with Local Authority guidelines for sewage treatment systems where relevant.
Control Strategies	Conformance with the Site Water Management Plan.
	Minimisation of the amount of water discharge from site by maintaining 0.5 m of freeboard on dams by regularly removing sediment.
	Design of sedimentation dams with a capacity to ensure that the dams are capable of containing runoff from a 1:10 year storm event without uncontrolled discharge.
	Ensure that sediment dams onsite comply with relevant design criteria.
	Ensure that the quality of water on site complies with the QWQG (2013) water quality and ANZECC (2000) monitoring guidelines as relevant.
	Ensure that erosion control measures are installed to minimise sedimentation of surface water runoff, for example, on cleared areas and topsoil stockpiles.
	Ensure that material is not deposited in or adjacent to watercourses.
	Monitoring to be undertaken in accordance with the Site Water Quality Monitoring Plan.
	Conduct regular maintenance of runoff control measures, including diversion banks and sediment dams.
	Maintenance of vegetative cover where practicable to minimise erosion and silt generation.
	Regular review of monitoring data, investigation of any non-conforming results and amendment of operational procedures and activities as appropriate.
	To obtain and comply with requirements of *Water Act 2000* if required in the future for water supply and storage facilities.
	To ensure that all sewage treatment systems are managed in accordance with Local Authority guidelines.

5.4 Waste

Waste material generated by current mining activities includes:

- Comingled office commercial waste;
- Waste stone and overburden,
- Waste oil drums and chemical containers,
- Scrap steel,
- Tyres from heavy machinery and company vehicles, and
- Wooden pallets.

The total waste stone and overburden from the Project was 221,000 t in 2017 and is forecast to be 160,000 t in 2018. This overburden contains low grade limestone which will be crushed for road rubble where feasible and sold to external customers or used to install new all-weather access roads. All remaining materials are deposited on the waste rock dump.

Mining industrial and domestic wastes generated by the current operations are collected from the plant areas in conventional waste receptacles and stored pending disposal in the main plant area on ML50146. These wastes are disposed of as required to an approved waste facility. Scrap steel and batteries are recycled.

5.4.1 Waste Protection Commitments

Waste related environmental protection commitments for the operation of the Project are outlined in **Table 13**. Commitments include objectives, indicators / standards and control strategies to minimise waste.

Table 13: Environmental Protection Commitments – Waste

Aspect	Commitment
Objectives	To implement waste reduction, re-use and recycling measures.
	To dispose of wastes in a manner that does not cause any environmental harm.
Indicators / Standards	To provide appropriate waste storage facilities for wastes prior to their disposal.
	Compliance with DES Waste Management Policy, Regulations and guidelines.
	Provision of appropriate waste storage facilities onsite and the use of approved waste disposal facilities off-site.
	Recycling of scrap steel and batteries (and other materials as practicable).
	Registration of any contaminated land on the DES Contaminated Land Register (CLR).
Control Strategies	Management of all onsite waste handling facilities in accordance with DES waste regulations and guidelines.
	Disposal of all waste at approved waste disposal facilities.
	Handling and disposal of all waste products using methods to avoid contamination of land, surface water and groundwater.
	Establishment of a waste register for the site.
	Maintenance of an onsite register of potential contamination and remediation of any contaminated land prior to surrender of lease.

Aspect	Commitment
	The waste dump shall be reduced and progressively cleaned up by: 1. recycling scrap material; 2. disposing of any hazardous wastes in an approved manner; and 3. disposing of other wastes in an approved waste disposal facility.

5.5 Land

The site is currently characterised by low undulating hills dominated by a mosaic of open pastures and isolated patches of mid-high regrowth open forests on crests. Rehabilitation at the Project generally includes revegetation of the site to a pre-mining condition, suitable for grazing activities. A detailed Rehabilitation Plan for the Project also provides specific objectives and methodology for rehabilitation.

5.5.1 Land Protection Commitments

Land and rehabilitation related environmental protection commitments for the Project are outlined in **Table 14**. Commitments include objectives, indicators / standards and control strategies to minimise impacts to land.

Table 14: Environmental Protection Commitments – Land

Aspect	Commitment
Objectives	To minimise the area of disturbed land that requires rehabilitation, i.e. to rehabilitate the site so it has a stable, self-sustaining, non-polluting landform similar in aspect to surrounding landscapes.
	To minimise visual impacts from mine operations.
	To revegetate the disturbed land areas using self-sustaining vegetation cover similar to that in the surrounding grazing land.
	To ensure successful rehabilitation and lease surrender that satisfies DES, DNRME and landowners is achieved at the cessation of mining.
	To rehabilitate rock surfaces in a manner to minimise potential for erosion.
	To avoid or satisfactorily mitigate the risk of erosion and to ensure sound sediment control practices.
Indicators / Standards	Final quarry and waste dump landforms as stated in the Control Strategies.
	Rehabilitation that satisfies DES and landowners as follows: ▪ mined landform of similar topography to surrounding landscapes; ▪ minimal visual impacts on surrounding sensitive receptors; and ▪ vegetation establishment on rehabilitated areas that is characteristic of similar off-site areas.
	Revegetation using locally endemic species of grasses and trees at densities similar to those that exist in the surrounding grazing land.
	Successful rehabilitation of lease areas to the satisfaction of DES and landowners.
	Lease surrender to the satisfaction of DES, DNRME and landowners.
	Zero/Low incidence of observed erosion to disturbed areas.
Control Strategies	**Rehabilitation:** The Rehabilitation Program for the existing operations will be updated to accommodate the new lease areas, to provide for the following: ▪ Implementation of DES Guidelines, particularly EM1122 'Rehabilitation requirements for mining projects.

Aspect	Commitment
	▪ Design criteria (e.g. slope angles, surface water drainage) and post-mine use for all mine site domains, including the open pit. Criteria and post-mine domain use will comply with legislative requirements for safety and relevant DES guidelines, and will aim to minimise visual impacts. ▪ Topsoil management including stripping, stockpiling and handling procedures, locations, erosion management and revegetation prior to use. ▪ Identification of reference sites from which to nominate rehabilitation completion or success criteria (e.g. species composition, extent of groundcover, species density). ▪ Nomination of completion criteria and progressive targets based on reference sites, against which to measure rehabilitation success. ▪ Development and implementation of re-vegetation methods including topsoil spreading, contour ripping, species selection and seeding to achieve completion criteria. On-going monitoring of rehabilitation development against completion criteria and nomination of corrective actions to be implemented should rehabilitation not be meeting success targets. ▪ Weed and animal control (e.g. spraying, fencing) to minimise impact on rehabilitated areas. Fencing will be designed to allow native fauna to access rehabilitated areas. ▪ Capping of all exploration drill holes as soon as practicable after use. ▪ Annual internal review of the Rehabilitation Program based on monitoring results. ▪ At the cessation of mining, the site will be rendered safe to the satisfaction of DNRME.
	Erosion Prevention – Disturbed Areas: Reshaped dump faces will be landscaped to minimise the potential for gully erosion. On completion of earthworks, faces will be planted with a combination of pasture and native grasses (in consultation with the landowner). Contour banks will be constructed at the bottom of waste rock emplacements in order to catch run-off.
	Erosion Prevention – Topsoil Stockpiles Topsoil will be stored in windrows no more than 2 m high. If soil is not to be placed immediately, it will be planted with grasses to maintain soil condition and limit erosion (in consultation with the landowner). Disturbed areas and stockpiles will be inspected monthly and after significant rainfall events to identify potential erosion issues.

5.6 Nature Conservation

The Site has been used for grazing or mining purposes for many decades and is not recognised as essential habitat for any flora or fauna of conservation value.

5.6.1 Nature Conservation Protection Commitments

Detailed Vegetation and Fauna Management Plans has been developed for the site (**Appendix E** and **Appendix F** respectively). These include details of monitoring and management measures to minimise potential impacts on significant flora and fauna species.

Protection commitments for nature conservation during the operation of the Project have been included in **Table 15**. Commitments include objectives, indicators / standards and control strategies to minimise potential impacts on flora and fauna species.

Table 15: Environmental Protection Commitments – Nature Conservation

Aspect	Commitment
Objectives	To avoid or minimise the potential impact of the Project on flora and fauna.
Indicators / Standards	No harm to flora of conservation value or to native fauna.
Control Strategies	**Vegetation clearing** The clearing of trees will be carried out in a manner that ensures that fauna living in or near the site have sufficient time to move away from areas of clearing without human intervention. This will be achieved by adopting the following mitigation strategies: ▪ A pre-clearing vegetation site inspection by an experienced botanist to identify the presence of any conservation significant flora species. ▪ An experienced fauna spotter/catcher will be present during clearing operations. ▪ Damage to native vegetation outside of the extended area will be prevented and no unauthorised disturbance will occur in these areas. Areas identified for vegetation clearance will be clearly defined and detailed in site inductions. ▪ Vegetation clearing will be conducted in sequential stages and only to the extent necessary for safe and effective operations. ▪ The direction of sequential clearing will be away from disturbance areas and towards any retained vegetation or habitat links. ▪ No clearing of vegetation will occur between the hours of 6pm and 7am. ▪ Cleared material will not be deposited within 20 m of any watercourses. ▪ All native vegetation removed will be reused in revegetation areas. Logs and large rocks will be placed in nearby vegetation or adjacent to such vegetation to create shelter habitat for terrestrial fauna species. These 'stockpiles' may then be used on mine closure to create artificial habitats within rehabilitation areas. ▪ Any planned disturbance areas not required during the operational phase will be revegetated with native species endemic to the local area. In locations where canopy species cannot be planted, native grasses and shrubs should be used. Strategies for flora and fauna protection during vegetation clearing are included in the Vegetation Management Plan and Fauna Management Plan (**Appendix E** and **Appendix F**, respectively).
	Pest Management Feral animals known or expected to occur on the site are not expected to gain a significant benefit from the proposed actions. However, effective pest management is important in the overall management of the site to reduce potential detrimental impacts, as a result of the proposed works. Refer **Appendix G** for feral animal management guidelines developed for the Site.
	Habitat Restoration and Management With appropriate management, over time the disturbed areas will be enhanced and will provide additional and/or supplementary habitats for many of the site's potential fauna. Strategies for restoration and management of fauna habitats are included in the Vegetation Management Plan and Fauna Management Plan**.**
	Monitoring The ongoing monitoring of the site's fauna population is important in ensuring that the study area and associated lands continue to provide suitable habitat for any resident and migratory species.

5.7 Cultural Heritage

5.7.1 Aboriginal Heritage

There is no recorded Aboriginal cultural heritage on the Project Site. Terrequip Environmental has a duty of care to take all reasonable and practicable measures to ensure the activities of the Warwick Limestone Mine do not harm Aboriginal cultural heritage. Terrequip Environmental is committed to

ensuring that no damage is done to cultural heritage sites of significance in the areas they are responsible for. Terrequip Environmental have an approved Cultural Heritage Clearance Statement and associated Cultural Heritage Management Agreement, which provides for the protection or relocation of any cultural heritage artefact/s.

5.7.2 European Heritage

Searches of State and National databases have indicated that there is no recorded European cultural heritage on site. The property located approximately 330 m north-west of ML50236 is claimed by the owner to be of historical interest. Terrequip Environmental is committed to actions that will protect the environs of the lease area.

5.7.3 Cultural Heritage Protection Commitments

Cultural heritage protection commitments for the operation of the Project are outlined in **Table 16**. Commitments include objectives, indicators / standards and control strategies to minimise potential impacts on Aboriginal and/or European cultural heritage.

Table 16: Environmental Protection Commitments – Cultural Heritage

Aspect	Commitment
Objectives	To avoid or minimise the potential impact of the Project on Aboriginal or European cultural heritage.
Indicators / Standards	Compliance with the *Aboriginal Cultural Heritage Act 2003* and associated regulations and guidelines.
	No harm to Aboriginal or European cultural heritage.
Control Strategies	No cultural heritage significance has been identified to date onsite. However, should items be discovered during the course of operations onsite, Terrequip Environmental will: ▪ Immediately notify the Cultural Heritage Coordination Unit (DNRME) of the find; and ▪ Undertake a formal cultural heritage survey of the site.

5.8 Community

Terrequip Environmental endeavours to build positive relationships with neighbouring landowners and the local community in the vicinity of the Site. Permanent employment is provided for 10 full-time people, supported by a further 5-8 contract personnel. In addition, numerous service industries are supported by the operation, including engineering workshops and transport companies.

A school bus route terminates at the O'Deas Road / Keoghs Road intersection. Trucks travelling from the Phoenix Pit to the crushing plant within Aspinal Pit cross O'Deas Road east of this intersection. Trucks from East/West Pit also use this intersection, and the following safety features are in place:

- Trucks will not travel along the public road; they will travel on a formed gravel road within the ML boundaries;
- The intersection will be kept clear of vegetation that may obscure visibility;

- Trucks will face (from both directions) a “Give Way” sign at the O’Deas Road / Keoghs Road intersection; and
- Unregistered trucks will hold a “Period Permit” enabling them to travel across the public road.

5.8.1 Community Protection Commitments

Community protection commitments for the operation of the Project have been outlined in **Table 17**. Commitments include objectives, indicators / standards and control strategies to maintain positive relationships with the local community.

Table 17: Community Protection Commitments

Aspect	Commitment
Objectives	To maintain positive relationships with neighbours and the general community.
Indicators / Standards	Zero complaints from neighbours and the general community about the Project.
Control Strategies	To continue a policy of good neighbour and corporate citizenship.
	Fitting of all vehicles with flashing lights to improve their visibility.
	Structuring of working hours to ensure no trucks cross O’Deas Road within 15 minutes of the scheduled school bus run.
	Maintenance of a register / log to record and manage complaints from the community about any aspects of site operations.
	Investigation of any complaints and amendment of operational procedures and activities as appropriate.

5.9 Light

The operation of the mine particularly with regards to security has the potential to cause a nuisance from light emission. This potential is recognised and will be controlled by choosing fittings that have a tightly controlled spill light pattern and placing lighting so that it is directed away from any sensitive source. Light fittings and placement will be selected to comply with the requirements of *Australian Standard AS 4282 -1997 – Control of the Effects of Outdoor Lighting*.

5.10 Staff and Contractor Training

Terrequip Environmental is committed to ensuring that all personnel and contractors on site have a sound level of understanding of their environmental management duties and responsibilities of the operations. In order to achieve this, Terrequip Environmental as a workforce education program for site environmental management. This program is part of all staff and major contractor inductions.

5.11 Energy Efficiency and Cleaner Production

Terrequip Environmental is focused on ensuring that the Project is operated efficiently with respect to its energy requirements. The main sources of energy (electricity and diesel) are monitored monthly to ensure that plant and equipment are running efficiently. Opportunities for reduction in energy

consumption are continually sought. As part of the Terrequip Environmental's internal Greenhouse Gas Management Program, tonnes of CO_2 equivalent emissions are recorded relating to energy use.

6 Rehabilitation and Remediation

Terrequip Environmental propose that the specific areas of disturbance within each ML will be rehabilitated in accordance with the specifications and plans described below. Detailed methodologies for rehabilitation are provided as part of the Vegetation Management Plan (**Appendix E**). Further details of proposed rehabilitation activities to achieve the below will be presented in a Final Land Use and Rehabilitation Plan.

Should the operation cease earlier than expected, then the disturbance figures will be less than those shown in the tables below but will be in accordance with the Plan of Operations current at the time of closure.

6.1 East/West Pit – ML50236, ML50239 and ML50083

Upon closure, any disturbed land will be rehabilitated in accordance with Schedule F of the EA.

Table 18: Final Land Use and Rehabilitation Approval Schedule for ML50236

Tenure ID	Disturbance type	Surface area (ha)	Post mine land description	Post mine land (capability / suitability) classification #	Slope range (degrees°)
ML50236	Main Pit Void	0.00	-	-	-
	Waste Dump	1.62	Re-contoured for drainage, Land not suitable for cultivations but well suited to pasture improvement	vi	Min of 20° Max of 30°
	Sediment Dams	0.00	-	-	-
	Road and Tracks	0.00	-	-	-
	Topsoil	0.00	-	-	-

 # "land capability" as defined in the DME 1995 Technical Guideline for the Environmental management of Exploration and Mining in Queensland.

Table 19: Final Land Use and Rehabilitation Approval Schedule for ML50239

Tenure ID	Disturbance type	Surface area (ha)	Post mine land description	Post mine land (capability / suitability) classification #	Slope range (degrees°)
ML50239	Main Pit Void	0.38	Water storage / Grazing	vi	70°
	Waste Dump	1.74	General Grazing Land	vi	Min of 20° Max of 30°
	Sediment Dams	0.54	Remain as Stock Dams	vii	20°
	Road and Tracks	0.00	-	-	-
	Topsoil	0.00	-	-	-

 # "land capability" as defined in the DME 1995 Technical Guideline for the Environmental management of Exploration and Mining in Queensland.

Table 20: Final Land Use and Rehabilitation Approval Schedule for ML50083

Tenure ID	Disturbance type	Surface area (ha)	Post mine land description	Post mine land (capability / suitability) classification #	Slope range (degrees°)
ML50083	Western Open Pit	5.00	Water Storage	viii	70°
	Eastern Open Pit	5.00	Backfilled to RL 524	vi	70°
	Waste Dump	5.00	General Grazing Land	vi	30°
	Sediment Dams and Stormwater Control	1.01	Remain as Stock Dams	viii	30°
	ROM Pad and Stockpiles	1.50	All will be removed	vi	Max of 10°
	Roads and Tracks	1.50	Some tracks to remain as farm access tracks	vi	Max of 10°
	Topsoil	0.33	Respread as required	vi	Max of 10°

 # "land capability" as defined in the DME 1995 Technical Guideline for the Environmental management of Exploration and Mining in Queensland.

6.2 Aspinal Pit – ML50146

Upon closure, any disturbed land will be rehabilitated in accordance with Schedule F of the EA.

Table 21: Final Land Use and Rehabilitation Approval Schedule for ML50146

Tenure ID	Disturbance type	Surface area (ha)	Post mine land description	Post mine land (capability / suitability) classification #	Slope range (degrees°)
ML50146	Open Pit	2.50	Land not suitable for cultivation but well suited to pasture improvement	vi	70°
	Waste Dump	4.50	Re-contoured for drainage. Land not suitable for cultivation but well suited to pasture improvement	vi	Min of 20° Max of 30°
	ROM Pad and Stockpiles	10.00	All will be removed or rehabilitated	vi	Max 10°
	Roads and Tracks	3.15	Some access tracks to remain as farm access tracks	vi	Max 10°
	Sediment and Stormwater Control	2.00	Remain as Stock Dams	viii	Max 20°
	Fixed Plant	1.24	All not required by land holder will be removed	vi	Max 10°
	Office / Maintenance Buildings	0.50	All not required by land holder will be removed	vi	Max 10°
	Topsoil	1.50	Respread as required	vi	Max of 10°

 # "land capability" as defined in the DME 1995 Technical Guideline for the Environmental management of Exploration and Mining in Queensland.

6.3 Phoenix Pit – ML50237 and ML50238

Upon closure, any disturbed land will be rehabilitated in accordance with Schedule F of the EA.

Table 22: Final Land Use and Rehabilitation Approval Schedule for ML50237

Tenure ID	Disturbance type	Surface area (ha)	Post mine land description	Post mine land (capability / suitability) classification #	Slope range (degrees°)
ML50237	Main Pit Void	11.50	Water storage / Grazing	vi	70°
	Waste Dump	14.50	Re-contoured for drainage, Land not suitable for cultivations but well suited to pasture improvement	vi	Min of 20° Max of 30°
	Sediment Dams and Stormwater Control	3.50	Remain as Stock Dams	viii	20°
	Road and Tracks	5.65	Roads to remain as farm access tracks	vi	Max of 10°
	Topsoil	5.00	Respread as required	vi	Max of 10°
	Mobile Crushing ROM and Product Stockpiles	6.60	All infrastructure to be removed and area re-contoured for drainage. Land not suitable for cultivations but well suited to pasture improvement	vi	Max 10°
	Crib Hut and Parking	1.00	All infrastructure to be removed and area re-contoured for drainage. Land not suitable for cultivations but well suited to pasture improvement	vi	Max 10°

 # "land capability" as defined in the DME 1995 Technical Guideline for the Environmental management of Exploration and Mining in Queensland.

Table 23: Final Land Use and Rehabilitation Approval Schedule for ML50238

Tenure ID	Disturbance type	Surface area (ha)	Post mine land description	Post mine land (capability / suitability) classification #	Slope range (degrees°)
ML50238	Main Pit Void	1.50	Water storage / Grazing	vi	70°
	Waste Dump	1.00	Re-contoured for drainage, Land not suitable for cultivations but well suited to pasture improvement	vi	Min of 20° Max of 30°
	Sediment Dams and Stormwater Control	0.50	Re-contoured for drainage. Land not suitable for cultivations but well suited to pasture improvement	vi	Max 10°
	Mobile Crushing ROM and Product Stockpiles	2.60	Re-contoured for drainage, Land not suitable for cultivations but well suited to pasture improvement	vi	Max 10°

Tenure ID	Disturbance type	Surface area (ha)	Post mine land description	Post mine land (capability / suitability) classification #	Slope range (degrees°)
	Road and Tracks	2.50	Re-contoured for drainage, Land not suitable for cultivations but well suited to pasture improvement	vi	Max of 10°
	Topsoil	1.00	Respread as required	vi	Max of 10°

 # "land capability" as defined in the DME 1995 Technical Guideline for the Environmental management of Exploration and Mining in Queensland.

GLOSSARY

Acronym	Definition
ACH Act	*Aboriginal Cultural Heritage Act 2003*
CHMA	Cultural Heritage Management Agreement
DES	Department of Environment and Science
DNRME	Department of Natural Resources, Mines and Energy
EMP	Environmental Management Plan
EMS	Environmental Management System
EP Act	*Environmental Protection Act 1994*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ERA	Environmentally Relevant Activity
LOM Plan	Life of Mine Plan
ML	Mining Lease
MNES	Matters of National Environmental Significance
MR Act	*Mineral Resources Act 1989*
MSES	Matters of State Environmental Significance
NC Act	*Nature Conservation Act 1992*
RE	Regional Ecosystem
ROM	Run of Mine
SCL	Strategic Cropping Land
WoNS	Weeds of National Significance

Appendix A – Environment and Sustainability Policy Statement

Appendix B – Visual Amenity Assessment Report

Appendix C – Site Water Management Plan

Appendix D – Dust Management Plan

Appendix E – Vegetation Management Plan

Appendix F – Fauna Management Plan

Appendix G – Feral Animal (Fox and Cat) Management Guidelines

Appendix 4

Rocktest Rock Engineering Consultants (5 June 2019): Warwick Limestone Mine Geothechnical Risk Assessment and Management for Sibelco Version 1.0

WARWICK LIMESTONE MINE

GEOTECHNICAL RISK ASSESSMENT AND MANAGMENT

for

DOCUMENT CONTROL

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Signature	
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Position	Principal and Senior Rock Mechanics Engineer
Date	5 June 2019

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5 June 2019

Sibelco Australia Pty Ltd
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Attention: PAUL TIMMINS
via email to Paul.Timmins@sibelco.com.au

Dear Paul,

This report provides an opinion on the principal geotechnical hazards and associated risks currently applicable to the pits at Warwick. It recommends strategies for ensuring that the residual risks are as low as reasonably practicable post abandonment.

After the strategies have been implemented, there will still be non-mitigatable geotechnical risks associated with the site for the long-term due to the presence of the pits. The landholders must manage these risks to ensure they remain acceptable.

I trust that this report provides the information you require. Please contact this office if you wish to discuss any aspect of it or require further assistance.

For and on behalf of
ROCKTEST

Tony Meyers
Senior Principal Rock Mechanics Engineer
RPEQ 10442

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1 INTRODUCTION

1.1 Background

Sibelco Australia plans to relinquish the mining leases at the Warwick Limestone mine in 2019. Sibelco engaged Rocktest in April 2019 to prepare a geotechnical closure report.

Tony Meyers of Rocktest visited the site in May 2019 to obtain data necessary to prepare this report.

1.2 Scope of Works

The activities required of Rocktest by Sibelco were:

1. Visit Warwick mine to inspect the three pits, East-West, Phoenix and Aspinal (Figures 1 to 4), and the waste rock dumps adjacent to the East-West pit (Figures 5) and the Phoenix pit (Figures 6).
2. Collect geotechnical data from the walls of the pits.
3. Discuss the current performances of the walls and the dump slopes and the principal geotechnical hazards applicable to each.
4. Recommend strategies and controls to ensure the residual risks applicable to the features post relinquishment are acceptable for the long-term. The strategies and controls are to be practical and appropriate considering the intended use and proposed frequency of occupancy of the site.
5. Provide an opinion on the residual risks applicable to the hazards after strategies and controls have been implemented.

This report aims to address the scope of works within the following limitations:

- Access restrictions required data be obtained from relatively few locations[1] at which non-blast damaged rocks were exposed within safely accessible areas on the pit walls.
- Data was obtained from visual assessment of weathered rocks exposed on the walls. Some characteristics of the rocks will not be representative of the characteristics of less weathered rocks at depth.

These requirements imposed constraints on the study. These constraints are noted within the applicable section of text and, where necessary, recommendations are made for addressing them.

1.3 Information Available

Sibelco provided to Rocktest digital terrain model files:

- WAR20150721_75cm_South trim.dxf
- WAR20181211_Phoenix_Surface_50cm.dxf
- Gatewing 20150721 Aspinal Plant.dxf

[1] Relative to the areal extents of the walls.

1.4 Terminology

Time periods referred to in this report are:

- Short-term < 10 years
- Medium-term 10 – 100 years
- Long-term > 100 years

Strategies and recommendations in this study consider a 100-year period.

2 GEOLOGY

2.1 General Stratigraphy

Table 1 summarises the general stratigraphy in the area around the Warwick mine.

The stratigraphy comprises sandy clay topsoil overlying moderately[2] dipping altered siltstones which overly and underly limestones and marbles. Each rock unit dips [3] towards the south-west.

The relative proportions of the various carbonates in a particular area are a function of the degree to which alteration has occurred. Dissolution of the upper surfaces of the limestones have created karst features; predominantly an irregular upper surface (Figure 7) and dilated[4] joint apertures (Figure 8); the latter features being particularly evident at the east end of the East-West pit where caves are present.

Andesites have intruded throughout the site diluting the reserves (Figure 9).

2.2 Macro Scale Geology

The "bent" plan view of the East-West pit is due to the rocks in the region having been folded and faulted along strike. The hinge of a downward closing synclinal fold and associated faulting can be seen in the north-west corner of this pit (Figures 10). Evidence of folding is less obvious in the other pits.

The limestones at the northwest end of the East-West pit are offset from those at the southeast end of the pit by 100-m due to shearing along a very-highly persistent[5] northeast-southwest striking lateral fault located in the "bridge" midway between the east and west sections of the pit.

The limestones in the Phoenix pit are offset from those at the southeast end of the East-West pit by 330-m, due possibly to shearing along another very-highly persistent northeast-southwest striking lateral fault.

Many other less persistent faults extend across all pits (Figure 11). Many of these faults are parallel to, and likely associated with, the more persistent faults that have displaced the orebodies between pits. Displacements along the smaller faults have generally been small; the majority being less than 300-mm with a small proportion being up to ≈1000-mm.

The apertures of the faults are generally tight. They rarely contain gouge and adjacent surfaces are generally not crushed; characteristics favourable for rock mass strength. The lack of these features suggests that shearing along the faults may have occurred in a low stress environment. There is negligible evidence of the rockmass either side of most faults having been dragged (i.e. bent) during shearing; a characteristic also beneficial for rockmass strength. There are however shear zones, up to 300-mm thick, adjacent to some of the

---

[2] Dip terms: Very shallow 0-20°; Shallow 20-40°; Moderate 40-60°; Steep 60-75°; Very steep 75-90°.

[3] Descriptions in these sections are based on ISRM (1985) International Society for Rock Mechanics. Suggested Methods for the Quantitative Description of Discontinuities in Rock Masses, Int. Jnl. Rock Mech., Min. Sci. & Geomech. Abstr. Vol. 15 pp.319-368.

[4] The term "dilation" is used to describe the aperture of a lineal feature, such as a joint, increasing in width. It can occur by chemical or physical weathering or by mechanical means for example by vibration or shear displacement.

[5] The term persistence refers to the areal extents of the faults. Persistence classification: 1-m ≤ Low ≤ 3-m ≤ Medium ≤ 10-m ≤ High ≤ 20 m, Very-high >20 m.

faults. These zones are not unexpected, especially adjacent to faults along which more extensive shear displacements occurred. Rocks within these zones have been unravelling.

The orientations of the faults tend to be similar to the orientations of either the bedding surfaces or the jointing. Benches that were designed for stabilities on the basis of the orientations of these latter discontinuities[6] have therefore been generally free from instabilities associated with one or more of the faults.

Bench scale instabilities involving intersections of two or more of the faults, or intersections of faults and jointing and/or bedding surfaces, have occurred to bench scale (Figure 12). Instabilities could extend over several benches although none of this scale has occurred to date.

Table 1. General stratigraphy

Approximate depths (m)	Material	Description
0-2	Topsoil	Tertiary age clayey sand, low to medium plasticity, dark-tan to light-brown, containing well-graded gravels to 5-mm diameter.
2-7		As above but including distinctly to extremely weathered floaters of altered siltstone up to 30 cm diameter.
7-15	Siltstone (overlying)	Altered siltstone ("rabbit rock"), fine grain, red-brown to dark-brown, medium to high strengths, slightly- to distinctly-weathered, highly jointed.
15-30	Limestone/ Marble	Limestone is fine grain cream to grey. Marble is crystalline white. High- to very-high strengths. Fresh to slightly-weathered, highly-jointed to massive. Discontinuities are sharp with some Fe staining.
>30	Siltstone (underlying)	Altered siltstone, fine grain, red-brown to dark-brown, medium- to high-strengths, slightly-weathered, highly-jointed.
Various	Andesite	Carbonates and overlying and underlying siltstones are intersected by Devonian age, mafic intrusions, possibly andesites. Finely crystalline, medium- to dark-grey, high-strengths, fresh to slightly-weathered, massive. The thicknesses of the intrusions range from 0.5-m to 2.0-m. They tend to follow vertical to sub-vertical jointing from depth until reduced vertical stresses at shallower depths have allowed them to extrude along horizontal jointing.

[6] The term discontinuity refers to any surfaces having tensile strengths less than those of the adjacent rocks. It includes faults, joints and bedding surfaces.

2.3 Micro Scale Geology

The macro scale faulting and folding have invariably contributed to high volumetric densities of less persistent discontinuities (i.e. bedding surfaces and joints) in all pits. The spatial and shear strength characteristics[7] of these discontinuities have been the primary contributors to the performance of the batters at bench scale.

A limited program of discontinuity mapping[8] was carried out in the East-West and Phoenix pits to obtain data necessary to quantify the characteristics of the discontinuities. Similarities in the orientation characteristics of the discontinuities mapped in each pit justified combining the data from the two pits. The relatively close proximities of the pits (< 850-m) with respect to the regional geology likely contributes to these similarities.

2.3.1 Discontinuity Orientations

Figures 13a show the poles[9] to the sampled discontinuities plotted as points on a stereonet[10]. Figure 13b shows the poles contoured based on densities. The sets are defined as the areas of highest densities.

Five distinct sets of discontinuities can be recognised. Set 1 contains bedding surfaces; Sets 2 to 5 contain joints. The number of sets is consistent with the rockmass having undergone moderate deformation[11].

Each of these sets is quantified by the average of the orientations of the discontinuities assigned to the set and a value for Fisher's constant; the latter value quantifying the maximum deviations of the orientations from the mean. The values of these parameters are listed in Table 1.
Set 1 dips moderately[12] towards the southwest.

- Set 2 dips steeply to very-steeply towards the northeast and the southwest.
- Set 3 dips steeply to very-steeply towards the northwest and southeast.
- Set 4 dips moderately to steeply towards the east.
- Set 5 dips steeply to very-steeply towards the west and the east.

---

[7] The spatial characteristics that have had the greatest influence on performance are (1) the number of sets of discontinuities, as it influences the number of discontinuities per unit volume of rockmass (2) the orientations of the discontinuities, as they influence the numbers of discontinuities that daylight from surfaces (3) the spacings between adjacent discontinuities, as they influence the sizes of individual rocks and (4) the persistences of the discontinuities, as they can influence the volumes involved in failure events.

[8] The orientation, location, size and roughness of 420 discontinuities that intersected 4 scanlines were recorded.

[9] A discontinuity is a 2D feature. It is represented on a stereonet as a "great circle". The "pole" to a discontinuity is a 1-dimensional downward directed line that is orientated perpendicular to the plane. It is represented on a stereonet as a point.

[10] The outer rim of the stereonet represents the dip direction (trend) of the discontinuity from 0° (North) to 360°. The dip (plunge) of the discontinuity from 0° (horizontal) to 90° (vertical) is represented as the distance from the rim of the stereonet towards its centre.

[11] Three sets are typical where negligible deformation has occurred. The number increases as the degree to which a rockmass has been deformed increases.

[12] Dip terms: Very shallow $0\text{-}20^o$; Shallow $20\text{-}40^o$; Moderate $40\text{-}60^o$; Steep $60\text{-}75^o$; Very steep $75\text{-}90^o$.

Table 1. Characteristics of the discontinuity sets.

Set	Mean Orientation DipDirn/DipA (degrees)	Fisher's Constant, F	Number/ Weighted Number (%)	Mean Spacing (m)
1	228/48	15	80/242 (20/24)	0.38
2	039/82	19	94/280 (7/5)	0.40
3	305/88	24	81/164 (20/24)	0.79
4	070/37	16	48/149 (11/14)	0.53
5	271/89	17	65/125 (26/20)	0.69
Random	none	< 1	52/85 (12/9)	0.50
		Total	420/1055 (100/100)	

2.3.2 Discontinuity Deviations

The greater the degree to which a rock mass is deformed, the more the discontinuities within each set deviate from the mean orientation of the set. The amount of deviation influences how a section of a wall will perform relative to adjacent sections of the wall. Increasing deviation increases unpredictability. In this study, the deviations are defined in terms of Fisher's constants (F). The values applicable to the sets (i.e. $13 \leq F \leq 19$) equate to moderate deviations[13].

Random discontinuities develop during each stage of deformation; the proportion (P_r) increasing as cumulative damage occurred. The moderate[14] proportion within the data ($P_r = 9\%$) is consistent with the values of Fisher's constants.

The number of sets, the deviations about the mean values and the degree of randomness are consistent with the tectonic histories of the rockmasses around all pits involving moderate deformations; a result consistent with the observed folding and faulting at local and regional scales. These characteristics have contributed to the challengers in the past maintaining stable benches during mining, particularly during the period when the Aspinal pit and the upper benches in the East-West pit were excavated. During these periods, mining procedures were not as rigorous as they were when the other pits were subsequently excavated and blast damage and over-excavation occurred frequently.

[13] Values of Fisher's constants greater than 50 are rare as they imply the discontinuities within sets are more parallel than typically occurs. values of 25 to 35 are typical for many rock masses that have not been deformed significantly. Values above 15 typically occur when moderate deformation has occurred. Values less than 15 can be indicative of significant deformation having occurred.

[14] A proportion of random discontinuities less than 5% is rare. Values of 10% to 20% are typical for rock masses that have not been deformed significantly. Value exceeding 40% are high; often indicative of significant deformation.

2.3.3 Discontinuity Spacings and Rock Shapes

Spacings

The spacings between adjacent discontinuities from the same set have had a significant influence on the sizes of the individual rocks.

As indicated in Table 1, adjacent discontinuities from all sets are generally moderately to widely spaced[15], ranging from 0.4-m to 0.8 m. However, there are significant variabilities between the individual spacing values, which range from 50-mm to 7-m. This variation contributes to the wide distribution of rock sizes. This distribution can be seen within the walls and in heaps of blasted rocks where a few "very large" rocks occur with a much larger proportion of small to moderate sized rocks.

The significant fraction of moderate and greater sized rocks has contributed to the fair performances of most sections of most walls in all pits at multi-bench and overall scales[16]. There are however areas on every wall where spacings are significantly less than the mean values. The rock masses in these areas have lower strengths as evidenced by accelerated weathering and localised instabilities that extend over multiple benches (Figure 14).

Shapes

The combination of five sets of discontinuities, a moderate random component and moderate average spacings between adjacent discontinuities from all sets has resulted in individual rocks having shapes that range from tabular (i.e. slabby) to blocky[17].

The distribution of the sizes of the rocks and their shapes have influenced the trajectories of the rocks when they have detached from the batters.

- The blockier shaped rocks generally rolled and bounced down the batters. Some of the rocks gained sufficient momentum to traverse off lower berms. A moderate proportion of these rocks came to rest beyond the walls on the floors of the pits and on the ramps. Their run-out distances do not appear to have exceeded ≈20 m, even on the highest walls. The exceptions are those rocks that launched off protrusions in batters during their traverse.
- A high proportion of the more tabular shaped rocks that detached slid down the batters. Most of these rocks did not launch beyond the lower berms hence are the more common shapes accumulated on the berms and near the toes of the pit walls.

---

[15] Spacings: 0.06 ≤ Close ≤ 0.2-m ≤ Moderate ≤ 0.6-m ≤ Wide ≤ 2-m ≤ Very wide ≤ 6 m

[16] Large block sizes contribute to blocks interlocking which can contribute to rock mass strength, weathering rates and the long-term performances of the walls. However, loosening of the rocks by excessive blasting may have diminished much of the influence of block interlocking on rock mass strength.

[17] "Blocky": equi-dimensional; "Tabular": one dimension considerably smaller than the other two; "Columnar": one dimension considerably larger than the other two.

Most benches contain areas from which moderate volumes (< 10 m^3) of small rocks detached. These rocks would have flowed rather than bounced down the batters. The trajectories of a high proportion of these rocks would have been restricted by protrusions on the very-rough surfaces of most batters. Rocks that continued to flow collected in piles upon those lower berms that had sufficient retention volumes remaining after previous flows. Otherwise the rocks flowed off the berms and ended up collecting on the floors near the toes of the pit walls.

2.3.4 Persistences

The extents to which the discontinuities persist[18] beneath overlying rocks without terminating in solid rock or against other discontinuities has influenced the performances of the walls.

The persistences are functions of the lengths of the traces of the discontinuities exposed on the walls[19]. The average of these length for each set was estimated by observation; quantifying[20] them more accurately was unnecessary for this study.

The trace-lengths range from 0.9-m for Set 5 to 1.1-m for Set 2. The persistences of the discontinuities from these sets will be relatively similar to these lengths which classifies them as having low persistences.

The combination of low persistences and moderate spacings between adjacent discontinuities has been favourable for the stabilities of the walls at multi-bench and wall scales. For large instabilities to have developed, “down-stepping” between adjacent discontinuities has had to occur to enable very-highly persistent surfaces, required to underlie large masses of rocks, to form. The lack of bench scale and larger instabilities in all walls is evidence of this characteristic.

2.3.5. Discontinuity Shear Strengths

Instability have been dominated by gravity driven sliding of masses of rock and rotation of the individual rocks. Sliding occurred when the driving forces being applied to a mass of rocks exceeded the shear strengths of the discontinuities that underlay the rocks[21].

In this study, the shear strengths were quantified in terms of a degraded peak friction angle[22]. The discontinuities are assumed to have negligible cohesive strengths due to:

---

[18] The persistence is the two-dimensional areal extent of a discontinuity.

[19] When the 2D surface of a discontinuity intersects a 2D surface of a slope, the line formed along the slope by the intersection is referred to as the trace of the discontinuity. The length of the line is a function of the persistence of the discontinuity. The line cannot be longer than the maximum areal extent (e.g. diameter) of the discontinuity.

[20] Discontinuity persistence is challenging to quantify as it cannot be measured without pulling apart a rock mass and measuring the area of each discontinuity; an impossible task. The characteristics of the parameter must therefore be estimated using a statistical procedure. One such procedure assumes that the discontinuities are circular shaped discs, with diameters that are functions of the lengths of the traces exposed when the discontinuities intersect slopes. A numerical method is used to back analyse the diameters of the discs from the trace length data.

[21] Assuming the mass of rock is free to move out of the batter.

[22] Any movement along a discontinuity erodes some of the asperities that provide it with its initial peak strength. The movement destroys any cohesive bonds that were present leaving a surface that is purely frictional.

- blast damage having occurred to all benches in all pits, particularly in the East-West pit,
- most discontinuities having undergone shear displacement during tectonic deformation and
- relatively low stresses being applied to the discontinuities at the shallow depths of the pits.

In this study, the peak friction angle is defined according to the relationship of Barton and Bandis (1982[23]) in terms of the parameters listed in Table 2. Application of the relationship provides the range of peak frictions angles listed in the table. A lower bound friction angle of 21° ($\bar{x}$ – 2S) is assumed in Section 4.1.

Table 2. Discontinuity shear strength parameters.

Characteristic	**# of tests**	**Min**	**Mean $\bar{x}$**	**Max**	**Stnd Dev. S**	**Source**
Intact rock densities ρ_i (kg/m^3)	14	2481	2650	2994	162	Immersion tests
Intact rock strengths σ_c (MPa)	20	5	65	105	25	Point load tests
Basic friction angles ϕ_b	28	14	18	28	3	Tilt tests
Joint Roughness Coefficients JRC	280	2	4	8	2	Field assessments using classification chart
Estimated peak friction angles ϕ_r		17	31	58	5	Barton-Bandis equation[24]

2.4 Earthquakes

Geoscience Australia (2013)[25] places Warwick in a zone of low earthquake hazard. It indicates that a ground accelerations of 0.06g have a 10% probability of being exceeded in a 250-year period. This relationship corresponds to a 2500-year average recurrence interval for this intensity of movement. There is therefore a 10% probability that an acceleration (A_e) of less than 0.03g (100/250^{ths} of 0.06g) will be exceeded during the 100-year period considered in this study.

Several studies have reported on PGA values exceeding 0.2g generating falls of individual rocks from pit walls[26] in low stress conditions. PGA values of 0.03g are unlikely to generate rockfalls. On this basis, a 100-year event at this site is unlikely to increase significantly the risk to persons within the pit when a large earthquake occurs.

Large (wall) scale instabilities being triggered by earthquakes within any pit are rare. They are not expected to do so at this site. Even so, implementing strategies to reduce to the greatest extent practical the likelihood for persons to be within the pits or close to the crests of the walls will be prudent to reduce the risk applicable is such an event occurs.

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[23] Barton, N. and Bandis, S (1990) Review of predictive capabilities of JRC-JCS model in engineering practice. In *Proc. Rock Joints*. Balkema pp.803-810.

[24] A Monte-Carlo simulation method was applied to model the ranges in all parameters.

[25] Geoscience Australia (2013) Atlas of Seismic Hazard Maps Australia. (Edt. Leonard M. et.al.) GeoCat 77399.

[26] Rockfalls have been reported for PGA values of 0.16g in pits where discontinuities contain significant joint pressures.

3 SPECIFICATIONS OF THE PITS

Tables 3 and 4 list the average specifications of the pits.

- The East-West pit has the greatest surface areas and the greatest maximum depths of the three pits. In all pits, the maximum depths occur centrally; the depths reducing towards each end of each pit.
- The average strike of the major axis of each pit is parallel with the strike of the limestone orebody in that pit.
- The hanging-wall and footwall along the major axis of each pit comprise at least some siltstones. The walls parallel to the minor axes comprise limestones.
- The batter angles of the footwalls are either parallel to bedding surfaces within the limestones or the batters break back to these angles.

The depths of soil and extremely-weathered rocks and the overall slope angles and heights of the walls listed in Tables 5 and 6.

Table 3. Average specifications of the pit.

	East-West Pit		Phoenix	Aspinal
	West pit	East pit	Pit	Pit
Strike of major axis	138°	228°	055°	163°
Max length at crest (m)	267	280	304	126
Min width at crest (m)	142	174	158	76
Maximum depth of pit (m)	40	51	32	19
Average batter angles	75°	70°	65°	70°
Max number of benches	6	6	5	2
Design berm widths (m)	7	7	7	6
Max bench heights (m)	21	14	12	15

Table 4. Dip directions of the pit walls.

		Wall			
		North (Sth dip)	South (Nth dip)	East (West dip)	West (East dip)
Pit		Dip direction (degrees)			
East-West	West	140→282	029→061	229→278	097→140
	East	223→230	057	273→358	085→148
Phoenix		141→179	315→333	045→102	228→290
Aspinal		162→212	none	263→284	068→071

Table 5. Maximum depths of soil and extremely weathered rocks.

		Wall			
		North (Sth dip)	South (Nth dip)	East (West dip)	West (East dip)
Pit		Depth (m)			
East-West	West	18	10*	10	13*
	East	9	5	2	9
Phoenix		5	11	10*	13*
Aspinal		15	none	19	15

* A high proportion of the soil is fill within karst in the weathered limestones.

Table 6. Maximum heights and average overall slope angles of walls.

		Wall			
		North (Sth dip)	South (Nth dip)	East (West dip)	West (East dip)
Pit		Depth (m)/Overall Slope Angle			
East-West	West	18/31°	10/32°	10/29°	13/14°
	East	9/28°	5/38°	2/34°	9/25°
Phoenix		5/34°	11/32°	10/12°	13/29°
Aspinal		15/16°	none	19/31°	15/25°

4 PERFORMANCES OF THE PIT WALLS

4.1 Theoretical Stabilities of the Walls and Benches

Quantifying the propensities (P_f)[27] for instabilities to develop in each of the four pits provides a measure of their possible performances over the long-term. The technique applied in this study considers whether the orientations and the shear strengths of the discontinuities are favourable for rocks to slide or topple at bench and wall scales. The technique is discussed in Appendix 2.

The results of the analyses are listed in Table A2.1 and summarised in Figures 15 to 22. The figures also indicate the sections through each wall that were analysed. The results indicate:

- All walls in all pits have propensities to be unstable at bench and wall scales.
- Wedges of rocks underlain by pairs of intersecting discontinuities sliding towards the pits are overwhelming the most typical modes of instabilities in all pits. Toppling of masses of rocks towards the pits are the next mode likely modes albeit half as likely as wedges sliding. These results are consistent with observations.
    - Benches on north walls (south dipping) are most prone to wedge sliding and to a significantly lesser extent to block toppling.
    - Benches on south walls (north dipping) are similarly prone to toppling and wedge sliding.
    - Benches on east walls (west dipping) are most prone to wedge sliding and to a significantly lesser extent to flexural toppling.
    - Benches on west walls (east dipping) are most prone to wedge sliding and to a slightly lesser extent to flexural and block toppling..
- The propensities for overall scale instabilities are an average of 3.8 times greater than those for bench scale instabilities in all pits. This result is consistent by observation
- The walls and benches in East-West pit and Phoenix pit are similarly prone to instabilities at both scales. The walls and benches in Aspinal pit are slightly less prone to instabilities than those in the other pits. Batters in the latter pit have therefore been able to remain steeper for longer periods than have the batters in the other pits.

Based on acceptance criteria suggested by Read and Stacey (2009[28]), the recommended maximum P_f values for bench and wall scale instabilities are less than 50% and 20% respectively on the bases that:

- The trajectories of a moderate proportion of individual rocks that fall are terminated on the berms. Most of the other rocks come to rest near the toes of the walls (Section 2.4.3)
- The combination of low discontinuity persistences and moderate spacings between adjacent discontinuities is favourable for the stabilities of the walls at multi-bench and wall scales.

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[27] A value of P_r of 0% implies instability will not occur. A value of 100% implies it will occur sometime in the future. There is no measure of when it will occur.

[28] Reid, J and Stacey P (2009) Table 9.9 in *Guideline for Open Pit Slope Design*. CSIRO Publishing.

In addition, the likelihood of persons being within the trajectory of a falling rock at the time it falls is low due to:

- the pits being located on private land hence the frequency of occupation of a pit is low and
- most instabilities occur during or soon after long duration or intense rainfall when persons are unlikely to be within a pit.

A comparison of the acceptance criteria with the results summarised in Figures 15 to 22 indicates:

East-West pit: West Pit

The propensities for bench scale instabilities in benches dipping:

- towards the south (i.e. north wall) exceed by 10% the recommended level of acceptability;
- in other directions are near or at the level of acceptability.

The propensities for wall scale instabilities in walls dipping:

- towards the north (i.e. south wall) exceed slightly the recommended level of acceptability;
- in other directions are acceptable.

East-West pit: East Pit

The propensities for bench scale instabilities in benches dipping:

- towards the southwest (i.e. north wall) exceed by 11% the recommended level of acceptability;
- in other directions are near or at the level of acceptability.

The propensities for wall scale instabilities in all walls are acceptable.

Phoenix pit

The propensities for bench scale instabilities in benches dipping:

- towards the northeast (i.e. southwest wall) exceeds slightly the recommended level of acceptability;
- in other directions are acceptable.

The propensities for wall scale instabilities in all walls are acceptable.

Aspinal pit

The propensities for bench scale instabilities in any of the benches are acceptable.

The propensities for wall scale instabilities in walls dipping:

- towards the east (i.e. west wall) exceed by 15% the recommended level of acceptability
- in other directions are at or below the level of acceptability.

The following section compares these theoretically based conclusions with the actual performances of the benches and walls.

4.2 Actual Performances of the Walls and Benches

Historical mining practises were not always conducive to achieving stable benches and walls in the Aspinal pit and in the upper benches of the East-West pit because:

- Difficulties were encountered achieving design specifications using standard production blasting techniques in the structurally complex rocks.
- The strengths of the benches were reduced by excessive blast vibrations resulting in a requirement to . over-scale batters and crests in an attempt to remove damaged rocks.
- A lack of success in reducing blast induced overbreak along crests resulting in losses of berm widths.
- An inability to properly scale the batters of 15-m high benches with the available excavators left overhanging and loose rocks along crests.
- Inadequate scaling and limited cleaning of berms resulted in a moderate proportion of all berms containing excessive volumes of rockfall debris.
- Gradients on berms were inadequate to prevent water pooling and eventually draining into the underlying benches or over their crests. These actions have accelerated weathering of the rocks and destabilised some sections of batters.

These factors and the geotechnical characteristics of the rockmass have contributed to the historical performance of the walls and will continue to do so over the long-term. The performances of the components of each wall are considered in the following sections.

4.2.1 Walls and Crests

- No wall scale instabilities have occurred in any pit.
- Most (>98%) sections of the crests of all walls are at their planned limits and show negligible evidence of sections having broken back.
- The crests of all pits were walked and inspected for subsidence and/or the development of highly persistent cracking; indicators that wall scale instabilities may have been triggered. No evidence was observed around any pit.

These performances are consistent with the results of the stability analyses. Over the long-term, wall scale instabilities are not expected to occur.

4.2.2 Batters

- Most batter angles vary significantly ($\pm 15^{o}$) from the specified design angles. Some sections of some batters are overhanging.
- A high proportion of rocks that were loose at the time of mining fell prior to mining ceasing. Only a moderate proportion (<30%) of the total area of batters in East-West and Aspinal pits and a low proportion(<5%) of the area in Phoenix pit are estimated to still contain loose rocks. Many of these rocks will fall over the long-term.

- Most batters in the older benches in East-West pit and a few batters on the west and north walls of the Phoenix pit contain overhanging rocks (Figures 23 to 29). Some of the overhangs are expected to detach over the long-term.
- All benches in all pits contain evidence of bench or lesser scale instabilities having occurred (e.g. Figures 23 to 29).
  - Wedge and planar sliding modes are particularly evident on benches on the north and east walls of all pits. Wedge sliding has created the sawtooth roughness profile on most of the batters (Figure 30).
  - Some daylighting planes (i.e. "slippery-backs") are evidence of planar failures having occurred.
  - Toppling modes (Figure 31) are most evident on benches on south and west dipping walls in all pits.

  These observations are consistent with the results of the stability analyses.
- Falls of individual rocks and masses of rocks have resulted in the surfaces of all older batters ending up rough to very-rough. The roughness invariably causes falling rocks to launch out from the batters and end up out from their toes thereby increasing the rockfall hazards applicable to persons on the pit floors.
- Shallow instabilities triggered by erosion have occurred on batters cut in soil and in highly-weathered rocks. Obvious examples are in the batters adjacent to the central ramp in the East-West pit (Figure 32) and the main ramp in Phoenix pit (Figure 33). Both ramps are to be retained after mine closure therefore hazard control will be required to reduce the rates of erosion.
- Relatively few multi-bench instabilities have occurred in any pit. Those that have occurred have generally been shallow and involved two benches.

4.2.3 Berms

- Berm widths vary significantly, particularly in the East-West pit (Figure 34) and the Aspinal pit. Some sections of almost all berms have widths similar to or greater than the 3-m to 5-m widths generally recommended[29] for 10-m to 15-m high final benches. However, a high proportion (<60%) of the total lengths of berms in all pits are thinner than the widths recommended for the adjacent bench heights and some sections have lost their berms. These sections may be functioning as required when the volumes of debris collected upon them are less than the retention capacities of the sections. However, those sections that are at or near capacity will unlikely retain additional material or terminate the traverses of falling rocks.
- The only advantage of sections of some berms being thin and/or full of debris is that access by person along the berms is restricted or not possible.
- All berms were inspected[30] for subsidence and/or the development of cracking; indicators that bench or multi-bench scale instabilities having been triggered.

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[29] As a rule of thumb, berms on a production bench should be 2/3^{rds} the height of the adjacent bench. Final berms should be 1/3rd the height of the bench assuming the adjacent batter is well scaled and the bench is not blast damaged.

[30] Berms that cannot be accessed safely were inspected from safe locations using binoculars.

- A small number of cracks were observed in berms in the Phoenix and the Aspinal pits (<20 respectively).
- Many cracks were observed in berms in the East-West pit (<100).

All of the cracks observed have low persistences (< 3-m), are offset from crests by less than 1-m and generally appear to be shallow dipping. These characteristics indicate that most cracks are likely to be underlying relatively small volumes of rocks. They are unlikely to be associated with bench or greater scale instabilities.

4.2.4 Benches

- Most (>85%) benches on most walls are still present. Benches in Phoenix pit are generally more competent than older benches in the East-West pit.
- Although a high proportion of the older benches have been damaged by blasting, a general lack of dilated discontinuities within batters suggests that damaged sections of benches have failed and the remaining cores are generally competent.

4.2.5 Floors of Pits and Ramps

- The pit floors are relatively free of rockfall debris considering the large numbers of individual rocks that have fallen. Falls therefore occurred in the periods soon after the benches were excavated with the frequencies of falls progressively reducing in subsequent years.
- The floors of all pits are accessible by at least one ramp. A least one ramps into each pit is accessible by foot and by vehicle.

4.2.6 Overland Flows and Water within Pits

- The topographies surrounding all pits are moderately undulating. Overland flows of water sheeting off areas up contour of the walls have flowed to some sections of some wall pit crests unless bunds have been installed to redirect flows.
- Erosion by water flows has cut gullies along the sides of all ramps and along some haul-roads. Gullies are most apparent on ramps and haul-roads at the east and west ends of the East-West pit (Figures 36 to 38) and the Phoenix pit (Figures 39 and 40)..
- Erosion channels have been cut within those upper benches and ramps that comprise soils and extremely-weathered rocks containing filled karst (e.g. Figures 7 and 41). Channels are significantly less prevalent in the less weathered, more durable, limestones exposed in the lower batters.
- Flows of water down walls has contributed to water ponding on the floor of all pits.
- Groundwater has contributed to water ponding at both ends of the East-West pit and within Phoenix pit. The water restricts significantly access to the toes of adjacent sections of the walls which reduces somewhat the risks applicable to rockfall along these sections.

4.2.7 Summary of Observations

The performances of the walls and benches has been consistent with the results of the stability analyses.

The observed characteristics that highlight how the walls and benches have performed that are indicators of how they are likely to perform over the long-term are noted in Table 7. Based on these observations, in the long-term:

- wall and multi-bench scale instabilities will be rare;
- bench scale instabilities are unlikely;
- falls of individual rocks will likely occur from most benches due primarily to ongoing weathering.

Table 7. Summary of observed instabilities.

Scale of Instabilities	*Comments*
Wall scale	No wall scale instabilities have occurred in any pit at any time.
	No very-persistent cracks were observed beyond any of the pit crests
	Bedding surfaces dip into the hanging (south) walls hence are unlikely to act as surfaces upon which large-scale masses of rocks are likely to slide.
	The average low persistences of individual discontinuities and moderate spacings between adjacent discontinuities from the same sets have been favourable for the stabilities of the walls in relation to wall-scale and multi-bench scale instabilities.
Multi-bench scale	Most multi-bench scale instabilities have been associated with particular features including zones of closely spaced rocks, sheared zones around faults and occasional intersections of very highly-persistent (<20-m) faults and discontinuities which are infrequent. There are a few locations where multi-bench scale erosion channels have been cut by overland flows of water.
Bench scale	Bench-scale instabilities are more obvious than multi-bench and wall scale events, However, they are not prevalent even though the orientations of the discontinuities have been favourable to instabilities. The persistence of most discontinuities having been insufficiently large to underlie bench scale volumes of rocks.
Individual rocks	Large volumes of rocks on most berms are evidence that rockfalls have been frequent. However, a comparison of berms from the current time with those from 15-years ago (Figures 42 to 44) indicates that a significant proportion of the falls occurred in the years soon after each batter was cut with the frequency of falls decreasing progressively afterwards. This characteristic is conducive to the frequencies remaining relatively low during the long-term.

5 PIT WALL RISK ASSESSMENTS

5.1 Qualitative Assessment

A qualitative risk assessment for each credible potential geotechnical hazard identified in Section 4 is presented in Table 6. The risks are classified using a system based on Standards Australia AS/NZS ISO 31000:2009 *Risk Management – Principles and Guidelines*. The system rates likelihood and consequence according to the descriptors in Tables A1.1 and A1.2 in Appendix 1. The risk is classified for comparative purposes using the matrix in Table A1.3.

The following items were considered:

- Location/Domain. There are similar domains in all pits:
  - Pit floors.
  - Ramps.
  - Crests of the walls.
  - Berms.
- Likelihood of injury or loss-of-life for persons. Unauthorised access to the site by the public is assumed to be possible. Authorised access to the pits is assumed to be likely for a variety of reasons including:
  - installing and servicing water pumping equipment in pits containing pooled water;
  - rounding up stock or wildlife;
  - undertaking routine inspections to ascertain the performances of the pit walls and ground control infrastructure;
  - general interest.
- Hazard identification e.g. single rocks, masses of rocks and crest loss.
- Likelihood of event. Frequency of events is estimated based on observations of the numbers of instabilities in the pits.
- Likely initiating events for the hazards are not included in the table as they are consistent for all domains; progressive weathering of rocks, excess hydrostatic pressures and earthquakes.

Results of Risk Assessment

Table 6 is the risk assessment matrix.

The assessments indicate that the risks applicable to most scenarios are in the range of Moderate to High. These classifications are due primarily to the significant consequence of a person being impacted by a rock rather than the likelihood of an impact occurring, which is generally low due to the low frequency of occupation of a pit.

The implications of the risk classifications are listed in Table A1.4 in Appendix 1. In summary, the classifications indicate that the risks must be reduced by the application of controls.

The next stage of the assessment aims to quantify whether the residual risk applicable after applying controls will be acceptable.

Table 6. Qualitative "Current" Risk Assessment

		i	ii	iii	iv		
Domain	**Hazard/Event**	**Likelihood of hazard being triggered**	**Likelihood of impact**	**Likelihood of event (i & ii)**	**Consequence of impact**	**Current risk Level (iii & iv)**	
Floors	Individual rock impacts person	B	D	C	1 - 3	M - H	moderate to high
	Mass of rocks engulfs person	D	D	D	1	H	high
Ramps	Individual rock impacts vehicle	B	C - D	C	1 - 4	M - H	moderate to high
	Mass of rocks impacts vehicle	D	C - D	C	1 - 3	M - H	moderate to high
	Collapse of the shoulder of the ramp subsumes vehicle	D	D - E	D	1 - 2	M - H	moderate to high
Crests	Collapse of a crest subsumes person	C	D	C	1 - 3	M - H	moderate to high
Berms	Individual rock impacts person on a berm on a high wall	A	D - E	C	1 - 3	M - H	moderate to high
	Mass of rocks engulfs person on a berm	C	D - E	D	1	H	high
	Collapse of a berm subsumes person	D	D - E	D	1 - 3	M - H	moderate to high

5.2 Quantitative Risk Assessment: Rockfalls Pit Floor

A quantitative risk assessment was completed to quantify the risk applicable to one or more persons after strategies have been implemented to manage the risks. The assessment assumes that the strategies aim to limit the number of persons who access the pits and to restrict entry to the areas around them. The assessment is based on the general principals outlined in AGS (2007) [31].

The scenario considered involves one or more persons associated with the private land being in a pit within the trajectory of a falling rock. A series of simplifying assumptions are made to estimate the risk to the person/s:

- An average of 17.3 trips to a pit per annum; one trip every 3 weeks.
- Each trip involves occupying a potential impact zone within a pit for an average of 30 minutes (0.5 hours). This time exceeds that required for most tasks.

The probability of persons occupying a zone is:

$(0.5/24) \times (17.3/365) = 9.9 \times 10^{-4}$

The lack of a high number of recently fallen rocks on the ramps and on the floors suggests that the average annual frequency of rocks traversing beyond the toes of the walls and impacting a zone is low (< 2 impacts p.a.[32]). However, the stability assessments indicate a high propensity for rocks to fall from benches and an expected increase in falls as weathering progresses. On this basis, an indicative conservative annual frequency for the long-term is assumed to be 5[33] impacts p.a.

The average number of rockfalls that occur in a zone each day is therefore:

$5 / 365 = 1.4 \times 10^{-2}$

The probability of one or more persons being impacted by a rock is equal to 1 minus the probability of no person being impacted:

$1 - (1 - 9.9 \times 10^{-4})^{1.4 \times 10^{-2}} = 1.4 \times 10^{-5}$

Impact by a rock is assumed to result in loss-of-life; a conservative assumption as less than half the number of persons impacted by rocks are usually killed.

AGS (2007) suggest that the limit of tolerability for loss-of-life associated with a rockfall from an existing slope is 1×10^{-4} for the person most at risk. Acceptable risks[34] are usually considered to be at least one order of magnitude smaller than the limit of tolerability i.e. 1×10^{-5}. The estimated risk to persons of 1.4×10^{-5} is at the

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[31] Australian Geomechanics Society Sub-Committee on Landslide Risk Management. In *Australian Geomechanics* Vol. 35 pp.49-92, 2007

[32] per annum.

[33] This number is not an estimate of the average number of rocks that impact the floors of all pits each year. It is the number of rocks that impact a specific location in a pit each year.

[34] Acceptable risks are within a range that society desires to achieve. Tolerable risks are risks within a range that society are prepared to live with to secure certain benefits, even though society would prefer the risks to be lower (i.e. within the range of acceptability). It is a range of risks that is non-negligible and that should be kept under review and reduced as low as reasonably practical (ALARP principle).

limit of acceptability. On this basis, the risk over the long-term may be acceptable but would benefit from being reduced.

The decision to accept or not the risk should not be based solely on this result. There are issues that must be considered in relation to the risk assessment procedures:

- The 10^{-5} acceptance criterion is not absolute. Society shows a wide range of tolerance to risk, and the criteria are only mathematical expressions of general societal opinions. A value higher than the 1×10^{-5} acceptance criterion may be considered to be acceptable if the risk is "As Low As Reasonable Achievable" (ALARA).
- Defining whether the 1×10^{-5} acceptance criterion is applicable for this site requires input from all stakeholders including Sibelco, the landholder and the Regulating Authority.
- There are many approaches that can be used to calculate risk. Each approach potentially gives significantly different outcomes for the same scenario and when applied by different practitioners. In addition, the data upon which any assessment is based relies on judgement and estimates due to the lack of long-term reliable records of rockfall frequencies at this site. How the pits will be used by various landholders over the long-term and the frequencies the pits will be accessed cannot be known. These limitations result in there being considerable uncertainty in any estimated risk value no matter how it is calculated.
- Invariably, a more thorough understanding of the risks would result from additional time and effort collecting and interpreting field data and setting up a more representative risk model. However, the cost required to do so would outweigh the benefits of having a better model. The issue therefore becomes one of matching the data collection and analysis methods to the scale of the problem, the resources available and the aversion of the stakeholders to risk.

Notwithstanding these issues, based on the result of the qualitative and quantitative analyses:

- The risks must be reduced.
- Hazardous areas should not be accessed by persons until risk controls are developed, approved by Sibelco and the Regulating Authority and implemented.
- Controls can involve elimination, substitution or isolation. The latter control is most likely to be the one most applicable to this site. Applying it pragmatically requires a combination of strategies; restricting as much as possible persons from accessing areas within the pits and behind their crests, reducing hazards and controlling the trajectories of falling rocks.

6 WASTE ROCK DUMPS

The site contains two waste rock dumps (WRDs). WRD 1 is located adjacent to the East-West pit. WRD 2 is located adjacent to Phoenix pit.

The dumps comprise a mixture of moderately-to extremely-weathered siltstones and slightly- to moderately-weathered limestones. The rocks are well-graded; containing a mix of sizings from fines to boulders.

6.1 Characteristics of the WRDs

6.1.1 East-West Pit: WRD 1

- WRD 1 (Figures 1, 2 and 5) is located west of the East-West pit. It is centred at 412586-mE, 6858469-mN. The toe of its north slope is close (-m) to the crest of the south pit wall.
- The major axis along the length of the dump trends northwest and is 290-m long. Its minor axis trends northwest and is 183-m wide.
- The dump has a surface area of ≈56,200-m^2.
- Its maximum height of 32-m occurs centrally along the major axis.
- It has been constructed in up to 5 benches. The maximum bench height is 14-m occurring on the south side of the dump.
- The footing below the dump is natural ground which dips slightly at 6° to the southwest. No information is available as to whether the topsoil was stripped from the ground prior to constructing the dump.
- Most of the batters have been cut back to shallow 17° to 25° other than a 90-m length on the south side that is at the 36° angle-of-repose[35] of the loose rocks.
- Rocks were last placed on the dump in 2013. Since then, the upper surface has been contoured and a thin layer of topsoil placed. A sparse to moderate density of grasses has established naturally (Figure 45); evidence that vegetation will grow on the dumps.

6.1.2 Phoenix Pit: WRD 2

- WRD 2 is located southeast of Phoenix pit (Figure 6).
- It comprises two sections, North (Figure 6a) and South (Figure 6b). The sections are separated by 5,600-m^2 of natural scrub.
- Topsoil was stripped from the natural surfaces to form the footings for each section of the dump.

[35] The angle-of-repose is a function primarily of the ranges of rock sizes and the dynamics of the dumping and rilling processes and less a function of the mineralogy of the rocks. The angles were measured at many locations on the surveyed DXF surface of the dumps.

- Rocks were last placed on the dump in 2019 (Figure 46). The slopes and upper surfaces have not subsequently been contoured and no topsoil has been spread. Doing so will be required.

North Section

- The north section is centred at 413772-mE, 6858422-mN. Its west slope is 70-m from the crest of the east wall of the pit.
- The major axis along the length of the section trends north and is 80-m long. The minor axis trends east and is 96-m wide.
- The section has a surface area of ≈20,088-m^2.
- Its maximum height of 20-m occurs at the north end of the major axis.
- It has been constructed in up to 3 benches. The maximum bench height is 13-m.
- The footing at the base of the section dips at 2° to the east.

South Section

- The south section is centred at 413655-mE, 6858229-mN. Its north slope is 150-m from the crest of the south wall of the pit.
- The major axis along the length of the section trends northeast and is 230-m long. The minor axis trends northeast and is 106-m wide.
- The section has a surface area of ≈20,088-m^2.
- Its maximum height of 7.5-m occurs at the southwest end of the major axis.
- It has been constructed in up to 2 benches. The maximum bench height is 10.5-m.
- The footing at the base of the section dips at 2° to the southwest.

6.1.3 Construction Methods

WRD 1 and WRD 2 were constructed by edge tipping from tip heads at the crests of the dumps.

Trucks laden with waste rocks backed up to a tip head and tipped the rocks over the crest. Alternatively, the trucks dumped rocks on the flat upper surfaces from where the rocks were pushed by dozer over the crests. In both scenarios, the rocks rilled down the underlying slope upon previously dumped rocks thereby creating "rill slopes" at the 34° to 36° angles-of-repose of the loose rocks.

Densification of the rocks within the bodies of the dumps was minimal; comprising normal consolidation and compaction of relatively thin upper layers by vehicle wheel loading.

6.1.4 Weathering and Drainage

The stabilities of the dumps have been, and will continue to be, influenced by the rates at which the rocks within them weather. These rates are influenced primarily by flows of stormwater across and through the dumps. The flows occur generally during long-duration rainfall and/or intense rainfall events[36].

All dumps have experienced all rainfall conditions typical in this temperate region. The lack of significant deposition of fines down contour of any of the dumps is evidence that these events have not eroded significantly the rocks and/or causes significant volumes of fines to migrate through the dumps. Additional factors that may have contributed to the lack of fines are:

- The upper surfaces of WRD 1 is graded to shed water towards the edges of the dump rather than allow it to pool on the surface and migrate through the body of the dump.
- The well-graded sizings of the materials within the dumps and minor compaction and consolidation of these materials has been conducive to achieving moderate to low permeabilities.
- The medium to high strengths of the siltstones and the high to very-high strengths of the limestones contributes to high durabilities which are not conducive to rapid weathering.
- The formation of a shallow crust of low permeability cemented carbonates on the surfaces of the dumps reduces the ingress of water into their bodies.

6.2 Stabilities of WRDs

6.2.1 Current Stabilities

Edge tipping resulted in the slopes of both dumps dipping at the 36° to 38° angles-of-repose of the rocks after slight consolidation over time.

- Most of the slopes on WRD 1 were subsequently been cut back to $\approx 17^{o}$ to 25° (average = 25°). At these angles, the slopes are very-stable.
- The slopes remain at the angles-of-repose on both sections of WRD 2. These slopes are currently sufficiently strong to support their own weights.

No evidence was observed of significant instabilities on any of the slopes on any of the dumps.

[36] Intense rainfall events cause water to pool and run off surfaces. Long duration rainfall events involve greater than 25 mm of rain falling within a 48-hour period.

6.2.2 Long-Term Stabilities

The angles of the slopes of WRD 2 are to be reduced prior to site abandonment. Subsequently the stabilities of the slopes will be similar to those of the slopes of WRD 1. At these angles, the slopes are likely to remain stable unless conditions change significantly. The most likely changes that can reduce the stabilities are:

- Excess static loads applied close to the crests of the slopes by the wheels of very-heavy vehicles. Bunds placed around the toes of the dumps will ensure that once the site is vacated, no vehicles are likely to traverse these areas.
- Dynamic forces being applied within the dump. These forces would likely be caused by dynamic loading by an earthquake. As discussed in Section 2.5, an earthquake having an intensity at the dumps sufficiently strong[37] to fail slopes is unlikely to occur in this region over the period considered in this study.
- A decrease in the shear strengths of potential sliding surfaces within the dump due likely to:
  - A significant increase in water pressures along the sliding surfaces during periods of long-durations and/or high intensity rainfall. A sufficiently high increase in pressure is unlikely due to vegetation, surface contours and compaction limiting the rates of infiltrations into the bodies of the dumps and hence internal flows through the dumps.
  - A reduction in the strengths of the intact materials along the sliding surfaces due to weathering. Any significant reductions are unlikely due to the high durabilities of the materials.
- Excessive erosion due to overland flows causes deep gullying in a slope. Gullies on any of the slopes are currently neither wide nor deep due likely to the high durabilities of most of the rocks. Progressive increases in rainfall frequency and intensity during the long-term are not expected to be sufficiently great to increase significantly the flow rates.

Based on these considerations, the slopes are expected to perform acceptably over the long-term. If any instabilities do occur, the likelihood of a person being impacted by displacing materials or engulfed in crest subsidence is low because:

- An instability will reduce the angle of the respective slope by only a few degrees. Flows will likely involve relatively small volumes of rocks as most sections of most benches are not high (<8-m). Some of the displaced rock will be retained on berms. Those that are not retained and traverse to the toes of the slopes will have short run out distances due to the slope angles and heights of the benches being insufficient for the rocks to gain significant momentums. The rocks are unlikely to traverse to low (1-m) bunds that are to be placed 10-m out from the toes of all slopes.
- Flows of rocks will generally occur during, or within a few hours after, periods of long duration and/or intense rainfall events. Persons are very-unlikely to be on a section of a crest that subsides, or be below the subsidence zone, at the time a flow occurs.

Implementation of the strategies described in Section 8 will reduce further the risks applicable to instabilities.

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[37] A strong earthquake is defined as one where the intensity at a dump equals or exceeds MM-V1 on the Modified Mercalli intensity scale.

7 RISK REDUCTION STRATEGIES FOR PITS

The principal hazards applicable to persons in the pits during the short- to long-terms are falls of individual rocks and masses of rocks. This conclusion is supported by the results of stability analyses (Section 4.1) and observation (Section 4.2).

Partially backfilling Aspinal pit will reduce significantly the long-term residual risks applicable to rockfalls. However, achieving a similar reduction in risks by reducing the number and frequency of rockfall hazards in the East-West and Phoenix pits is neither possible nor would be cost effective as:

- Fully or partially backfilling the pits will require:
  - Modifying a stable topography and destroying revegetation on WRD 1 to obtain backfill.
  - Permanently modifying the local topography, destroying landholder value and temporarily destroying vegetation to excavate additional backfill from beyond the pits.
  - Preventing the pits from being used as permanent sources of water for the landholder.
- Alternatively, battering back the walls of the pits will increase by greater than 150% the footprint of each pit which will modify the local topography, destroy landholder value and permanently destroy vegetation.
- Draping the walls in rockfall control mesh would be prohibitively expensive.

For these reasons, East-West and Phoenix pits will, for the long-term, likely remain as permanent voids within which rocks will fall at times and from locations that are spaced randomly. The strategies recommended in the next sections aim to still achieve acceptable long-term residual risks by limiting as much as practical the likelihood of persons being at location where and when the rocks impact within the pit floor i.e. no persons results in no risk.

Even if all strategies are implemented, there will be non-mitigatable geotechnical risks for the long-term due to the presence of the voids. The landholder must manage these risks over the long-term to ensure that they remain acceptable. Requirements for on-going management are noted in Section 7.6.

7.1 Partially Backfill Aspinal Pit

Partially backfill Aspinal pit to eliminate the hazards associated with wall instabilities and to remove the requirement to install abandonment barriers around the pit.

<u>Materials</u>

- The backfill is to comprise superfluous ore, fines and waste rocks stockpiled near to the pit.
- Where possible, aim to select materials that have as uniform grading as possible. Uniformity will assist in providing consistent compaction. If practical, screen out -25 mm rock. The oversize rock will form the armour. The undersize will comprises the backfill.

Construction

1. Trucks are to end dump backfill in front of a section of crest of a wall. Trucks are not to end dump directly over the crest.
2. Using a dozer, push the backfill off the crest.
3. Repeat Steps 1 and 2 until backfill is at, or lower than, the angle-of-repose of the loose rocks when uncompacted of approximately 35°. The highest point of the fill should be slightly above the crest.
4. Using the dozer, continue to push backfill off the crest, while tracking down the backfill previously placed. Continue the process until the backfill extends to the pit floor.
5. Repeat Steps 1 to 4 until backfill extends from every section of the pit crest to the floor.
6. Compact each section of backfill by successively tracking from the pit crest to the floor until no further compaction occurs. A lack of wheel ruts with successive passes is an indicator of compaction being sufficient.
7. If necessary, repeat Steps 1 to 6 until the pit walls comprise all well compacted backfill dipping from the crests to the floor.

7.2 Accessibility to East-West and Phoenix Pits

- The presence of the pits should not to be promoted. Remove all signage from areas visible to the public indicating their presence. Where possible and practical establish tree lines to block visual lines of site from publicly accessible areas.
- Access to the general area around the pits should be via sturdy locked gates with signs indicating "Authorised Entry Only".
- The only persons allowed near the pits should be those associated with the landholding or accompanied by such persons.
- Children should not be allowed within the general area of the pits. They should be actively discouraged from encroaching beyond the pit crest barriers.
- Deep rip (35 – 50 cm) all tracks that provide access to the pits other than the minimum number required by the landholder to access the ramp/s into each pit. Deep ripping will:
  - reduce the visibilities of tracks and their accessibility for vehicles;
  - reduce overland flows of water by creating paths for water to permeate into the ground rather than flow over pit crests and
  - uncompact the soil and provide it with a rough surface that is likely to collect windblown seed which may with time germinate and stabilise the soils beyond the pits.
- Haul-roads that are located between pit crests and pit crest abandonment barriers (Section 7.3) are to be removed. For example, the haul-roads at both ends of Phoenix pit (Figures 39 and 47) and East-West pit are to be removed. If access is required at these ends of the pit, new roads shall be constructed behind the barriers.

7.3 Pit Crest Barriers

A minimum of one physical barrier is required beyond potential failure zones behind the crest of each wall. Barriers are to be obvious and must have the longevity necessary to restrict access by vehicles, persons and stock to exclusion zones behind the crests for the long-term.

Barriers are to encircle each pit. There are to be no gaps. Locked gates can be incorporated into barriers to enable access to ramps.

7.3.1 Offsets and Locations of Barriers from Pit Crests

In lieu of Queensland specific guidelines on barriers, the offsets of barriers from wall crests should comply with the requirements in the Western Australian Guidelines (1997)[38].

The WA Guidelines require barriers to be offset 10-m behind the point at which a construction line from the toe of a wall intersects the natural ground surface. The line is to be orientated at 45° in fresh rocks and 25° in weathered rocks. The minimum offsets calculated on these bases for each of the sections highlighted in Figures 15 to 22 are listed in Table A3.1. The assessments indicate that all barriers are to be offset from walls a minimum of 10-m[39]. The exceptions are in the East-West pit where 14-m offsets are required at Sections 4 on the south wall of the west pit and on the southwest wall of the east pit.

The barriers are to fully encircle the pits. There is to be no access anywhere between a barrier and the pit crest. The only break in a barrier will be at the section of road leading to the top of the ramp that enables access to the pit floor. The barrier is to extend either side of the road to the pit crest thereby ensuring no access can be gained to the area behind the crest.

7.3.2 Abandonment Bunds

Bunds are to be used rather than fences wherever safe and practical to do so. Bunds remain in place for the long-term with negligible maintenance whereas fences fall down if not maintained.

<u>Bund Specifications</u>

- Bunds are to be constructed from unweathered, durable limestones. The limestones are to be excavated from WRD 2 adjacent to Phoenix pit using a top-down method.
- Desirably, rocks should be screened of the fine fraction (<5-mm) to ensure bunds are free-draining. However, if impractical to do so, water flows through bunds will eventually dissipate the fines leaving the coarse fraction within the bund.

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[38] Government of Western Australia Department of Industry and Resources (1997) *Safety Bund Walls Around Abandoned Open Pit Mines: Guideline*. MOSHAB Approved. Document No: ZMA048HA. 14 pages.

[39] The overall slope angle is a primary parameter in the offset calculation. The lower the angles, the lesser the offsets required. The angles are moderately shallow at most sections of all pits. Hence only minimum 10-m offsets are required.

- Bunds are to have a nominal minimum height of ≈2-m which requires a base width of ≈5 to 6-m.
- Leave gaps, 0.5-m wide at the toes of the bunds at contour lows where water has obviously been flowing. These gaps are required to reduce the likelihoods of the bunds changing significantly the flow characteristics of the natural surfaces and being eroded by the flows.

East-West Pit

- An abandonment bund is to fully encircle the East-West pit. A gate shall be provided within the bund to enable access to the road leading to the central ramp.
- A bund is required along the south wall of the East-West pit even though WRD 1 is located along this wall. The bund is to be placed on the crest of the north wall of the dump. It shall replace a small (0.5-m) bund currently installed at this location (Figure 1b). A bund shall proceed up the east and west slopes of the dump

Phoenix Pit

- An abandonment bund is to fully encircle Phoenix pit. A gate shall be provided within the bund to enable access to the road leading to the main ramp.
- A 316-m long bund has been installed behind the crest of the east wall of the pit. The bund is 3.5-m high which is acceptable for an abandonment bund. However, the bund is offset only 7.5-m from the crest, 2.5-m less than the offset required based on the Guidelines. On this basis, the offset should be increased. However, doing so is unnecessary as the wall is unlikely to experience wall-scale instabilities.
- A haulroad currently located between the east wall bund and the crest is to be removed.

7.3.3 Fences

Fences can be used where bunds are inappropriate, for example:

- The topography prevents safe access by earthmoving equipment hence is inaccessible by vehicles.
- Trees prevent accessibility or vegetation is too sensitive to be cleared to enable bunds to be installed.
- Property boundaries and access tracks required by the landholder are inconsistent with bund locations.
- Locations within contour lows that act as wide water courses during flood conditions. Bunds across these locations could impede natural flows.

Fence Specifications

- Fences should be of the Type B style. This style has 7 plain-strand, high-tensile, 2.5-mm diameter wires. Barbed wires are not to be used[40]. Figure 48 shows a general specifications of the fence.
- The upper wire of a fence should be a minimum of 1.15-m above ground level to discourage persons from stepping over the fence.
- Posts should be spaced no greater than 5.4-m apart.
- Intermediate star droppers should be spaced no greater than 1.8-m apart.
- Vehicular access through fences requires gates. Gates require:
  - A secure lock that cannot be accessed to be cut.
  - Rigid wire mesh that cannot be cut readily.
  - A sturdy frame attached to rigid posts with sturdy hinges that cannot be removed.
  - Heavy galvanising of all components.
- Attach signs along each run of each fence and to gates at maximum 20-m spacings.
- Fences can be expected to remain functional for 10 to 15 years. Longevity will require routine inspection and maintenance to ensure fences remain sturdy and damage and corrosion are addressed.

7.3.4 Signs

- Bunds, fences and gates require signs warning “Danger Deep Void” or similar.
  - Signs should incorporate a drawing of the hazard in addition to words so that children and non-English speaking persons can understand its meaning.
  - Signs should comprise aluminium sheets; a minimum of 30 cm x 30 cm in
  - Letters should be at least 3.5 cm high. Graphics should be enamelled.
  - Signs should be placed at maximum 20-m spacings.
  - Posts upon which signs are attached should be sturdy. Secure galvanised fasteners should be used.
  - Place signs where they can be seen by persons approaching from any direction. They should be placed wherever an access route or track meets a fence.
  - Secure galvanised fasteners should be used to attach signs to posts, gates and fences.

[40] Barbs cause serious injuries to kangaroos and emus that jump or clamber through fences.

7.4 Access into Pits

- Children are not to be allowed to enter a pit unsupervised by a responsible adult.
- A pit should be entered only if doing so is absolutely necessary. Tasks that do not need to be completed within a pit (e.g. servicing pumps and generators) should be completed elsewhere.
- Pits must not be accessed or remained within while rain is falling. They are not to be accessed within 2-days of an intense rainfall event or if rain has been falling sporadically for a long duration (e.g. 5 days).
- All ramps into any pit that the leaseholder does not wish to access are to be deep ripped.
- If access is required into a pit, and multiple ramps are available into that pit, retain only one of the ramps. Other ramps and access routes are to be deep ripped prior to installing barriers (i.e. abandonment bunds or fences) behind the crests. The ramps retained are to be the least hazardous of the available ramps based on:
  - the widths of the ramps - wider is preferable;
  - the competency of the rocks in the underlying benches – cracks in the surface must not be present and the bench not have been blast-damaged;
  - the conditions and performances of the adjacent slopes as evidenced by low numbers and small sizes of rocks on the ramps.
- The recommended ramps are:
  - East-West Pit: The central ramp on the north wall (Figure 49) and possibly the western ramp on the west wall (Figure 50).
  - Phoenix Pit: The main ramp along the east pit wall (Figure 33).

  Do not use other ramps.
- Install sturdy locked gates across the entire width of the top of the ramps being retained to restrict entry to the pit by vehicles and stock. The gate is to contain signs “Danger Rockfall Hazard” and “Danger Deep Void” or similar. The general requirements for signs are listed in Section 7.3.4.
- A fence or a bund a minimum of 1.6-m high should be installed anywhere along the length of the access ramp or anywhere else within a pit where access can be gained to a berm or elsewhere on to a wall.
- Drivers should not stop vehicles on a ramp.

7.5 Pit Floor

- Areas around the pit floors that are accessible yet are not required are to be deep ripped.
- Place toe bunds (rock traps) on the floor out from each wall to:
  - limit the traverses of rocks that roll off walls and reduce the likelihood of rocks entering accessible areas;
  - prevent vehicles and restrict persons from accessing potentially more hazardous areas.
- Toe bunds are to be a minimum of 1.8-m high. They are to be constructed from rocks having the same characteristics as those used for abandonment bunds and constructed using the same procedure (Section 7.3.2).
- Vehicles are to park along the major axis long the pit as far away from the pit walls as practical. Areas for parking are to be defined by toe bunds.
- Persons should remain in the pit for the minimum time necessary to complete a task.
- Limit to the greatest extent practical, the amount of equipment (pumps, generators etc.) on the floors of the pits.

7.6 Water Management on Access Routes

Ongoing erosion of the ramps, haul-roads and upper batters cut in topsoils, filled karst and extremely weathered rocks will be primary triggers for instabilities.

- Remove unrequired ramps and haul-roads, other than those required to access ramps, to reduce water flows and scouring along these routes:
  - Rip to loosen and furrow to depths of between 0.25-m and 0.5-m the upper surface of roads and ramps using a winged-tyne. Furrows should be cut perpendicular to the natural contours. The final surfaces should comprise a ‘hummock’ or wave profile within which natural seeds and rain can collect.
  - If flows of water along an inclined surface may cause erosion to the surface, construct a series of low bunds at regular intervals along contour down the surface.
    - Bund spacings should not exceed 20-m for gradients less the 8° (12%). Spacings should be 15-m for greater gradients.
    - Bunds should be a minimum of 1-m high.
    - Bunds should comprise a low to moderate permeability core of compacted durable limestones. The limestones should be well-graded with a range of rock sizes.
- Ramps and haul-roads that are to be retained require quality drains to be installed:
  - Grade surfaces to achieve cross-slopes of 3° (19H:1V) with the grade falling away from pit crests towards the adjacent batters.
  - Side drains should be cut along the toe of the batter:
    - Drains should be a minimum of 1.8-m wide (where possible) and 0.3-m deep.

  - Drains should be lined. Concrete canvas (Figure 51) provides a good lining for the long-term. The canvas should be 5-mm thick and installed according to the manufacturer's instructions. Alternatively, drains should be lined with high permeability, coarse (no fines), durable limestones.

- Cross drains should be cut at regular intervals down the inclines of ramps and haul-roads:
  - Cross drain spacings should not exceed 20-m for gradients less the 8° (12%). Spacings should be 15-m for greater gradients.
  - Drains should be a minimum of 1.0-m wide and 0.3-m deep.
  - They should be filled with high permeability, coarse (no fines), durable limestones.

- Water shedding off the 550-mRL berm (Figure 52) above the batter adjacent to the central ramp is destabilising the batter below and eroding the ramp.
  - If water is flowing on to the berm from the 560-mRL berm above, install bunds to modify drainage paths to force water to flow to the west and not towards the 550-mRL berm.
  - If water cannot be prevented from flowing on to the 550-mRL berm, a horizontal lined berm drain will be required to direct water to a vertical lined batter drain. The drains are to be lined with concrete canvas (Figure 51). The canvas is to be fixed securely to the surface with deep anchors.

7.7 Rockfall and Erosion Control Adjacent to Ramps

Rockfall management is required on batters adjacent to accessible ramps. These ramps will be:

- East-West pit: The central ramp on the north wall (Figure 49) and possibly the western ramp on the west wall (Figure 50);
- Phoenix pit: Main ramp on the eastern wall (Figure 33).

The procedures recommended for managing the hazards are outlined in the following sections.

7.7.1 East West Pit Rockfall Control

<u>Central Ramp</u>

Rockfalls are being generated primarily from the crest of the 550-mRL berm. Several shallow slips have occurred along the 80-m long section of the batter. The primary triggers of these instabilities are surface erosion by water shedding off the 550-mRL berm above the ramp and the 60° batter angle being too steep for the weathered rocks.

The 60° batter angle cannot practically or cost effectively be reduced to 50° or lower as required to achieve acceptable stabilities. Insufficient widths (< 7-m) are available on the 550-mRL berm to enable a standard mining drill rig to access to the berm.

The hazard can be addressed effectively, and at a lower cost than drilling and blasting, by draping the batter in rockfall mesh woven from high-tensile strength wires (Figures 53 and 54). Doing so is commonplace in pits. The drapery will:

- apply minor support to the surface rocks,
- hold the concrete canvas batter drain securely,
- control the horizontal displacements of individual rocks that detach to ensure they do not launch beyond the shoulder of the ramp,
- retain masses of fallen rocks within the width of the shoulder thereby preventing them from flowing on to the ramp.

Construction

- The mesh is supported by an upper boundary rope on the 550-mRL berm and attached to a lower boundary rope adjacent to the ramp. Attachment of the mesh to the ropes is with press claws, hog rings or lacing wire. Contractors specialising in the installation of drapery have small drill rigs than can access the berm safely.
- The upper boundary rope will be secured taught to the berm with a series of spiral rope anchors spaced at 3.5-m centres maximum or at the widths of the mesh panels. This style of anchor provides better dynamic loading characteristics than do solid dowels.
- The ends of the lower boundary rope will be terminated at spiral rope anchors. Along its length, the rope will be clipped with shackles to fully-grouted threadbar type dowels or wire-rope anchors at 3.5-m centres maximum or roll widths.

Drapery of the area required can typically be installed in less than 10-days.

The unit cost to supply and install drapery is approximately $80 per square metre plus mobilisation costs. With a surface area of approximately 1280-m^2 to be covered, the total cost is likely to be approximately $103,000 plus mobilisation. A more accurate quote will be provided by a ground control contractor[41].

Western Ramp

Remove the ramp from service if practical to do so using the ripping procedure noted in Section 7.6.

If the ramp is required to be retained:

- Increase, to a minimum of 1.8-m, the height of the toe bund (rock traps) currently installed out from the toe of the adjacent batter (Figure 50b).
- The bund is to be continuous, unlike the current bund.
- The location of the inner toe of the bund is to coincide with the inner toe of the current bunds.
- The bund is to be constructed from rocks having the same characteristics as those used for abandonment bunds and constructed using the same procedure (Section 7.3.2).

[41] This office can provide details of suitable contractors.

7.7.2 Phoenix Pit Ramp Erosion Control

Main Ramp Erosion and Rockfall Control

Gullying in topsoil, karst fill and in weathered limestones on the east batter adjacent to the main ramp is associated with waterflows resulting from direct impact of the batter by rain. Gullying may also have been associated with surface water flowing over the crest of the wall. However, a bund along the crest is likely to be sufficiently high (1-m) to prevent these flows.

Erosion will be ongoing and, if not addressed, in the medium- to long-terms the associated gullying will trigger instabilities. Eventually instabilities could render the ramp unusable.

The rate of erosion can be reduced significantly by installing quality erosion control matting. However, quality matting (not jute) is costly and requires significant time to install properly. Installing matting without seeding will provides only medium-term erosion control.

Hydroseeding

Reducing the rate of erosion for the long-term requires establishing grasses within the soils to bind and reinforce the grains which will reduce their displacements downslope. Grasses also reduce the rate of runoff and allow surface water to infiltrate the soil rather than flow over it.

The most efficient and cost-effective method to seed the large area (3020-m^2) of the steep slope (35° to 50°), its crest and the ripped haul-road behind the crest by hydroseeding[42] (Figure 55). The combination of hydroseeding and hydromulching is an accepted method for rehabilitating mine slopes comprising soils and weathered materials similar to those in this batter.

Hydromulching[43] the batter, using a product suitable for use on steep slopes, is recommended after hydroseeding to provide a protective layer over the seeds from rain and wind and reduce the loss of soil moisture, much like an erosion control blanket. It will remain effective for 6 to 12 months during which time the seed should have germinated; likely required as rainfall in this area can be difficult to predict.

The unit cost for hydroseeding is approximately $23,000 per hectare. At this rate, the batter, crest and the haul-road would cost approximately $9,000 to spray. Hydromulching would double the cost but provide a superior result. A more accurate quote will be provided by a hydroseeding contractor[44].

Aim to achieve as dense a seed distribution on the slopes as practical. Spraying should occur at a time when regular rainfall is most likely to occur and temperatures are mild to encourage germination.

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[42] Hydroseeding is the hydraulic application of water, seed, fertiliser and the option of growth supporting additives.

[43] Hydromulching is the hydraulic application of mulch to increase erosion control effectiveness, growth establishment and functional longevity

[44] This office can provide details of suitable contractors.

8 RISK REDUCTION STRATEGIES FOR WASTE ROCK DUMPS

8.1 Considerations

The primary factors that will influence their performances are associated with water flows; gullying caused by overland flows and water permeating through the bodies of the dumps. As discussed in Section 6.2, the slopes on the two dumps are likely to perform generally acceptably over the long-term after abandonment works have been completed. These works involve grading and shaping the surfaces to ensure they shed water effectively and slowly. These works are required predominantly on WRD 2, less so on WRD 1.

8.2 Construction Works

8.2.1 Grading and Shaping WRD 2

- Works on the dump are to begin after limestones have been extracted from the dump to create abandonment bunds around East-West and Phoenix pits and various other bunds required around the site (incl. pit floors). Rocks required for the bunds etc. are to be extracted from the upper surface of the dump using a top-down method. Doing so will reduce the overall height of the dump. Rocks are not to be excavated by undercutting the toes of the slopes. The greater the total volume of rocks removed, the less will be the height of the dump and the lower will be the residual risk after the site is vacated.
- Reduce to 25° or less the angles of the slopes.
- Create uniform upper surfaces. Crown the surfaces and establish grades of between 3° (30H:1V) and 5° (11H:1V) from the crown to the crests of the slopes to encourages water to sheet off the surfaces rather than pool.
- Compact the surfaces to achieve as high a material density as practical by successively tracking across it with a dozer or preferably a roller. Tracking should occur parallel to the slope crests to reduce the likelihood of creating contour lows that could result in gullying perpendicular to the crests.
- Repeat compaction until no further displacement of the surfaces occurs with additional tracking. A lack of wheel ruts with successive passes is an indicator that compaction is sufficient.

8.2.2 Remove access to WRD 1

Figure 56 highlights the ramp that provides access to the upper surface of WRD 1. A shallow (0.5-m) gully has developed adjacent to the ramp (Figure 37). The ramp should be removed and the gully reinstated.

1. Install the abandonment bund along the north crest of the dump accessing the crest using the ramp using the procedure in Section 7.3.2.
2. Remove the ramp by ripping using the procedure in Section 7.6.
3. To prevent scouring of the ripped materials, install check dams down the inclined surface at 10-m intervals. Dams should comprise low (0.5-m) bunds constructed from coarse durable rocks.

8.2.3 Establish Grass on the Surfaces

Vegetation will increase the strengths of the material underlying the surfaces and slopes of WRD2, reduce their erodibilities and enhance the visual amenity of the area.

- Spread a layer of topsoil a minimum of 10-mm thick over the upper surfaces and slopes.
- Hydroseed the topsoil with seeds from native grasses. The area to be covered can be determined after rocks for bunds have been removed and the dump has been graded and shaped.
- Aim to achieve as dense a seed distribution as practical. Spraying should occur at a time when regular rainfall is most likely to occur and temperatures are mild to encourage germination.

5.2.4 Manage Rockfalls on WRD 1 and WRD 2

Place a rock catch bund a minimum distance of 10-m out from the toes of the slopes to:

- intercept the trajectories of rocks that roll off the slopes
- prevent overland flows from up contour of a dump from inundating the toes;
- delineate an exclusion zone to prevent vehicles from accessing the slopes.

The bunds should be a minimum of 1-m high. they should be constructed from compacted, durable limestones comprising a wide range of rock sizes.

9 INSPECTIONS AND MAINTENANCE

9.1 Pits

- The landholder should undertake inspections on foot. The inspection can be carried out by any adult person having good physical health[45] and a diligent nature.
- Fences generally remain functional for 10 to 15 years. Maintaining longevity require routine inspections at maximum 1 yearly intervals or whenever the landholder is nearby. Check for damage and corrosion. These conditions will require maintenance. Sections of fences deemed to be no longer functional are to be replaced. Vegetation which may obstruct signs should be trimmed routinely.
- Rockfall mesh generally remain functional for a minimum of 50 years if not overloaded with fallen rocks. Maintaining longevity require routine inspections at maximum 1 yearly intervals or whenever the landholder is nearby. Check for damage and corrosion. These conditions will require maintenance. Sections of mesh deemed to be no longer functional are to be replaced. Large masses of rocks within mesh should be removed by unshackling the lower boundary rope. Specialist contractors should be engaged to undertake these works.
- Maintenance on bunds is likely to be minimal. Routine inspections at maximum 2 yearly intervals or whenever the landholder is nearby are required. Check for damage and erosion; conditions that will require maintenance.
- If a section of a barrier (fence or a bund) has been damaged by wall instability or instability encroaches 5-m or greater towards a barrier, install a new section of barrier 10-m behind the existing section.
- Pit walls should be inspected whenever the landholder is within a pit.
- Inspection of pit walls and the areas between their crests and the bunds should aim to identify development of new or widening cracks. Cracks having a nominal length of approximately 20-m and 5-m or more behind the crest may be evidence that a wall scale instability is developing. If so, the area on the adjacent section of floor must not be accessed until the failure event has occurred or there have been no changes in the crack widths, lengths or the number of cracks for a minimum of two-years.
- If any event occurs that may have implications for the risks to persons in a pit, do not access the areas and obtain advice from a mining rock mechanics specialist.
- Remain vigilant for unauthorised access to a pit. Increase security if access is suspected.
- Remain aware of the residual risks associated with the pits. Pass on this awareness to all parties involved with the site over the long-term.

[45] The inspection route is relatively long.

9.2 Dumps

- Annual inspections of dumps are required prior to the wet season and after intense rainfall or periods of long duration rainfall to check for instabilities and excessive erosion that may require remediation.
- Crowning and shallow surface grades on the surfaces of the dumps will reduce the likelihood for preferential flow paths to develop. However invariably they will, eventually resulting in gullies developing down slopes.
    - Gullies should be lined with geotextile fabric, erosion control mesh or rocks.
    - Flow velocities should be reduced with check dams placed within gullies. Dams can comprise straw bales fixed with wooden stakes or low (0.5-m) bunds constructed from coarse durable rocks.
- Water pools in wheel ruts. Failures of sections of dumps elsewhere have been associated with ruts, within a distance of 20-m to the crests, being routinely filled. To prevent rutting, and for safety, vehicles are not to be driven on dumps.
- Promptly seal off cracks that develop in the surfaces, particularly cracks within 20-m of a crest, to prevent water ingress. Do so by compacting the areas around cracks and replace any settled fill with compacted clay.
- If practical to do so, encourage grasses to develop in barren areas by covering the area with a thin layer of clays, hand seeding and fertilising then applying another layer of clay. Temporary fencing may be required to keep animals away from germinating grasses.

10 SUMMARY

10.1 Pits

Over the long term, the most significant geotechnical hazards are falls of individual rocks from all walls in all pits. As the rocks weather, localised bench scale instabilities may occur. Multi-bench and wall scale instabilities are unlikely. A series of quantitative and qualitative risk assessments indicated that the risks applicable to the instabilities are sufficiently high that strategies must be implemented to reduce the risks to acceptable levels.

The most effective way to eliminate the risks is to prevent all access to all pits or to undertake major excavation works on the walls which will increase the heights of the floors to above the standing groundwater level. Neither strategy is practical nor desired by the landholder as they wish to access permanent water in the pits.

The following strategies enable landholder access to the pits and reduce the risks to acceptable levels. The strategies are detailed in the sections noted. These sections provide important details on each strategy.

- Partially backfill Aspinall pit with superfluous stockpiled limestones and waste rocks to reduce the angles of the walls to less than 35° (Section 7.1).
- Apply rigorous access restrictions to the general areas around the pits and within the pits (Sections 7.2 and 7.4). The pit floors must not be accessed for 2-days after intense or long duration rainfall. They are to be accessed only be adults and by children when supervised by an adult. Berms must not be accessed.
- Delineate safely accessible areas on the pit floor with high bunds. The specifications of the bunds are to be the same as those of the abandonment bunds (Section 7.5).
- All haulroads within and around the pits are to be removed by ripping (Section 7.2).
- Access to the floor of the East-West pit shall be restricted to the central ramp.
    - Water flowing down the ramp is to be controlled by installing a side drain and cross drains (Section 7.6).
    - Water flowing over the crest of the 550-mRL berm above the ramp is to be controlled with berm and batter drains (Section 7.6).
    - Rockfall mesh is to be draped down the batters adjacent to the ramp (Section 7.7.1).
- Access to the floor of Phoenix pit shall be restricted to the main ramp. All other ramps are to be ripped (Section 7.4).
    - Water flowing down the ramp is to be controlled by installing a side drain and cross drains (Section 7.6).
    - The batter adjacent to the ramp is to be hydroseeded (Section 7.7.2).
- Abandonment barriers are to be installed a minimum of 10-m beyond the crests of both pits (Section 7.3).
    - There are to be no gaps in the barriers that could allow access to the areas between them and the pit crests. The only gaps are to allow access to the roads to the ramps. Access through the gap will be via locked gates with signs. The barrier is to extend either side of the road to the pit crest thereby preventing access to the area behind the crest.

- The barriers are to comprise bunds with signs except in areas where bunds are unsuitable. Type B fences with signs can be used in these areas.
- On the south wall of the East-West pit, an abandonment bund is to be located along the crest of the north slope of the waste rock dump WRD 1 (Sections 7.3.1 and 7.3.2). It is to join the bund encircling the pit crests without gaps.
- An existing bund, that is offset 8-m from the crest of the east wall of Phoenix pit, is suitable as an abandonment bund. The haul-road between it and the pit crest is to be removed (Section 7.6).

10.2 Dumps

The primary factors that will influence the performances of the dumps during the long-terms are associated with water flows; gullying caused by overland flows and water permeating through the bodies of the dumps. The slopes on the dumps are likely to perform generally acceptably over the long-term after abandonment works have been completed.

<u>East-West Pit Waste Rock Dump (WRD 1)</u>

- The dump is to remain in-situ with only minor works.
- No rocks are to be extracted from the dump for constructing abandonment bunds etc.
- The access ramp at the west end of the dump is to be removed. Check-dams are to be installed down the incline to reduce the velocities of water flows (Section 8.2.2).
- An abandonment bund is to be located along the crest of the north slope of the dump (Sections 7.3.1 and 7.3.2).

<u>Phoenix Pit Waste Rock Dump (WRD 2)</u>

- Rocks for abandonment bunds and other bunds are to be obtained from this dump using a top-down extraction method. Rocks are not to be sourced from the toes of the dump slopes (Section 8.2.1).
- Uniform well compacted upper surfaces are to be created. The surfaces are to be crowned with grades of between 3° (30H:1V) and 5° (11H:1V). The angles of the slopes are to be reduced to 25° or less (Section 8.2.1).
- Topsoil is to be spread and hydroseeded (Section 8.2.3).

<u>Both WRDs</u>

- A rock catch bund is to be placed a minimum distance of 10-m out from the toes of the slopes (Section 5.2.4).

10.3 Additional Considerations

- Regular inspections are required of the abandonment bunds and fences, rockfall mesh, crests and walls (Section 9.1).
- Undertake repairs on fences, bunds and erosion gullies as required.
- Seek advice from a ground control contractor if rockfall mesh is damaged or requires cleaning.
- If any instability may increase the risk to person on the pit floor do not access the area and seek advice from a mining rock mechanics specialist.
- If persistent cracks develop behind the crest of a wall, the area on the adjacent section of floor must not be accessed until the failure event has occurred or there have been no changes in the crack widths, lengths or the number of cracks for a minimum of two-years.
- There will be non-mitigatable residual risks for the long-term due to the presence of the pits and the dumps. The landholders must manage these risks over the long-term to ensure that they remain acceptable.

11 CLOSURE

As required by Sibelco, this report has:

- Discussed the performances of the walls in the pits and the dump slopes and the principal geotechnical hazards applicable to them currently and over the long-term.
- Provided comments on the principal geotechnical risks.
- Recommend controls for reducing the risks associated with each hazard identified. The controls are practical and appropriate considering the intended use and proposed frequency of occupation of the site post abandonment.
- Provided an opinion on the residual risks applicable to the hazards after controls have been implemented.

We trust that it provides the information you require. Please contact this office if you have any queries on any matter discussed within it or wish to discuss any aspect of the report in more detail.

Anthony (Tony) Meyers

B.Eng (Mining), PhD (Rock Mechanics) MIEAust, CPEng, NPER(Civil), MAusIMM, RPEQ, IntPE(Aus)

Senior Principal Rock Mechanics Engineer

ADDITIONAL INFORMATION

- The recommendations in this report have been based on certain assumptions and very few observations. It would be very rare if the conditions at the site did not vary from those observed even if exhaustive investigations had been undertaken. Hence, it is unlikely that the conditions observed will represent the extremes of conditions that exist. As such, even though the aim of this report is to address issues influencing geotechnical related risks applicable at the Warwick limestone mine, it is possible for events to occur or conditions to exist that were not planned for and as such should not be unexpected.
- The report was prepared on completion of the field work and is based on conditions encountered and reviewed at the time of preparation. Natural developments in, and changes to, or surrounding a volume of geomaterials over time, which are out the control of the Rocktest Engineer ("Engineer"), will change the stresses that act through the geomaterials and their engineering characteristics. Changes in these conditions may significantly alter the way in which the ground conditions behave. As such, the conclusions reached in this report will be less applicable over time and may not be applicable or relevant at a later point in time. Rocktest disclaims responsibility for any changes that might have occurred or the implication of these changes on the assessments or recommendations in this report.
- This report was prepared specifically for Sibelco Australia Pty Ltd ("Client") and for a specific purpose. It was not prepared for the use by any party other than the client and its respective consulting advisers.
- It is not possible to make a proper assessment of the report without a clear understanding of the terms of engagement upon which it was prepared, including the scope of instructions, directions and information provided by the client to those who prepared the report and the assumptions made in the report. The report may not address issues that would need to be addressed if the intention, environment, circumstances, time requirements and brief were different from those for which the report was prepared. Only the Engineer has a true understanding of the affects that these limitations and the assumptions made in the report may have on the conclusion reached within the report. As such, no party other than the Client should use the data, contents of the report or the techniques used in it for application to conditions different from those for which the report was intended without an independent and detailed review being carried out as to its suitability, relevance and accuracy.
- This report must be read in full. No responsibility is accepted for use of any part of the report in any other context or for any other purpose other than that for which it was prepared.
- Where engineering advice, recommendations and/or designs are provided, all elements/components of the advice, recommendations and/or designs are intended to function in combination. The Engineer accept no liability arising out of their partial application.
- The Engineer will not accept any responsibility for negligence, nor any loss or damage suffered by the Client due to the occurrence of events or the existence of any factors which are out of the Engineer's control. The Engineer will indemnify the Client for claims or loss arising from a breach of professional duty in the provision of the professional services. The liability of the Engineer is reduced to the extent that the Client or other person(s) caused or contributed to the loss or occurrence which gave rise to the claim.
- This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

The above clauses do not in any way attempt to absolve the Engineer from any professional responsibilities in relation to the diligent and careful performance of duties in providing this report. Rather, they are intended to be a guide as to where the Engineer's responsibilities end, and where forces of nature assume responsibility for the composition of a volume of geomaterials and its performance.

FIGURES

(a)

(b)

Figure 1. (a) North and (b) South walls at the west end of East-West pit. Waste rock dump WRD 1 is behind the crest. The west ramp (right) may be retained.

(a)

(b)

Figure 2. (a) Northeast and (b) Southwest walls at the south end of East-West pit. Waste rock dump WRD 1 is behind the crest.

(a)

(b)

Figure 3. (a) North and (b) South walls of Phoenix pit. The main ramp is to be retained.

(a)

(b)

Figure 4. (a) East and (b) West walls of Aspinal pit. The pit to be partially filled thereby reducing the slope angles .

(a)

(b)

Figure 5. WRD 1 to the west of the East-West pit. The dump to remain in-situ. (b) The bund along the crest is inadequate as an abandonment barrier. It is to be replaced with an abandonment bund (Section 7.3.2). The bund is to tie into the bund encircling the pit at the east and west ends of the dump.

(a)

(b)

Figure 6. WRD 2 a) North section 35-m east of the Phoenix pit and b) South section 140-m south of the pit. The dump will provide rocks for the abandonment bunds. The dumps will then be graded, shaped, topsoil placed and hydroseeded.

Figure 7. Dissolution has resulted in the upper surface of the limestone being karstified hence irregular. Example is from the south wall at the north end of the East-West pit.

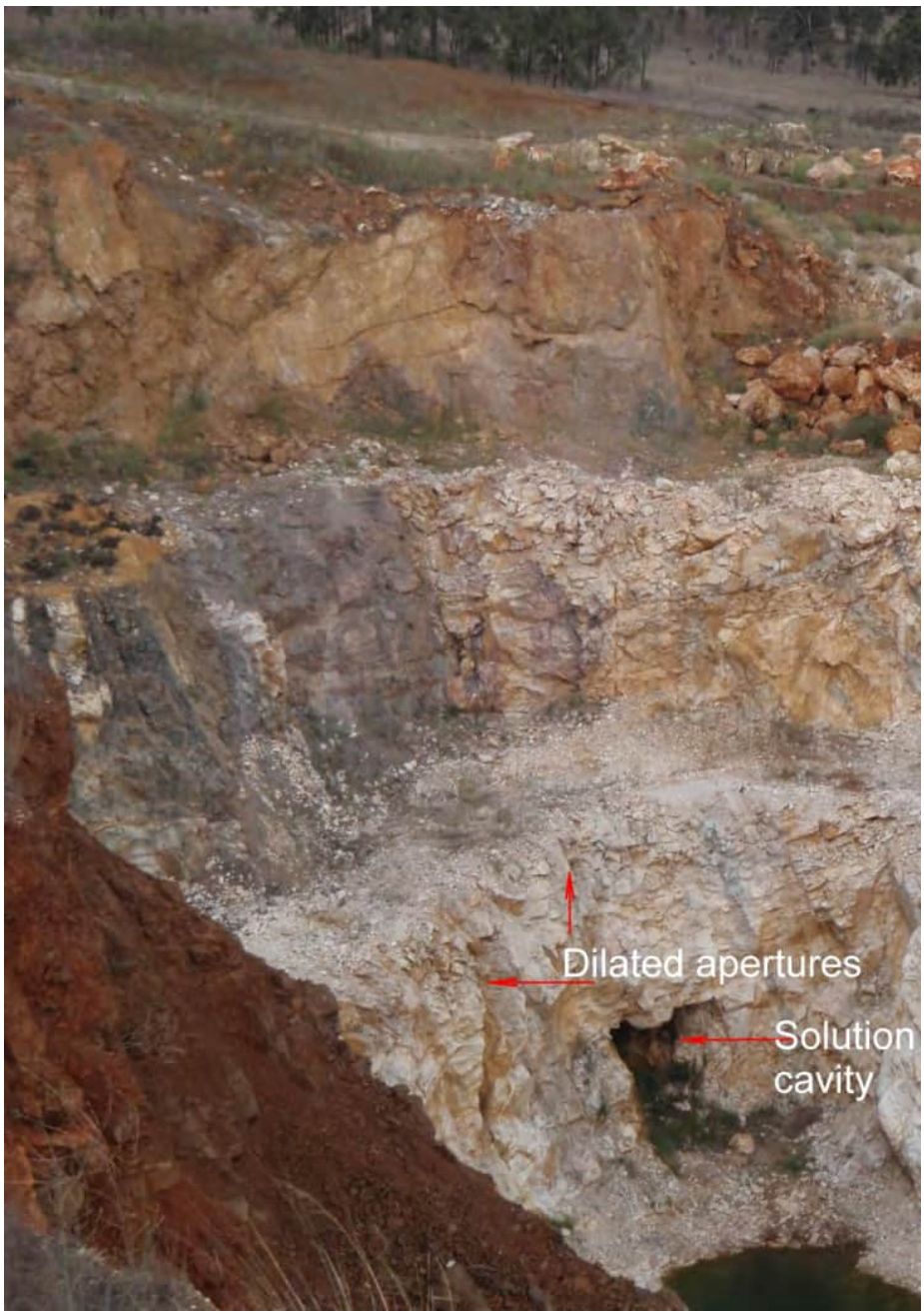


Figure 8. Karst features exposed in the northwest wall at the south end of the East-West pit.

Figure 9. Limestone intruded by grey andesite exposed in the west wall at the north end of the East-West pit.

Figure 10. Example of synclinal fold in the upper benches at the west end of the East-West pit.

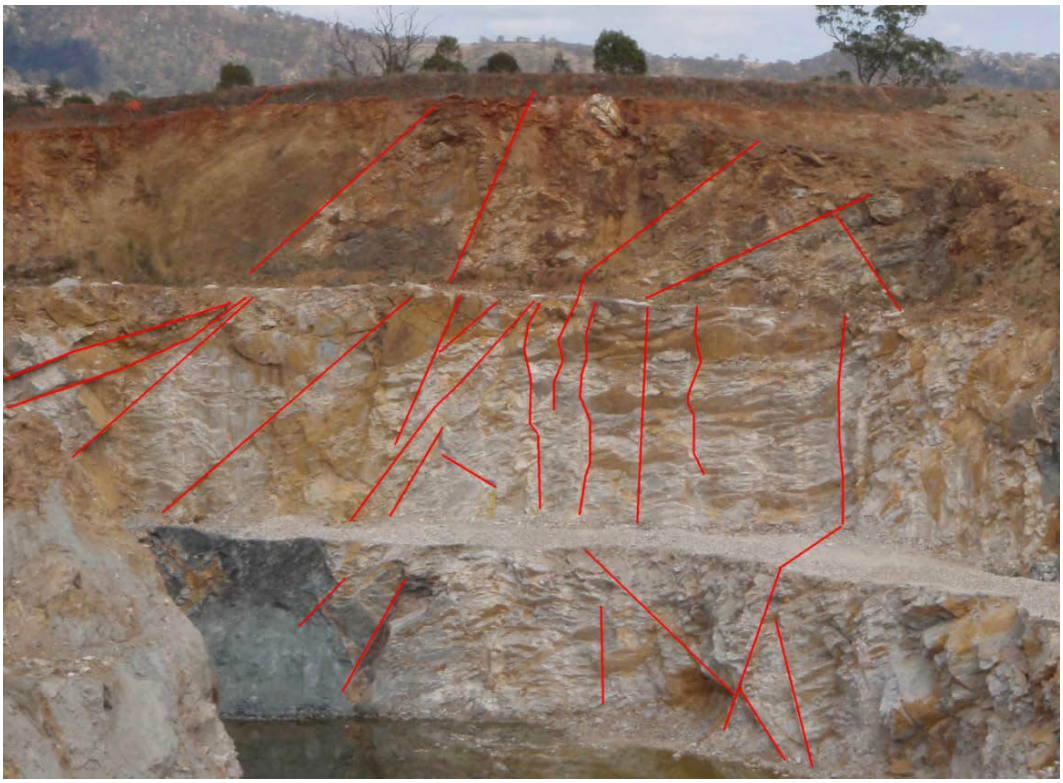


Figure 11. Examples of faulting exposed in the upper benches at the west end of the East-West pit.

Figure 12. Examples of traces of large wedges formed by the intersections of faults and bedding.

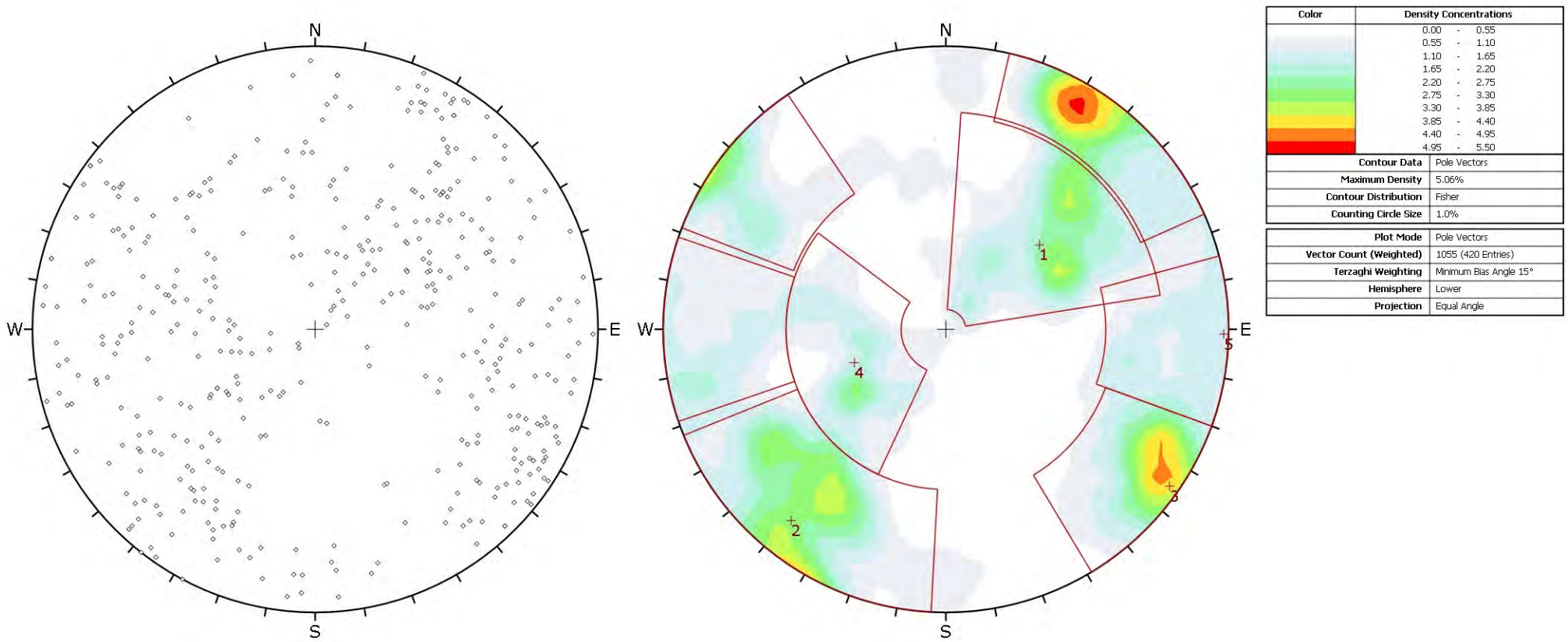


Figure 13 a) Poles to the logged discontinuities plotted on a stereonet.
b) Poles contoured to highlight five sets of discontinuities.

Figure 14. Examples on the south wall at the west end of the East-West pit of discontinuity spacings being significantly less than the mean values. The rock masses in these areas have accelerated weathering and localised instabilities that extend over multiple benches.

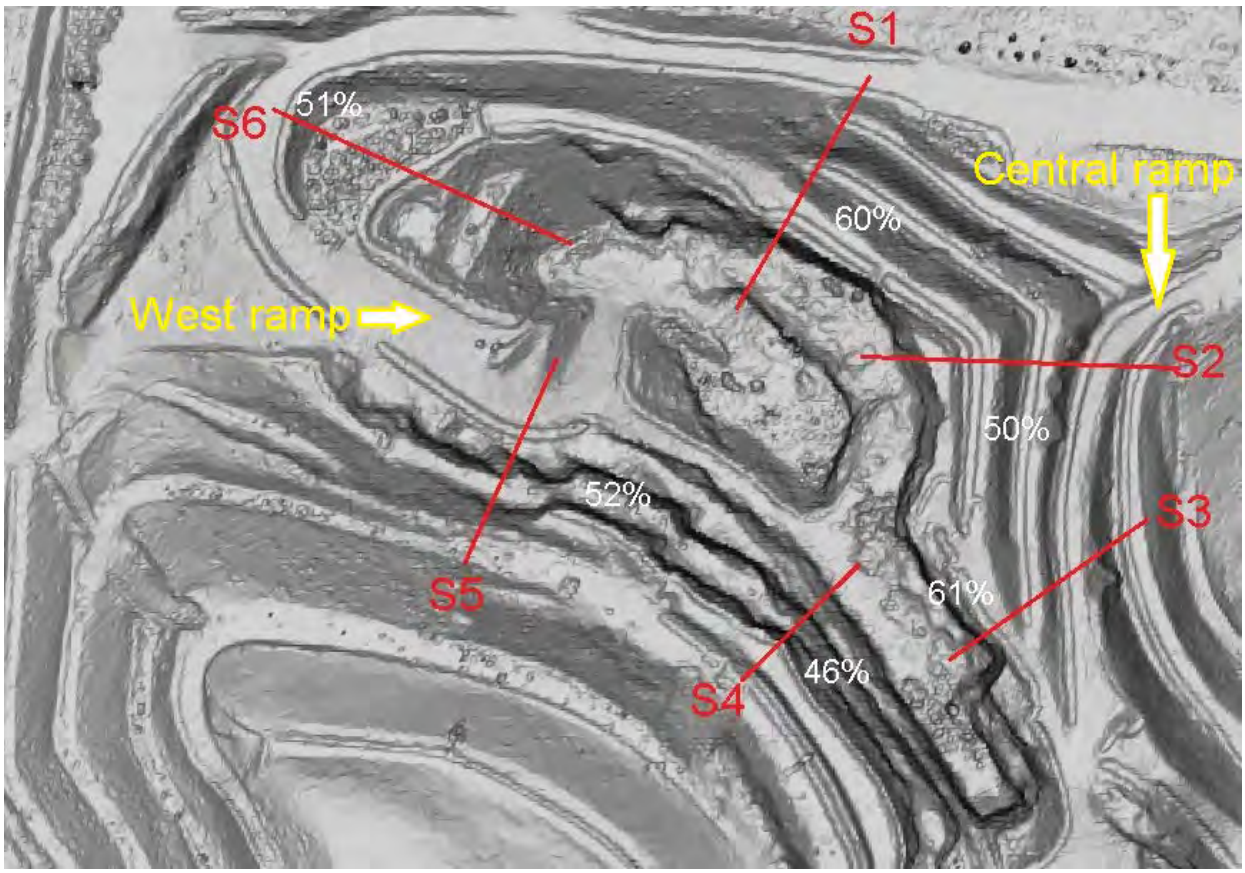


Figure 15. Upper bound bench scale stabilities (PoFs) at the west end of the East-West pit.

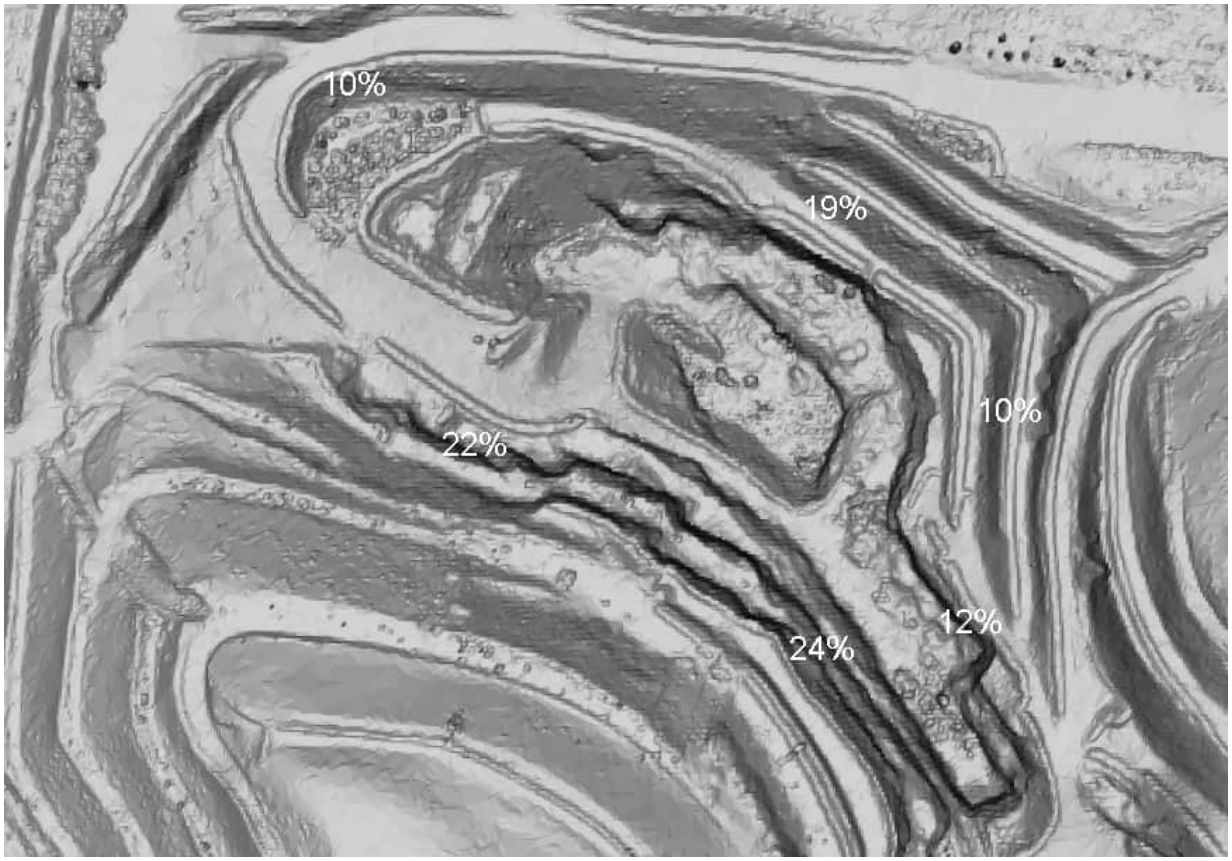


Figure 16. Upper bound overall scale stabilities (PoFs) at the west end of the East-West pit.

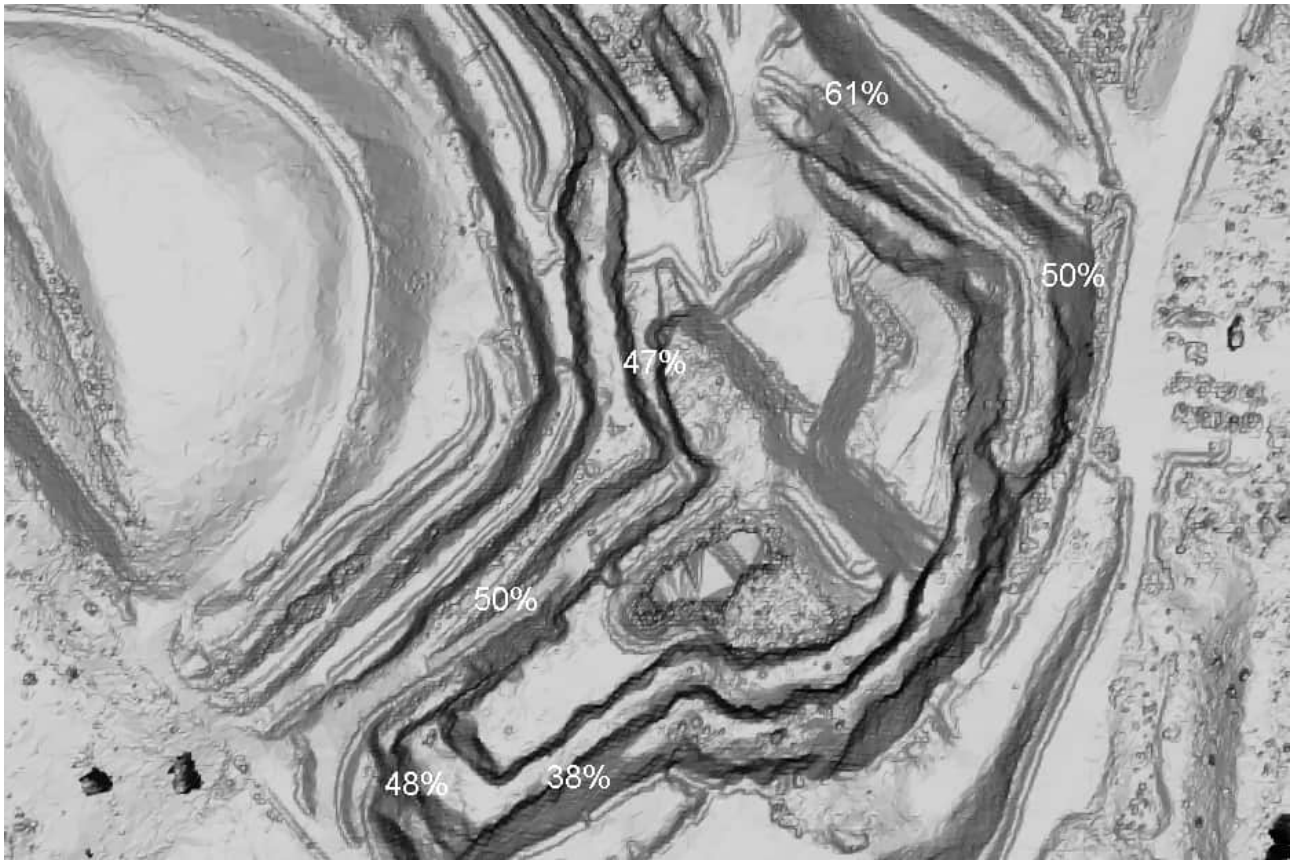


Figure 17. Upper bound bench scale stabilities (PoFs) at the east end of the East-West pit.

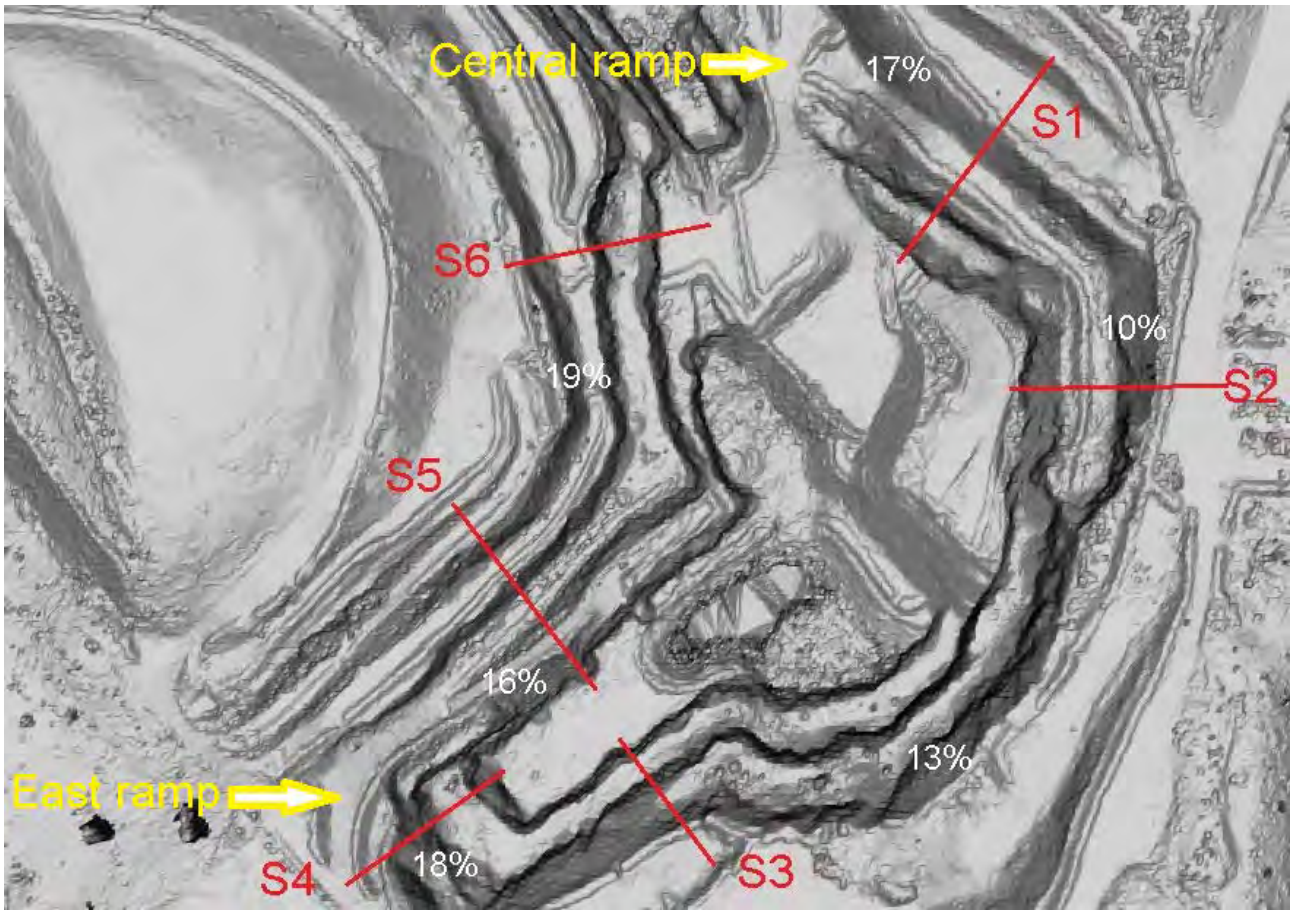


Figure 18. Upper bound overall scale stabilities (PoFs) at the east end of the East-West pit.

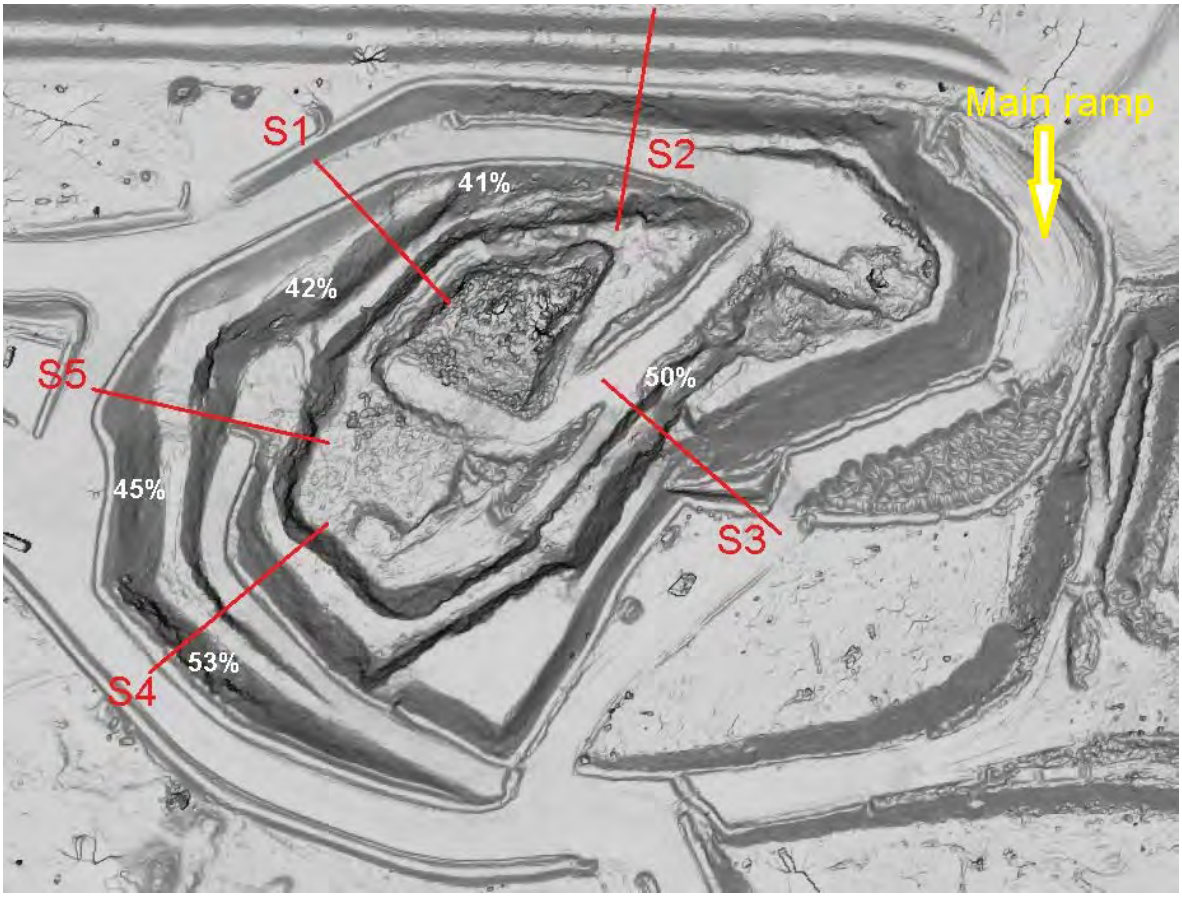


Figure 19. Upper bound bench scale stabilities (PoFs) around the Phoenix pit.

Figure 20. Upper bound overall scale stabilities around (PoFs) the Phoenix pit.

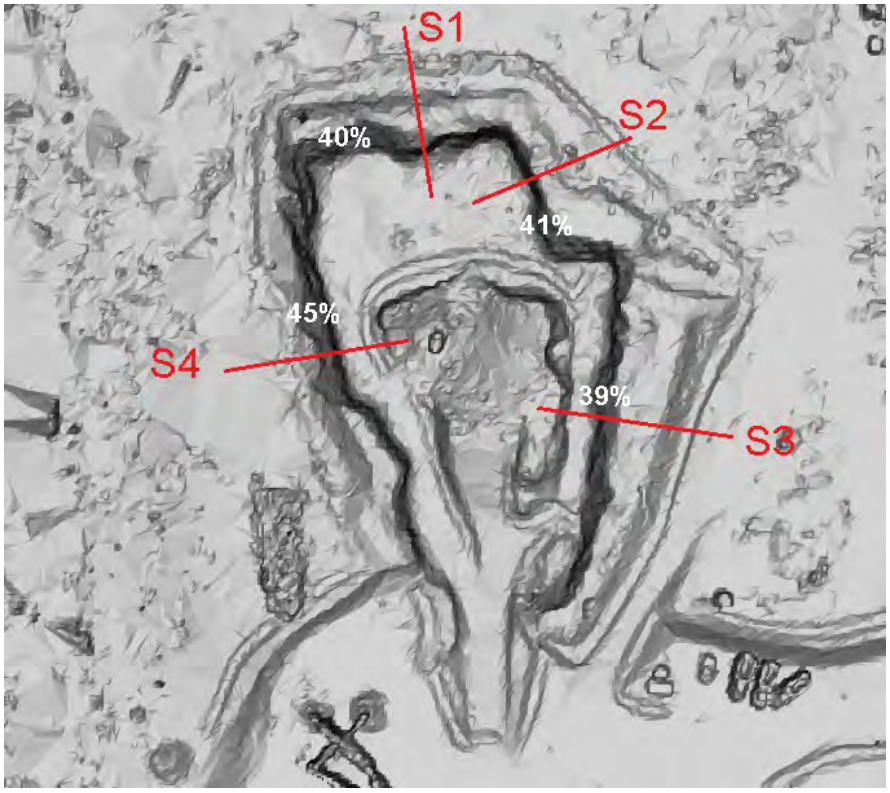


Figure 21. Upper bound bench scale stabilities (PoFs) around the Aspinal pit.

Figure 22. Upper bound overall scale stabilities (PoFs) around the Aspinal pit.

Figure 23. Loose and overhanging rocks (highlighted) on the batters of the north wall at the west end of the East-West pit.

Figure 24. Scree filled berms, loose rocks on batters and overhanging rocks (highlighted) on the northeast wall at the east end of the East-West pit.

Figure 25. Loss of widths of some sections of some berms, loose rocks on batters (highlighted) on the southwest wall at the east end of the East-West pit.

Figure 26. Loss of widths on some berms and scree filled sections of berms, loose rocks on batters and overhanging rocks (highlighted) on the north wall of the Phoenix pit.

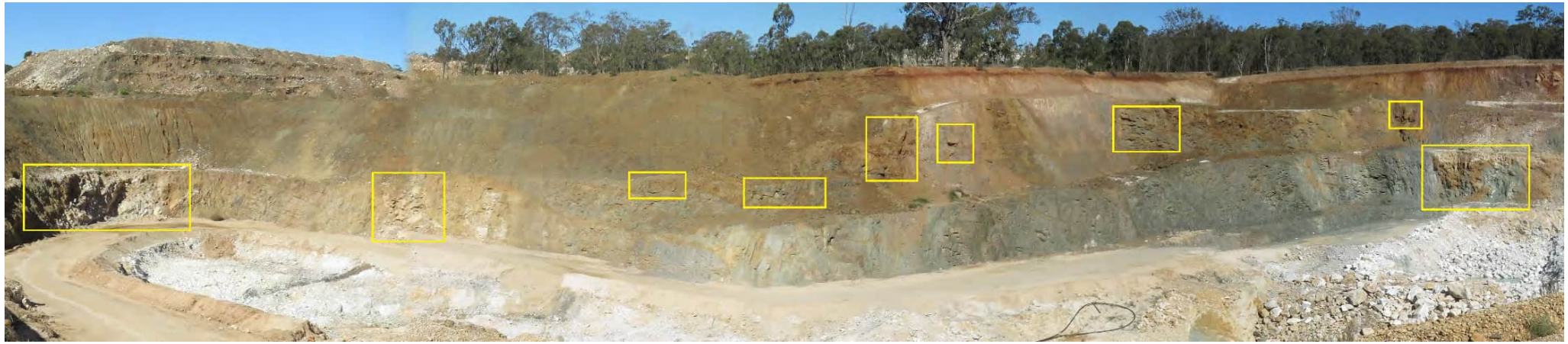


Figure 27. Loose rocks on the batters and overhanging rocks (highlighted) on the south wall of the Phoenix pit.

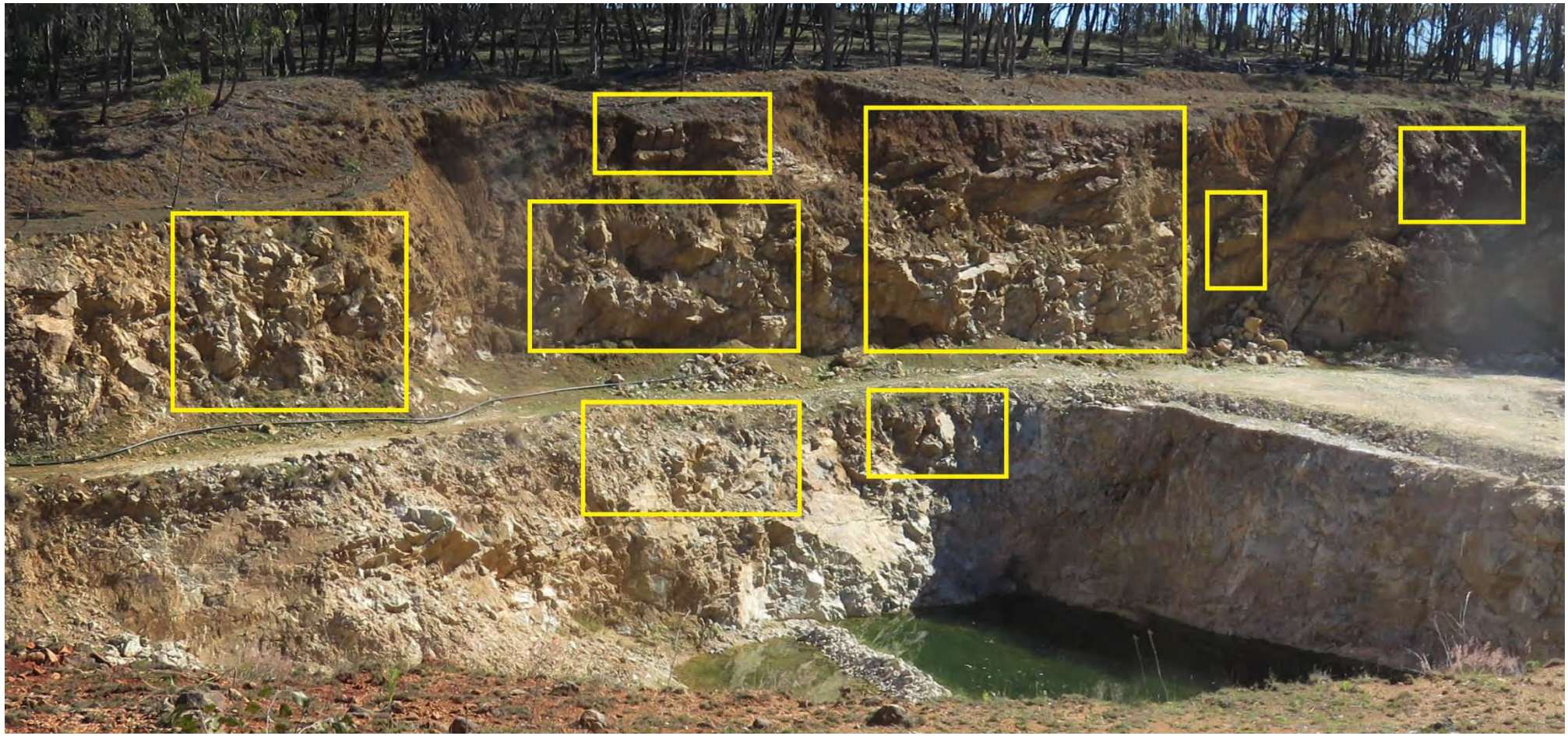


Figure 28. Loose rocks on the batters and overhanging and toppling rocks (highlighted) and scree on the berms on the west wall of the Aspinal pit.

Figure 29. Loose rocks on the batters and overhanging rocks (highlighted) and loss of berm widths and scree on the berms on the east wall of the Aspinal pit.

Figure 30. Sawtooth profile on the lower batter of the north wall of the east pit in the East-West pit due to multiple wedges sliding.

Figure 31. Toppling rocks on an east dipping batter on the upper bench of the Phoenix pit.

Figure 32. Loose rocks (highlighted) within soil and weathered siltstones near the crest of the batter adjacent to the central ramp in the East-West pit are currently hazards for users of the ramp. Batter should be draped in rockfall mesh, debris removed from the toe and drainage installed across and down the ramp. Flows of water from the overlying 550-mRL berm are not be modified with berm and batter drain and crest bunds.

Figure 33. Erosion on the batters adjacent to the main ramp in the Phoenix pit. If not controlled will increase the likelihood for instabilities. Batter is to be hydroseeded

Figure 34. Loss of widths of most sections of the berms and scree filled berms, loose rocks on batters and overhanging rocks on the south wall at the west end of East-West pit. If the adjacent western ramp is to be retained, the height and continuity of the current toe bund are to be increased. Otherwise the ramp will be removed.

.

Figure 35. Two deep gullies cut in the haul-road and ramp at the west end of the East-West pit by water shedding off the ramp require remediation.

Figure 36. Deep gully cut by water shedding off the west end of WRD 1 is contributing to erosion of the ramp at the west end of the East-West pit. Drain will be remediated when the ramp is removed.

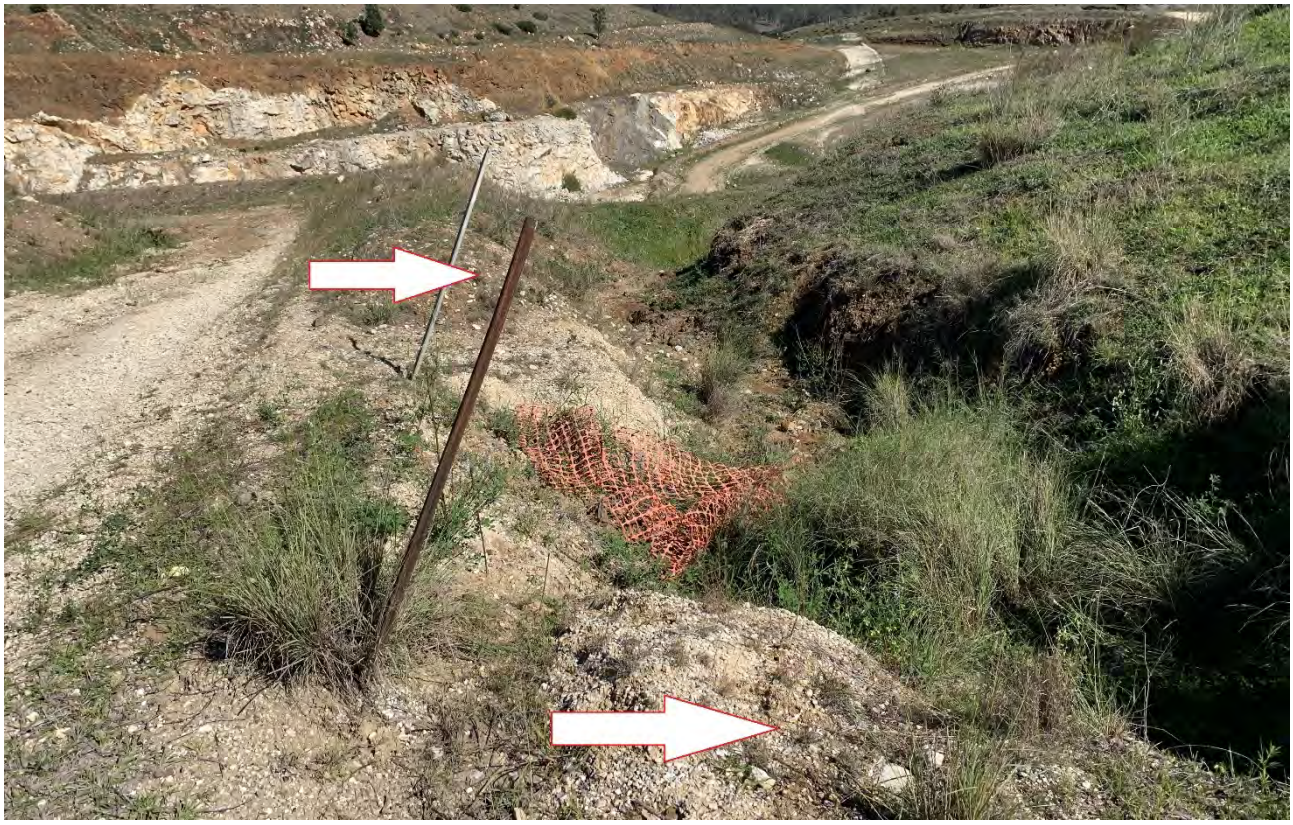


Figure 37. Gully cut by water shedding off the central ramp on the north wall of the East-West pit requires lining and sediment traps.

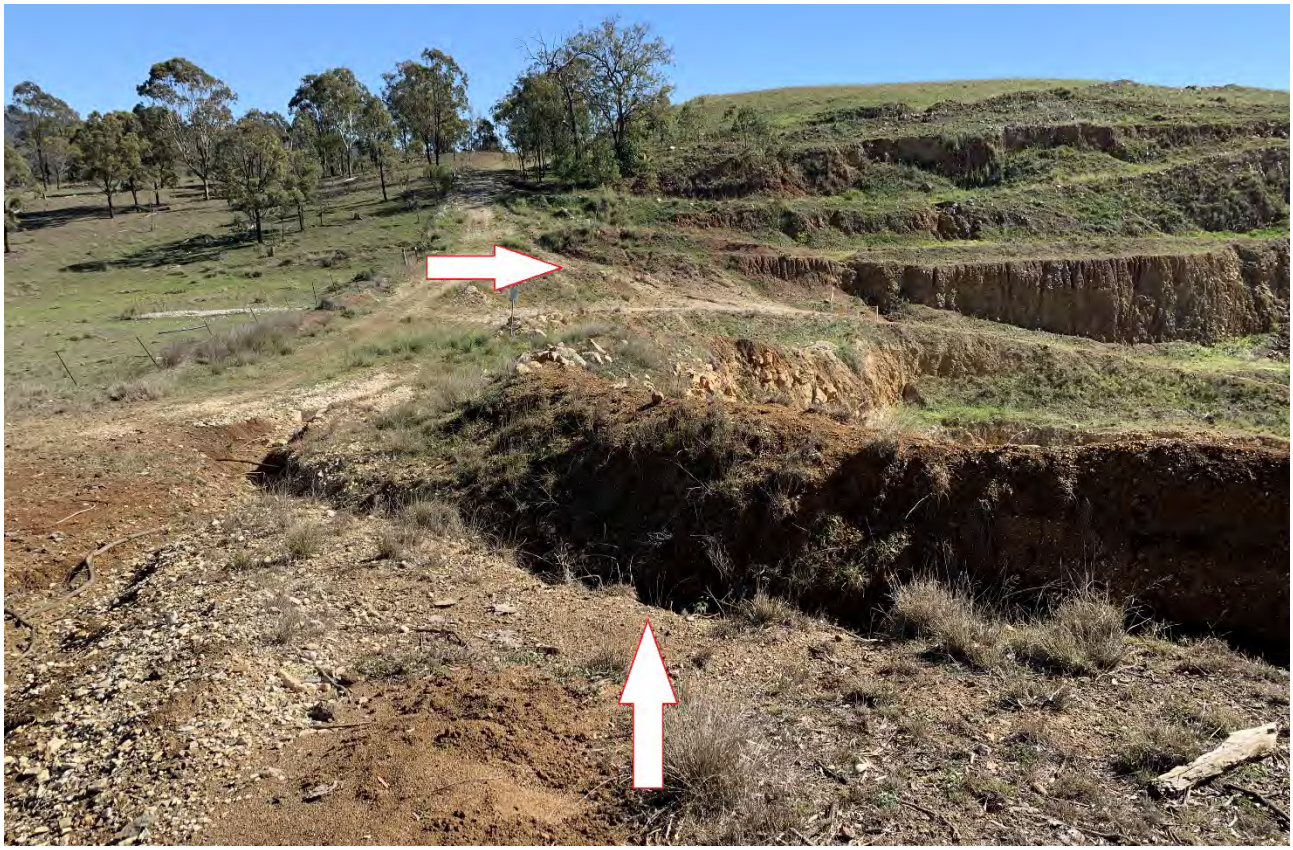


Figure 38. 2 x deep gullies cut by water shedding off the haul-road along the east end of the East-West pit requires repair. Haul-road to be graded to shed water to the east and ripped.

Figure 39. The haul-road along the east end of the Phoenix pit is to be graded to shed water to the east, removed by ripping and hydroseeded.

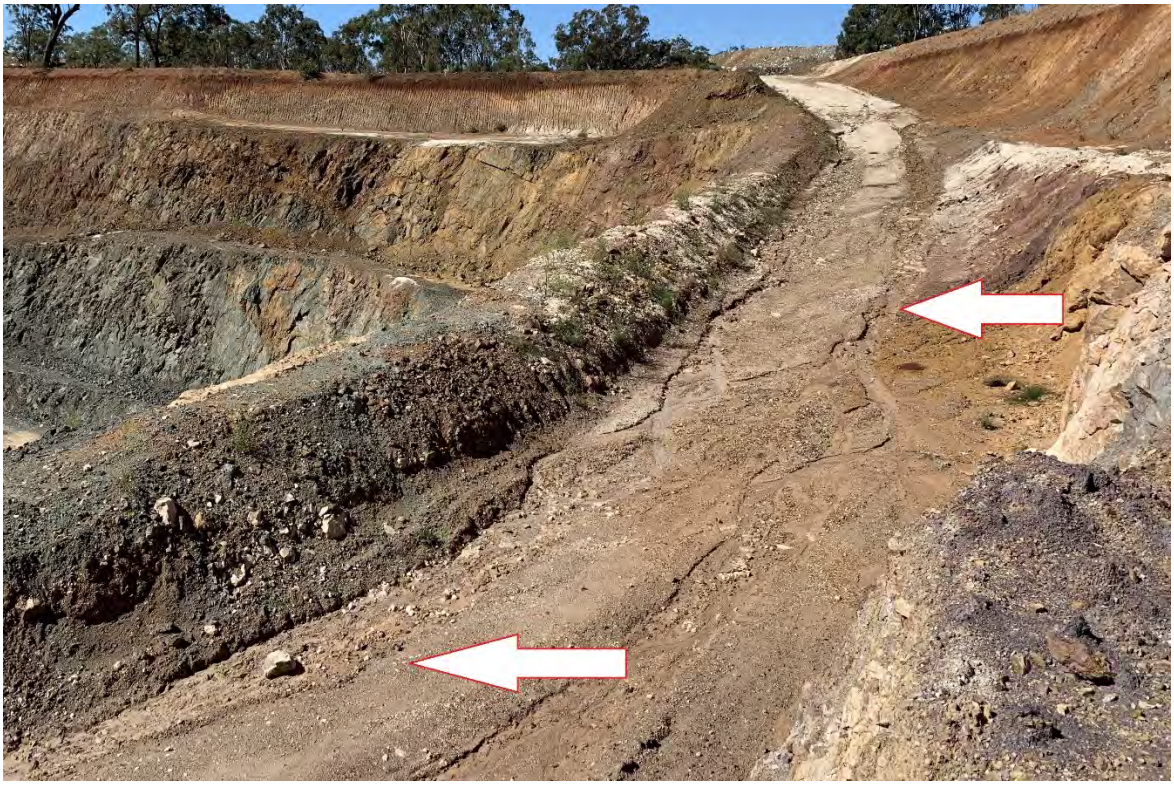
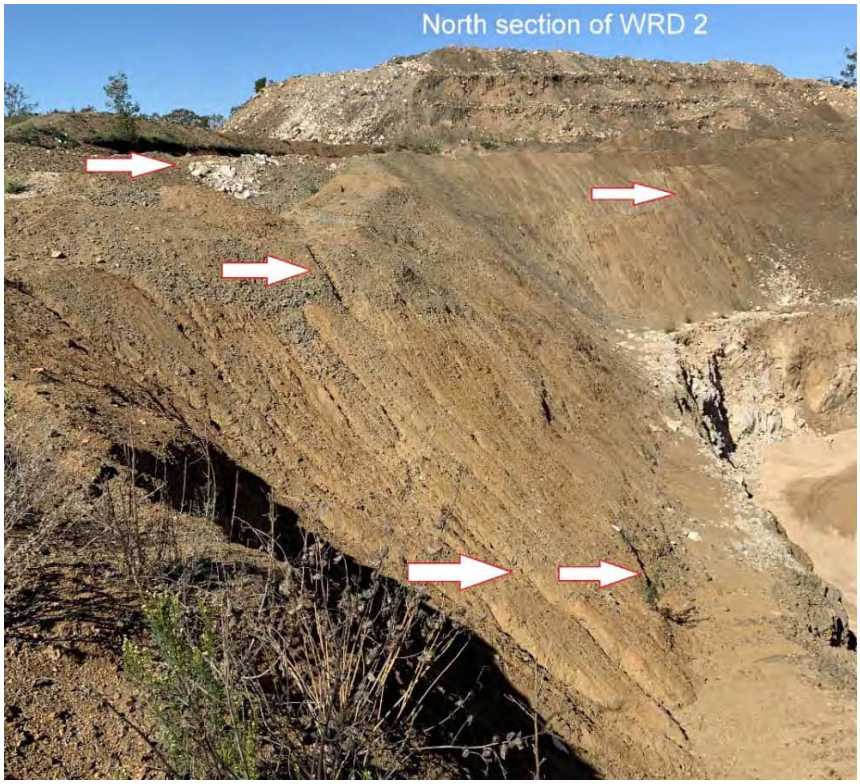


Figure 40. The ramp along the west end of the Phoenix pit requires ripping and drainage control to prevent shallow gullies cut by water from triggering instabilities.



(a)

(b)

Figure 41. Overland flows are eroding topsoil, karst fill and extremely weathered limestones and siltstones in the upper bench at the east end of Phoenix pit (b) The bund along the crest of the is likely sufficiently high to prevent overland flows of water from flowing from behind the crest.
Removal of the haul-road and hydroseeding is required.

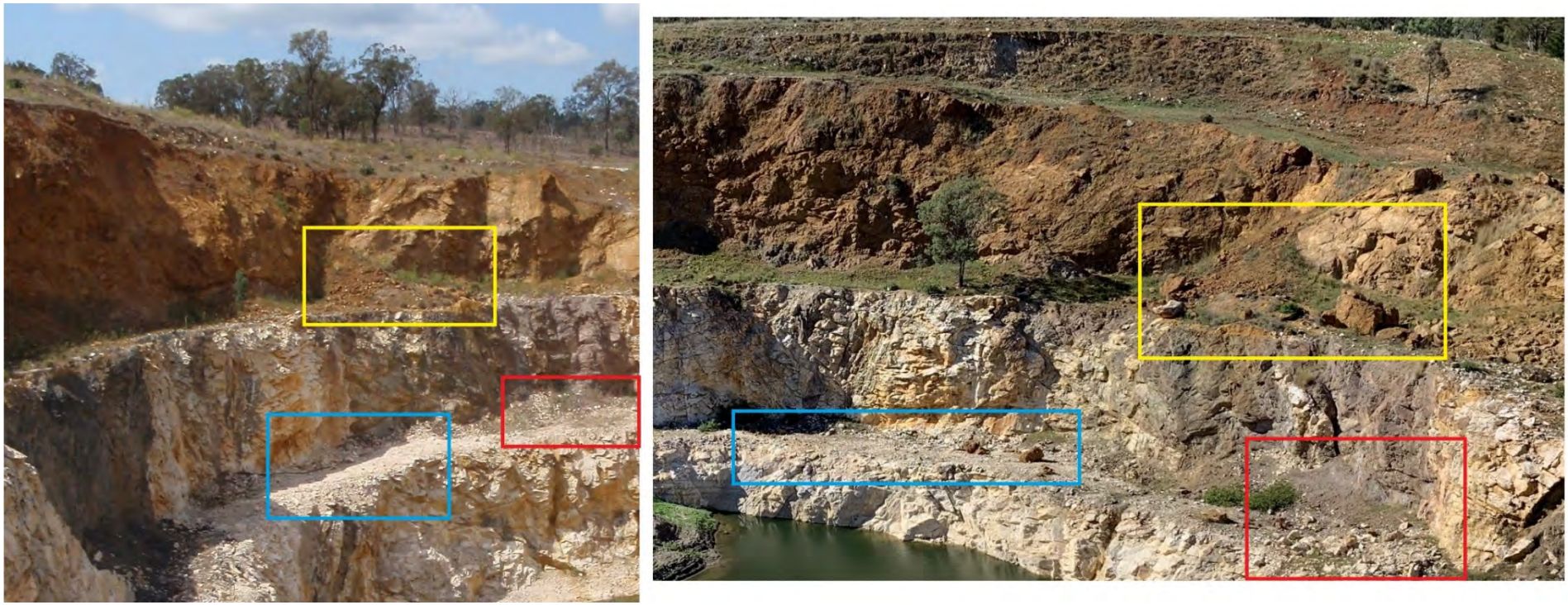


Figure 42. No significant differences in the volumes of rockfall debris on berms on the northeast wall at the east end of East-West pit in (left) 2004 and (right) currently.

Figure 43. No significant differences in the volumes of rockfall debris on berms and the loss of berm widths on the south wall at the west end of East-West pit in (left) 2004 and (right) currently.

Figure 44. No significant differences in the volumes of rockfall debris on berms and the loss of berm widths on the southwest wall at the east end of East-West pit in (left) 2004 and (right) currently.

Figure 45. Upper surface of waste rock dump 1 (WRD 1) to the west of the East-West pit. The surface has been contoured and topsoil spread enabling a low to moderate density of grasses to establish.

Figure 46. Upper surface of the southern section of waste rock dump 2 (WRD 2) to the southeast of Phoenix pit. The surface shaping, grading, crowning, topsoil and hydroseed.

Figure 47. A section of the 3.5-m high bund placed 8-m behind the crest of the east wall of Phoenix pit. Although the offset is less than the 10-m requirement, it is considered acceptable at this location. The haul-road is to be graded to the east, ripped and hydroseeded.

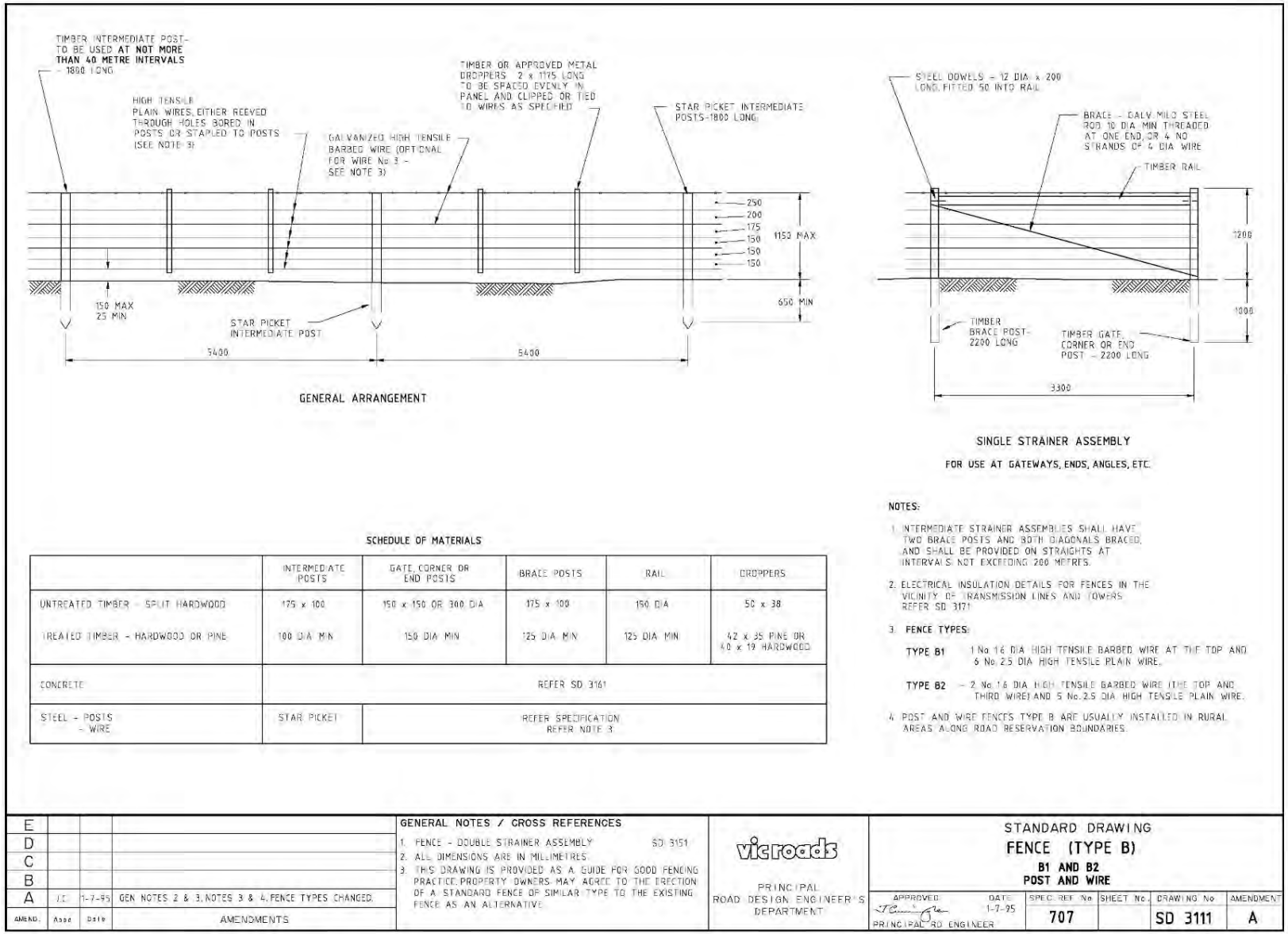


Figure 48. Example of Type B fences suitable for limited use as an abandonment barrier where an abandonment bund cannot be used.

Figure 49. Batter adjacent to the central ramp in the East-West pit requires draped rockfall mesh and improved drainage on the ramp and 550-mRL berm above the ramp.

(a)

(b)

Figure 50. (a) If the western ramp in the East-West pit is to be retained, the heights of (b) the current toe bunds are to be increased. If the ramp is not to be retained, the surface is to be ripped and a series of low bunds are to be installed at regular intervals along contour down the inclined surface to reduce flow rates.

Figure 51. Example of concrete canvas liner for ramp drains

Figure 52. Water shedding off the 550-mRL berm is destabilising the 540-m to 550-mRL batter adjacent to the central ramp. Lined drains are required above and along the berm and down the batter.

Figure 53. Example of a batter draped in high tensile strength rockfall mesh.

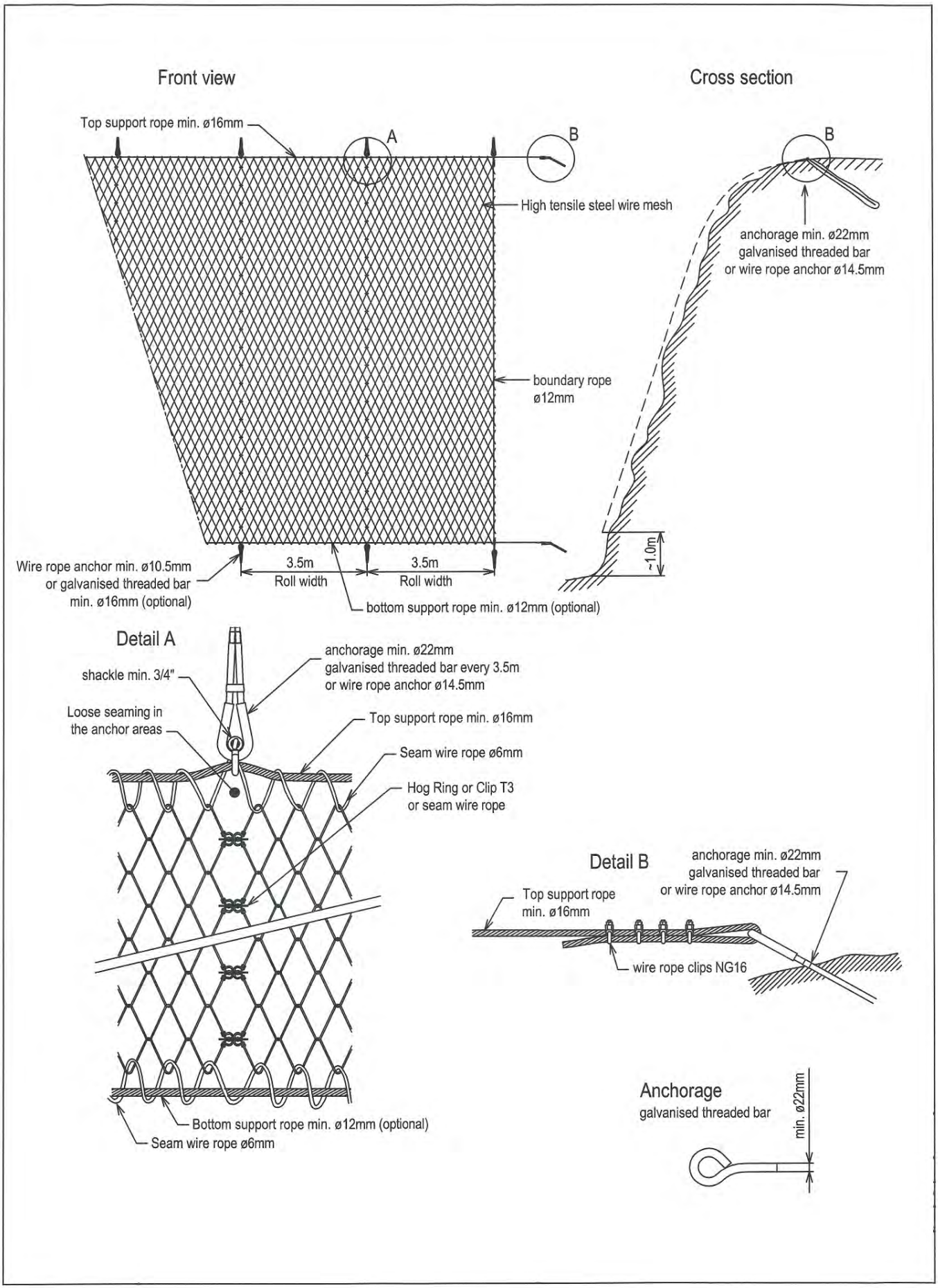


Figure 54. General characteristics of a mesh "drape" rockfall control system

Figure 55. Hydroseeding, and desirably hydromulching, are recommended for the batter adjacent to the main ramp along the east wall of the Phoenix pit and for spraying topsoil on WRD 2.

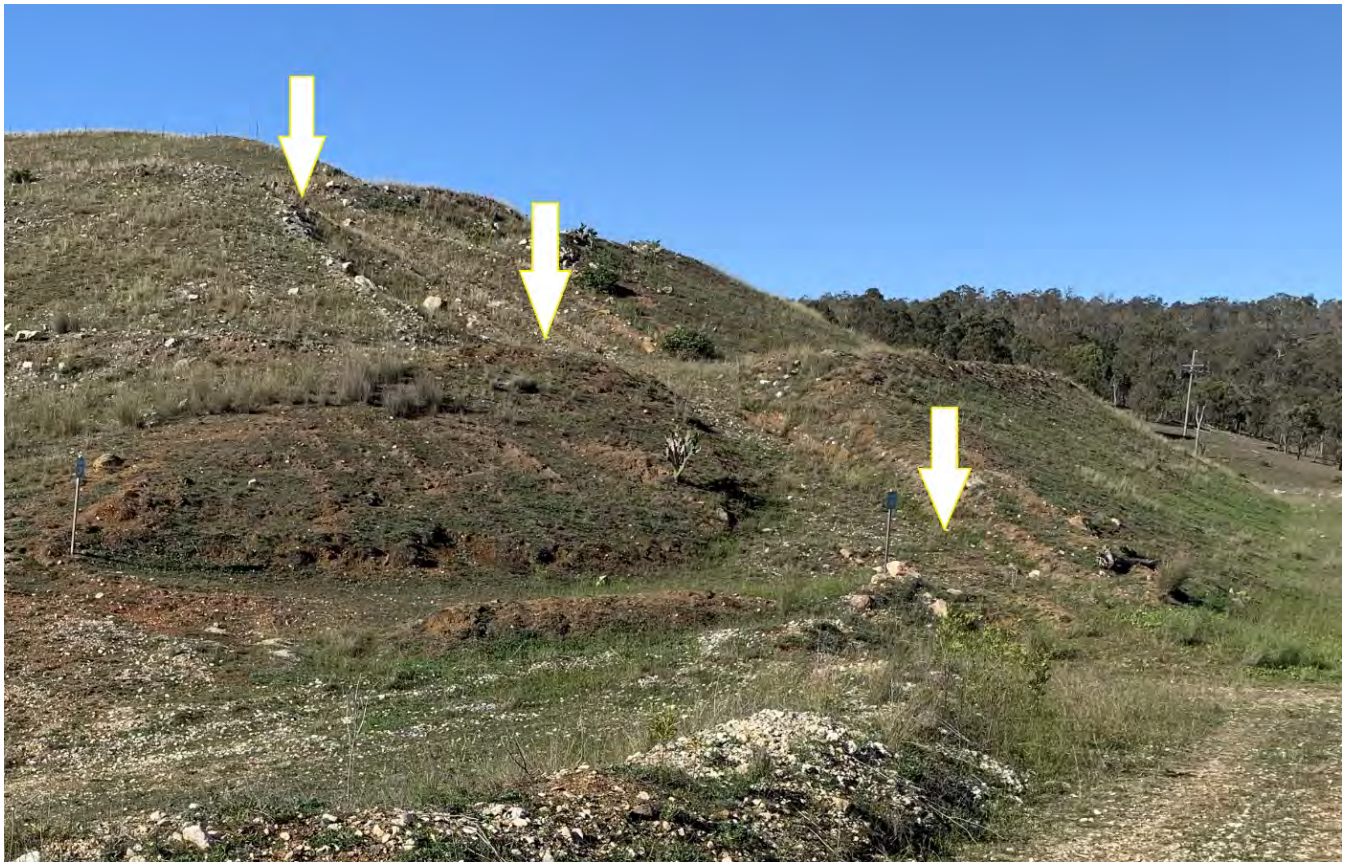


Figure 56. The ramp at the west end of WRD 1 on the south wall of the East-West pit is to be removed by ripping after an abandonment bund has been being installed along the north crest of the dump.

APPENDICES

APPENDIX 1 RISK ASSESSMENT CLASSIFICATIONS

Table A1.1 Quantitative Measures of Likelihood

Level	Descriptor	Description
A	Almost certain	Will occur, is of a continuous nature, or the likelihood is unknown. Expected to occur in most circumstances
B	Likely	Will probably occur in most circumstances
C	Possible	Might occur at some time.
D	Unlikely	Could occur at some time but is not expected to occur.
E	Rare	Has almost never occurred but conceivably could. May occur only in exceptional circumstances

Table A1.2. Quantitative Measures of Consequence: Health and Safety

Severity Level	Descriptor	Description
5	Insignificant	No injuries. No medical treatment required.
4	Minor	Objective but reversible disability requiring hospitalisation. First Aid treatment.
3	Moderate	Moderate irreversible disability or impairment to one or more persons. Medical treatment required.
2	Major	Extensive injuries. Severe irreversible disability to one or more persons.
1	Catastrophic	Fatality

Table A1.3 Risk Matrix

		Consequence of Event				
		5	4	3	2	1
Likelihood of Event		Insignificant	Minor	Moderate	Major	Catastrophic
A	Almost certain	L	H	H	E	E
B	Likely	L	M	H	H	E
C	Possible	L	M	M	H	H
D	Unlikely	L	L	M	M	H
E	Rare	L	L	L	M	M

Table A1.4. Risk Level Implications.

Extreme (E)	Do not proceed with task until risk is reduced. Go back and review controls to include more effective measures. Detailed action plan required, allocation of resources and effective monitoring. Controls should involve Elimination, Substitution or Isolation.
High (H)	Reduce risk urgently. Controls should involve Elimination, Substitution or Isolation. Senior management consultation. May be tolerable in special circumstances only.
Medium (M)	Take reasonable steps to mitigate the risk. Until elimination, substitution, isolation or engineering controls can be implemented, institute administrative or PPE controls. Management responsibility must be specified.
Low (L)	Reduce risk when/if convenient. Manage by routine procedures. Review by supervisor. Proceed with activity.

APPENDIX 2 KINEMATIC STABILITIES OF THE PITS WALLS

This study used the stereographic method, as implemented in the software Dips[46], to assess whether the kinematics[47] applicable to the walls of the pits are conducive to instabilities. The method calculates the proportions of the logged discontinuities that are conducive to:

- masses of rocks sliding along single (planar) or multiple (wedge) discontinuities and
- individual rocks or masses of rocks toppling.

Although significant limitations in the analysis method limit the veracities of the results, they are of a standard suitable for the scope and purpose of this study.

Analyses

The assessments assumed conducive to the following:

- The sets of discontinuities have the orientation characteristics listed in Table 1.
- Batters dip at the average angles listed in Table 3.
- Walls dip at the overall slope angles listed in Table 6.
- Batters and walls dip towards the means of the ranges listed in Table 4.
- Discontinuities have conservative peak shear strengths of 21° as discussed in Section 2.4.5.

The propensity for a failure mode to develop was defined as follows:

- For planar sliding and toppling, the propensity is the percentage (P_f) of the total number of poles[48] to the logged discontinuities that are within the highlighted "critical zones" [49].
- For wedge sliding, the propensity is the percentage (P_f) of the total number of intersections between pairs of discontinuities that are within the "critical zones".

Figure A2.1 shows an example of a stereonet applicable to wedge sliding.

The results of the analyses are listed in Tables A2. and discussed in Section 4.1.

---

[46] The kinematic analysis software, Dips, is produced by Rocscience Inc, Toronto.

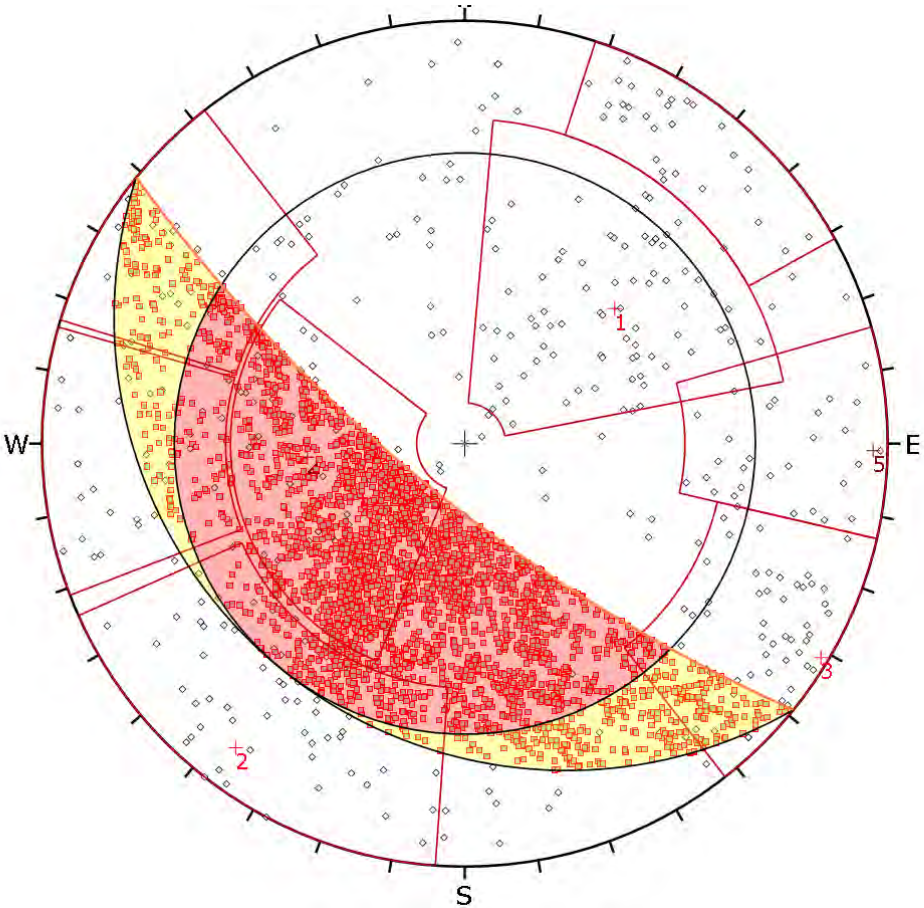
[47] Kinematics describes the motion of rocks without considering their masses nor the forces that may cause the motion. It is primarily concerned with the orientations of discontinuities bounding rocks with respect to the orientations of slopes from which rocks may move.

[48] In a stereonet analysis, a discontinuity is assumed to be a planar feature represented on a stereonet as a "great circle". The "pole" to a discontinuity is a downward directed line orientated perpendicular to the plane. It is represented on a stereonet as a point.

[49] The propensity for wedge sliding is defined as the proportion (P_f) of the total number of lines representing intersections of pairs of discontinuities that are within the highlighted "critical zone".

Table A2.1. Results from stability analyses.

					Bench Scale Stability Analysis					Overall Scale Stability Analysis				
					Sliding		Toppling			Sliding		Toppling		
			Dip Dirn	Overall slope angle	Planar	Wedge	Flexural	Block		Planar	Wedge	Flexural	Block	
Pit	Section	Wall	(deg)	(deg)	$PoF_{individual}$				$PoF_{combined}$	$PoF_{individual}$				$PoF_{combined}$
East-West	west pit	1	219	35	12.5	42.2	8.4	13.8	60%	1.6	6.9	3.2	8.7	19%
		2	278	28	8.2	28.9	14.1	10.0	50%	0.1	0.7	2.9	6.9	10%
		3	229	29	15.3	42.4	8.3	12.1	61%	0.4	2.2	1.7	7.9	12%
		4	61	45	4.9	20.5	15.8	15.9	46%	1.2	5.5	5.9	13.9	24%
		5	29	37	3.6	19.2	14.5	27.4	52%	0.5	4.1	5.3	13.4	22%
		6	140	18	4.8	33.6	10.0	13.9	51%	0.0	0.0	0.0	9.6	10%
	east pit	1	223	34	14.1	42.5	9.0	13.1	61%	1.4	5.7	2.8	8.4	17%
		2	275	26	7.8	30.0	14.1	9.8	50%	0.1	0.4	2.9	6.7	10%
		3	320	32	2.1	19.6	8.4	13.7	38%	0.2	1.9	3.4	7.7	13%
		4	57	37	5.3	20.4	16.1	17.7	48%	0.6	2.9	3.4	12.5	18%
		5	148	32	5.4	35.8	4.6	13.4	50%	0.3	3.5	2.8	10.3	16%
		6	85	35	7.7	22.3	14.6	13.3	47%	0.9	1.9	5.7	11.3	19%
Phoenix		1	141	34	4.8	34.0	9.6	13.8	51%	0.0	3.8	6.9	10.8	20%
		2	179	25	4.9	39.7	2.1	14.7	52%	0.0	1.2	0.2	8.6	10%
		3	213	31	11.0	41.2	7.0	14.9	59%	0.8	4.2	2.1	8.5	15%
		4	45	24	5.6	19.4	18.5	24.2	53%	0.0	0.4	0.5	9.6	10%
		5	102	31	9.2	24.0	19.1	14.8	52%	0.0	1.0	8.1	11.1	19%
Aspinal		1	169	15	4.3	39.0	1.9	13.8	51%	0.0	0.0	0.0	8.4	8%
		2	263	27	10.8	34.0	11.6	9.6	53%	0.0	0.4	2.9	7.1	10%
		3	284	28	6.9	26.6	14.1	10.3	47%	0.3	0.9	2.9	6.8	11%
		4	75	35	6.5	20.6	15.0	13.5	45%	0.8	2.2	4.4	11.2	18%



Symbol	Feature
◇	Pole Vectors
▫	Critical Intersection

Kinematic Analysis	Wedge Sliding		
Slope Dip	75		
Slope Dip Direction	219		
Friction Angle	21°		
Weighted Results	Critical	Total	%
Wedge Sliding	232280	550812	42.17%

Plot Mode	Pole Vectors
Vector Count (Weighted)	1051 (420 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Intersection Mode	Grid Data Planes
Intersections Count (Weighted)	550812
Hemisphere	Lower
Projection	Equal Angle

Figure A2.1. Example of the results from a wedge sliding stability analysis. This example applies to a bench on the north wall of the west pit in the East-West pit. Each point represents the line formed by the intersection of two discontinuities. The proportion (42%) of points in the red and yellow "critical" zones is a measure of the propensity for a wedge sliding mode of instability to occur.

APPENDIX 3 BARRIER OFFSETS FROM CRESTS

Offsets are based on procedure in Government of Western Australia Department of Industry and Resources (1997) *Safety Bund Walls Around Abandoned Open Pit Mines: Guideline.* MOSHAB Approved. Document No: ZMA048HA. 14 pages.

			Wall							
Pit	Section	Wall	N sth dipping	S nth dipping	W east dipping	E west dipping	Wall height (m)	Overall slope angle (deg)	Depth of weathering (m)	Required Bund offset (m)
East-West	west pit	1	1				42	35	18	10
		2				1	49	28	10	10
		3				1	42	29	10	10
		4			1		40	38	13	14
		5		1			33	21	13	10
		6	1				31	18	18	10
	east pit	1	1				35	34	9	10
		2				1	28	26	2	10
		3		1			34	32	5	10
		4			1		28	39	9	13.7
		5	1				40	32	9	10
		6			1		41	35	9	10
Phoenix		1	1				25	34	5	10
		2	1				21	25	5	10
		3	1				21	31	5	10
		4		1	1		32	24	12	10
		5			1		30	31	13	10
Aspinal		1	1				14	15	15	10
		2				1	12	27	19	20.2
		3				1	18	28	19	15.9
		4			1		13	35	15	21.6

Appendix 5

Epic Environmental Pty Ltd (20 November 2020): Water Management Plan – Warwick Limestone Mine

TERREQUIP ENVIRONMENTAL PTY LTD PTY LTD

WATER MANAGEMENT PLAN

TERREQUIP ENVIRONMENTAL PTY LTD PTY LTD
WATER MANAGEMENT PLAN

20 NOVEMBER 2020

WARRICK LIMESTONE MINE

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Document History and Status

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1 PURPOSE AND SCOPE

This document covers aspects of the water management required for Terrequip Environmental Pty Ltd (Terrequip Environmental) to comply with their requirements under the Environmental Authority EPML00136213 (hereon referred to as the EA) and ensure consistency with Terrequip Environmental site management principles.

This Plan details the management of water at Terrequip Environmental's Warwick limestone operation. It applies to all Terrequip Environmental controlled activities for this site and covers all new developments, all construction activities, and onsite operations through to site closure.

As per conditions C9 and C10, this plan covers all activities including:

- Water usage and management;
- Sampling methodology;
- Direct and indirect discharge involving surface water (including run-off);
- Impounded water;
- Groundwater; and
- Erosion and sediment control.

2 LEGAL COMPLIANCE OBLIGATIONS

All key legislation and regulations associated with site operations are included in the sites Compliance Register which is developed in accordance with Terrequip Environmental 's EHS Legal Compliance Obligations Procedure.

The following table (Table 1~~Table 1~~) identifies specific conditions of approval and their corresponding requirements relevant to site operations in relation to water management.

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Table 1: Condition C10 of the EA

Item	The site WMP must:
(a)	be carried out by a person possessing appropriate qualifications and experience in the field of surface water monitoring program design to be able to competently make recommendations about these matters
(b)	identify the environmental values of the licensed place and water quality objectives (i.e. ANZECC trigger levels for stock water) by monitoring locations (i.e. sediment dams) on the site for water quality characteristics (including total dissolved solids mg/l, total suspended solids mg/l, and pH) and identify any potential receiving waters in the event of an uncontrolled release that will be protected
(c)	provide representative water sampling, in consideration of the availability of water on the site, carried out with sufficient regularity and spatial and temporal replication to make statistically valid conclusions about the water quality on the site
(d)	give considerations to relevant methodology and water quality criteria by the Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand in Australian Guidelines for Water Quality Monitoring and Reporting 2000 and "Australian and New Zealand Guidelines of Fresh and Marine Water Quality 2000"
(e)	determine potential environmental harm within the predicted zone of influence arising from mining activities
(f)	incorporate a risk management approach to how changing levels of flood, drought and water quality risks should be addressed e.g. increasing the lip of sediments ponds to increase capacity
(g)	Determine measures to manage and/or recycle storm water discharges to minimise stormwater contaminated from the mining activities reaching any surrounding watercourses
(h)	develop and implement a system for emergency spills or discharges including procedures to minimise extent and duration of release, staff training, investigation and reporting procedures
(i)	manage the environmental impacts of any uncontrolled release of wastewater to the environment so that any impacts are minimised e.g. improving sediment control measures and/or separating clean water from undisturbed areas and water from disturbed areas
(j)	manage site water quality and quantity during the (3) phases of mining: development, operation and decommission
(k)	safeguard against the potential for soil erosion
(l)	provide details of operational monitoring and monitoring of hydrological processes including associated performance indicators

3 ENVIRONMENTAL VALUES AND RISK

All environmental risks associated with site operations have been assessed in accordance with Terrequip Environmental 's EHS Risk Management, JRAs & SOPs Procedure. An environmental risk register has been developed which details the environmental risks associated with the impact on water resources.

The Project area lies within the Headwaters of the Southern Condamine which forms part of the Condamine River Basin (WQ4223), in turn forming part of the QLD Murray-Darling and Bulloo Basins (Basin 422) As a result the following environmental values are applicable:

- Aquatic ecosystems;
- Irrigation;
- Farm supply;
- Stock water;
- Human consumption;
- Secondary recreation;
- Visual recreation;
- Drinking water;
- Industrial use; and
- Cultural and spiritual values

4 RESPONSIBILITY

It is the responsibility of all employees and contractors to undertake practices to manage surface water and groundwater in accordance with this Water Management Plan (WMP). The following people are the key Terrequip Environmental personnel responsible for the implementation and review of this Management Plan.

All works will be carried out by a person possessing appropriate qualifications and experience in the field of surface water monitoring.

Table 2: Water Management Responsibilities

Personnel	Summary of Responsibility
Site Supervisor	▪ Ensure the implementation of all control, monitoring and reporting measures as specified in this Plan; ▪ Ensure compliance with Conditions of Approval; ▪ Participate in the annual review of the Plan; ▪ Ensure changes to operational plans are communicated to the Environmental Manager and support staff; and ▪ Participate in the annual review of the Plan;
General Manager Operations	▪ Ensure performance targets specified in this Plan are being met; ▪ Participate in the annual review of the Plan where required; and ▪ Consult with the Environmental Manager regarding communication with government agencies.
Environmental Manager	▪ Provide technical advice in the development and implementation of the Plan; ▪ Put systems in place to implement the controls, monitoring and reporting measures specified in this Plan; ▪ Participate in the annual review of the Plan; ▪ Approve amendments to the Plan; ▪ Conduct biennial environmental audits of site operations against performance. ▪ Communicate with government agencies on environmental matters in consultation with the Site Supervisor and General Manager as required.
Mining Support	▪ Provide technical support and advice for management of water; and ▪ Provide technical support and advice for mine planning.

5 EXISTING ENVIRONMENT

5.1 SURFACE WATER

The Warwick Plant site and Aspinal pit areas (on ML 50146) are located on a natural ridgeline which drains to the northeast via Lucky Valley Gully which then flows toward the Condomine Creek 3 kilometres to the northeast (**Appendix B – Site map**).

The East-West pit area is located on the western side of a local topographic high and rainfall run-off drains west via Lord John Creek and then on to Oaky Creek, which then flows north into the Condomine River some 9 kilometres (kms)to the north of the mine area.

The Phoenix pit area located on the east side of Keogh Road which is a local topographic high and drainage divide between the East-West Pit area and the Phoenix pit area. Drainage lines control rainfall run-off in a north-easterly direction via 'Frenchman's Gully' which then joins Luck Valley Gully prior to draining to the Condomine Creek.

The local drainage features surrounding the mine area are all ephemeral, and usually only run after significant rainfall (Appendix C).

5.2 GROUNDWATER

The Warwick limestone mining areas are within the Balone-Condomine Groundwater Management Area (MineOnlineMap). Local groundwater levels are around 20 to 25m depth below ground level as observed from drill logs and minor seepage in pits. Groundwater flow is very slow as observed from the minor pit seepage. Rainfall run-off and slow percolation and subsurface drainage is the main source of water to the pits.

A groundwater bore (Bore Licence WL86305T, maximum annual extraction 10ML) located on ML50083 is currently inactive and has been for several years. Yields are less than 1 litre/ second has been estimated by site personnel. Groundwater levels are below 15m below surface. Historical data suggests groundwater salinity is of the range 750 – 2240EC (ERM, 2008). Minor groundwater seepage is observed in the Phoenix pit at approximately 20m below ground level.

Typically, aquifer transmissivity is low in limestone. This means that the impacts on other groundwater users in the area are considered negligible due to the low transmissivity and their proximity to potential mine influence. The nearest bore (bore number 86326) in the area are some 2 kms to the east and is located in weathered granite yielded less than 0.5 litres per second (l/s). Groundwater quality was described as potable water from a drill depth of 22 m, with pH of 8.4 and salinity of 2191EC.

5.3 SURROUNDING WATER USE

The Warwick limestone mining operation is surrounded by farmland, mostly cattle grazing. Hence the main water users are farmers for cattle drinking water. Further down catchment, the Condomine River supplies water for irrigation, raw drinking water supply and recreational activities such as fishing, swimming, and boating as well as other activities outlined in section 3.

6 EROSION AND SEDIMENT CONTROL

6.1 MANAGEMENT OF EROSION AND SEDIMENT CONTROL

Aims:

- To minimise risk of movement of mine contaminated waters and sediment off-site; and
- Minimise effect of potential anthropogenic influences to environmental features on-site and off-site.

Best practice:

- Design and maintenance of water retention and sediment control structures (dams and levees) to meet regulatory requirements that are suitable for the climate and geographic location;
- Assess the potential risk for dam failure and determine the need for an appropriately qualified engineering assessment if required; and
- Regular on-going inspections to ensure compliance with Environmental Authority requirements and best practice.

Table 3: Erosion and Sediment Control Monitoring

Description of monitoring	Timing/ Frequency	Monitoring Method
Site Dam Inspections	Monthly or prior to wet climate event and post wet climate event	4WR-F9.108.01 Site Dam Inspection Checklist
Dam Water Levels	Weekly	Monitoring data form 2018 Warwick
Rehab areas	Quarterly	Site EHS Inspection
Mine pit boundaries and internal levees	Weekly	Site EHS Inspection

6.2 SEDIMENT DAMS

The Warwick site watershed sub-catchments and sediment dam capacity requirements were assessed in March 2018. The assessment outcome realised some shortfalls in sediment dam capacities due to progressive expansion of the mine operation and to discrepancies with EA specifications for sediment dam capacities. The 2008 WMP stated that a 1:10 year Average Recurrence Interval (ARI) rainfall was with DES for planning purposes. The Amalgamated EA (March 2018) specifies the following required dam storage criteria in **Table 4**~~**Table 4**~~.

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Terrequip Environmental recognises there are dam capacity deficiencies in all but Sediment Dam 8 and therefore pump and pipe systems will be required to transfer water to available storage areas such as mining voids of East-West pit and Aspinal pits to manage excess run-off and prevent uncontrolled discharges.

Table 4: Sediment and Water Storage Dams

Water Storage ID	Location (Coordinates GDA 94)		Mining Lease	Rainfall Criteria specified for capacity	Preferred water transfer destination
	East	North			
Sediment Dam 1	413378	6859379	ML50146	1:10yr ARI	Aspinal Pit void
Sediment Dam 2	413397	6859342	ML50146	1:10yr ARI	Aspinal Pit void
Sediment Dam 3	413350	6859771	ML50146	1:10yr ARI	Aspinal Pit void
Sediment Dam 4	413321	6859814	ML50146	1:10yr ARI	Aspinal Pit void
Catchment Dam 1	413248	6859102	ML50146	1:50yr ARI	Aspinal Pit void
Catchment Dam 2	413169	6859154	ML50146	1:50yr ARI	Aspinal Pit void
Sediment Dam 6	412421	6858553	ML50083	1:10yr ARI	East-West Pit void
Sediment Dam 7	413363	6858918	ML50146	1:10yr ARI	Aspinal Pit void
Sediment Dam 8	413298	6858587	ML50237	1:10yr ARI	East-West Pit void
Sediment Dam 9	413843	6858437	ML50237	1:10yr ARI	East-West Pit void

6.3 SEDIMENT DAM WATER MANAGEMENT

Sediment Dam 1 and Sediment Dam 2 operate as one system with Sediment Dam 2 decanting to Sediment Dam 1. Sediment Dam 2 has an outlet pipe to decant clean water off-site as required. The 120mm diameter outlet pipe has a riser pipe top at RL552.25 m. Discharge is achieved by opening the valve on the downstream side of the overflow discharge pipe (Outlet RL550.16). The lowest point on the spillway is RL552.45 m.

Catchment Dam 1 effectively acts as a water supply and sediment dam capturing run-off from the stockpile and plant area. Dust suppression water is obtained from this dam. Overflow from Catchment Dam 2 flows into Catchment Dam 1.

Catchment Dam 2 captures run-off water from disturbed and undisturbed areas, effectively acting as a sediment dam and supply of water for Catchment Dam 1.

Sediment Dam 3 and 4 are located north of the plant area. Historically, this area has had minimal disturbance in 'sub-catchment A' and the requirement for sediment dam capacity is also minimal.

Sediment Dam 6 located in the East-West sub-catchment "G" is west of the rehabilitated waste dump and was originally intended to manage water run-off from the north-western area outside of the pit. Run-off currently filters through a naturally generated system of reeds which filter out sediment into Sediment Dam 6. The area is rehabilitated land and is not considered "disturbed" ground, therefore a Sediment Dam is considered non- essential in this location.

Sediment Dam 7 located in sub-catchment "F" adjacent to the current wash-down area captures rainfall run- off from the Run of Mine (ROM) stockpile area and the access road to the plant and manages sediment from the wash down system.

Sediment Dam 8 is located on Phoenix mine area (sub-catchment area "I") and receives run-off from the topographic high along Keogh Road, west of the Phoenix mine. The discharge invert is at RL537 m and is

designed to drain water to a point that equates to spare capacity to accommodate a 1:10 yr ARI rainfall run-off event.

Sediment Dam 9 (sub-catchment area “J”) is located south of the active Phoenix mine area. Planning is underway to increase the Sediment Dam storage capacity by constructing a secondary Sediment Dam downstream (nominally Sediment Dam 10).

7 WATER MONITORING PROGRAM

The purpose of the water monitoring program is to ensure compliance with EA requirements and to minimise potential off-site environmental impacts.

The EA conditions allow settled storm water release only if sediment dams have the required sediment dam capacity and water quality meets the following limits:

- Maximum pH = 9.0; and
- Maximum Electrical Conductivity (EC) = 1500 µS/cm.

However, since the Sediment Dam capacities are insufficient for the stated rainfall intensities listed in the EA and reproduced in Table 4 (except Sediment Dam 8), then no off-site discharge is permitted.

Obtaining regular water quality data is still required to satisfy the EA section C10 (c) and may also provide future opportunity to apply for concessions to allow controlled discharges.

All surface water sampling will be conducted as per the Queensland Monitoring and Sampling Manual (EHP, 2009) and more recently published methodologies (DES, 2018).

7.1 SURFACE WATER QUALITY MONITORING PROGRAM

A program of regular monitoring (quarterly) and event-based monitoring is employed at Warwick Limestone Operation. For a practical guide for the Warwick site, a 'significant rainfall event' of 50mm in 24hrs is considered appropriate, which would occur more than once per year (**Appendix C**).

A quarterly sampling program is designed to provide data to make valid conclusions about water quality on site over time as required to meet EA condition 'C10 (c)':

"Provide representative water sampling, in consideration of the availability of water on the site, carried out with sufficient regularity and spatial and temporal replication to make statistically valid conclusions about the water quality on the site".

7.1.1 Quarterly Surface Water Quality Monitoring

Surface water monitoring involves quarterly sampling of each sediment dam and water storage dams (Table 4~~Table 4~~).

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Sample analytes include:

- Total Dissolved Solids (mg/L);

- Total Suspended Solids (mg/L);
- pH; and
- Electrical Conductivity (µS/cm).

7.2 WATER LEVEL MONITORING AND MANAGEMENT IN DAMS

Controlled or uncontrolled releases from site is not permitted according to the EA unless sediment dams have the minimum required design capacity to meet the EA specified rainfall events (Section 6.2). The March 2018 assessment of sediment dam capacity determined that only Sediment Dam 8 has sufficient storm water capacity to meet the EA requirements.

Therefore, as a minimum, weekly dam water level checks should be undertaken in addition to immediately following or during a 'significant rainfall event'. Sediment Dam water levels should be inspected prior to a significant event to ensure management of dam water levels and prevention of uncontrolled discharge.

The following dam water level management strategies are to be employed at Warwick:

7.2.1 Catchment Dam 2 – Catchment Dam 1 – Sediment Dam 7 System

Catchment Dam 2

Ensure minimum water levels are present in Catchment Dam 2 at all times with excess water pumped to Aspinal pit as required.

Catchment Dam 1

Operate Catchment Dam 1 to suit operation needs (plant to use dust control and wash- downs as required) but maintain maximum level equivalent of the bottom of the culvert pipe (RL545.18 m). Pump excess water to Aspinal Pit as required.

Sediment Dam 7

Regularly pump sediment contaminated water from Sediment Dam 7 back to either Catchment Dam 2 or alternatively to Aspinal Pit void.

7.2.2 Sediment Dam 3 & 4 – Aspinal Pit Void

Pump from Sediment Dam 3 and 4 to Aspinal Pit (distance of 375 m).

7.2.3 Sediment Dam 2 – Sediment Dam 1 – Aspinal Pit Void

Pump from Sediment Dam 1 and 2 to Aspinal Pit (distance of 300 m).

7.2.4 Sediment Dam 8, Sediment Dam 9 – East-West Pit Void

Pump from Sediment Dam 9 to Sediment Dam 8 (distance of 600 m). Pump from Sediment Dam 8 to East-West Pit void as required to ensure storm water capacity is available (distance of 550 m).

8 REPORTING

Table 5: Water Reporting Requirements

Description of Reporting	Frequency of reporting	Reporting tool:	Reporting to
Water level and water quality data	Rainfall event and quarterly	Monitoring data form 2018 Warwick	Site Supervisor/ Environmental Manager
Incidents – uncontrolled water release	Event based	IMS	Site Supervisor/ Environmental Manager
Site Inspection Reports – Dams water levels	Weekly Dam Water Levels	4WR-F9.108.01 Site Dam Inspection Checklist	Site Supervisor/ Environmental Manager
Site Inspection Reports – Dam and levee infrastructure	Monthly and following significant rain event	Site EHS Inspection Reports	Site Supervisor/ Environmental Manager

9 INCIDENTS, COMPLAINTS AND REGULATORY BREACHES

The following section details Terrequip Environmental 's management approach in responding to, investigating, and acting on incidents, complaints and regulatory breaches. This section details a standard approach applied across all Terrequip Environmental sites. All incidents, complaints and regulatory breaches are recorded and tracked through Terrequip Environmental 's incident management system (IMS);

Corrective actions arising from these events are documented and tracked in the IMS and added to the Site Action Plan where responsibilities are assigned, and completion dates established. Progress on open actions is reported regularly to senior management ensuring such events are managed in a timely manner and reoccurrences limited.

9.1 INCIDENTS

- Follow the Environment, Health and Safety (EHS) Incident Notification and Investigation CWP-10.202;
- Contact Site Supervisor;
- Contact Environmental Manager; and
- Contact relevant Regulatory Authority (where required).

9.2 EMERGENCY RESPONSE

Refer to the Site Emergency Plan 4WR-P10.201.01.

9.3 REGULATORY BREACH

Any verified regulatory breach (i.e. breach of regulations, licence condition or conditions of approval) will be logged in the IMS as a breach. Relevant external agencies will be notified in accordance with any prescribed legislation or specific conditions of approval.

A detailed investigation will follow to determine the root cause of the breach. will document the investigation in writing and provide a report to the relevant government agencies within an agreed timeframe. The report will detail the investigation findings and any short term and/or long-term actions that have or will be taken to prevent future breaches from occurring.

Any compliance breach will prompt a review of the site's legal compliance and environmental risk registers. The Site Action Plan will be updated to include any corrective actions.

10 CHANGES TO OPERATIONS

Any assessment of new development or operational changes must be conducted in accordance with CWP pertaining to:

- Key Risk Requirement – Planning, Design, Construct & Commission;
- EHS Managing Change Procedure; CWP-6.002;
- Environmental Approvals, Licences and Permits Procedure; and
- EHS Risk Management, JRAs & SOPs Procedure.

The environmental assessment must confirm that water management under normal and worst-case conditions will comply with State or national water quality regulations, criteria and/or licence conditions.

11 TRAINING

All training shall be determined and implemented in accordance with the Terrequip Environmental's Training Procedure CWP- 7.501.

12 REVIEW

Site performance will be reviewed on a quarterly basis by senior management via the Environment Program Reports. Any recommendations from this review shall be passed to the General Manager Operations for consideration.

Incidents, complaints, and regulatory breaches will prompt a review of the site's environmental compliance and risk registers. This will ensure these registers accurately reflect the legal obligations and environmental risk of site operations.

This WMP will be reviewed on an annual basis. The review shall be conducted with the Site Supervisor, Environmental Manager, and the General Manager Operations.

The review will involve the examination of all monitoring data, complaints, incidents, regulatory breaches (should they occur) and comparisons of this data and information to mandatory limits outlined in the EA and internal Key Performance Indicators (KPIs).

Procedural changes or a review of targets and/or KPIs should be employed if targets are not met. A review of the site environmental compliance and risk registers will also occur at this stage to ensure completeness and that this WMP adequately controls these obligations and risks.

Any amendments to this WMP will be approved by the Environmental Manager and General Manager Operations.

13 LIMITATIONS AND DISCLAIMER

Epic Environmental Pty Ltd (Epic) has prepared the following report for the exclusive benefit of Terrequip Environmental Pty Ltd (Client) and for the singular purpose of Managing Water at the Warwick Limestone Mine. All interpretations, finding or recommendations outlined in this report should be read and relied upon only in the context of the report as a whole.

The following report cannot be relied upon for any other purpose, at any other location or for the benefit of any other person, without the prior written consent of Epic. Except with Epic's prior written consent, this report may not be:

a. released to any other person, whether in whole or in part;
b. used or relied upon by any other party; or
c. filed with any Governmental agency or other person or quoted or referred to in any public document.

This report has been prepared based on information provided by the Client and other parties. In preparing this report Epic:

a. presumed the accuracy of the information provided by the Client (including its representatives);
b. has not undertaken any verification to the accuracy or reliability included in this information (with the exception where such verification formed part of the scope of works);
c. has not undertaken any independent investigations or enquiries outside the scope of works with respect to information provided for this report; and
d. provides no warranty or guarantee, expressed or implied, as to the accuracy or reliability of the information provided in this report.

In recognition of the limited use of this report, the Client agrees that, to the maximum extent permitted by law, Epic (including its representatives and related entities) is not liable for any losses, claims, costs, expenses, damages (whether pursuant to statute, in contract or tort, for negligence or otherwise) suffered or incurred by the Client or any third party as a result of the information, findings, opinions, estimates, recommendations and conclusions provided in this report.

Without limiting the above, Epic (including its representatives and related entities) is not liable, in any way whatsoever:

a. for the use or reliance of this report for any purpose other than that for which it has been prepared;
b. for any use or reliance upon this report by any person other than the Client;
c. where another person has a different interpretation of the same information contained in the report;
d. for any consequential or indirect losses, or for loss of profit or goodwill or any loss or corruption of any data, database or software.

If a section of this disclaimer is determined by any court or other competent authority to be unlawful and/or unenforceable, the other sections of this disclaimer continue in effect. Where further information becomes available, or additional assumptions need to be made, Epic reserves its right to amend this report, but is not obliged to do so.

14 REFERENCES

Industry guidelines, codes of practice, policy and regulations

AS/NZS 5667.1: Water quality – Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples

Department of Environment and Heritage Protection (EHP) (2009). Monitoring and Sampling Manual, Version 2, ISBN 978-09806986-1-9

Department of Environment and Science (DES) (2018). Monitoring and Sampling Manual.

Stormwater and environmentally relevant activities Guidelines – (DEHP, 2014)

Water Management – A Guide to Leading Practice Sustainable Development in Mining https://industry.gov.au/resource/Documents/LPSDP/guideLPSD.pdf;

Manual for Assessing consequence categories and hydraulic performance of structures (ESR/2016/1933), DEHP

Structures which are dams or levees constructed as part of environmentally relevant activities (ESR/2016/1934, DEHP)

Relevant Terrequip Environmental Procedures:

Water Management Key Risk Requirement (CWP-6.124)

Site EHS Inspection Checklist

EHS Risk Management, JSAs & SOPs Procedure

EHS Audit Procedure

EHS Incident Notification & Investigation Procedure

EHS Objectives, Targets, Plans and Performance Measure Procedure

EHS Legal Compliance Obligations Procedure

Environmental Approvals, Licences and Permits

APPENDIX A – EA SECTIONS C1 - C16

Schedule C - Water

C1 Release to waters:

(a) **With respect to ERA 16-(2c) Extractive, 16-(2b) Extractive, 16-(3b) Screening:** Contaminants must not be released from the boundary to any waters or the bed banks of any waters other than authorised by this schedule.

(b) **With respect to Schedule 2A 21 Mining Activities:** Contaminants must not be released from the boundary of the mining lease(s) to any waters or the bed and banks of any waters other than authorised by this schedule.

C2

(a) **With respect to ERA 16-(2c) Extractive, 16-(2b) Extractive, 16-(3b) Screening:** Not withstanding condition C1(a), in the event of a significant rainfall event (i.e. a 1:10 year rainfall event) that may cause any sediment dam(s) and/or water supply dam(s) to overtop, the holder of this approval is authorised to release treated/settled stormwater, supply water and sediment dam water to drainage lines in accordance with the contaminant release limits defined in Schedule C - Table 1.

(b) **With respect to Schedule 2A 21 Mining Activities:** Notwithstanding condition C1(b), in the event of a significant rainfall event (i.e. a 1:100 year rainfall event) that may cause any sediment dam(s) and/or water supply dam(s) to overtop, the holder of this environmental authority is authorised to release treated/settled stormwater, supply water and sediment dam water to drainage lines in the catchment of Lord John Creek (including Lucky Valley Gully and Frenchman Gully) in accordance with the contaminant release limits defined in schedule C-Table 1.

Schedule C - Table 1 (Contaminant release limits)

Parameter	Units	Minimum	Maximum
pH	-	6.0	9.0
Electrical conductivity	µS/cm	-	1500

C3 (a) **With respect to ERA 16-(2c) Extractive, 16-(2b) Extractive, 16-(3b) Screening:** Any release must be managed in accordance with the Unimin Australia Limited *Warwick Limestone Deposit Site Water Management Plan* (September 2008) or subsequent amendment.

(b) **With respect to Schedule 2A 21 Mining Activities:** With respect to condition (C2)(b), the release must be managed in accordance with the Site Water Management and Monitoring Plan in a manner that will ensure the contaminant release limits specified in Schedule C - Table 1 are not exceeded.

C4 **Erosion and sediment control:** Erosion protection measures and sediment controls must be provided and maintained to effectively minimise the likelihood of erosion and release of sediments from the site and be maintained during site clearing, construction, mining operations and rehabilitation. Such measures should include diversion drainage works and sedimentation traps and dams.

C5 Erosion control and sediment control structures must be maintained at all times and repaired or replaced as required after rainfall events.

C6 **Groundwater:** All reasonable and practicable measures must be taken to prevent the contamination of groundwater.

C7 Contaminants must not be directly or indirectly released to any groundwater as a result of mining activities.

C8 Any draw down of groundwater must not impact on the users of groundwater.

C9 **Site Water Management and Monitoring Plan:**

(a) **With respect to ERA 16-(2c) Extractive, 16-(2b) Extractive, 16-(3b) Screening:** The holder of this approval must implement the Unimin Warwick Limestone Deposit Site Water

Management Plan (September 2008) or subsequent amendment.

(b) **With respect to Schedule 2A 21 Mining Activities:** The holder of this environmental authority must develop and implement a Site Water Management and Monitoring Plan, within twelve (12) months of the date this environmental authority takes effect, for the site.

C10 The Site Water Management Plan must:

(a) be carried out by a person possessing appropriate qualifications and experience in the field of surface water monitoring program design to be able to competently make recommendations about these matters;
(b) identify the environmental values of the licensed place and water quality objectives (i.e. ANZECC trigger levels for stock water) by monitoring locations (i.e. sediment dams) on the site for water quality characteristics (including total dissolved solids mg/l, total suspended solids mg/l, and pH) and identify any potential receiving waters in the event of an uncontrolled release that will be protected;
(c) provide representative water sampling, in consideration of the availability of water on the site, carried out with sufficient regularity and spatial and temporal replication to make statistically valid conclusions about the water quality on the site;
(d) give considerations to relevant methodology and water quality criteria by the Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand in Australian Guidelines for Water Quality Monitoring and Reporting 2000 and "Australian and New Zealand Guidelines of Fresh and Marine Water Quality 2000";
(e) determine potential environmental harm within the predicted zone of influence arising from mining activities;
(f) incorporate a risk management approach to how changing levels of flood, drought and water quality risks should be addressed e.g. increasing the lip of sediments ponds to increase capacity;
(g) Determine measures to manage and/or recycle storm water discharges to minimise stormwater contaminated from the mining activities reaching any surrounding watercourses;
(h) develop and implement a system for emergency spills or discharges including procedures to minimise extent and duration of release, staff training, investigation and reporting procedures;
(i) manage the environmental impacts of any uncontrolled release of wastewater to the environment so that any impacts are minimised e.g. improving sediment control measures and/or separating clean water from undisturbed areas and water from disturbed areas;
(j) manage site water quality and quantity during the (3) phases of mining: development, operation and decommission;
(k) safeguard against the potential for soil erosion;
(l) provide details of operational monitoring and monitoring of hydrological processes including associated performance indicators.

C11 With respect to condition (C9)(b), the holder of this environmental authority must submit to the administering authority a draft of the Site Water Management and Monitoring Plan as soon as practicable following the date of issue of the environmental authority for comment prior to implementation of the plan.

C12 A copy of the Site Water Management Plan and any subsequent amendment of the Site Water Management Plan must be kept at the place to which this approval relates and be

available for examination by Emergency Services Personnel or an authorised person on request.

C13 A record of the results of the surface water-monitoring conducted, including background water quality monitoring, must be kept and forwarded to the administering authority on request.

C14 **Water Storage:** Sediment collection and water supply dams must be designed and maintained to prevent overtopping in accordance with Schedule C - Table 2 and to facilitate the settlement of suspended solids in stormwater contaminated by approved activities.

Schedule C - Table 2 (Storage Design - all mining leases unless specified otherwise)

Storage Type	Design Wet Period Storage (4 month wet season)	Spillway Critical design Storm*
Sediment Dams Any new sediment dams	1:10	>1:10
Water Supply Dams (Two (2) on ML50148) Any new water supply dams	1:50	>1:50

**the critical storm has a duration that produces the peak discharge for the catchment*

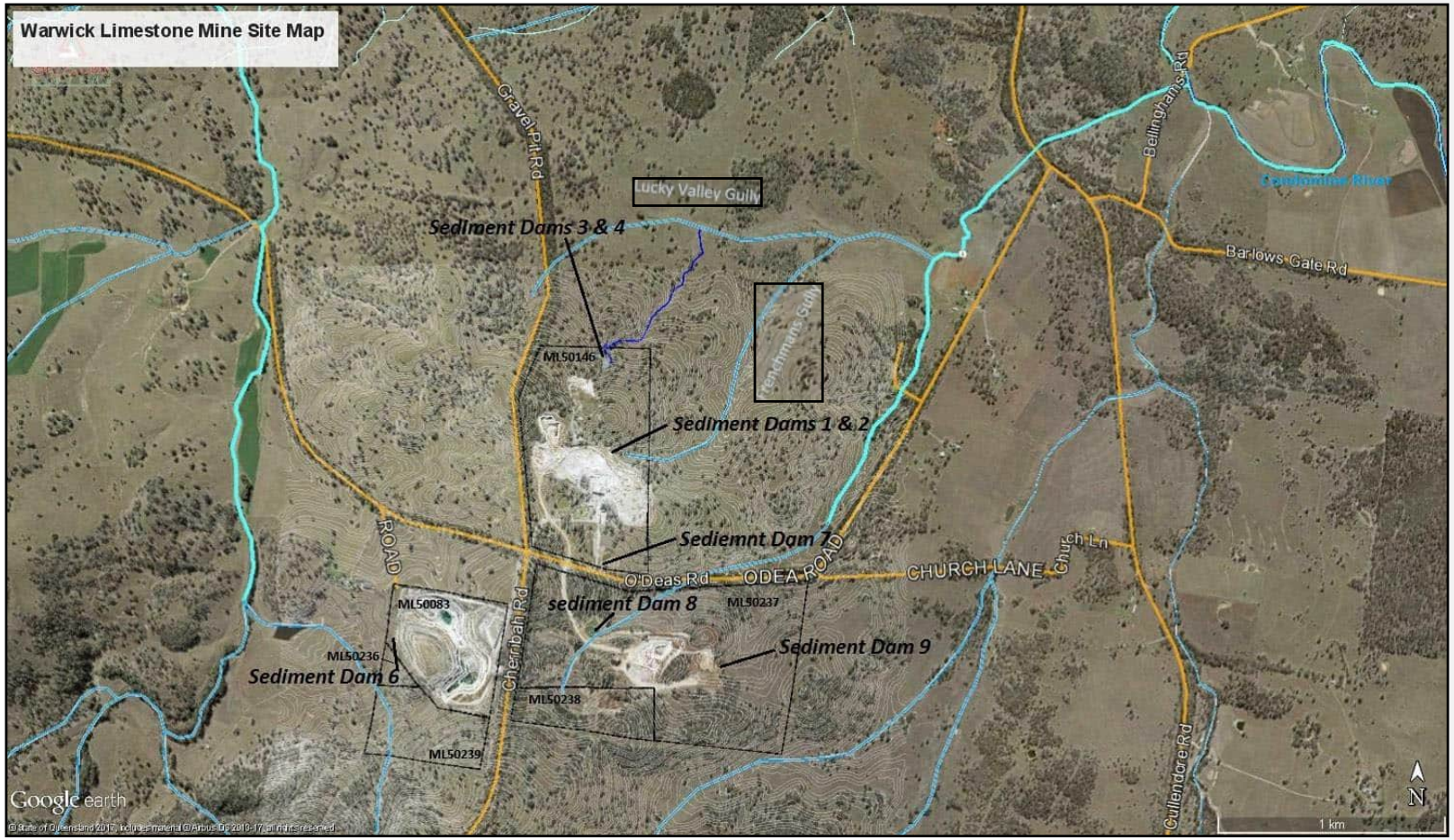
C15 The base and walls of the sediment dams must be constructed, installed and maintained:

(a) to minimise the likelihood of effluent through the bed or banks of the dam to any waters (including groundwater);
(b) to ensure the stability of the dams construction; and
(c) to maintain a minimum freeboard of 0.5m.

C16 (a) **With respect to ERA 16-(2c) Extractive, 16-(2b) Extractive, 16-(3b) Screening:** Water and/or stormwater collected in excavation pits must be utilised (i.e. for dust suppression) and/or redirected to the sediment dam(s) and/or water supply dam(s) on the mine site as soon as practicable after accumulation in the pits.

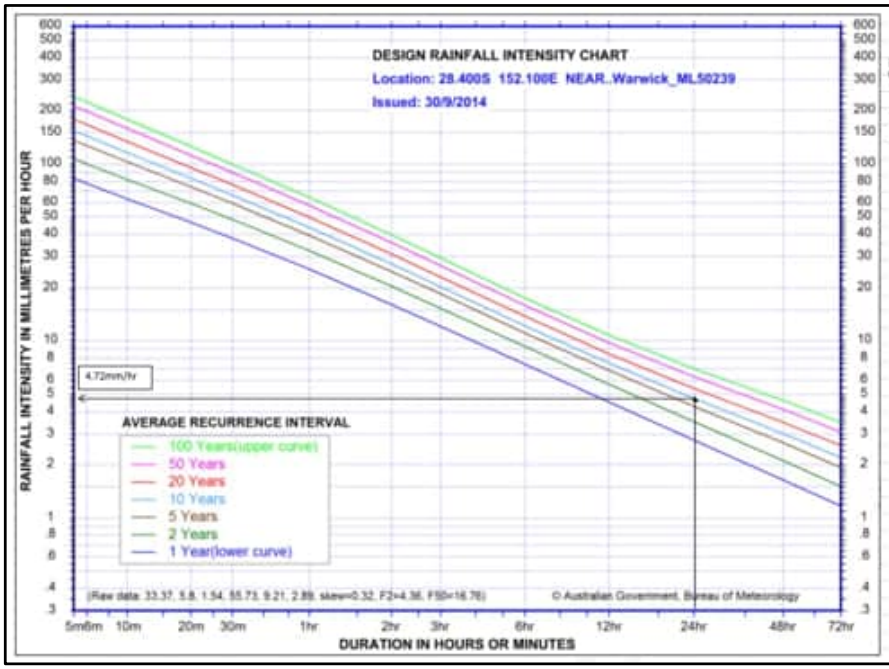
(b) **With respect to Schedule 2A 21 Mining Activities:** Water and/or stormwater collected in excavation pits one - three (1-3) on mining lease 50083 must be utilised (i.e. for dust suppression) and/or redirected to the sediment dam(s) and/or water supply dam(s) on the mine site as soon practicable after accumulation in the pits.

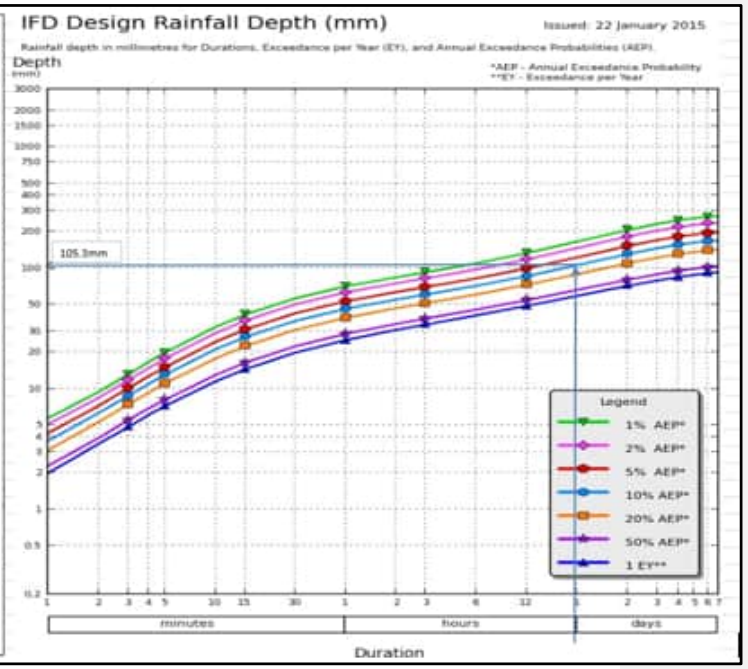
APPENDIX B – SITE PLAN



APPENDIX C - RAINFALL DATA

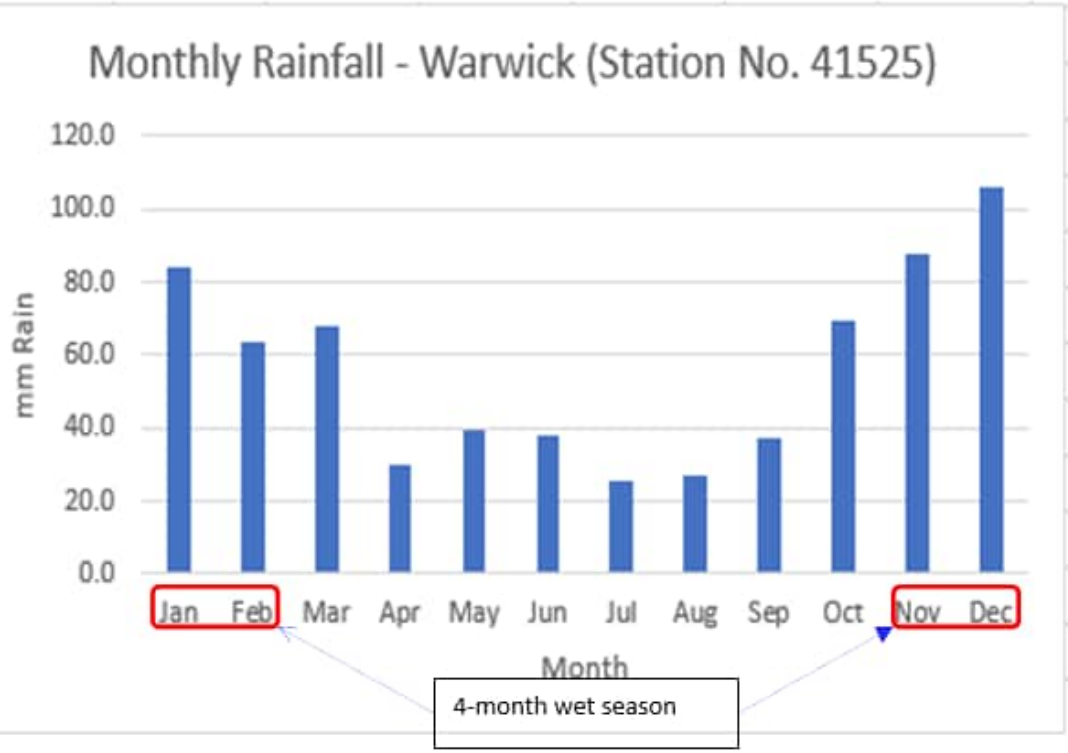
Rainfall Intensity



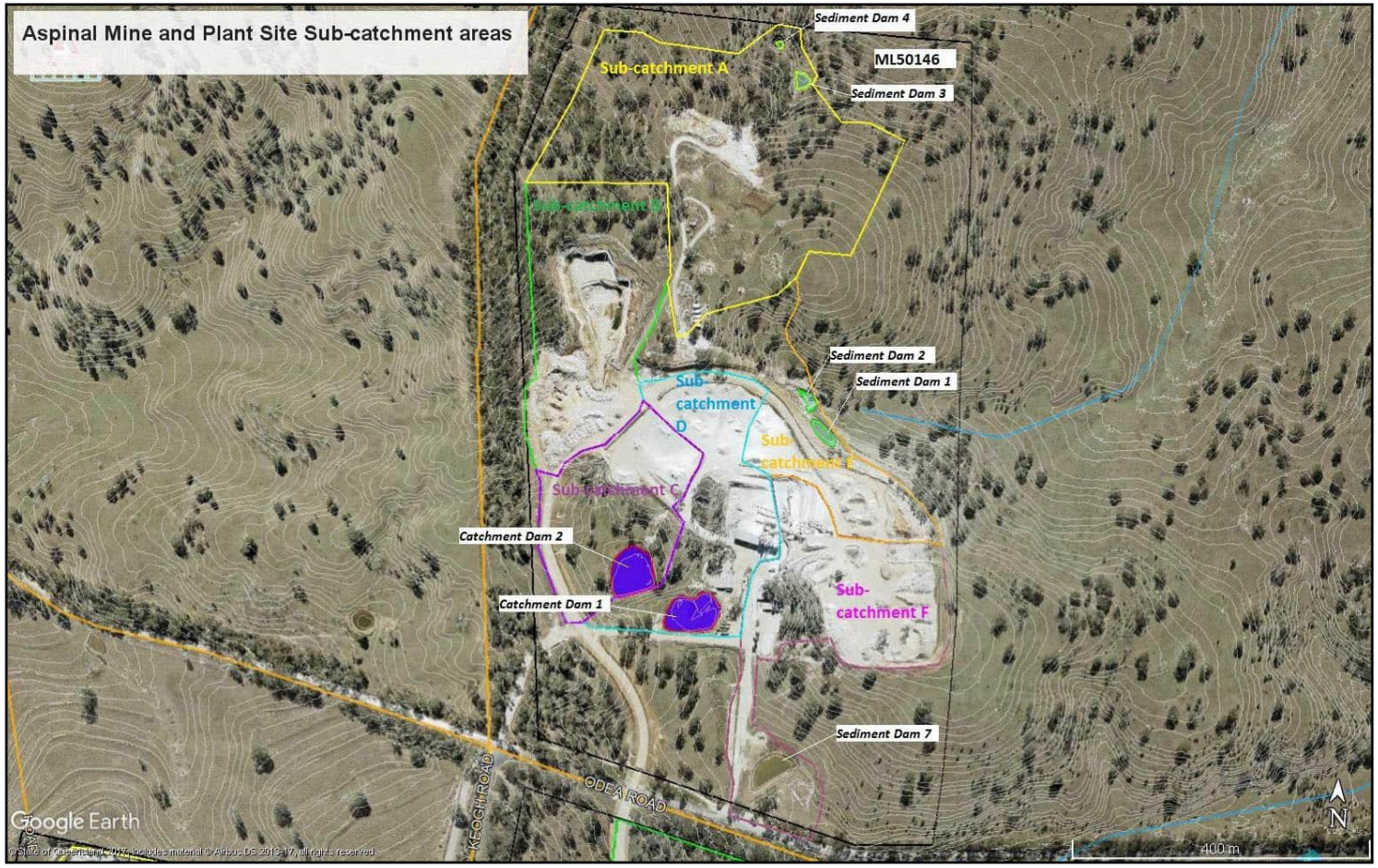


Average Monthly Rainfall

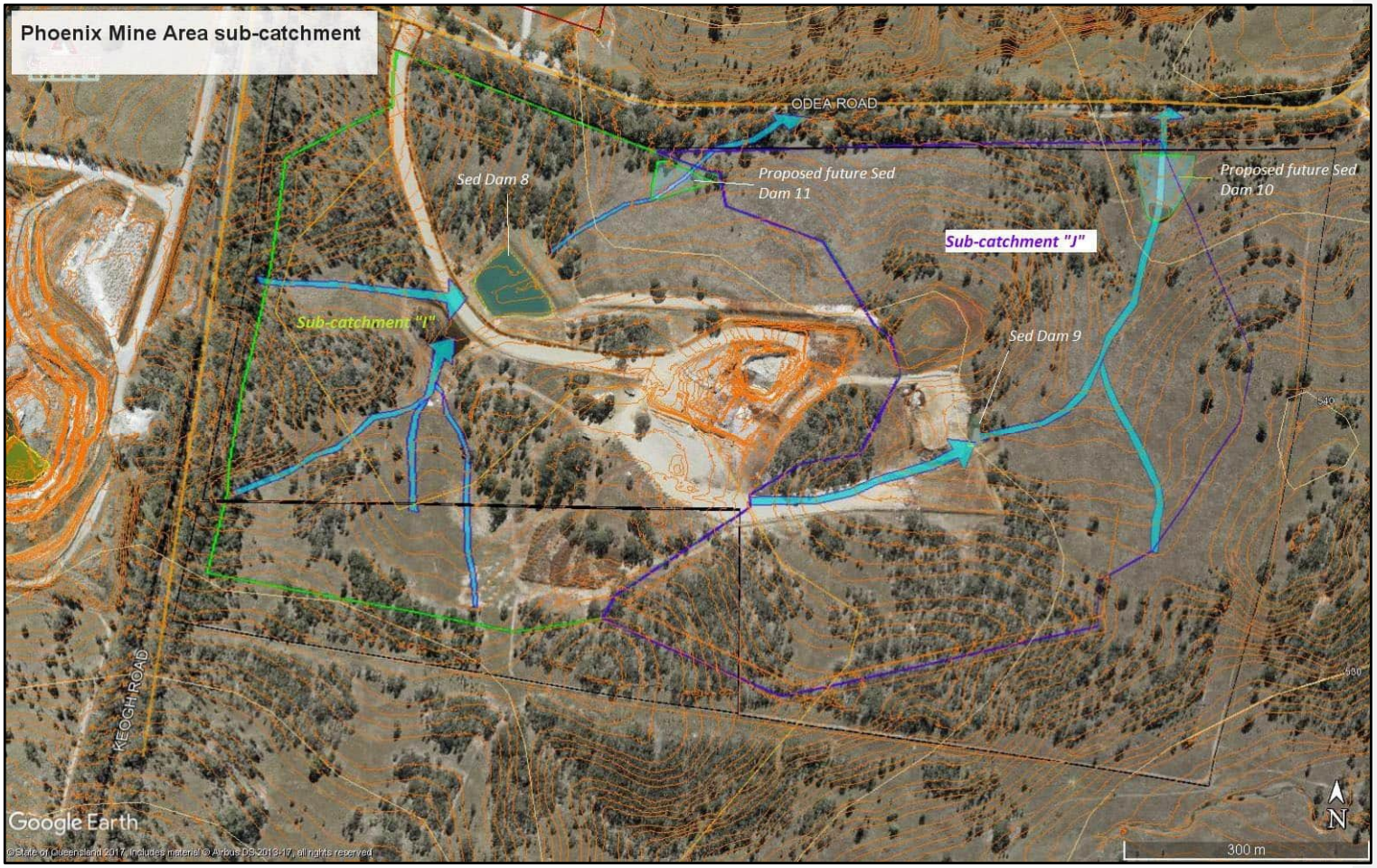
Month	Rainfall (mm)
Jan	84.0
Feb	63.5
Mar	68.2
Apr	29.7
May	39.3
Jun	38.0
Jul	25.5
Aug	27.1
Sep	36.9
Oct	69.3
Nov	87.9
Dec	106.0



APPENDIX D – SUB-CATCHMENT MAPS



East-West Pit Area Sub-catchments
ML50083
Sub-catchment 'H'
Sed Dam 6
Sub-catchment 'G'
ML50236
ML50289


Phoenix Mine Area sub-catchment
ODEA ROAD
Sed Dam 8
Proposed future Sed Dam 11
Proposed future Sed Dam 10
Sub-catchment "J"
Sub-catchment "I"
Sed Dam 9
KEOGH ROAD
Google Earth
300 m
N

The Epic team provides a wide range of skills and experience on numerous environmental management issues, across a wide range of public, commercial and industrial projects. At Epic, we focus on the practical aspects of environmental planning, engineering and science. Our comprehensive services in:

- Strategic advice and project support;
- Contaminated site assessment, management and remediation;
- Asbestos assessment and advisory;
- Naturally Occurring Radiological Material assessment and management;
- Contaminated land auditing services (QLD –Contaminated Land Auditor; NSW – Contaminated Site Auditor);
- Statutory planning and impact assessment covering QLD, NSW and Commonwealth legislation;
- Environmental approvals and permitting – full array;
- Ecological (fauna, flora and habitat) site assessments;
- Site suitability assessments;
- Environmental offset assessments and development of management strategies;
- Waste auditing and management;
- Landfill design and management;
- Compliance and auditing;
- Erosion sediment control; and
- Hydrogeology.

CONTACT

Sydney / Brisbane / Melbourne / Hobart

1800 779 363
enquiries@epicenvironmental.com.au

www.epicenvironmental.com.au

Appendix 6

Australian Laboratory Services Pty Ltd (19 May 2020): Material Testing Certificate of Analysis Ref BR20104442

Australian Laboratory Services Pty. Ltd.

32 Shand Street
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Brisbane QLD 4053
Phone: +61 7 3243 7222 Fax: +61 7 3243 7218
www.alsglobal.com/geochemistry

ALS Brisbane is a NATA Accredited Testing Laboratory. Corporate Accreditation No: 825, Corporate Site No: 818.

To: TERREQUIP
SUITE 2B
19 LANG PARADE
MILTON QLD 4064

Finalized Date: 26-MAY-2020
Account: TERREQ

CERTIFICATE BR20104442

Project: Warwick Limestone Monthly

P.O. No.: 20012

This report is for 11 Limestone samples submitted to our lab in Brisbane, QLD, Australia on 19-MAY-2020.

The following have access to data associated with this certificate:

DAVID AQUILINA	JACOB FULLER	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LOG-22	Sample login - Rcd w/o BarCode
LEV-01	Waste Disposal Levy
TRA-21	Transfer sample
BAG-01	Bulk Master for Storage
PUL-32	Pulverize 1000g to 85% < 75 um
PUL-QC	Pulverizing QC Test

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
ME-GRA05CE	LOI by CERES Furnace TGA System	HAG
ME-XRF26	Whole Rock By Fusion/XRF	XRF
ME-GRA05	H2O/LOI by TGA furnace	TGA

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Comments: CaCO3 is Total Ca expressed as CaCO3. Fe2O3 results may be elevated due to Fe contamination of samples when grinding in steel mill.

Signature:

Shaun Kenny, Brisbane Laboratory Manager

Australian Laboratory Services Pty. Ltd.

32 Shand Street
Stafford
Brisbane QLD 4053
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www.alsglobal.com/geochemistry

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To: TERREQUIP
SUITE 2B
19 LANG PARADE
MILTON QLD 4064

Finalized Date: 26-MAY-2020
Account: TERREQ

Project: Warwick Limestone Monthly

CERTIFICATE OF ANALYSIS BR20104442

Sample Description / Method / Analyte / Units / LOD	WEI-21 Recvd Wt. kg 0.02	PUL-QC Pass75um % 0.01	ME-XRF26 Al2O3 % 0.01	ME-XRF26 BaO % 0.01	ME-XRF26 CaO % 0.01	ME-XRF26 CaCO3 % 0.02	ME-XRF26 Cr2O3 % 0.01	ME-XRF26 Fe2O3 % 0.01	ME-XRF26 K2O % 0.01	ME-XRF26 MgO % 0.01	ME-XRF26 MnO % 0.01	ME-XRF26 Na2O % 0.01	ME-XRF26 P2O5 % 0.01	ME-XRF26 SO3 % 0.01	ME-XRF26 SiO2 % 0.01
00105AGLIME -1805AGLIME	0.20	99.0	0.54	<0.01	53.7	95.8	<0.01	0.35	0.09	0.38	0.05	0.02	0.02	<0.01	2.08
015S/FINE -1805S/FINE	0.21		0.75	<0.01	52.7	94.0	<0.01	0.41	0.13	0.45	0.06	0.04	0.02	0.01	3.29
0105FINEGRIT - 1805FINEGRIT	0.21		0.33	<0.01	54.3	96.9	<0.01	0.18	0.06	0.34	0.04	0.01	0.02	<0.01	1.09
0105CALGRIT - 1805CALGRIT	0.21		0.67	<0.01	52.5	93.7	<0.01	0.41	0.11	0.33	0.08	0.03	0.01	<0.01	3.67
0105-40 CALSTONE - 1805-40CALSTONE	0.20		0.50	<0.01	53.8	96.0	<0.01	0.31	0.10	0.39	0.06	0.02	0.01	<0.01	2.50
NYORA 1A	0.16		34.45	<0.01	0.65	1.16	<0.01	1.14	0.22	0.16	0.01	0.06	0.01	<0.01	49.30
NYORA 1B	0.17		35.22	<0.01	0.80	1.43	<0.01	1.12	0.24	0.18	<0.01	0.06	0.01	<0.01	48.30
NYORA 2A	0.23		13.28	<0.01	0.58	1.04	<0.01	1.40	0.06	0.15	0.01	0.03	0.01	<0.01	78.88
NYORA 2B	0.24		14.89	<0.01	0.59	1.05	<0.01	1.61	0.06	0.14	0.01	0.04	0.01	<0.01	75.86
NYORA 3A	0.17		35.41	<0.01	0.21	0.37	<0.01	1.17	0.23	0.30	<0.01	0.13	0.01	0.07	47.92
NYORA 3B	0.26		30.94	<0.01	0.10	0.18	<0.01	1.44	0.17	0.21	0.01	0.08	0.03	0.01	53.90

Comments: CaCO3 is Total Ca expressed as CaCO3. Fe2O3 results may be elevated due to Fe contamination of samples when grinding in steel mill.

***** See Appendix Page for comments regarding this certificate *****

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SUITE 2B
19 LANG PARADE
MILTON QLD 4064

Finalized Date: 26-MAY-2020
Account: TERREQ

Project: Warwick Limestone Monthly

CERTIFICATE OF ANALYSIS BR20104442

Sample Description	Method / Analyte / Units / LOD	ME-XRF26 SrO % 0.01	ME-XRF26 TiO2 % 0.01	ME-XRF26 Total % 0.01	ME-GRA05 LOI % 0.01
00105AGLIME -1805AGLIME		0.02	0.03	99.65	42.37
015S/FINE -1805S/FINE		0.02	0.05	99.50	41.57
0105FINEGRIT - 1805FINEGRIT		0.02	0.02	99.63	43.22
0105CALGRIT - 1805CALGRIT		0.02	0.05	99.72	41.83
0105-40 CALSTONE - 1805-40CALSTONE		0.02	0.03	99.86	42.12
NYORA 1A		<0.01	0.94	99.64	12.65
NYORA 1B		<0.01	0.87	99.80	12.97
NYORA 2A		<0.01	0.53	99.99	5.00
NYORA 2B		<0.01	0.57	99.41	5.57
NYORA 3A		<0.01	0.86	99.80	13.25
NYORA 3B		<0.01	2.16	100.15	11.02

Comments: CaCO3 is Total Ca expressed as CaCO3. Fe2O3 results may be elevated due to Fe contamination of samples when grinding in steel mill.

***** See Appendix Page for comments regarding this certificate *****

Australian Laboratory Services Pty. Ltd.
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To: TERREQUIP
SUITE 2B
19 LANG PARADE
MILTON QLD 4064

Finalized Date: 26-MAY-2020
Account: TERREQ

Project: Warwick Limestone Monthly

CERTIFICATE OF ANALYSIS BR20104442

CERTIFICATE COMMENTS

ACCREDITATION COMMENTS

NATA Accreditation covers the performance of this service but does not cover the performance of ALS Brisbane Sample Preparation. Corporate Accreditation No: 825, Corporate Site No: 818. The Technical Signatory is James Lo, XRF Supervising Chemist

Applies to Method: ME-GRA05 ME-XRF26

LABORATORY ADDRESSES

Processed at ALS Brisbane located at 32 Shand Street, Stafford, Brisbane, QLD, Australia. Processed at ALS Brisbane Sample Preparation at 116 Delta Street, Geebung, QLD 4034, Australia

Applies to Method:

BAG-01	LEV-01	LOG-22	ME-GRA05
ME-GRA05CE	ME-XRF26	PUL-32	PUL-QC
TRA-21	WEI-21		

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To: TERREQUIP
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19 LANG PARADE
MILTON QLD 4064

Finalized Date: 28-AUG-2020
Account: TERREQ

CERTIFICATE BR20170262

Project: Warwick Limestone Monthly
P.O. No.: PO20085
This report is for 4 Rock samples submitted to our lab in Brisbane, QLD, Australia on 10-AUG-2020.
The following have access to data associated with this certificate:

DAVID AQUILINA	JACOB FULLER	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LOG-22	Sample login - Rcd w/o BarCode
LEV-01	Waste Disposal Levy
TRA-21	Transfer sample
PUL-32	Pulverize 1000g to 85% < 75 um
PUL-QC	Pulverizing QC Test
BAG-01	Bulk Master for Storage

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
ME-GRA05CE	LOI by CERES Furnace TGA System	HAG
ME-XRF26	Whole Rock By Fusion/XRF	XRF
ME-GRA05	H2O/LOI by TGA furnace	TGA

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****
Comments: CaCO3 is Total Ca expressed as CaCO3

Signature:

Shaun Kenny, Brisbane Laboratory Manager

Australian Laboratory Services Pty. Ltd.

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To: TERREQUIP
SUITE 2B
19 LANG PARADE
MILTON QLD 4064

Finalized Date: 28-AUG-2020
Account: TERREQ

Project: Warwick Limestone Monthly

CERTIFICATE OF ANALYSIS BR20170262

Sample Description	Method / Analyte / Units / LOD	WEI-21 Recvd Wt. kg 0.02	PUL-QC Pass75um % 0.01	ME-XRF26 Al2O3 % 0.01	ME-XRF26 BaO % 0.01	ME-XRF26 CaO % 0.01	ME-XRF26 CaCO3 % 0.02	ME-XRF26 Cr2O3 % 0.01	ME-XRF26 Fe2O3 % 0.01	ME-XRF26 K2O % 0.01	ME-XRF26 MgO % 0.01	ME-XRF26 MnO % 0.01	ME-XRF26 Na2O % 0.01	ME-XRF26 P2O5 % 0.01	ME-XRF26 SO3 % 0.01	ME-XRF26 SiO2 % 0.01
1/7 - 27/7 Aglime		0.35	99.1	0.25	<0.01	55.1	98.3	<0.01	0.14	0.05	0.36	0.04	0.01	0.02	<0.01	0.80
1/7 - 22/7 S/Fine		0.30		0.43	<0.01	54.1	96.5	<0.01	0.19	0.09	0.41	0.05	0.01	0.03	0.01	1.33
1/7-27/7 Finegrit		0.33		0.29	<0.01	54.7	97.6	<0.01	0.19	0.06	0.34	0.04	0.01	0.01	0.01	1.10
1/7 - 27/7 Calgrit		0.53		0.41	<0.01	54.3	96.9	<0.01	0.15	0.08	0.38	0.03	0.01	0.02	<0.01	1.19

Comments: CaCO3 is Total Ca expressed as CaCO3

***** See Appendix Page for comments regarding this certificate *****

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MILTON QLD 4064

Finalized Date: 28-AUG-2020
Account: TERREQ

Project: Warwick Limestone Monthly

CERTIFICATE OF ANALYSIS BR20170262

Sample Description	Method Analyte Units LOD	ME-XRF26 SrO % 0.01	ME-XRF26 TiO2 % 0.01	ME-XRF26 Total % 0.01	ME-GRA05 LOI % 0.01
1/7 - 27/7 Aglime		0.02	0.01	100.10	43.30
1/7 - 22/7 S/Fine		0.01	0.02	99.56	42.88
1/7-27/7 Finegrit		0.02	0.01	99.87	43.08
1/7 - 27/7 Calgrit		0.01	0.02	99.55	42.95

Comments: CaCO3 is Total Ca expressed as CaCO3

***** See Appendix Page for comments regarding this certificate *****

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MILTON QLD 4064

Finalized Date: 28-AUG-2020
Account: TERREQ

Project: Warwick Limestone Monthly

CERTIFICATE OF ANALYSIS BR20170262

CERTIFICATE COMMENTS

ACCREDITATION COMMENTS

NATA Accreditation covers the performance of this service but does not cover the performance of ALS Brisbane Sample Preparation. Corporate Accreditation No: 825, Corporate Site No: 818. The Technical Signatory is James Lo, XRF Supervising Chemist

Applies to Method: ME-GRA05 ME-XRF26

LABORATORY ADDRESSES

Processed at ALS Brisbane located at 32 Shand Street, Stafford, Brisbane, QLD, Australia. Processed at ALS Brisbane Sample Preparation at 23 Pineapple Street, Zillmere, QLD, 4034, Australia

Applies to Method:

BAG-01	LEV-01	LOG-22	ME-GRA05
ME-GRA05CE	ME-XRF26	PUL-32	PUL-QC
TRA-21	WEI-21		

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To: TERREQUIP
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MILTON QLD 4064

Finalized Date: 12-OCT-2021
This copy reported on 18-OCT-2021
Account: TERREQ

CERTIFICATE BR21259766

Project: Warwick Limestone Mnthly Smpls
P.O. No.: 20493
This report is for 6 samples of Rock submitted to our lab in Brisbane, QLD, Australia on 27-SEP-2021.
The following have access to data associated with this certificate:

DAVID AQUILINA	JACOB FULLER	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LEV-01	Waste Disposal Levy
LOG-22	Sample login - Rcd w/o BarCode
PUL-32	Pulverize 1000g to 85% < 75 um
TRA-21	Transfer sample
PUL-QC	Pulverizing QC Test
BAG-01	Bulk Master for Storage

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
ME-GRA05CE	LOI by CERES Furnace TGA System	HAG
ME-XRF26	Whole Rock By Fusion/XRF	XRF
ME-GRA05	H2O/LOI by TGA furnace	TGA

This is the Final Report and supersedes any preliminary report with this certificate number.Results apply to samples as submitted.All pages of this report have been checked and approved for release.
***** See Appendix Page for comments regarding this certificate *****
Comments: CaCO3 is Total Ca expressed as CaCO3

Signature:

Shaun Kenny, Brisbane Laboratory Manager

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To: TERREQUIP
SUITE 2B
19 LANG PARADE
MILTON QLD 4064

Finalized Date: 12-OCT-2021
Account: TERREQ

Project: Warwick Limestone Mnthly Smpls

CERTIFICATE OF ANALYSIS BR21259766

Sample Description	Method / Analyte / Units / LOD	WEI-21 Recvd Wt. kg 0.02	PUL-QC Pass75um % 0.01	ME-XRF26 Al2O3 % 0.01	ME-XRF26 BaO % 0.01	ME-XRF26 CaO % 0.01	ME-XRF26 CaCO3 % 0.02	ME-XRF26 Cr2O3 % 0.01	ME-XRF26 Fe2O3 % 0.01	ME-XRF26 K2O % 0.01	ME-XRF26 MgO % 0.01	ME-XRF26 MnO % 0.01	ME-XRF26 Na2O % 0.01	ME-XRF26 P2O5 % 0.01	ME-XRF26 SO3 % 0.01	ME-XRF26 SiO2 % 0.01
1/9 N/lime 23/9 N/lime		0.77	98.0	0.29	<0.01	54.9	98.0	<0.01	0.19	0.04	0.31	0.05	<0.01	0.02	0.01	0.70
1/9Aglime 23/9 Aglime		0.76	99.1	0.65	<0.01	54.0	96.4	<0.01	0.37	0.11	0.43	0.06	<0.01	0.02	0.05	2.04
1/9 - 40 23/9 - 40 calcium rock		0.74		1.30	<0.01	51.7	92.3	<0.01	0.97	0.16	0.75	0.07	0.11	0.02	0.05	4.56
1/9Finegrit A 23/9 Finegrit A		0.73		0.34	<0.01	54.7	97.6	<0.01	0.21	0.06	0.35	0.05	<0.01	0.02	0.01	0.96
1/9Superfine 23/9 Superfine		0.72		0.56	<0.01	54.4	97.1	<0.01	0.29	0.10	0.41	0.05	<0.01	0.03	0.02	1.55
1/9 calgrit 23/9 calgrit		0.72		0.41	<0.01	55.0	98.2	<0.01	0.18	0.06	0.31	0.05	<0.01	0.02	0.01	1.00

Comments: CaCO3 is Total Ca expressed as CaCO3

***** See Appendix Page for comments regarding this certificate *****

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MILTON QLD 4064

Finalized Date: 12-OCT-2021
Account: TERREQ

Project: Warwick Limestone Mnthly Smpls

CERTIFICATE OF ANALYSIS BR21259766

Sample Description	Method Analyte Units LOD	ME-XRF26 SrO % 0.01	ME-XRF26 TiO2 % 0.01	ME-XRF26 Total % 0.01	ME-GRA05 LOI % 0.01
1/9 N/lime 23/9 N/lime		0.02	0.01	100.30	43.78
1/9Aglime 23/9 Aglime		0.03	0.04	100.55	42.75
1/9 - 40 23/9 - 40 calcium rock		0.03	0.12	100.35	40.48
1/9Finegrit A 23/9 Finegrit A		0.02	0.02	100.20	43.45
1/9Superfine 23/9 Superfine		0.02	0.03	100.45	42.97
1/9 calgrit 23/9 calgrit		0.02	0.02	100.60	43.51

Comments: CaCO3 is Total Ca expressed as CaCO3

***** See Appendix Page for comments regarding this certificate *****

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MILTON QLD 4064

Finalized Date: 12-OCT-2021
Account: TERREQ

Project: Warwick Limestone Mnthly Smpls

CERTIFICATE OF ANALYSIS BR21259766

CERTIFICATE COMMENTS

ACCREDITATION COMMENTS

NATA Accreditation covers the performance of this service but does not cover the performance of ALS Brisbane Sample Preparation. Corporate Accreditation No: 825, Corporate Site No: 818. The Technical Signatory is James Lo, XRF Supervising Chemist

Applies to Method: ME-GRA05 ME-XRF26

LABORATORY ADDRESSES

Processed at ALS Brisbane located at 32 Shand Street, Stafford, Brisbane, QLD, Australia. Processed at ALS Brisbane Sample Preparation at 23 Pineapple Street, Zillmere, QLD, 4034, Australia

Applies to Method:

BAG-01	LEV-01	LOG-22	ME-GRA05
ME-GRA05CE	ME-XRF26	PUL-32	PUL-QC
TRA-21	WEI-21		

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To: TERREQUIP
SUITE 2B
19 LANG PARADE
MILTON QLD 4064

Finalized Date: 21-MAR-2022
This copy reported on 24-MAR-2022
Account: TERREQ

CERTIFICATE BR22062747

Project: Warwick Limestone Monthly
P.O. No.: 20625
This report is for 6 samples of Rock submitted to our lab in Brisbane, QLD, Australia on 14-MAR-2022.
The following have access to data associated with this certificate:

DAVID AQUILINA	JACOB FULLER	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LEV-01	Waste Disposal Levy
LOG-22	Sample login - Rcd w/o BarCode
PUL-32	Pulverize 1000g to 85% < 75 um
TRA-21	Transfer sample
PUL-QC	Pulverizing QC Test
BAG-01	Bulk Master for Storage

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
ME-XRF26	Whole Rock By Fusion/XRF	XRF
ME-GRA05	H2O/LOI by TGA furnace	TGA

This is the Final Report and supersedes any preliminary report with this certificate number.Results apply to samples as submitted.All pages of this report have been checked and approved for release.
***** See Appendix Page for comments regarding this certificate *****
Comments: CaCO3 is Total Ca expressed as CaCO3

Signature:

Shaun Kenny, Brisbane Laboratory Manager

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To: TERREQUIP
SUITE 2B
19 LANG PARADE
MILTON QLD 4064

Project: Warwick Limestone Monthly

Finalized Date: 21-MAR-2022
Account: TERREQ

CERTIFICATE OF ANALYSIS BR22062747

Sample Description	Method / Analyte / Units / LOD	WEI-21 Recvd Wt. kg 0.02	PUL-QC Pass75um % 0.01	ME-XRF26 Al2O3 % 0.01	ME-XRF26 BaO % 0.01	ME-XRF26 CaO % 0.01	ME-XRF26 CaCO3 % 0.02	ME-XRF26 Cr2O3 % 0.01	ME-XRF26 Fe2O3 % 0.01	ME-XRF26 K2O % 0.01	ME-XRF26 MgO % 0.01	ME-XRF26 MnO % 0.01	ME-XRF26 Na2O % 0.01	ME-XRF26 P2O5 % 0.01	ME-XRF26 SO3 % 0.01	ME-XRF26 SiO2 % 0.01
1/2/22 N/lime 28/2/22 N/lime		0.83	98.1	0.52	<0.01	54.1	96.6	<0.01	0.36	0.08	0.42	0.06	0.02	0.02	0.02	1.65
1/2/22 Aglime 28/2/22 Aglime		0.83	98.1	0.61	<0.01	53.7	95.9	<0.01	0.47	0.12	0.43	0.06	0.02	0.02	0.02	2.19
1/2/22 -40 Calcium Stone 28/2/22 -40		0.82		0.73	<0.01	53.6	95.6	<0.01	0.43	0.13	0.47	0.06	0.03	0.02	0.04	2.51
1-2/22 Finegrit 28/2/22 finegrit		0.76		0.74	<0.01	53.8	95.9	<0.01	0.43	0.14	0.47	0.06	0.04	0.02	0.02	2.73
1/2/22 Superfine 28/2/22 Superfine		0.96		0.56	<0.01	54.5	97.3	<0.01	0.28	0.10	0.42	0.06	0.01	0.03	0.02	1.59
1/2/22 Calgrit 28/2/22 Calgrite		0.72		0.92	<0.01	53.1	94.7	<0.01	0.43	0.19	0.51	0.05	0.04	0.03	<0.01	4.18

Comments: CaCO3 is Total Ca expressed as CaCO3

***** See Appendix Page for comments regarding this certificate *****

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To: TERREQUIP
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19 LANG PARADE
MILTON QLD 4064

Project: Warwick Limestone Monthly

Finalized Date: 21-MAR-2022
Account: TERREQ

CERTIFICATE OF ANALYSIS BR22062747

Sample Description	Method / Analyte / Units / LOD	ME-XRF26 SrO % 0.01	ME-XRF26 TiO2 % 0.01	ME-XRF26 Total % 0.01	ME-GRA05 LOI % 0.01
1/2/22 N/lime 28/2/22 N/lime		0.02	0.03	100.15	42.83
1/2/22 Aglime 28/2/22 Aglime		0.02	0.03	100.15	42.45
1/2/22 -40 Calcium Stone 28/2/22 -40		0.02	0.04	100.30	42.24
1-2/22 Finegrit 28/2/22 finegrit		0.02	0.04	100.60	42.07
1/2/22 Superfine 28/2/22 Superfine		0.02	0.03	100.60	42.97
1/2/22 Calgrit 28/2/22 Calgrite		0.02	0.04	100.45	40.93

Comments: CaCO3 is Total Ca expressed as CaCO3

***** See Appendix Page for comments regarding this certificate *****

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To: TERREQUIP
SUITE 2B
19 LANG PARADE
MILTON QLD 4064

Finalized Date: 21-MAR-2022
Account: TERREQ

Project: Warwick Limestone Monthly

CERTIFICATE OF ANALYSIS BR22062747

CERTIFICATE COMMENTS

ACCREDITATION COMMENTS

NATA Accreditation covers the performance of this service but does not cover the performance of ALS Brisbane Sample Preparation. Corporate Accreditation No: 825, Corporate Site No: 818. The Technical Signatory is James Lo, XRF Supervising Chemist

Applies to Method: ME-GRA05 ME-XRF26

LABORATORY ADDRESSES

Processed at ALS Brisbane located at 32 Shand Street, Stafford, Brisbane, QLD, Australia. Processed at ALS Brisbane Sample Preparation at 23 Pineapple Street, Zillmere, QLD, 4034, Australia

Applies to Method:

BAG-01	LEV-01	LOG-22	ME-GRA05
ME-XRF26	PUL-32	PUL-QC	TRA-21
WEI-21			

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Finalized Date: 9-AUG-2022
Account: TERREQ

CERTIFICATE BR22201119

Project: Warwick Limestone Monthly Samp
P.O. No.: PO-20733
This report is for 6 samples of Rock submitted to our lab in Brisbane, QLD, Australia on 22-JUL-2022.
The following have access to data associated with this certificate:

DAVID AQUILINA	JACOB FULLER	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LEV-01	Waste Disposal Levy
LOG-22	Sample login - Rcd w/o BarCode
PUL-32	Pulverize 1000g to 85% < 75 um
PUL-QC	Pulverizing QC Test
BAG-01	Bulk Master for Storage

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
ME-XRF26	Whole Rock By Fusion/XRF	XRF
ME-GRA05	H2O/LOI by TGA furnace	TGA

This is the Final Report and supersedes any preliminary report with this certificate number.Results apply to samples as submitted.All pages of this report have been checked and approved for release.
***** See Appendix Page for comments regarding this certificate *****
Comments: CaCO3 is Total Ca expressed as CaCO3

Signature:

Shaun Kenny, Brisbane Laboratory Manager

Australian Laboratory Services Pty. Ltd.
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To: TERREQUIP
SUITE 2B
19 LANG PARADE
MILTON QLD 4064

Finalized Date: 9-AUG-2022
Account: TERREQ

Project: Warwick Limestone Monthly Samp

CERTIFICATE OF ANALYSIS BR22201119

Sample Description / Method / Analyte / Units / LOD	WEI-21 Recvd Wt. kg 0.02	PUL-QC Pass75um % 0.01	ME-XRF26 Al2O3 % 0.01	ME-XRF26 BaO % 0.01	ME-XRF26 CaO % 0.01	ME-XRF26 CaCO3 % 0.02	ME-XRF26 Cr2O3 % 0.01	ME-XRF26 Fe2O3 % 0.01	ME-XRF26 K2O % 0.01	ME-XRF26 MgO % 0.01	ME-XRF26 MnO % 0.01	ME-XRF26 Na2O % 0.01	ME-XRF26 P2O5 % 0.01	ME-XRF26 SO3 % 0.01	ME-XRF26 SiO2 % 0.01
1/6/22 - 30/6/22 N/lime	0.74	99.1	0.27	<0.01	54.8	97.8	<0.01	0.17	0.04	0.33	0.05	<0.01	0.02	0.01	0.69
1/6/22 - 30/6/22 Aglime	0.88	99.1	0.92	<0.01	52.9	94.4	<0.01	0.47	0.12	0.37	0.07	<0.01	0.02	0.01	2.98
1/6/22 - 30/6/22 - 40 calcium rock	0.87		1.11	<0.01	52.0	92.7	<0.01	0.90	0.14	0.53	0.11	0.04	0.02	0.02	3.78
1/6/22 - 30/6/22 Finegrit A	0.98		0.40	<0.01	54.7	97.6	<0.01	0.22	0.08	0.33	0.05	<0.01	0.01	0.01	1.41
1/6/22 - 30/6/22 Superfine	0.82		0.81	<0.01	53.4	95.3	<0.01	0.46	0.17	0.45	0.06	0.03	0.02	0.02	2.72
1/6/22 - 30/6/22 calgrit	0.62		1.50	0.01	50.7	90.6	<0.01	0.79	0.27	0.50	0.08	0.06	0.02	0.04	6.21

Comments: CaCO3 is Total Ca expressed as CaCO3

***** See Appendix Page for comments regarding this certificate *****

Australian Laboratory Services Pty. Ltd.
32 Shand Street
Stafford
Brisbane QLD 4053
Phone: +61 7 3243 7222 Fax: +61 7 3243 7218
www.alsglobal.com/geochemistry

ALS Brisbane is a NATA Accredited Testing Laboratory. Corporate Accreditation No: 825, Corporate Site No: 818.

To: TERREQUIP
SUITE 2B
19 LANG PARADE
MILTON QLD 4064

Finalized Date: 9-AUG-2022
Account: TERREQ

Project: Warwick Limestone Monthly Samp

CERTIFICATE OF ANALYSIS BR22201119

Sample Description / Method / Analyte / Units / LOD	ME-XRF26 SrO % 0.01	ME-XRF26 TiO2 % 0.01	ME-XRF26 Total % 0.01	ME-GRA05 LOI % 0.01
1/6/22 - 30/6/22 N/lime	0.01	0.01	99.89	43.49
1/6/22 - 30/6/22 Aglime	0.03	0.04	100.05	42.08
1/6/22 - 30/6/22 - 40 calcium rock	0.02	0.08	99.86	41.08
1/6/22 - 30/6/22 Finegrit A	0.02	0.02	100.35	43.11
1/6/22 - 30/6/22 Superfine	0.01	0.04	100.30	42.08
1/6/22 - 30/6/22 calgrit	0.03	0.08	100.20	39.86

Comments: CaCO3 is Total Ca expressed as CaCO3

***** See Appendix Page for comments regarding this certificate *****

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CERTIFICATE OF ANALYSIS BR22201119

CERTIFICATE COMMENTS

ACCREDITATION COMMENTS

NATA Accreditation covers the performance of this service but does not cover the performance of ALS Brisbane Sample Preparation. Corporate Accreditation No: 825, Corporate Site No: 818. The Technical Signatory is James Lo, XRF Supervising Chemist

Applies to Method: ME-GRA05 ME-XRF26

LABORATORY ADDRESSES

Processed at ALS Brisbane located at 32 Shand Street, Stafford, Brisbane, QLD, Australia. Processed at ALS Brisbane Sample Preparation at 23 Pineapple Street, Zillmere, QLD, 4034, Australia

Applies to Method:

BAG-01	LEV-01	LOG-22	ME-GRA05
ME-XRF26	PUL-32	PUL-QC	WEI-21

Appendix 7

Landholder Agreements

SIBELCO

COMPENSATION & ACCESS AGREEMENT

Landholder	Benjamin Darrel Usher
Land	Lot 106 on ML623 and Lot 2 on RP36822

B.U.

SIBELCO

COMPENSATION & ACCESS AGREEMENT

THIS AGREEMENT is made on the 30th day of April 2019

BETWEEN

SIBELCO AUSTRALIA LIMITED ACN 000 971 844 of Level 16, 111 Pacific Highway, North Sydney, New South Wales 2060 (Sibelco)

AND

BENJAMIN DARREL USHER of "Avoca", 150 O'Dea's Road, Elbow Valley, Warwick QLD 4370 (Landholder)

WHEREAS:

A. The Landholder is the registered owner of Lot 106 on ML623 and Lot 2 on RP36822 situated in the Parish of Wildash County of Merivale (Land).

B. Sibelco is the holder of Mining Lease No. 50146 located on the Land (Mining Lease).

C. Sibelco is also the holder of other mining tenements not located on the Land, including mining lease no. 50083 and mining leases 50236, 50237, 50238 and 50239 (Other Tenements).

D. This Agreement covers that part of the Land which is also covered by the Mining Lease, as outlined on the attached plan (Mining Lease Land).

E. Sibelco occupies and conducts mining, processing and ancillary operations on the Mining Lease Land.

F. Sibelco is in the process of applying for a renewal of the Mining Lease. The parties confirm that the existing Compensation and Access Agreement dated 23 December 2010 terminated on 31 December 2018 (Expired Agreement). Accordingly, the parties would like to enter into a new compensation and access agreement to be effective from 1 January 2019 (Effective Date).

The parties agree as follows:

1. DEFINITIONS

1.1. Definitions

Act means *Mineral Resources Act 1989* (Qld).

Annual Payment means $48,917.30 (GST exclusive) for the financial year ending 30 June 2020, which is payable by the 30 September 2019, or as reviewed under clause 4.1.4.

CPI means the Consumer Price Index (All Groups) for the City of Brisbane published by the Australian Bureau of Statistics or the Commonwealth of Australia or if that index ceases to be published then the index which is substituted for it by the Australian Bureau of Statistics or the Commonwealth of Australia.

Extractive Limestone means limestone when mined or extracted for its physical properties (e.g. for roadbase or construction purposes).

Initial Payment means $4,703.58 (GST exclusive)

B.U.

Limestone means Extractive Limestone and Mineral Limestone.

Mineral Limestone means limestone when mined or extracted for its chemical properties.

Non-Operational Land means such portion of the Mining Lease Land that is not Operational Land.

Operational Land means such portion of the Mining Lease Land which Sibelco has notified the Landholder that it is conducting exploration or mining operations or otherwise reasonably required for operational purposes from time to time and land containing any plant, equipment, accessories or quarry related to Sibelco's operations.

Processing Payment means the amount payable under clause 4.3.

Processing Rate means $0.1487 per tonne (GST exclusive) for the year ending 30 June 2019, or as reviewed under clause 4.3.3.

Relinquishment Application means the application to relinquish the Mining Lease and Other Tenements once Sibelco has completed the rehabilitation activities in accordance with the criteria:

a) developed in consultation with the Landholder, the Department of Environment and Science and the Department of Natural Resources, Mines and Energy (as required); and

b) set out within the Mining Lease Land's Environmental Authority and Plan of Operations.

Roadway means any road way or track constructed on or through the Mining Lease Land.

Site means Sibelco's Warwick operations.

Tonnage Payment means the amount payable under clause 4.2.

Tonnage Rate means $1.224 per tonne (GST exclusive) for the year ending 30 June 2019, or as reviewed under clause 4.2.3.

2. CONSENT AND NO OBJECTION TO MINING LEASE

2.1. The Landholder:

2.1.1. consents to Sibelco entering the Land for the purposes set out in this Agreement;

2.1.2. has no objection to the Mining Lease or Other Tenements (as renewed);

2.1.3. has no objection to the current, material change of use application disclosed to the Landholder in respect of mining and extractive operations under the Mining Lease and Other Tenements and the current Application under the Vegetation Management Act disclosed to the Landholder (MCU Applications);

2.1.4. will, if required, provide consent to the MCU Applications;

2.1.5. will, if required, provide consent to the Relinquishment Application; and

2.1.6. acknowledges that the Mining Lease Land includes the whole of the surface and below the surface of the Land.

B.H.

3. CONSIDERATION

3.1. The parties agree that the compensation payable by Sibelco under this Agreement is in consideration for:

3.1.1. deprivation of possession of the surface of the Land;

3.1.2. diminution of the value of the Land or any improvements on the Land;

3.1.3. diminution of the use made or which may be made of the Land or any improvements on the Land;

3.1.4. severance of any part of the Mining Lease Land from other parts of the Land or from other lands of the Landholder;

3.1.5. any surface rights of access;

3.1.6. all loss or expense that arises; and

3.1.7. the right to process material won on other land on the Mining Lease,

as a consequence of the determination of the renewal of the Mining Lease.

4. COMPENSATION

4.1. Annual Payment

4.1.1. Subject to the foregoing and clause 9, the Annual Payment is payable by Sibelco to the Landholder each year in advance for the 12 month period ending on 30 June of the following year.

4.1.2. Although Sibelco has made an annual payment under the Expired Agreement to cover the period to 30 June 2019, the parties have agreed that Sibelco will pay an additional amount to the Landholder for the period from the Effective Date to 30 June 2019 in the amount of $1,333.84 (plus GST) within 10 days of signing this Agreement;

4.1.3. Thereafter, the Annual Payment under this Agreement will be payable before 30 September 2019 (in advance) for the 12 month period ending 30 June.

4.1.4. The Annual Payment for each subsequent year is payable on or before each 30 September during the term of this Agreement and the amount of the Annual Payment for each subsequent year is calculated by applying the average CPI percentage increase (if any) for the previous four quarters to 30 June of the current year to the Annual Payment payable in the previous year, provided however the Annual Payment under this clause will not be less than the amount of the Annual Payment of the previous year.

4.1.5. The Annual Payment will no longer be payable from the day that Sibelco submits the Relinquishment Application.

Rather, Sibelco will pay the Landholder $10,000 plus GST per annum and adjusted on a pro rata basis from the date that the Relinquishment Application is made and the date that the Relinquishment Application is granted.

B.M.

4.2. Tonnage Payment

4.2.1. Subject to clause 9, for each 12 month period ending on 30 June during the term of this Agreement, with the first period ending on 30 June 2019, Sibelco must pay the Landholder the Tonnage Payment calculated in accordance with the following formula as compensation for the Limestone that Sibelco mines (or otherwise extracts) and sells from the Mining Lease Land. The Tonnage Payment includes a minimum 'take or pay' quantity of 10,000 tonnes of Limestone:

Tonnage Payment = TR x Q

Where:

TR = Tonnage Rate.

Q = the number of tonnes of Limestone mined or extracted and sold from the Mining Lease Land for the 12 month period ending on 30 June (as stated in the royalty return), subject to a minimum 'take or pay' quantity of 10,000 tonnes*

* For example, if the actual quantity of Limestone mined or extracted and sold from the Mining Lease Land is less than 10,000 tonnes, Q = 10,000.

4.2.2. The first Tonnage Payment under this Agreement is payable before 30 September 2019 (in arrears).

4.2.3. The Tonnage Payment for each subsequent year is payable on or before each 30 September during the term of this Agreement and the amount of the Tonnage Rate for each subsequent year is calculated by applying the average CPI percentage increase (if any) for the previous four quarters to 30 June of the current year to the Tonnage Payment payable in the previous year, provided however the Tonnage Rate under this clause will not be less than the amount of the Tonnage Rate of the previous year.

4.2.4. The Tonnage Payment ceases at the completion of mineral extraction activities namely that no further tonnes are to be mined, processed or sold from the Site.

4.3. Processing Payment

4.3.1. Subject to clause 9, for each 12 month period ending on 30 June during the term of this Agreement, with the first period ending on 30 June 2019, Sibelco must pay the Landholder the Processing Payment calculated in accordance with the following formula if Sibelco processes into saleable product on the Mining Lease Land more than 250,000 tonnes of Limestone (saleable) that has been mined or extracted from any land including the Mining Lease Land and sold:

Processing Payment = PR x (Q – 250,000)

Where:

PR = Processing Rate.

Q = the number of tonnes of Limestone that has been mined or extracted from any land including the Mining Lease Land, processed on the Mining Lease Land into saleable product and sold for the 12 month period ending on 30 June.

B.M.

4.3.2. The first Processing Payment under this Agreement is payable before 30 September 2019 (in arrears). Accompanying each Processing Payment, Sibelco shall provide a statement of the number of tonnes of Limestone which were processed in the preceding 12 month period ending 30 June whether or not (i) it processes into saleable product or (ii) it reaches the threshold of 250,000 tonnes of Limestone required for a Processing Payment to be made.

4.3.3. The Processing Payment for each subsequent year is payable on or before each 30 September during the term of this Agreement and the amount of the Processing Rate for each subsequent year is calculated by applying the average CPI percentage increase (if any) for the previous four quarters to 30 June of the current year to the Processing Payment payable in the previous year, provided however the Processing Rate under this clause will not be less than the amount of the Processing Rate of the previous year.

4.3.4. The Processing Payment ceases at completion of mineral extraction activities namely that no further tonnes are to be mined, processed or sold from the Site.

4.4. **Initial Payment / MCU Applications**

In consideration of the Landholder consenting to the MCU Applications (defined in Clause 2.1.3), Sibelco will pay the Landholder the one off, Initial Payment within 10 days of the signing of this Agreement by the parties.

5. OBLIGATIONS OF SIBELCO

Sibelco must:

5.1. upon completion of mining operations on the Mining Lease Land, carry out rehabilitation of the Mining Lease Land in accordance with the approved Site Plan of Operations, the Mining Lease and the Act;

5.2. repair, reinstate, rehabilitate or make good in respect of any damage done to the Landholder's fences, gates, buildings, dams, stock, pastures or crops arising from access to or exploration or mining activities on the Mining Lease Land or gaining access to the Mining Lease Land;

5.3. on the completion of the mining operations leave intact any water storage dams on the Mining Lease Land;

5.4. ensure that employees and contractors who bring dogs or other animals onto the Mining Lease Land be responsible for keeping them under control and acknowledge that the Landholder reserves the right to request the removal from the Mining Lease Land of any dog or other animal brought onto the Mining Lease Land that is deemed to be causing a nuisance;

5.5. endeavour to protect livestock by maintaining the Mining Lease Land free of rubbish and plastic;

5.6. permit the Landholder to have access to water from the bore and dam located on the southern boundary of the Mining Lease Land for the purpose of stock water, with the cost of connection and conveying water from this point at the Landholder's expense;

5.7. keep and maintain full, accurate and detailed records of the quantities of all Limestone, mined, extracted from and processed into saleable product upon the Mining Lease Land during the term of this Agreement;

B.M.

5.8. permit the Landholder (or any person authorised by the Landholder and approved by Sibelco, which approval will not be unreasonably withheld) to view such records kept pursuant to clause 5.7 at such times agreed in advance with Sibelco, provided that the Landholder and any authorised representative must keep confidential all information that is disclosed. Nothing in this clause will operate to prevent the Landholder from disclosing confidential information to the Landholder's accounting, taxation or legal advisors for the sole purpose of obtaining advice as to the meaning, effect and enforcement of this Agreement and in any Court of competent jurisdiction relating to any claim made by or against the Landholder relating to this Agreement;

5.9. give notice in writing to the Landholder at the end of each financial year of the tonnage of the Limestone extracted/mined, processed and sold from the Mining Lease Land;

5.10. observe and comply at its own cost and expense with:

5.10.1. all statutes, regulations and other legislative instruments applying to the activities of Sibelco on the Mining Lease Land; and

5.10.2. all licences, permits and authorities issued in respect of the activities of Sibelco on the Mining Lease Land, in particular but not limited to any development permit, licence or authority issued by the Environmental Protection Agency, the Southern Downs Regional Council and the Mining Lease,

as determined in writing by the relevant regulator, tribunal or court;

5.11. provide to the Landholder a written notification of the intention to remove the bagging shed from the Mining Lease Land or to rehabilitate any Roadway on the Mining Lease Land at least thirty (30) days prior to its removal or rehabilitation (as the case may be);

5.12. If requested by the Landholder in writing to Sibelco given within thirty (30) days of the notice referred to in the preceding sub-clause, leave the bagging shed or any Roadway identified by the Landholder in its notice to Sibelco in accordance with this clause on the Mining Lease Land at the expiry of this Agreement;

5.13. Sibelco may notify the Landholder of any other infrastructure that it will be willing to transfer to the Landholder and the Landholder may elect to keep those items by providing 10 days written notice. Any items that the Landholder takes possession of under this Agreement does so at his own risk.

5.14. not start fires on the Mining Lease Land without the prior consent of the Landholder.

5.15. give the Landholder written notice that it has ceased mining, processing and selling mineral from the site within 10 business days of such cessation;

5.16. provide the Landholder with a copy of the Mining Lease Land's Environmental Authority and Plan of Operations setting out the criteria for rehabilitation of the Mining Lease for the Landholder's consultation as part of the Relinquishment Application.

6. OBLIGATIONS OF THE LANDHOLDER

6.1. The Landholder acknowledges that this Agreement (or any amended agreement which may subsequently be entered into by the parties and approved pursuant to section 283A of the Act) provides in full all compensation to which the Landholder is entitled under the Act in respect of Sibelco's exploration and mining operations (and associated activities including under the MCU Applications) on the Mining Lease Land and the Landholder further acknowledges that this Agreement constitutes an agreement made pursuant to section 279 of the Act.

6.2. The Landholder must:

6.2.1. allow Sibelco to exercise its rights under this Agreement and under the Mining Lease, free from any interference or disturbance by the Landholder or any person acting through, under or on behalf of the Landholder;

6.2.2. subject to clause 5, allow Sibelco to remove at any time all improvements, fixtures, fittings, plant and equipment erected, installed or brought onto the Mining Lease Land by Sibelco either before or after the date of this Agreement (which shall remain the property of Sibelco, whether or not attached to the land in a permanent fashion); and

6.2.3. not enter the Operational Land without first obtaining the consent of Sibelco and, in any access to the Mining Lease Land, must comply with any safety directions of Sibelco.

7. TERM

The term of this Agreement commences on the Effective Date and continues until such time as the renewed Mining Lease expires, is surrendered, cancelled or terminated and all rehabilitation works required of Sibelco have been completed, but does not continue if the term of the renewed Mining Lease is subsequently renewed and a new compensation agreement with the then Landholder has commenced.

8. ASSIGNMENT

8.1. Subject to any necessary statutory consents, the Landholder will have the right to assign, sell or otherwise dispose of the Landholder's interest in all or part of the Land provided that at or prior to completion of the said assignment, sale or disposal, the Landholder obtains from the purchaser a covenant in writing in favour of Sibelco that the purchaser will be bound by the terms of this Agreement as if named as a party to this Agreement instead of the Landholder from the date of completion and the Landholder will provide a copy of such covenant to Sibelco within 30 days of such completion.

8.2. If the Landholder assigns, sells or otherwise disposes of the Landholder's interest in all or part of the Land without obtaining the covenant as and when required by clause 8.1, then this Agreement will terminate and the Landholder will be liable to Sibelco for any resulting losses or costs to Sibelco.

8.3. Sibelco has the right to assign the Mining Lease or any part of the Mining Lease to a third party provided that Sibelco (i) provides the Landholder written notice within 7 days of assignment; and (ii) obtains from the assignee a covenant in writing in favour of the Landholder that the assignee will be bound by the terms of this Agreement as if named as a party to this Agreement instead of Sibelco from the date of such covenant.

8.4. If Sibelco assigns, sells or otherwise disposes of the Mining Lease without obtaining the covenant as and when required by clause 8.3, then this Agreement will terminate and Sibelco will be liable to the Landholder for any resulting losses or costs to the Landholder.

9. SURVIVAL

Whether the Mining Lease renewal and/or the MCU Applications are not made, rejected or withdrawn (whether in whole or part), the parties agree that the agreement shall continue to remain on foot. For the avoidance of doubt, Sibelco will be responsible to pay:

9.1 the Initial Payment under clause 4.4;

9.2 the payments in clause 4.1;

9.3 the Tonnage Payment and the Processing Payment under clause 4.2 and clause 4.3 respectively and where relevant; and

9.4 any costs pursuant to clause 10.

10. STAMP DUTY AND COSTS

Sibelco must pay:

10.1 any stamp duty payable on this Agreement;

10.2 its own costs negotiating and executing this Agreement; and

10.3 any reasonable legal costs incurred by the Landholder in negotiating and executing this Agreement up to $20,000 and after presentation of the relevant invoices.

11. NOTICES

Any notice in writing required to be given by one 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 Sibelco to:

Liam O'Grady
Tenement Services
Sibelco Australia Limited
Level 16, 111 Pacific Highway NSW 2069

and in the case of the Landholder to:

Benjamin Usher
'Avoca', 150 O'Dea's Road
Elbow Valley, Warwick 4370

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) will be deemed to have been received on the seventh day (excluding Saturdays, Sundays and public holidays) after the same was posted.

12. COMPLETE AGREEMENT AND AMENDMENT

This Agreement represents the complete agreement between the parties with respect to this subject-matter and supersedes any previous representations and verbal or written agreements between them. This Agreement may only be amended in writing.

13. COUNTERPARTS

This Agreement may be executed in any number of counterparts which, when executed and exchanged (including exchange by facsimile transmission) shall together be deemed to constitute the one and the same instrument.

14. GST

14.1. The parties acknowledge and agree that:

14.1.1. unless the context so excludes the terms used in this clause shall have the same meaning as they do in the "A New Tax System (Goods and Services Tax) Act 1999 as amended" ("the GST Act"); and

14.1.2. the consideration or payments reserved pursuant to the terms of this Agreement are expressed as the GST exclusive value of the supply to which they relate.

14.2. In the event that the supply or any part thereof made pursuant to this Agreement is a taxable supply, then the price of the supply or the relevant part to be paid pursuant to this Agreement shall be equal to the GST exclusive value of the supply or the relevant part plus the GST payable on the supply.

14.3. If for any reason the Commissioner of Taxation determines by letter, assessment or ruling that GST is payable by the provider of the supply on the supply made pursuant to the terms of this Agreement or any part thereof and the price paid for the supply or any part thereof did not include GST, then the recipient of the supply shall pay to the provider of the supply the GST payable by the provider of the supply in respect of the supply or part of the supply forthwith upon receiving a copy of the letter, assessment or ruling of the Commissioner of Taxation and a valid Tax Invoice issued by the provider of the supply to the recipient of the supply.

15. SIBELCO TO INDEMNIFY

15.1. Sibelco indemnifies the Landholder against all direct damages, losses, costs and expenses which the Landholder may sustain, expend or be put to by reason of or on account of:

15.1.1. any neglect or default on the part of Sibelco to observe and perform any of the covenants or agreements of the part of Sibelco in this Agreement; and

15.1.2. any action, suit, proceeding, claim or demand which may be brought or made against the Landholder for any injury or loss by any servant, agent, licensee or invitee of Sibelco when using or whilst on the Mining Lease Land, except to the extent that the Landholder has caused or contributed to that injury or loss.

16. INTEREST

Sibelco shall pay to the Landholder interest on the sums which are in arrears under this Agreement calculated at the rate of 2.5% above the cash rate target set by the Reserve Bank of Australia and should such publication or determination of the Reserve Bank of Australia be discontinued then such comparable interest rate that is published by the Reserve Bank of Australia or its successor from time to time as determined by the Landholder with such interest being calculated on a daily basis from the time such sums respectively fall due to the date of payment.

17. INSURANCE

At all times during the term of this Agreement, Sibelco must maintain and keep in force, at Sibelco's own cost and expense, in respect of the Mining Lease Land and the business carried on such land, public liability insurance up to a limit of $10,000,000. Sibelco will produce a certificate of the existence of the insurance whenever requested by the Landholder.

18. NO WARRANTY AS TO SUITABILITY

The Landholder does not warrant that the Mining Lease Land or any part thereof is suitable or may be used for any particular purpose or for any purpose whatsoever.

19. SIBELCO OCCUPIES AT OWN RISK

Sibelco agrees to occupy and use the Mining Lease Land at the risk of Sibelco and the Landholder will not be liable to Sibelco for any damage to the plant and equipment, fixtures or any other property of any description of or in the possession of Sibelco and contained in or about the Mining Lease Land occasioned by water, heat, fire, electricity, vermin, explosion, tempest, riot, civil commotion, bursting pipes or by entry of water from any source whatsoever or by the operation of any fire equipment or any losses of profits resulting therefrom.

20. SIBELCO GIVE NOTICE OF FAILURE BY LANDHOLDER

20.1. Notwithstanding anything contained in this Agreement or any implication or rule of law to the contrary, where:

20.1.1. the Landholder fails to do any act or thing to or in respect of the Mining Lease Land which the Landholder might legally be liable to do and of which Sibelco is or ought to be aware; and

20.1.2. such act or omission is capable of being rectified without Sibelco incurring any cost, damage or liability,

then the Landholder will only be liable to Sibelco for any damage or loss that Sibelco suffers by reason or the act or omission if Sibelco has given a notice in writing of such act or omission and the Landholder has without reasonable cause failed within a reasonable time to take proper steps to rectify such act or omission.

21. ANTECEDENT BREACHES

The termination of this Agreement shall not prejudice or affect any rights or remedies of the Landholder against Sibelco on account of any antecedent breach by Sibelco of any of the terms, covenants and restrictions on the part of Sibelco pursuant to this Agreement.

22. FURTHER ASSURANCES

Each party must do or cause to be done all acts and things necessary or desirable to give effect of the provisions of this Agreement and refrain from doing all acts and things that could hinder performance by any party of the provisions of this Agreement.

23. ELECTRONIC TRANSACTIONS ACT (QLD) 2001 AND COUNTERPARTS

23.1. Subject to clause 11, the parties acknowledge and agree that:

23.1.1. in respect of this Agreement or this Agreement they may communicate, transact and exchange documents by electronic means pursuant to the Electronic Transactions Act (Qld) 2001 whether by facsimile transmission or email;

23.1.2. a copy of this Agreement signed by any party transmitted electronically to any other party will have the same effect as if it were an original document handed to the other party;

23.1.3. further original copies of this Agreement may be executed at a later date but if they are, they will not affect the effect of any relevant copy of this Agreement transmitted electronically by any party to any other party;

23.1.4. the parties expressly consent pursuant to the Electronic Transactions Act (Qld) 2001:

(i) for all information required to be given in writing to them;

(ii) for all information permitted to be given to them in writing;

(iii) for all signatures required to be given by them;

(iv) all documents to be produced by or to them,

in respect of this Agreement and any transaction, agreement, representation warranty or covenant evidenced by it can be given or produced by electronic communication whether by facsimile or email;

23.1.5. notwithstanding the preceding sub-clause, notices that are to be given under the terms of this Agreement once it becomes evidence of a binding agreement between the parties shall be given in accordance with the other provisions of this Agreement; and

23.1.6. this Agreement can be signed in a number of counterparts (whether transmitted to the other party electronically or not), which together will be taken as evidence of one instrument.

24. WAIVER

Failure of any party at any time to insist upon performance of any provision of this Agreement is not a waiver of that party's rights to insist on performance of that or any other provision of this Agreement unless that waiver is expressly referred to as a waiver in writing signed by the party so waiving.

25. DEFAULT

25.1. With the exception of clauses 8.2 and 8.4, a breach of any term of this Agreement will not entitle a party to terminate this Agreement.

25.2. In the event that a party (Defaulting Party) breaches any term of this Agreement, the other party will be entitled to pursue the Defaulting Party for damages in respect of the breach.

26. EFFECT OF AGREEMENT

This Agreement does not constitute for either party a joint venture party, agent, employee or fiduciary of the other, and any act or omission from either party should not bind or obligate the other and the parties agree that goodwill does not attach to the subject matter of this Agreement.

27. FENCING

27.1. The Landholder shall have the right to continue to depasture livestock on the Non-Operational Land provided however that should Sibelco be required for any reason whatsoever to fence any part of the Mining Lease Land then Sibelco will:

27.1.1. only fence off so much of the Mining Lease Land that is Operational Land;

27.1.2. provide stock water facilities in replacement of any stock water facility fenced off from the rest of the Mining Lease Land; and

27.1.3. attend to such fencing and provision of stock water facilities described in clauses 27.1.1 and 27.1.2 at Sibelco's sole cost, discretion and expense.

27.1.4. ensure that it provides to the Landholder reasonable access (whether through or around the Operational Land) to the Non-Operational land and the balance of Landholder's land of which the Mining Lease forms part.

28. LANDHOLDERS' RIGHT OF ENTRY

28.1. The Landholder, together with its servants and agents, shall have reasonable access to the Non-Operational Land at all reasonable times for the depasturing of the Landholder's livestock on the Non-Operational Land from time to time, provided however that the Landholder shall not interfere with the activities of Sibelco on the Mining Lease Land.

28.2. The Landholder, together with any servants and agents approved by Sibelco (acting reasonably), shall be permitted to enter the Operational Land for the purposes of ascertaining the level of compliance of Sibelco with its obligations set out in this Agreement.

28.3. The Landholder's right to access the Operational Land under clause 28.2, is subject to the following conditions being satisfied at all times:

28.3.1. access to the Operational Land must only be at such time as agreed in advance by Sibelco acting reasonably;

28.3.2. access to the Operational Land must be under the supervision of Sibelco's representative;

28.3.3. when on the Operational Land, all of Sibelco's policies, procedures and any other directions and instructions, including Sibelco's site induction and sign in and out rules and Sibelco's health, safety, no smoking, drugs and alcohol and environment policies; and all applicable laws, must be complied with.

28.4. Sibelco will not be directly or indirectly responsible for the safety and welfare of the Landholder's livestock on any part of the Operational Land.

29. LOCAL AUTHORITY RATES

In the event that the activities of Sibelco under the Mining Lease and under the terms of this Agreement on the Mining Lease Land result in an increase in the Local Authority rates, charges and levies payable by the Landholder, Sibelco shall from time to time and forthwith upon written demand of the Landholder pay the difference between the Local Authority rates, charges and levies that would be assessed upon the land if same were only used for grazing and farming and the rates otherwise payable by the Landholder.

30. CONFIDENTIALITY

From the date that this Agreement is signed, the terms and conditions of this Agreement are confidential and no party shall disclose the same to any other person who is not a party, except to (a) its legal, financial, environmental advisors, bankers and related bodies corporate (who shall keep information disclosed confidential), (b) a regulator or disclosure required by law; or (c) unless the prior written consent or wavier of all of the other parties is first had and obtained.

Nothing in this clause is to be construed as a limit or cap on damages suffered by either party for a breach of this clause. It is acknowledged that either party shall be entitled to apply for and obtain temporary or permanent injunctions or declarations enforcing the provisions of this clause in the event of a breach by either party and to prohibit or restrain any act or omission by either party or any employee of either party that would constitute a breach of this clause.

31. INTERPRETATION

In this Agreement, unless the context so requires:

31.1. a reference to "this Agreement" shall mean any transaction, agreement, covenant or warranty which this Agreement evidences, and the content of this Agreement whether it be in the form of, or is referred to as, a deed, agreement, contract or otherwise;

31.2. the marginal notes or headings used herein are for convenience only and shall not form part of this Agreement for the purposes of interpretation;

31.3. for convenience, only the first letters of words and expressions defined in this Agreement are indicated by capital letters, however, the absence of a capital letter will not of itself mean that the word or expression is used with a different meaning from that given in the definition;

31.4. references to this Agreement shall be read as if the words "or any variation, amendment or modification thereof or substitution therefore" were added to the reference, notwithstanding any change in the identity of the parties;

31.5. words importing the singular shall include the plural and vice versa;

31.6. words importing any gender shall include all other genders;

31.7. references to persons includes corporations and other legal persons;

31.8. any reference to any party includes that parties, executors, administrators, successors and permitted assigns;

31.9. a party that is a trustee is bound both personally and in its capacity as a trustee;

31.10. an agreement, covenant, representation or warranty on the part of two or more persons binds them jointly and severally, whether or not they form part of one party to this Agreement, and where any party consists of more than one person the obligation or liability inter se of such persons as comprise that party shall be joint and several;

31.11. an agreement, covenant, representation or warranty in favour of two or more persons, whether or not they form part of one party to this Agreement, is for the benefit of them jointly and severally;

31.12. the respective covenants obligations of the parties hereto as set out in this Agreement whether positive or negative shall be construed as if each such obligation or covenant is a separate and independent covenant made by one party in favour of the other party;

31.13. the terms of this Agreement shall be interpreted in accordance with the Laws of Queensland and the parties agree to submit to the non-exclusive jurisdiction of the Courts of Queensland;

31.14. any term of this Agreement that can take effect after the completion of the dealing, transaction or agreement evidenced by this Agreement remains in force;

31.15. a right includes a benefit, remedy, discretion, authority or power;

31.16. an obligation includes a warranty or representation and a reference to a failure to observe or perform an obligation includes a breach of warranty or representation;

31.17. "$" or "dollars" is a reference to the lawful currency of Australia;

31.18. provisions will not to be interpreted adversely to the interests of a particular party simply because that party was responsible for preparing this Agreement;

31.19. the terms of this Agreement do not take effect until it is signed by all of the parties and any party who has signed this Agreement may withdraw same at any time prior to that party receiving notice that the document has been signed by all parties; and

31.20. unless the context indicates to the contrary, any reference to any statute is deemed to include reference to every statute amending or re-enacting the same and any orders or regulations made under such statute.

EXECUTED by SIBELCO AUSTRALIA LIMITED pursuant to section 127 of the *Corporations Act 2001*)
)
)

Director

THOMAS C. CUTRUSH
Name of Director

Director/Secretary

DERICK KORTE
Name of Director/Secretary

SIGNED by BENJAMIN DARREL USHER in the presence of)
)
)

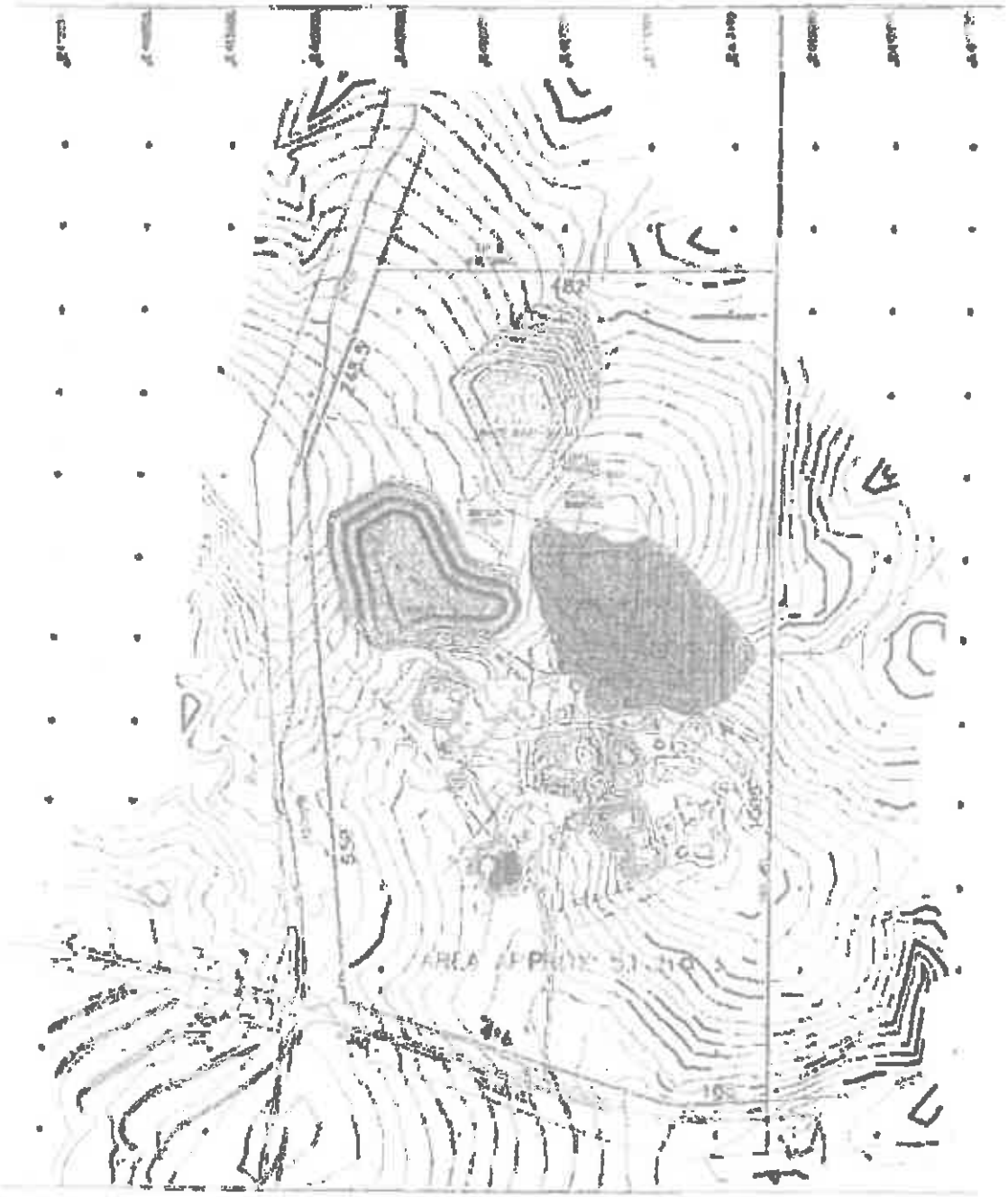
Signature of witness

JACOB KURTIS FULLER
Full name of witness

901 O'DAYS RD, ELBOW VALLEY
Address of witness

Signature of Benjamin Darrel Usher

Plan



B.M.

B.M.

Appendix 8

BAAM Ecological Consultants: Rehabilitation Plan for the Warwick Mining Leases Areas

APPENDIX 1
Rehabilitation Plan

BACKGROUND

One of the principles adopted by the International Council on Mining and Metals (ICMM) for sustainable development for mining is:

> "*rehabilitating land in accordance with appropriate post-mining land use*".

Rehabilitation for the Warwick Lease Areas will comply with the ICMM principles and the hierarchy for mine rehabilitation (EP Act) in the following manner:

1. *avoid disturbance that will require rehabilitation* – The original location for the access road to the proposed open pit on MLA50237 was moved to avoid disturbance to natural grasslands. The original waste dump location on MLA50237 was moved to avoid the clearing of 17 potential habitat trees.
2. *reinstate a "natural" ecosystem as similar as possible to the original ecosystem.* The areas proposed for mining activities are highly disturbed as a result of previous landuses and now support regrowth vegetation or pasture lands. Rehabilitation will include replanting of native flora species endemic to the local area to reflect densities and composition of flora species present.
3. *develop an alternative outcome with a higher economic value than the previous land use* NA
4. *reinstate previous land use (e.g. grazing or cropping)* Rehabilitation will include plantings of native and pasture grasses.

REHABILITATION PLAN

Rehabilitation and revegetation efforts conducted within the Unimin Mining Lease Area aim to re-establish vegetation communities that reflect pre-disturbance composition and abundance and are designed to reinstate the pre-disturbance land use.

Rehabilitation will be conducted sequentially as mining operations cease and land is subject to its final contouring or when disturbed areas, e.g. waste dump are no longer needed for operations. The objectives of the rehabilitation plan are presented in **Table 1**.

REHABILITATION TARGETS

To achieve the rehabilitation objectives, a recommended species planting schedule for all areas associated with the mining activities is presented in **Table 2.** Performance indicators and targets for each of the Target Climax Communities are contained in **Table 3**.

REHABILITATION TECHNIQUES

All existing native species, including mature and regrowth trees and saplings, shrubs, grasses and forbs located outside of the potential impact areas, are to be retained and managed as part of the rehabilitation phase and maintenance.

Where planting is required, recommended species presented within **Table 2** should be used. Recommendations regarding size of planting stock, mulch specifications and any other necessary treatments, such as weed control, are detailed in **Table 4**.

For all rehabilitation areas, habitat features such as rocks, fallen branches and dead trees and shrubs in are to be retained *in situ* unless they pose a safety risk to workers.

GENERAL REHABILITATION REQUIREMENTS

All declared weed and exotic species are to be removed according to the methods set out in the Vegetation Management Plan (VMP). All weed species listed in the VMP are to be eradicated from the rehabilitation area prior to any planting taking place. Other exotic and environmental weed species are to be controlled as necessary to protect rehabilitation plantings and to encourage natural regeneration of native species.

Where woody trees and shrubs are removed their roots shall be left to rot in situ as the roots help to prevent erosion.

Rehabilitation areas must be protected from impacts caused by grazing cattle. Fencing that excludes cattle but allows native fauna to access these areas should be erected prior to commencing rehabilitation.

MAINTENANCE AND WEED MANAGEMENT

The maintenance plan provided in **Table 5** applies to the site until the rehabilitation area is self sufficient and self-perpetuating.

Specific management requirements for declared plant species are provided the VMP.

Table 1 – Rehabilitation Objectives

	Objective	Details
1	Identify and delineate rehabilitation and revegetation areas	Base-line studies have identified the condition and extent of vegetation communities across the Site.
2	Prioritise and schedule rehabilitation works	Areas degraded as a result of mining activities are to be subject to staged rehabilitation when the land becomes available following final land contouring.
3	Control and eradicate declared and invasive weeds	Control and eradicate (where practical) state declared weeds (as listed under the *Land Protection (Pest and Stock Route) Management Act 2002*) and priority environmental weeds on the site through appropriate weed control methods.
4	Conserve and enhance existing native vegetation	Identify native vegetation to be retained, control weed species and undertake supplementary planting with native species to support existing native vegetation where necessary.
5	Conserve and enhance ecological process and habitat values	Conserve and identify existing habitat values, control weeds to encourage a diversity of wildlife, remove barriers to fauna movement.

Table 2 – Species Planting Schedule

Recommended Species	Common Name	Density	Notes
Open Pit Void MLA50237			
Tree layer		Species densities around water storage area to reflect pre-disturbance levels.	This area is to reflect a Eucalypt Woodland with a native grassy understory following rehabilitation works
Eucalyptus tereticornis	Queensland Blue Gum		
Eucalyptus moluccana	Gum Topped Box		
Eucalyptus crebra	Narrow-Leaved Ironbark		
Ground Layer		Seed of any mix of the recommended species to be liberally broadcast during conditions that will maximise germination (i.e. prior to rainfall events during the warmer months of the year).	
Paspalidium distans	Shotgrass		
Imperata cylindrica	Blady Grass		
Digitaria brownii			
Enneapogon gracilis	Slender Nineawn		
Digitaria ramularis			
Dichelachne crinita	Longhair Plumegrass		
Austrostipa setacea	Corkscrew Grass		
Triodia mitchellii	Buck Spinifex		
Cymbopogon refractus	Barbed-Wire Grass		
Eragrostis brownii	Brown's Lovegrass		
Chloris ventricosa	Tall Chloris		
Bothriochloa macra	Redleg Grass		
Themeda triandra	Kangaroo Grass		
Aristida lignosa			
Panicum effusum			
Eulalia aurea	Silky Browntop		
Lachnagrostis filiformis			
Austrostipa verticillata	Slender Bamboo Grass		
Dactyloctenium radulans	Button Grass		
Waste Dump MLA50237			
Tree layer		Species densities to reflect pre-disturbance levels.	This area is to reflect an Open Eucalypt Woodland with a native grassy understory following rehabilitation works
Eucalyptus tereticornis	Queensland Blue Gum		
Eucalyptus moluccana	Gum Topped Box		
Eucalyptus crebra	Narrow-Leaved Ironbark		
Ground Layer		Seed of any mix of the recommended species to be liberally broadcast during conditions that will maximise germination (i.e. prior to rainfall events during the warmer months of the year).	
Paspalidium distans	Shotgrass		
Imperata cylindrica	Blady Grass		
Digitaria brownii			
Enneapogon gracilis	Slender Nineawn		
Digitaria ramularis			
Dichelachne crinita	Longhair Plumegrass		
Austrostipa setacea	Corkscrew Grass		
Triodia mitchellii	Buck Spinifex		
Cymbopogon refractus	Barbed-Wire Grass		
Eragrostis brownii	Brown's Lovegrass		
Chloris ventricosa	Tall Chloris		
Bothriochloa macra	Redleg Grass		
Themeda triandra	Kangaroo Grass		
Aristida lignosa			
Panicum effusum			
Eulalia aurea	Silky Browntop		
Lachnagrostis filiformis			
Austrostipa verticillata	Slender Bamboo Grass		
Dactyloctenium radulans	Button Grass		
MLA50236, MLA50238 and MLA 50239			
As per EMP. Rehabilitate with pasture grasses.		No species recommended	Areas to be topsoiled and planted with pasture grasses.

Recommended Species	Common Name	Density	Notes
Roads And Tracks			
There are no species recommended for this area		No species recommended	These areas are to remain as access tracks post mine closure
Sediment Dams			
There are no species recommended for this area		No species recommended	These areas are to remain as stock dams post mine closure.

Table 3: Rehabilitation Targets

Rehabilitation Area	Rehabilitation Target	Performance targets
Open Pit Void MLA 50237	Eucalypt Woodland with native grassy understory surrounding retained water storage area	• 70% survival of canopy species outlined in Table 2 after 5 years. • 50% cover of native grasses and ground layer species outlined in Table 2 after 5 years. • No woody weeds. • <10% herbaceous weeds.
Waste Dump MLA 50237	Eucalypt Open Woodland with native grassy understory	• 70% survival of canopy species outlined in Table 2 after 5 years. • 50% cover of native grasses and ground layer species outlined in Table 2 after 5 years. • No woody weeds. • <10% herbaceous weeds.
MLA 50236 and MLA 50238	Improved pasture	• Eradicate extant weeds. • Maintain community condition of surrounding vegetation
Sediment Dams	Retained as stock dams	No performance targets provided
Roads and Tracks	Retained as farm access tracks	• Eradicate extant weeds. • Maintain community condition of surrounding vegetation

Table 4: Rehabilitation Methodology

Task	Recommendations
Delineate Rehabilitation Areas	Rehabilitation areas are to be clearly delineated on the ground with native fauna-fencing where necessary. Fencing will need to be designed to preclude cattle from entering rehabilitation areas.
Weed and Exotic Plant Removal and Control	Priority and environmental weeds (refer to Appendix 2 of the VMP) are to be removed immediately on detection. If using herbicides, particular care must be taken to avoid poisoning native species, particularly young saplings, native grasses and herbaceous species. Exotic grasses are to be treated (by spraying) 2-3 weeks prior to replanting – particular care must be taken to avoid spraying native grasses. Woody and herbaceous weed species are also to be treated prior to planting. Two weeks following spraying of rank exotic grasses, that are not required for pasture, these are to be knocked down by brushcutting – particular care must be taken to avoid slashing native species. For specific control requirements for priority weeds see **Appendix 2 VMP.**
Site Preparation	Any rubbish will need to be collected and disposed of offsite at a Council approved location or rubbish disposal depot.
Mulch	Mulching will be undertaken across the rehabilitation site when planting tubestock. Weed free mulch is to be applied to a depth of 100mm across the rehabilitation area.
Plant Supply	Seedlings shall be sourced from local provenance stock (where possible). Recommend species for rehabilitation are provided in **Table 2**. Densities are to be determined at a later date prior to initiation of rehabilitation activities. Planting stock shall be provided in forestry tubes with a minimum plant height of 20cm and a well developed root system. Seedlings are to be healthy and displaying signs of active growth – any plants displaying yellowing, disease, root curling or are root bound are not to be planted, nor are any plants with weeds growing in the pot.
Planting	Tubestock - Plant in a slight shallow twice the size of the tube container, ensuring rootball is just below soil surface. Fertiliser tablet to be placed adjacent to, but not touching, the rootball. Soil to be backfilled to the same level as when the plant was in the container Mulch to a depth of 100mm to surround plant, but not touch the stem. Seedlings are to be randomly arranged at the determined densities. Seedlings must be moist at time of planting, if necessary water stock prior to planting.
Watering	Seedlings are to be watered with a minimum of 5 – 10 litres of water each at the time of planting and then watered as part of general maintenance requirements.
Habitat Features	For all Rehabilitation Zones, habitat features such as rocks, fallen branches and dead trees and shrubs in all zones are to be retained in situ unless they pose a safety risk.
Maintenance and Monitoring	Plantings will be maintained for a period of 24 months during the rehabilitation phase.

Table 5: Maintenance Plan for Rehabilitation Works

Timing	Recommended Action
First three months after planting	**Control weeds** – Check for weeds monthly and control by hand removal, spot spraying e.g. of grasses, taking care not to damage planted and regenerating native species, including grasses and forbs. **Watering** – Water each seedling with a minimum of 5 – 10 litres of water weekly during the first month depending on prevailing weather conditions and then monthly or as necessary until seedlings are established (approximately 3 – 6 months). **General Site Maintenance** –Remove any rubbish dumped on site; check for signs of erosion; replace mulch as required. **Replacement Planting** – Replace dead or senescent plants according to the methods detailed in **Table 4**. **Monitoring** – Undertake regular monitoring.
3-24 months after planting	**Control weeds** – Continue monthly weed checks and control when necessary as specified for first three months. **Watering** – Continue to water each seedling as necessary until seedlings are established (approximately 3 – 6 months). Any replacement seedlings should be watered weekly during the first month following planting, then water as necessary until seedlings are established (approximately 3 – 6 months after planting). **Replacement Planting** – Replace dead or senescent plants according to the methods detailed in **Table 4**; and continue replacement planting until 95% survival rate achieved. **Mulching** – If mulch is depleted thereby allowing significant weed growth, replace mulch around affected plants with coarse forest mulch or sugar cane to a depth of 100mm and diameter of 1m, ensuring mulch does not contact any stems/trunks of native species. **General Site Maintenance** – e.g. Remove any rubbish dumped on site; check for signs of erosion; replace mulch as required. **Monitoring** – Undertake regular site monitoring tasks and photos.

Appendix 9

Plans and Maps

Analogue Site	Corner 1 Easting	Corner 1 Northing	Corner 2 Easting	Corner 2 Northing	Corner 3 Easting	Corner 3 Northing	Corner 4 Easting	Corner 4 Northing
1	413367.7322	6859561.955	413377.7291	6859561.955	413377.7291	6859551.958	413367.7322	6859551.958
2	413495.6964	6859023.524	413505.6933	6859023.524	413505.6933	6859013.528	413495.6964	6859013.528
3	412693.4371	6858230.741	412703.4341	6858230.741	412703.4341	6858220.744	412693.4371	6858220.744
4	413181.5345	6858297.806	413191.5314	6858297.806	413191.5314	6858287.809	413181.5345	6858287.809
5	414115.4793	6858356.98	414125.4762	6858356.98	414125.4762	6858346.984	414115.4793	6858346.984

AUSROCKS RESOURCE CONSULTANTS

0 m 125 m 250 m 375 m 500 m

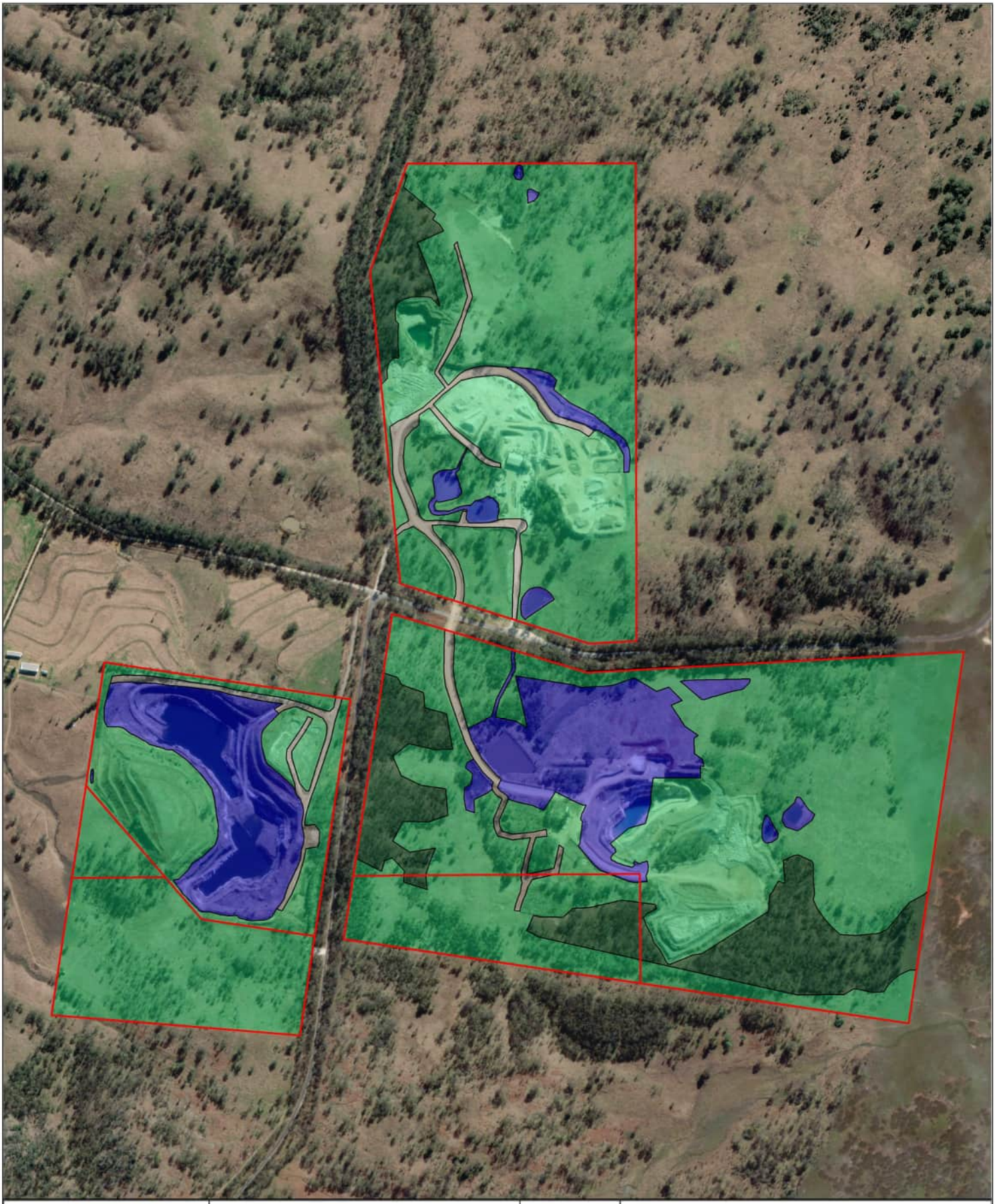
Ausrocks Pty Ltd
PO Box 359
Virginia BC
QLD 4014
(07) 3161 4108
www.ausrocks.com.au
64 056 939 014

N

Legend

- Analogue Sites
- ML boundary
- RA1 Infrastructure
- RA10 Existing Rehab (Grazing)
- RA2 Topsoil Stockpiles
- RA3 ROM & Product Stockpiles
- RA4 Waste & Overburden Dumps
- RA5 Roads & Tracks
- RA6 Sediment Dams & Stormwater Control
- RA7 Eastern Open Pit (Backfill to RL 524)
- RA8 Main Pit Voids (Water Storage)
- RA9 Main Pit Voids (Grazing)

Title	**Terrequip Warwick Limestone Mine Rehabilitation Areas & Analogue Sites**	Project No.	AUQ00238A
		Drawing No.	WLM012
Scale	1:7,500	Datum	GDA2020
Date	26/09/2023		
Drawn	RM	Checked	NV
Status	v1.1		



AUSROCKS RESOURCE CONSULTANTS

0 m 125 m 250 m 375 m 500 m

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PO Box 359
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64 056 939 014

N

Legend

- ML boundary
- PMLU - Grazing
- PMLU - Roads
- PMLU - Undisturbed / Native Veg
- PMLU - Water Storage

Title	**Terrequip Warwick Limestone Mine Post Mine Land Use Areas**	Project No.	AUQ00238A
		Drawing No.	WLM011
Scale	1:7,500	Datum	GDA2020
Date	26/09/2023		
Drawn	RM	Checked	NV
Status	v1.1		

AUSROCKS RESOURCE CONSULTANTS

0 m 125 m 250 m 375 m 500 m

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PO Box 359
Virginia BC
QLD 4014

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www.ausrocks.com.au
64 056 939 014

N

Legend

- Analogue Sites
- ML boundary
- New Max Footprint

Title	**Terrequip Warwick Limestone Mine** **Maximum Extent Disturbance Footprint**	Project No.	AUQ00238A
		Drawing No.	WLM013
Scale 1:7,500	Datum GDA2020	Date	26/09/2023
Drawn RM	Checked NV	Status	v1.1